Labour Productivity and Distributive Aspects of Indian Manufacturing Sector

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CERTIFICATE

This is to certify that the thesis entitled "**Labour Productivity and Distributive Aspects of Indian Manufacturing Sector"** submitted by **Sudhansu Mohan Sahoo** bearing Redg. No. 03SEPH04 in partial fulfilment of the requirements for the award of Doctor of Philosophy in Economics is a bonafide work carried out by his under my supervision and guidance.

The thesis has not been submitted previously in part or in full to this or any other university or institution for the award of any degree or diploma.

Dr. Alok Kumar Mishra	**Prof. G. Nancharaiah**
Research Supervisor	**Dean, School of Economics**

DECLARATION

I, Sudhansu Mohan Sahoo, hereby declare that the thesis entitled "**Labour Productivity and Distributive Aspects of Indian Manufacturing Sector"** submitted by me under the guidance and supervision of **Dr. Alok Kumar Mishra** is a bonafide research work. I also declare that it has not been submitted previously in part or in full to this university or any other university or institution for the award of any degree or diploma.

Place: Hyderabad **Signature of the Candidate**

Date: (Sudhansu Mohan Sahoo)

Regd. No: 03SEPH04

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Glossary

ADF	Augmented Dickey Fuller
AR	Auto Regression
ARMA	Auto Regressive Moving Average
ASI	Annual Survey of Industries
BOP	Balance of Payments
CAGR	Compound Annual Growth Rate
CI	Capital Intensity per Labour
CPI	Consumer Price Index
CSO	Central Statistical Organisation
DF	Dickey Fuller
DS	Difference Stationary
EPW	Economic Political Weekly
EPWRF	Economic Political Weekly Research Foundation
FMOLS	Fully Modified Ordinary Lease square
FY	Fiscal Year
GA	Growth Account
GAA	Growth Accounting Approach
GCF	Gross Capital Formation
GDI	Gross Domestic Income
GDP	Gross Domestic Product
GNP	Gross National Product
GP	Gross Profit
GRP	Gross Rate of Profit
GVA	Gross Value Added
GVO	Gross Value Output
IC	Invested Capital
IIP	Index of Industrial Production
INGP	Index of Gross Rate of Profit
INRI	Index of Nominal Rate of Interest
INRP	Index of Net Rate of Profit
INT	Interest Paid
INV	Investment

ITT	Information Technology and Telecommunication
IW	Industrial Workers
LB	Ljung Box
LC	Labour Compensation
LP	Labour Productivity
LPG	Liberalisation-Privatisation-Globalisation
MOSPI	Ministry of Statistics and Program Implementation.
NCF	Net Capital formation
NIC	National Industrial Classification
NP	Net Profit
NRI	Nominal Rate of Interest
NRP	Net Rate of Profit
NVA	Net Value Added
OLS	Ordinary Least Square
PF	Production Function
PFA	Production Function Approach
PIAM	Perpetual Inventory Accumulation Method
PP	Partial Productivity
PP	Philips Perron
RBI	Reserve Bank of India
SAG	Simple Annual Growth
SD	Standard Deviation
TFPG	Total Factor Productivity Growth
TO	Total Output
TPE	Total Person Engaged
TS	Trend Stationary
VADD	Value Added Double Deflation
VAR	Vector Auto Regression
VASD	Value Added Single Deflation
WPI	Wholesale Price Index

Table of Contents

Labour Productivity and Distributive Aspects of Indian Manufacturing Sector

Chapter - I

Background, Objectives and Methodology of the Study

1.1 Background:

There are two ways of looking at productivity, one is Smith's way and the other is Harrods measure. It is Smith who first narrates productivity as the driving force to achieve a better standard of living and which generates huge wealth, in his famous piece '*The Wealth of Nations*' in 1776[1]. Smith viewed productivity as the eminent part to play a major role in his doctrine of 'Division of Labour'. The famous example of *pin making*, postulates that higher level of productivity can be achieved once the economic task is divided in a systematic manner. However, the general question that strikes is what causes improvement in productivity? Most people these days have a view that advancement in productivity is due to the introduction of machinery and other technology, which in turn derived from advancement in the sciences. Nevertheless, Adam Smith's answer to this advanced in productivity is rather different; advances take place due to the increased specification of labour in every step of productive activity. The work of various kinds of philosophers, scientists and engineers are examples of this division of labour. More basic than technology, it is the division of labour, which enables technology itself to develop and progress. Therefore, specialization is the key to increase in productivity, which in turn enhances the human and material well-being[2]. Smith further states that, the aim of improving standard of living depends on the productivity of labour, which depends on the division or specialization of labour; which further depends on the extent of the market. Once the productivity is increased through the division of labour then there is a higher level of production and the size of the market should be huge enough to absorb this high production. Therefore, productivity is depending not only on the division of labour and more specialization of production activity, but also on the size of the market. According to Smith, accumulation of capital is also necessary for the division of labour and increase in productivity. Anything that retard accumulation of capital, e.g. by reducing returns on capital, retard division of labour and thus hinder increase in productivity.

[1] Adam Smith (1776), *'An Inquiry into the Nature and Causes of the Wealth of Nations'* precisely known as *'Wealth of Nation'* among economic fraternity is divided into five books. The productivity issue is discussed elaborately in the first book where the concerns the division of labour (and thus technological progress), the theory of value and income distribution.

[2] This is what Adam Smith tries to explain in his *'Wealth of Nation'* Chapter-II,I.ii, pp. 25-30.

Division of labour represents the starting point of Smith's economic reflection. His reasoning of the argument is to explain the functioning of an economic system in which each person is engaged in a specific task and each firm produces a specific commodity. It is not that Smith is the first person to recognize the division of labour as a new phenomenon. Schumpeter (1954, p. 56) called it 'this external commonplace of economics'. Similarly, authors from classical Greece such as Xenophon and DiodorusSiculus, Plato and Aristotle[3] had already discussed it. In fact, the authors of the previous century, such as William Petty (1690)[4] also spoke about this economic concept. However, in economic literature Smith, is the first person, who applies division of labour as the center of analysis to explain those elements that determine the standard of living of a given country and its tendencies to progress and regress.

Smith's thesis can be viewed from another angle; the wealth of nations is identified with what today we call per capita income, or in substantially the standard of living of the citizens of the country under consideration[5]. Alternatively Smith's thesis of division of labour can be put in this way; recall that, national income (Y) obtains equal to the quantity of product on an average by each worker (or labour productivity) multiplied by the number of workers employed in production (L)

The equality between national income to the product between labour productivity (p) and number of productive labour (L)[6]

$$Y = p.L \tag{1.1}$$

Where, Y stands for national income. The above equality can also be reformulated by dividing with population (P) on both sides

[3] All of them are Greek historians and philosopher. Their major work are during 430 to 30 BC.

[4] In his 'Political Arithmetick', Petty made a practical study of the 'division of labour', showing its existence and usefulness in Dutch shipyards. Classically the workers in a shipyard would build ships as units, finishing one before starting another. But the Dutch had it organised with several teams each doing the same tasks for successive ships. People with a particular task to do must have discovered new methods that were only later observed and justified by writers on political economy.

[5] This consideration is found out in very first line of the Smith's '*The Wealth of Nation'* (1976, p 10).

[6] Roncaglia A (2005); "The Wealth of Ideas: A History of Economic Thought", Cambridge University Press, Ch-5, pp.127.

$$\frac{Y}{P} = p.\frac{L}{P} \tag{1.2}$$

From the equation-1.2, we obtain that per capita income equals to labour productivity (p) multiplied by the share of active workers over total population. This states that, the standard of living of the population depends on two factors i.e. the share of total productive labour in the total population and the productivity of the labour. According to Adam Smith, here the division of labour comes to play a major role. It is important to mention the fact that productivity depends mainly on the stage reached by the division of labour, which in turn determine by the size of the market[7].

According to Smith, one can connect productivity to the division of labour in three ways. First, the improvement in the skill of the workers when he regularly accomplishes a specific task rather than a multiplicity of tasks[8]. Secondly, the connection between the growth of the market and development of the division of labor as established in his thesis. Lastly, Smith argues, when firm's production expands due to the employment of labour that not only leads to division of labour but also stimulates their productivity. Therefore, the market must grow accordingly to absorb the production[9] of the factory with a division of labor that leads to higher levels of employment. Therefore, it is clear that the size of the market constitutes the main constraint on the development of the division of labour, improvement of the productivity and an increase in the welfare of the citizens, or in other words to the wealth of nations. Thus, Smith incorporates productivity growth with that of output growth and employment growth, as he believed that the growth in output can be explained with the help of productivity and employment growth.

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[7]Smith with his well-known example of the pin factory can very well illustrate positive effect of division of labour on productivity.

[8] This is through the saving labour time that usually lost when shifting from one task to another; and technical progress induced by the possibility of focusing attention on one specific work task.

[9] The Smith thesis, the connection between the size of the market and the division of labour has often been interrupted, in the traditional Marginalist theory of the firm based on the U-shaped cost curve. In Smith's pin making example production as a whole has increased by five thousand times by employing 10 workers and following the division of labour.

On the other hand the Harrodian measure of total factor productivity, looks at problems of measurement in temporary equilibria and begin gives an alternative approach to the problem of how total factor productivity should be measured in a Keynesian world. In the Keynesian world where unemployment of working and waiting is the more general case, monetary policy has an effect on both productivity growth and its measurement. Production function measure of productivity implies labour productivity and capital productivity towards the contribution of output growth and what is left as the residual is the total factor productivity. However, this approach is being used in the literature just by neglecting its well-known theoretical and practical impossibilities of assuming constancy in labour and capital substitution, the aggregation problem and the assumption of constant returns to scale in production process. In measure of total factor productivity, technology and its advance are either exogenous as in the early Solow growth model or endogenous in that the measured rate of productivity advance may well be a function of the rate of capital accumulation, either reproducible or human capital embodying the latest in information technology.

Based on the above theoretical backdrop, we acknowledge the significance of classical framework to bring productivity to the center stage to realize higher economic growth. In a progressive economy like India, it is more crucial to understand the economic rational of productivity enhancement to accomplish sustainable growth and to realize higher standard of living of its citizens. As one of the key segments of Indian economy, we are interested to examine the productivity dynamics of Indian manufacturing sector.

It is now more than half a century since India embarked on the path of planned economic development. Since the first five-year plan in the early fifties, the importance of industrialization to achieve higher-growth is felt. Therefore, in the subsequent plans we observe the crucial role assigned to industrialization. Industrialization is rightly perceived to be a dynamic force by means of which the Indian economy can achieve higher growth rates with social prosperity. During the first 25 years (1950-75) of planned industrialization, industrial production has more than quadrupled that Indian industry has made impressive strides since independence is so self-evident a proposition that it is hardly necessary to reiterate it. In the first fifteen years, i.e. 1951-65, the industrial production increased at an average rate of 7.7 percent per annum, however this has come down to a mere 3.6 per cent per annum in the next decade (1965-75). During the next decade, the industry which has recovered from the depression during the 60s and has been observed to be growing at a consistent pace during the decade of the 80s, which is called generally referred as the creeping liberalization period. The momentum observed in industrial growth during 80s has been further stimulated in the post-liberalization period of the 90s, due to the implementation of financial sector reforms, beginning from April 1991. The decade after India embarked Liberalisation-Privatization and Globalization (LPG) the industrial sector is increasing, supporting the overall economy by its above average growth.

Manufacturing holds a key position in the Indian economy, accounting for nearly 16 percent of India's real GDP in FY12 and employing about 12 percent of India's labour force. Manufacturing accounts for a large chunk of India's industrial production, a fact borne out by the sector's 75.4 percent share in the Index of Industrial Production (IIP). Manufacturing also contributes increasingly towards the total merchandise exports of the country. Over the past half century, this sector has grown at nearly 6 percent per year; at over one-and-a-half times of the domestic output – depicting a major break from the trend of the colonial past. Since 2000-01, the manufacturing sector grew at an above average growth of 7.3% y/y. All these trends show ampler strength to this sector that promises for the future growth of the economy. The contribution of manufacturing sector in overall GDP growth is gradually rising over the period and it emerges as an engine of growth that endows with more and more employment opportunity in the economy. In the coming years, the sector's importance to the domestic and global economy is set to increase even further as a combination of supply-side advantages, policy initiatives and private sector efforts would set India on the path of a global manufacturing hub. This also justifies the importance of productivity growth in this sector.

In Indian context, there are plethoras of studies on productivity growth in the Indian manufacturing sector. Studies like Ahluwalia (1991), Goldar (1986, 2000, 2004), Balakrishnan and Pushpangadan (1994), Upender (1996), Rao (1996), Kumar (2002), Aggarwal and Kumar (1991), Balakrishnan and Pushpangadan (1994), Balakrishnan P

(2010), Gangopadhyaya and Wadhwa (1998), Unel (2003), Balakrishnan and Suresh Babu (2003), Trivedi et.al.(2000), TSL (2003), Tendulkar (2003), Bidhe and Kalirajan (2004), Rath B (2005,), Madheswaran. S (2007), Banga and Goldar (2007), Bosworth, Collins and Virmani (2007), Badri Narayanan G. (2010), have measured the productivity trends, employment trends and growth of the Indian organized manufacturing sector during the post-independence period. A significant number of studies have focused on the measurement of total factor productivity growth (TFPG) and arrived at different projections within different underlying methodological framework.

Ahluwalia (1991) is the first to study on the effects of firms' dynamics on productivity dynamics. This study has taken into account structural changes in the economy as well as the changes in policy regime in India during 80's and 90's. Goldar and Veeramani (2005) studied the relationship of investment climate with the level of TFP for selected states of the country. Another attempt is made by Trivedi (2004) to interpret interstate differences in productivity movements in organized manufacturing sectors, in a larger perspective of employment and output trends. Kumar (2004) measured total factor productivity growth in the industrial manufacturing sector of 15 major states of India for the period 1982-83 to 2000-01 using non-parametric linear programming approach. Analyses have also been done to measure the sources of TFPG and level of business in technical change. The findings show improvement in TFP. Madheswaran. S, Hailin Liao and Badri Narayan Rath (2007), analyses the technical efficiency change and role of productivity change in economic growth by using stochastic production frontier for two-digit registered manufacturing sector in India. The TFP has been calculated from the estimated production function and the growth rate seems to have improved in a large number of industries during 1980-81 to 1997-98. Mita Bhattacharya et.al (2011), investigated the long-run relationship between labour productivity and employment, and between labour productivity and real wages in the case of the Indian manufacturing sector. The panel data set consists of 17 two-digit manufacturing industries for the period 1973–1974 to 1999–2001. The study finds that productivity-wages and productivity-employment is panel cointegrated for all industries. We find that both employment and real wages exert a positive effect on labour productivity.

1.2 Relevance and Justification of the Study:

Indian industries have gone through a considerable increase in base, diversification, structural changes in growth rates and short spells of stagnation/slow growth of industry during 60 years of planning and development. However, most of the studies on productivity in Indian industries are biased towards the conventional method of production function and growth account approach at the aggregate industry level. There are very few studies that have been carried on productivity analysis at disaggregate (2-digit industrial groups) level. Earlier studies on productivity focused on the trend and growth of total factor productivity (TFP). The conventional measure of production function (PF) approach is followed entirely without critical assessment of its loopholes and its impractical nature[10]. Hence, the present study probes into an alternative methodology, which we named as a 'straightforward' approach to productivity analysis, where we look into the trend and growth of productivity at both the aggregate and disaggregated 2-digit level.

Before proceeding, we prefer to mention over here that the present study is only deals with 'Labour Productivity'. One justification for the special emphasis on labour productivity is perhaps because labour is a universal key resource. The term labour productivity implies the ratio of the physical amount of output achieved in a given period to the corresponding amount of labour expended. By implication, productivity here means the physical volume of output attained per worker or per person engaged in case of Indian manufacturing sector.

The period for the present study covers four decades during which the Indian industries experienced significant changes. The four sub-periods that the study covers are seventies, eighties, nineties and the period 2000-01 to 2007-08. During the seventies, Indian economy slowly recovered from the industrial stagnation of the sixties. During the eighties, when the reform processes have been introduced partially, when the then

[10] The theoretical and methodological shortcomings and the flaws associated with neoclassical production function and the problem of aggregation are discussed briefly in the next chapter under the heading "Theoretical Underpinning". We have critically analysed the impracticability of the existence of the neoclassical production function, based on which the conventional approach of growth accounting and production function is used very often to measure productivity.

prime minister late Shri Rajiv Gandhi, introduced numerous measures to change the industrial scenario of the country. During the period of the nineties, Indian economy experienced significant change in economic structure and policies with the introduction of LPG[11] policies. The last sub-period of the study, spanning from 2000-01 to 2007-08, can be explained as the period of rapid economic growth, when real GDP growth averaged 7.3 per cent per annum. Over this period, the structure of India's GDP has undergone an immense transformation in the face of such rapid economic growth.

Pertaining to classical theory, factors should be paid on the basis of their contribution to the production process. If factors are paid as per their marginal productivity, then the total output should completely exhaust. Therefore, in the present study, we also analyses the distributive relationship in Indian manufacturing, which is more often neglected in the past literatures. Therefore, the present work is a study of productivity associated with the distributive relationship, which explains the degree of concentration of wealth to a particular group, which leads to greater inequalities in the economy. This can be considered as an addition to the knowledge of economic science and has immense policy importance not merely for efficient allocation of scarce resources but also to find out in particular the co-existence of socioeconomic inequalities. This in turn is associated with the economic well-being of the labour class as it directly determines their standard of living. Thus, the economic rationale behind such argument is that the theory of distribution is just not a tool to understand the pattern of income distribution, rather it plays a decisive role in determining the development and growth of the economy through better standard of living. In Indian manufacturing there are several research gaps as far as distribution is concerned. Therefore, the present attempt is a step initiated to fill this gap to understand the distribution of total produced output among the different factors of production and the underlying dynamics of their relative shares.

[11] The period during nineties, the early nineties when the full liberalization and/or reform process has been implemented (April 1991) and particularly the mid 1990's where in the country underwent import liberalization, privatization, globalization and economic reforms of all major sectors , including monetary, financial, fiscal, trade and infrastructural services.

1.3 Objectives of the Study:

In the light of the above discussion, the major objectives of the present study are as follows:

- To analyse the productivity trends and growth pattern of Indian manufacturing sector both at the aggregate and disaggregated 2-digit industry group level.
- To examine the relationship between growth of labour productivity and growth of output of Indian manufacturing sector.
- To examine the nexus between labour productivity, employment and real wages in the Indian manufacturing sector.
- To, examine the distributive aspects of Indian manufacturing sector.

1.4 Methodology:

Most of the empirical studies on productivity analysis in manufacturing sector focus on total factor productivity (TFP) based on the conventional growth accounting and production function approach. However, the purpose of the present study is to focus on the single factor productivity of labour through an alternative (classical) approach. The time series nature of the data provides enough room to incorporate sophisticated time series analysis to examine the relationship of different variables with that of labour productivity in Indian manufacturing.

The methodology used to probe the above objectives range from simple graphical and tabular analysis to growth and trend and correlation analysis, seasonality, unit root test, statistical moments of the data and other relevant econometric techniques. These different techniques are used to study different questions, based on their suitability for investigating the questions at hand.

The Johansen's (1988) Maximum Likelihood procedure of co-integration test is used to examine the long run equilibrium relationship among real labour productivity, employment and real wages at an aggregate manufacturing level. Impulse Response Function is carried out to trace the possible dynamic response of all the variables in the study to a shock or innovation in each variable. Variance Decomposition is used to detect the causal relation among the variables. It explains the extent to which a variable is explained by the shocks in all the variables in the system. The forecast error variance decomposition explains the proportion of the movements in a sequence due to its own shock versus shocks to the other variable.

1.5 Data Sources:

The database of the Indian economy, especially in the manufacturing sector has substantially, expanded during the past three decades. Although with the increasing quantity of data, the quality of the data has not improved. In India, despite all the limitations the basic source of data for most of the studies on manufacturing productivity is the Annual Survey of Industries (ASI) published by the Central Statistical Organisation (CSO)[12]. The limitations of the data have been discussed in the academic as well as non-academic sphere[13]. Among others Bhatia (1987), Pradhan &Saluja (1998)[14], Nagaraj (1999 and 2002)[15] etc. have discussed extensively on the loopholes in the Indian Industrial database and how to improve its quality. Even though there are many problems associated with the present database, this is the only available database which has published the Industrial statistics systematically for a long period. The Economic and Political Weekly (*EPW)* Research Foundation has created a systematic electronic database, using ASI results for the period 1973-74 to 1997-98, which follows National Industrial Classification (NIC) 1987. Due to the change in National Industrial Classification in 1998, it is difficult to gather comparable data for two digit industrial groups with NIC 1987 beyond 1997-98 time point. However, the EPW Research Foundation has come out with its concordance series, which provide comparable and compatible data on major variables for Indian manufacturing that cover the period 1973-74 to 2003-04. Beyond 2003-04, we have used the concordance table

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[12]The limitations of the data have been discussed in the academic as well as non-academic sphere[12]. Among others Bhatia (1987), Pradhan &Saluja (1998)[12], Nagaraj (1999 and 2002)[12] etc. have discussed extensively on the loopholes in the Indian Industrial database and how to improve its quality

[13] See Bhatia D.P. (1987), in EPW, where he has critically examine the flaws associated with Central Statistical Organization (CSO) methodology of estimating value added at constant prices.

[14] Pradhan B. K. (1998) 'Revised Index of Industrial Production: A Note' *Economic Political Weekly,* July, 11.

[15] Nagaraj R. (1999), "How Good are India's Industrial Statistics? An Exploratory Note", *Economic and Political Weekly,* February 6.

And Nagaraj R. (2002) "How to Improve India's Industrial Statistics", *Economic and political Weekly,* March9.

prepared by the CSO to expand the coverage of the database until 2007-08. This was done by adapting the NIC-2004 data to NIC-1998 by using a concordance table. However, it is difficult to get the comparable series from 2008-09 onwards. This is due to significant shift in classification of industrial groups and the underlying methodology[16] with the introduction of NIC-2008. The unavailability of the comparable data beyond 2008-09 is the reason why our analysis has 3 years data gap[17].

In the present research, we also rely on some of the other sources such as the Central Statistical Organisation (CSO) and the Reserve Bank of India (RBI), Ministry of Labour. There are few variables used in the study, which are not-available readily; in those cases we have estimated[18] the required variables by using the readily available variables from the above mentioned sources. Similarly, when the variables are in value term at current prices, we have used the price deflators to convert these nominal values into real variables. The Price Indexes are the wholesale Price Index of various commodities, which are used to deflate the variables for their corresponding 2-digit industry groups. The Consumer Price Index (CPI) of Industrial Workers (IW) is used to deflate the nominal wage variables to arrive at the wages at constant prices. The two price deflators used in the study are from Central Statistical Organization (CSO) and Handbook of Statistics, Reserve Bank of India (RBI). CSO, Ministry of Statistics and Program Implementation is responsible for maintaining the data related to the Index of Industrial Production (IIP) and Wholesale Price Index on yearly and monthly basis. Similarly, the Index of CPI of Industrial Workers has been derived from Handbook of Statistics on Indian Economy published by RBI. However, Labour Bureau, Ministry of Labour, Government of India (GoI), originally published CPI of industrial workers.

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[16]We also tried to extend the data further by using the concordance table prepared by CSO, but we observe that conversion is only possible in case of three and four-digit industrial groups. The available concordance table is not compatible with the conversion of 4-digit industrial groups (Following NIC 2008) to that of 2-digit industrial groups (that follows NIC 1998). During the conversion process, we come across a situation where we are able to convert the available 4-digit groups of NIC 2008 to the corresponding 3-digit groups that follow NIC 2004. But from this group of 3-digit industries with NIC 2004, we can-not disaggregate them into corresponding 2-digit industrial groups that follows the same industrial classification, to convert them to NIC 1998, 2-digit level. This conversion is impossible because of the overlapping that happens in case of the 3-digit groups of NIC 1998. Here in more than one 3-digit group (NIC 1998) comes under the single 4-digit group in NIC 2004, when converted from NIC 2008.

[17] The latest ASI report provides data till 2010-11 in the summary result table.

[18] See Appendix Note of Chapter-III for definition and measurement of variables used in the present study.

1.6 Scope of the Study:

The present study is only restricted toorganised manufacturing sector, whereas, the bulk of the employment generation takes place in the unorganized manufacturing sector in India. The study limits its data analysis by taking the latest as 2007-08. Nevertheless, the recent data for organised manufacturing is available until 2010-11. However, due to the long time series data it was a bit difficult to locate the 2-digit industries beyond 2007-08 because of NIC change. The focus of the present study is to analyse labour productivity only at 2-digit and the latest data do not facilitate principle variables at 2–digit level. Even if this does provide information at 2digit level, it is not matched with NIC-1998. The study can also be extended to both 3-digit and 4-digit groups as well for a possible state-level comparison with the availability of the data. Moreover, we also acknowledge that the present study is only restricted to labour productivity; capital and total factor productivity being not under the scope of the present study. Here the question comes why only labour productivity? As per Smith's idea, rising labour productivity is positively associated with standard of living. In this study, we are interested to know whether labourers are getting wages as per their productivity or not. As well, many methodological changes can also be implemented (by choosing different base year, different price deflators) for the better use of the existing data and to infer different findings. However, the present attempt is an important contribution both towards the theoretical as well as methodological perspective in the productivity analysis. At the same time, we cannot abandon the enormous scope for further research.

1.7 Chapter Scheme:

The present study consists of six chapters, including the present one. The present chapter is an introduction to provide a backdrop for the study. We have discussed the justification, objectives, data sources, and methodology and chapter scheme in this chapter. In the background, we attempt to delineate a critical as well as a constructive description towards building an alternative proposition related to the manufacturing productivity. Chapter 2 provides the theoretical underpinning of the study followed by a detail and critical assessment of the existing literatures on productivity. This chapter also discusses the theoretical preludes about the methodology followed in the existing literature. A critical assessment of the two basic approaches of productivity analysis is elaborately discussed. The technique of neoclassical production function is assessed critically and the impracticability of the production function is also briefly discussed. Third chapter highlights the productivity trends in the Indian manufacturing sector both in aggregate and disaggregated 2-digit groups' level and the factors that determine labour productivity in Indian manufacturing. We also attempt to empirically examine the existence of Verdoorn's Law and Kaldor's Technological Progress Function (TPF). At the same time, we have also developed a modified least square model by combining both Verdoorn's law and Kaldor's TPF to understand better the determinants of labour productivity. In chapter Four, we access the reason of rising productivity by analyzing the trend and growth of employment and labour compensation and their relationship with labour productivity in Indian manufacturing. This chapter also investigates empirically the long run relationship between employment, wages and productivity with time series econometric techniques. The fifth chapter of the study deals with the distributive aspects of Indian manufacturing sector, where we examine the trends of distribution of output between labour and capitalist class. An attempt has also been made to explain the growth and trend of the rate of profit and capital formation in the Indian manufacturing sector. Finally, in the sixth chapter we conclude with the major findings of the study, policy implications and limitations.

Chapter - II

Theoretical Underpinnings and Empirical Literatures of Productivity Dynamics

2.1 Introduction:

The importance of productivity for economic growth and development can hardly be over-emphasized. It remains the basic problem of economic progress, as it is required at both the early stages of development as well as in the permanent process of re-equipping the production apparatus of any nation. Productivity as a source of growth has moved to center stage in analyses of growth of developing economies in recent years. Earlier, the focus was mainly on the growth of capital, through greater mobilization of resources. As investment levels have increased substantially in most developing countries and the scope for further increases becomes more limited, attention has naturally turned to productivity improvements which offer a complementary route to growth by getting more out of limited resources. At the macro level, steady growth in productivity guarantees non-inflationary increases in wages as well as solves pressing problems of unemployment, increased trade deficit and an unstable currency (exchange rate). In essence, productivity provides the basis for analyzing the relative dynamism of different economic activities. Again, interests in productivity and what is happening to it are directed towards being able to know something about the process of technical change. This is so because economic growth, technical change and productivity are closely related. Having said that, this chapter is making an attempt to look at the theoretical underpinning and empirical literatures in the following sections.

In the next section we discuss the theories on productivity and contributions of major school of thoughts in productivity literatures. This section also intended to analyse the methodological challenges associated with the measurement of the productivity. The second section deals with the literature review of the existing work done in the area of productivity, Employment-wage and productivity relationship and distribution. Thus, in the 'Empirical Literatures' section we broadly review both national and international studies in the area of productivity and their respective findings. This section encompasses the existing knowledge that articulates the present study in the right direction.

2.2 Theoretical Underpinnings:

To understand the productivity dynamics, we need to discuss the existing theories on productivity. This is of immense importance due to its significant policy implications. Historically the concept of productivity growth has been regarded as a contributory factor to economic growth. Almost from the beginning of the modern scientific-technological era economists and policy makers have been concerned with the effects of technological advance on economic development and growth. It has only been during the eighteenth and nineteenth century, however, that concern with productivity advance has become widespread. Adam Smith (1776) gave classic expression to the role of productivity advance in national economic growth when he wrote:

> *"The annual produce of the land and labour of any nation can be increased in its value by no other means, but by increasing either the number of its productive labourers, or the productive powers of those labourers who had before been employed". . . in consequence either of some addition and improvement to those machines and instruments which facilitate and abridge labour; or of a more proper division and distribution of employment."*[1]

During the nineteenth century, David Ricardo (1815, 1817) and John Stuart Mill (1824, 1848), who dominated economic thought, likewise, recognized the importance of productivity change in economic development, but did not share Smith's optimistic view of the future. They theorized that as population grew and pressed against limited natural resources, productivity in agriculture and mining would decline and offset any rise in industrial productivity, thus tending to check population growth. Ricardo recognized that the "stationary state" might be postponed by technological advance, but he held that over the long run, the tendency towards a diminishing return in the extractive industries would prevail. Naturally, some economists disagreed with this dismal prognosis. Henry C. Carey,

[1]Adam Smith, An Inquiry Into the Nature and Causes of the Wealth of Nations, New York,Random House, 1937, p. 326. Various mercantilist writers before Smith had noted the importance of productivity in national economic growth (see E. A. Johnson, Predecessors of Adam Smith, New York, Prentice-Hall, 1937).

John Rae, and Henry George in America, for example, asserted that productivity advance rather than diminishing returns accompanies an economic expansion. Even Marx (1867) clearly recognized the capitalist dynamic that promotes cost-reducing innovations, although he mistakenly predicted that workers would not share in productivity gains.[2]

In speculating about economic change, it is obvious that the theorists were badly handicapped or misled by lack of economic data. Due to lack of considerable long time series data to substantiate the economic theories, it is difficult to enumerate any constructive assertion. It became generally apparent by the latter part of the nineteenth century that the Ricardo-Mill thesis was wrong, at least for relevant time periods. As Henry Sidgwick (1940) judiciously concluded *". . . our evidence does not enable us to lay down any concrete law."*[3]

With the development of marginal analysis, the focus of economics shifted to value theory which, with its assumptions of static technology, tastes, and resources, does not depend on economic time series for its content. Yet many economists continued to be fascinated by the "high theme of economic progress." Alfred Marshall himself, although one of the architects of the static equilibrium theory, cautioned that

> *"economic problems are imperfectly presented when they are treated as problems of statical equilibrium, and not of organic growth. For though the statical treatment alone can give us definiteness and precision of thought. . . it is yet only an introduction."*[4]

However, major progress in the study of economic change had to await a new impetus that would spur the development of the body of economic statistics necessary for fruitful analysis. That impetus came with the great depression of the 1930's and was heightened by subsequent events. In the postwar period, interest in obtaining data on productivity and related economic variables arose out of concern with the labor-

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[2]They emphasis that, capital must revolutionize the technical and social conditions of the labour process itself, before the productivity of labour can be increased.

[3]Henry Sidgwick, Principles of Political Economy, pp. 154—155 (quoted in Edmund Whit taker, *A History of Economic Ideas*, New York and London, Longmans, Green, 1940, p. 345).

[4]Alfred Marshall, Principles of Economics, 8th ed., London, Macmillan, 1920, p. 461.

displacing role of technology and with the possibility of secular stagnation. With World War II and the postwar era, concern with technological unemployment and stagnationevaporated and interest in productivity shifted to its income-expanding aspect. Strong advances in productivity were recognized as necessary to increase output and national security potentials during both the war and the "cold war" that followed. Productivity gains were seen as vital for the reconstruction of war-torn nations and for the development of economically backward countries in which there was increasing weight assigned to economic growth. Productivity advances were also regarded as a means of mitigating the inflationary tendencies arising from the generally buoyant demand situation in the postwar era. It was generally viewed that productivity enhancement as a major argument for raising wage rates and as the foremost means of increasing real labor income.

Interacting with the growing consciousness of the significant role of productivity advance in meeting major challenges of the period was the accelerated development of a body of economic statistics regarding output, inputs, productivity, and related variables. The obvious need during the ‘Great Depression’ (1930's) for improved economic intelligence in order to devise policies to combat depression in a more effective manner, led to appropriations for the expansion of statistical work. In this direction the potential importance for productivity estimation was the beginning of regular official national income estimates in 1932. These forces led to the emergence of various institutions to study and measure productivity at different level and to collect and maintain time series on output, input, employment, prices to facilitate and validate economic theories through productivity analysis. Thus, continuing accumulation of economic time series is facilitating the basis for a deeper understanding of the dynamic processes of economic growth.

However, the credit goes to the Solow[5] for popularizing this concept in 1957 in his paper “Technical Change and Aggregate Production Function”, published in *Review of Economics and Statistics.* Solow in his paper provides a framework in which the growth emanating from an increased application of factor inputs could be separated from that

[5]Smith (1776) was the first person to narratesproductivity, in his famous piece ‘*The Wealth of Nations*’.

due to the residual factors. This residual has been designated as productivity factor. Since then the productivity growth has been recognized as a key feature of economic dynamism. Earlier in the classical period, it is the capital accumulation which is taken as the driving force behind the process of development. But with the increasing recognition of the productivity growth at the policy level in recent years that has given way to a balanced perception which gives equal importance to productivity growth along with capital accumulation. Whether we take the structural view of development[6] or the classical one[7], productivity performance is crucial to the outcome. As Kuznet (1966) pointed out, rapid growth in industrial productivity was an essential element in the development and structural transformation of the present developed economies. Therefore the present section deals with the theoretical foundation and practical problem associated with productivity and distributive analysis.

Matter of fact, both the level of productivity and growth rate of productivity assumes critical importance. Despite this, there is hardly any consensus among different researchers on the magnitudes of level and the growth rates of productivity obtained. The measurement of capital stock as input and the methodological differences makes comparisons of productivity a different task. Hulten (2000), mentioned two limitations in the estimation of productivity, *firstly* comparison of productivity over time may not be very useful if the product composition of national income undergoes a major change. It has been argued in the recent literature that, the new knowledge based economy cannot be compared to the old tangible product based economy. *Secondly* productivity estimates may overstate economic performance by ignoring the environmental degradation which itself can limit the growth process in future[8]. Thus, it can be understood that productivity measurement over time and by use of different methodology may deliver different estimates, which are not comparable.

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[6] Which suggest a shift of labour and capital from less productive sectors to high productive sector can accelerate growth.

[7] In which growth takes place as a result of the long-term effects of capital accumulation, labour force expansion and total factor productivity growth, which include technical change under condition of competitive equilibrium.

[8] See Pushpa Trivedi & Others, study on Productivity, RBI.

Coming to the methodology and estimation of productivity, it is observed from the existing literatures that productivity and distribution analysis is biased towards the existence of the aggregate production function. But the question arises; does the aggregate production function exist in real world situations? The aggregation[9] of capital, labour and output is based on the stringent conditions that hardly been satisfied with the real economic condition. Therefore, it is of obvious importance that researchers and academicians should bear this in mind while undertaking productivity analysis using conventional method of both production function and growth accounting approach to estimate Total Factor Productivity (TFP). Fundamentally the neoclassical tool of production function, belongs to the stream of microeconomics, where production function is used to narrate the behaviour of producer and in a broader sense the behaviour of firms. The different concept of diminishing return, scale economies and technological efficiencies are explained with the help of the technique of production function. Latter on the microeconomic tool is used to explain the various economic phenomenons at the macrolevel, as like in the growth theories, the aggregate production function used to explain the growth laws. Then, with the surge of the new endogenous growth literature in the 1980's, there has been a growth of remarkable interest the analysis of growth and productivity.

The question is what motivates us to take into hand such study? The main motive behind the present attempt is to acquaint the new generation economist with the technique of an aggregate production function and its practical limitation. In the light of the conclusion derived from Cambridge-Cambridge controversy and from the aggregation problem[10]. One can question why macroeconomist continue using the aggregate production function. In this regard SylosLabini (1995) noted that;

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[9] The aggregation problem has been discussed elaborately by Stigum (1967), Whitaker (1968), Nataf (1967) and Fisher (1969a), (1969b) and (2001).

[10]The series of debate (theoretical and mathematical) between two group of economist in Cambridge during 1960, concerning the nature and role of capital goods and the critique of the dominant neoclassical vision of aggregate production and distribution.Some major elements can be explained in simple terms and as part of the 'aggregation problem''. That is, the critique of neoclassical capital theory might be summed up as saying that it suffers from the fallacy of composition, i.e., we cannot simply jump from microeconomic conceptions to an understanding of production by society as a whole.The debate and the aggregation problem arrived are rather negative.

> *"It is worth recalling these criticisms, since an increasing number of young and talented economist do not know them, or do not take them seriously, and continue to work out variants of the aggregate production function and include, in addition to technical progress, other phenomena"*

However, in one of the published survey on new growth theories, Jonathan Temple (1998)[11] raised his concern over the issue. He concluded;

> *"Arguably the aggregate production function is the least satisfactory element of macroeconomics, yet many economists seem to regard this clumsy device as essential to an understanding of national income levels and growth rates"*

Thus the above discussion on the theoretical underpinnings provide insight to aware of the recent generation of economist about the very serious problem that surround the aggregation of output, labour and capital, associated with the neoclassical aggregate production function. Moreover, before moving to review some of the existing literatures in the next section, it is important to to discuss in brief, different distribution theories first.

Theories of distribution as expressed by various schools of thoughts have developed over past three centuries. Starting with the classical theory of value, classical economists try to investigate economic dynamics. William Petty (1662) introduced a fundamental distinction between market price and natural price to enable the portrayal of uniformities in prices. Petty tried to develop a par between land and labour and had what might be called a land-and-labour theory of value. Adam Smith (1776) confined the labour theory of value to a mythical pre-capitalist past. Others may interpret Smith to have believed in value as derived from labour. He stated that natural prices were the sum of natural rates of wages, profits (including interest on capital and wages of superintendence) and rent. Ricardo (Ricardo) also had what might be described as a cost of production theory of value. He criticized Smith for describing rent as price-determining, instead of price-determined, and saw the labour theory of value as a good approximation.

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[11]Temple Jonathan (1998), Robustness Tests of the Augmented Solow Model, *Journal of Applied Econometrics*, 13, pp.361-75.

On the other hand by distribution, neoclassical economist means the relative income share of each factor that is received by the owners of the factors of production. A neoclassical economist postulates that interaction between supply and demand of each factor of production in the factor market determines their respective equilibrium prices. Factor demand in turn includes the marginal-productivity relationship of that factor in the output market. Neoclassical analysis in fact, not only applies to capital and land, but the distribution of income in labour markets. The neoclassical growth model provides an account of how the distribution of income between capital and labor are determined in competitive markets at the macroeconomic level over time with technological change and changes in the size of the capital stock and labor force.

On the rate of profit, Marx (1867) in his famous piece 'Das Capital', Chapter-13, Volume 3, propounded the economic hypothesis "*the tendency of the rate of profit to fall*". Economists as diverse as Adam Smith, John Stuart Mill and Stanley Jevons notices a long-run empirical trend for the internal rate of return on capital invested to produce industrial products to decline, however, Marx called this tendency as the most important law in political economy and try to explain this through a causal explanation for it, in terms of his labour theory of value. Marx (1894) in his original piece of Das Capital argued that increased investment in fixed capital relative to variable capital reduced the margin of surplus labour time relative to the total capital invested. He argued further that the surplus labour time is the source of surplus value. As explained, even as invested in constant capital increases productivity, it reduces the rate of profit. Then, as a tendency, capitalist go on and investing more in raising productivity or expanding the scale of production, which in turn reduces profits per unit further after a while, and so on and so forth, in a vicious cycle of diminishing returns.

2.2.1 Concept of Productivtiy:

The term "productivity" is generally used rather broadly to denote the ratio of output to any or all associated inputs, in real terms. The productivity concept can be measured through many approaches, however the measurement of productivity can be classified into two broad types such as –Partial productivity (PP) and Total Factor Productivity (TFP). Partial productivity measures refers to the ratio of output to a single factor of production. Productivity of labour and productivity of capital, are obtained by dividing real output by labour (O/L) and capital (O/K), respectively. In the economics literature, the most common measure of labour productivity is output per man-hour. This partial measure of productivity is useful for measuring the saving in particular inputs achieved over time, while this partial productivity does not measure over-all changes in productivity efficiency, since they are affected by changes in the composition of input, i.e.; by factor substitutions[12]. On the other hand the other measure of productivity is Total Factor Productivity (TFP). Total Factor Productivity broadly encompasses the contribution of technology and managerial aspects to the growth of real output. More exactly, TFP growth implies increasing output per unit of the composite inputs (labour, capital and other inputs). The estimation of TFP is further relied on two approaches, viz., Growth Accounting Approach (GAA) and Production Function Approach (PFA). However, in the absence of reliable alternatives, these approaches have assumed the existence of constant returns to scale and perfect competition. Moreover, the issue of identification of production function because of the simultaneity in determination of input intensities and output levels creates enormous challenge and acceptability in the real world situation. The problem associated with the neoclassical production function to measure TFP growth has been elaborately discussed above.

After discussing the theoretical underpinning of the significance of productivity, concepts and measurements related issues, we proceed to the next section, where we selectively review some of the imperative studies on productivity which provide insight to the existing knowledge and ideas.

2.3 Empirical Literatures:

This section review some of the past literature in the field of productivity in manufacturing industry. There are numerous studies in this regard that examine different aspects of productivity and its relation and causes to different factors that enhance growth in the overall industrial sector. Some of them provide insight to the methodological challenges, while others raised questions about the validity of existing

[12] The present study is based on the methodology of classical framework, where it is considered that factor inputs, such as labour and capital are complementary to each other not substitute.

methodology of production function and growth accounting approach. Before moving to the core chapters to investigate the objectives that we set for the present study, it is inevitable to first look into some of the selected and pertinent studies that help us to understand the existing literature.

The present study is embedded in this literature. Its objective is to examine the possible factors responsible to enhance productivity in Indian manufacturing at (at 2-digit NIC-1998 level classification) and effects of firms' dynamics of industry level productivity growth in the Indian context, using the hitherto unexplored industry level data at 2-digit level of Indian manufacturing for the period 1973-74 to 2007-08. In particular, we focus on labour productivity and its growth that explain the rising contribution of the manufacturing sector in overall growth.

Beyond doubt, it is unfeasible to analyze and review all the possible literature exists in productivity arena, as it is for long this emerges as the area of economic research to find out the source of economic growth. It's an indisputable fact that manufacturing is the engine of growth for today's many developed countries and it is playing the role of main driving factor for existing, emerging economies to guide them to their destiny to growth and advancement. In this regard it is needless to say that productivity enhancement in this sector is the core area of research for economic arena. Because of its linkages with the rest of the economy and increasing returns inherent in it, manufacturing sector promotes capital formation as a crucial catalyst for economic growth. Historical data prove this fact that capital accumulation in manufacturing is accompanied by technological progress (Kuznet 1966, 1973).

Kaldor (1966) delivered a series of lectures named 'The Frank W Pierce Memorial Lecture'in Cornell University. Latter these lectures were documented in *Strategic Factors in Economic Development (1967).* In this series of lectures he postulates 'growth laws' that provided the framework for the development of industrial economics. In the first law, he describes the strong causal relation between the rate of growth of manufacturing GDP and the rate of growth of aggregate output. This law is backed by three economic premises, first manufacturing as a matter of fact subject to increasing returns. Secondly, this continuously embodies technological dynamism in manufacturing. Due to this, growth in manufacturing results in the expansion of employment in the sector and causes labour transfer from agriculture to manufacturing and services.

The second law explicates the positive causal relation between the rate of growth of manufacturing output and manufacturing productivity. This causality first proposed by PJ Verdoorn, in his seminal work 'factors that determines the growth of labor productivity' in the year 1949, which later popularized by A P Thirwall. In his third law, he looks at the relation between the growth of GDP and manufacturing employment. He explains the growth of overall GDP has a positive relationship with manufacturing employment growth and due to labour shift from other sector; it is negatively associated with employment growth with non-manufacturing employment.

There has been a surge in the literature on industry dynamics allowing for firm heterogeneities and/or idiosyncratic shocks. Though the origin of this literature can be traced back to Schumpeter (1934, 1942) where he proposed the process of 'creative destruction' to explain the dynamics of industry evolution. The developments in this literature are inspired by the theory of firm selection and industry evolution proposed in the seminal works of Jovanovic (1982), Hopenhayn (1992), and Ericson and Pakes (1995). What is new in the emerging literature is that empirical findings have been developed in parallel with emerging theoretical literature due to the growing availability of longitudinal plant/firm-level data that permits the advanced and sophisticated analysis of industry dynamics (Foster et al 2001). One strand of this emerging literature emphasizes the potential role of entry and exit in the heterogeneity across plants and seeks to explore the impact of such micro heterogeneity on aggregate productivity growth. Following the pioneer works of Baily et al (1992) and Griliches and Regev (1995), this literature examines the contribution of new and existing firms by decomposing exercises of aggregate productivity growth (inter alia, Baldwin and Gu 2006, Cantner and Krüger 2008, Carreira and Teixeira 2009, Disney et al. 2003, and Foster et al. 2001). The common premise across these studies is that productivity growth is not only due to internal restructuring within established firms, but also to productivity of entry and exit of firms.

Differences between continuing, entering and exiting firms and its impact on productivity enhancement are empirically examined by Baily et al (1992). The empirical analysis is based on the decomposition methodology of aggregate productivity growth and subsequently developed by important contributions of several scholars like Griliches and Regev (1995), Foster et al (2001), Balwin and GU (2003), Oley Pakes (1996) and Melitz an Polanec (2009). The analysis thus makes an important contribution to the existing empirical literature by distinguishing between the productivity effects of two types of entrants: newly established plants and the existing survivors that have been learning about investment and innovation opportunities passively (Javonvic 1982) or actively (Pakes and Ericson 1989) and expanding to enter the large corporate sector.

Baumol (1986), Dollar and Wolff (1988), Barro and Sala-i-Martin (1991), and Bernard and Jones (1996a, 1996b) examine the issue of productivity convergence in the Western countries. In the Indian context, there are few recent studies which analyze growth and convergence in terms of per capita income across major states. Rao et al. (1999), Marjit and Mitra (1996)and Adabar's (2004) paper measured income convergence for aggregate economy using per capita Net Domestic Product across the major states in India. The results of these studies support an income divergence among Indian states. Kalirajan et al. (2000), examine the issue of per capita income convergence among the fourteen major states in India over pre and post reform periods. They further proved the existence of convergence of agricultural growth rates across Indian states. Their findings indicate that overall per capita income across states over the period has shown divergence while convergence was found in agricultural growth rates. Subhash Ray (2002) uses the state level data on manufacturing inputs and outputs for the year 1985-86 through 1995-96 to measure Tornqvist and Malmquist indices of productivity growth. According to him, the annual rate of productivity growth is higher during the post reform period than in the pre-reform period and there is a tendency towards convergence in the productivity growth rates across states.

Trivedi (2004) examines the interstate differences in productivity movements in organized manufacturing sectors during 1980-81 to 2000-01. Her study empirically confirms the existence of interstate differences in productivity levels and growth rates.

Mukherjee and Ray (2004) analyze state level data from the manufacturing sector in India for the period 1986-87 to 1999-00 to study the efficiency dynamics of a “typical” firm in individual states during the pre-reform and reform periods. They observe no major change in the efficiency ranking of states after the reform and no evidence was also found for convergence in the efficiency of distribution during the reform period.

However, except Kalirajanet al. (2000) study, none of the above Indian studies have examined the test for convergence at the sectoral level. Kalirajan et al paper examines the issue of convergence only in the case of agriculture sector. But industrial sector can also play an important role in poverty alleviation and employment generation in Indian context. Within the industrial sector, manufacturing plays a dominant role and after 2002, India suddenly experienced a spurt in brain-intensive manufacturing, involving design, customization and innovation. The sector has grown at an impressive average growth of over 9 per cent during 2003-04 to 2006-07 (Kumar and Sen Gupta, 2008). The manufacturing sector surge buttressed the earlier services spurt, and hence the overall GDP growth crossed 8 percent. Given the importance of the manufacturing sector, a study of productivity convergence of Indian manufacturing becomes imperative. The issue of productivity convergence would identify, whether the improved growth in manufacturing is flourishing in rich regions as compared to poor regions. If the manufacturing sector is only thriving in rich regions, then interstate disparities will become wider and may create more inequality. It will also reduce the interstate competitiveness of manufacturing in the long-run.

In Indian context, there is a plethora of studies on productivity growth in Indian manufacturing, but to the best of our knowledge, Ahluwalia (1991) is the first study on the effects of firms’ dynamics on productivity dynamics. This has taken into account the structural change of the economy as well as changes in policy regime in India during 80’s and 90’s. The first tentative moves towards deregulation were made during the early 1980s, but the pace of deregulation accelerated with the unveiling of the “new economic policies” in 1985. A series of piecemeal reforms were introduced with the objective of improving productivity in existing units. Under certain conditions, business houses were allowed to operate outside their permitted list of sectors. They were allowed to expand into related areas without seeking a fresh license under the facility of broad banding. Some sectors were de-licensed. Existing companies could set up new production units, without restriction on size, provided the latter were 100 per cent export oriented. Access to foreign technology, hitherto severely restricted, was relaxed across the board and duties on project related imports were reduced along with those on all other capital good. The upper limit of investment in the small scale sector was also revised to allow them to expand. Notably, all these reforms were favorable to existing companies, however, they did not facilitate the entry of new firms. Further, the status quo was maintained with respect to the licensing procedure which was heavily loaded in favor of incumbents (Bhagwati, 1982, 1988). Meanwhile, the exit policy was further tightened. In 1981 the government announced a new strategy under which large sick units employing more than 1000 employees and having investment worth Rs 90 million or more could be nationalized.

Balakrishnan and Pushangadan (1994)[13] feel that productivity estimation is sensitive to the measurement of real value added. The biased associated with assuming the constancy of the relative price[14] of material inputs leads to an incorrect result of productivity growth. They have examined how changes in the relative price of material inputs can affect the measure of real value added and thus measure productivity. As has been done by Goldar (1986) and Ahluwalia (1991), the measurement of productivity with the single deflated value added is valid only when the price of materials relative to the price of output is more or less constant for the period of analysis. With the change in the relative price, estimated productivity would, ceteris paribus, vary inversely[15]. Balakrishnan and Pushpangadan show with the help of a single output and a single material input that real Value Added arrived by the Single Deflation (VASD) method is not independent with respect to the current level of the relative price of material inputs[16]. Therefore, when there is a secular change in the relative price, the difference

[13] Total Factor-Productivity Growth in Manufacturing Industry: A Fresh Look, Economic and Political Weekly, July 30, 1994, pp. 2028-35.
[14] The ratio of the price index of raw materials to that of manufacturers.
[15] Bruno M (1984): Raw Materials, Profits and the Productivity Slowdown; *The Quarterly Journal of Economics*, Vol. XCIX, Feb, No.1.
[16] BP (1994) assumes the case of a single output and a single material input. Then value added at current price will be defined as

$$VA_t = P_t Q_t - P_{n.t} N_t \ldots\ldots\ldots\ldots..(1)$$

between the VASD and Value Added at Double Deflation (VADD) measure will widen. So, during the periods when the relative price increases, VASD will grow at a lower rate than VADD and *vice versa*. In turn because of this difference the measurement of total factor productivity is also adversely affected. But at the same time the VADD requires a material price index, which is used to deflate the material input component involve in the production. As this price index is not readily available from any source, therefore the researcher has to construct it independently. However, the data required for constructing an appropriate material price index is the prices of those specific material inputs which are used during the production of specific goods. Further, there are different industrial groups, those are producing different products with the different input combinations. In such a complex case we have to construct a material price index for the different products (as WPI is available for the different commodity groups), which further need information related to the input prices of specific inputs used in different industries. In the context of India, this information is partially available from Input-Output (I-O) table. The input-output table in Indian case is being prepared with such a limited coverage, that using it, is rather create more problem than solves it. From the review of existing literature on this we observe that enormous arguments put forward in this regard unable to come out with a satisfactory conclusion on which there will be a general consensus. Therefore, we prefer to stick to the traditional approach of value added at single deflation.

Ray (2002) examined the impact of reforms on efficiency and productivity in the manufacturing sector of Indian states for the period 1986–87 through 1995–96. Using data envelopment analysis, the study noted an improvement in Total Factor Productivity Growth

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Where, P is the price of output, Q is the output. $P_n$is the price of the material input N and t is the time subscript. Then VA (SD) and VA (DD) can be derived by deflating two parts of the right hand side of the equation (1) with the output price index and deflating value of output (P_tQ_t) with output price index and the value of input (P_nN_t) by input price index respectively. The value added thus obtained will be

$$VA\,(SD) = \frac{PtQt - Pn.t\,Nt}{Pt\,/\,P0} = P_0\,Q_t - \Pi_t P_0 N_t. \ldots\ldots\ldots\ldots\ldots\ (2), \text{ where, } \Pi_t = P_n / P_0.$$

$$VA\,(DD) = \frac{P_t\,Q_t}{P_t / P_0} - \frac{P_{n.t} N_t}{P_{n.t} / P_{n.0}} = P_0\,Q_t - P_{0.n}\,N_t \ldots\ldots\ldots\ldots (3)$$

Setting the base period price t one ($P_0 = 1$), then the expression 2 and 3 will be

$$VA\,(SD) = Q_t - \Pi_t N_t \ldots\ldots\ldots\ldots (2)'$$

$$VA\,(DD) = Q_t - N_t \quad \ldots\ldots\ldots\ldots (3)'$$

Value added arrived at single deflation method is no invariant with respect to the current level of the relative price of material inputs.

(TFPG) in most of the states during the reform period (1991–92 to 1995–96). The study showed that improvement in technical efficiency as well as faster technical progress have contributed to the observed acceleration in productivity growth. The study also found evidence of the tendency towards convergence in the TFP growth rate among Indian states in the reform years. Mitra et al. (2002) while analyzing the effect of infrastructure on productivity and efficiency across the Indian states found that regional disparities are still significant in India and have been increasing over time. The study advocated more public investment in infrastructure that favors the convergence of industrial productivity.

Productivity performance of the manufacturing sector in 10 major Indian states for the period 1980–81 to 2000–01 was studied by Trivedi (2004) using both growth accounting (GA) and production function approach. The study found considerable interstate differences in productivity levels and growth rates. Veeramani and Goldar (2005) examined the effect of investment climate on state-level total factor productivity in manufacturing and found that the state-level investment climate is a major determinant of productivity performance during 1980 to 2000 period. They also noticed that states with more pro-worker legislation experience lower productivity growth during the same period. In a recent study on the organized manufacturing sector in India for the period 1980–81 to 2003–04, Trivedi et al. (2011) notes a significant variation in TFPG of the manufacturing sector across Indian states. The study also finds that there has been a deceleration in TFPG in the period following reforms. According to the study, it is the supply constraint in the form of technological upgradation and organizational and institutional constraints that seem to be the major factor affecting the growth of the manufacturing sector. A brief review of these studies suggests that there exist limited attempts at understanding the factors that explain the productivity differential across states in India. We also find that most of these studies except Ray (2002) have not addressed the question of convergence in productivity growth across states. Moreover, these studies have considered a time period, which does not extend beyond the initial phase of reforms.

Madheswaran. S, Hailin Liao and Badri Narayan Rath (2007)analyses the technical efficiency change and role of productivity change in economic growth by using stochastic production frontier for two-digit registered manufacturing sector in India. The estimation of the parameters of production function and rate of technological progress and technical efficiency change for each industry group has been done by using the trans-log approaches to the model based on panel data. The TFP has been calculated from the estimated production function and the growth rate seems to have improved in a large number of industries during 1980-81 to 1997-98. The two TFP components, technical efficiency change and technological progress, have been estimated separately. The decomposition results show that TFP are not mainly driven by efficiency change but by technological progress. Finally, the measures of TFP growth components not only provide more insights and better understanding of the dynamic nature of the production process, but also have important policy implication. A thorough examination of industrial policy resolutions and five-year plans reveal that the importance and contribution of efficiency in industrial growth have been neglected or given second priority in the framework of industrial development strategy. In this direction, the governments should take some action to improve productivity efficiency of the manufacturing sector, especially, in the case of industrially backward states. Once efficiency increases, it enhances competitiveness by achieving the potential output.

Badri Narayanan G. (2010) rightly observed that the long-run relationship between the variables involved in the production function is an issue. He further mention that it is particularly important in developing countries, as the neoclassical production function is best suited for developed countries and its applicability to developing countries is questionable in various ways. He analyses the time-series analysis, taking the Indian textile industry as an example, which is currently at its crucial stage as a critical industry in an emerging economy, with the phasing out of Multi Fiber Arrangement in 2005. This study documents the existence of cointegration between capital and output, the negative impact of employment shocks on output changes, substitutability between changes in capital and labour, the negative effect of shocks to changes in capital stock on productivity and negative effect of employment shocks on future productivity. These results are in line with the general perceptions about this industry and with the standard neoclassical propositions, as explained in this article.

The paper by Rajesh Raj (2011) analyzes the size, growth and productivity performance of the unorganized manufacturing sector in India during the 1978–1979 to 2000–2001 period. The study shows evidence of an increase in the size of the sector with a slowdown in the reform period. Evidence indicates that the rate of growth varies widely across the two-digit industries, but the variation in growth rate is smaller during the 1990s. Textiles and machinery goods were the fastest growing segments of India's unorganized manufacturing sector in the reform period. The partial factor productivity approach shows that labor productivity has improved in 2000–2001 over 1978–1979 while capital productivity reported a decline in the same period. The sector, on the other hand, registered a fall in total factor productivity (TFP) during the reform period. It is found that technological progress has been the main contributor to the growth in TFP in the pre-reforms period while technical regress contributed to the decline in TFP in the reform period. A completely different picture has been noticed since the mid-1990s, when the sector made significant progress in TFP primarily attributed to technological progress which outweighed the decline in technical efficiency. It is also found that capital intensity is an essential factor augmenting labor productivity levels in the sector, which is important for improving the wages paid to the workers in the sector.

Alongside, the issue of what determines labour productivity in manufacturing sector received significant attention both in developed and emerging literatures. As well, there is a plethora of approaches adopted in this regard both at the aggregate and dis-aggregate levels. Lindbeck (1983), in his empirical examination of slowdown of productivity growth, identifies the major determinants of labour productivity in the seventies, which are inflation rate, lower profits, and higher relative prices of various inputs of major macroeconomics importance. His econometric results show a negative impact on the expected inflation rate of labour productivity. Fortune (1987) examines some determinants of labour productivity in manufacturing in the USA. He relates output per worker in manufacturing to expected inflation rate, expected interest rates, expected rate of growth of income, labour costs, and capital utilization. His results indicate that the expected growth rate of GNP and expected inflation have a greater positive impact and expected interest rates have a greater negative impact on labour productivity. Both, an increase in labour costs and increase in capacity utilization, result in a decline in labour productivity.

Abbas (2003) presents a model capturing sources of Australian aggregate labour productivity using annual time-series data from 1970 to 2001. Labour productivity in his model is determined by real net capital stock in Information Technology and Telecommunications (ITT), real net capital stock in the non-ITT sector, trade openness, human capital, the wage rate, international competitiveness, and the union membership rate. Empirical estimates indicate that, in the long-term, policies aimed at promoting various types of investment, trade openness, international competitiveness, and the use of wage as a stimulant in a decentralized wage negotiation will improve labour productivity. In the short term, all the above variables except for human capital and labour reforms determine productivity performance. Madden and Savage (1998) employ a multivariate co-integration technique to determine the short and long term Australian labour productivity during 1950 to 1994. Their results indicate that, in the short term, Australian labour productivity is mainly determined by the real capital stock per worker, investment in Information Technology and Telecommunications (ITT), and trade openness. In the long term, fixed capital accumulation and investment in ITT are the only significant determinants of labour productivity.

Sunil Kumar (2002) studied the determinants of labour productivity in Indian context. Kumar analyzes the factor influencing labour productivity in Indian manufacturing by using ASI data for the period 1969 to 1994-95. By applying multiple regressions, he finds that the most significant factors explaining the disparities in growth of labour productivity are the growth of capital intensity and man-day lost per 100 employees. Sahoo (1995) has made an attempt to look into the main factors influencing the regional productivity disparities in organized factory sector in thirteen districts of Orissa state with reference to two points of time: 1973-74 and 1984-85. A multivariate regression model is specified and the results show that the capital-output ratio, skilled manpower, and wage rate have the most significant variables defining regional productivity disparities in 1973-74. But wage rate, skilled manpower, and factory size have the major contributory variables in order of their priority in 1984-85. Naidu and Ravindrakumar (1992) have been examining the impact of internal factors on labour productivity from the census of 13 major and medium industries of Kurnool district of Andhra Pradesh. The findings of the study reveal that age of the plant, educational background of the employee had a positive impact on labour productivity and firms with higher labour productivity range had strong financial strength to offer better wages. This study differs from the studies undertaken by Kumar (2002) in two respects. First, we have updated a large regional database for Indian manufacturing. It contains annual data for the period 1980-2001 for aggregate manufacturing in 15 Indian states. Second, in the area of methodology, we have applied panel data analysis to identify the state-specific and time-specific characteristics of each state.

Manufacturing sector in India, despite a steady growth over several decades, faces stiff competition from other developing economies in Asia and elsewhere, both in domestic as well as global markets. The important requisite needed for competitiveness is productivity enhancement. Being a labour abundant economy, India can boost productivity through employment generation, paying higher wages to employees and technological innovation. Thus, improving productivity and employment in the manufacturing sector is a viable route to making Indian manufacturing a global manufacturing hub. Productivity-related studies gained prominence in India in the 1950s and early 1960s. In the later part of the 1960s, a number of studies were conducted. Several studies, like Ahluwalia (1991), Goldar (1986, 2000, 2004), Upender (1996), Kumar (2002), Aggarwal and Ganesh (1991), Balakrishnan and Pushpangadan (1994), Rao (1996), Gangopadhyay and Wadhwa (1998), Unel (2003), Trivedi et al. (2000) and TSL (2003), Tendulkar (2003), Lall et al. (2004), Bell and Rousseall (2001), Krishna and Mitra (1998) and Bidhe and Kalirajan (2004), examine productivity trends, employment trends and growth of India's organized manufacturing sector during the post-independence period. Some of these studies have focused on the measurement of Total Factor Productivity Growth (TFPG) and found different results based on different methodological frameworks.

Moreover, studies like Balakrishnan and Suresh Babu (2003), find the growth rate of labor productivity and employment in the nineties has risen as compared to the eighties. But at the same time, the growth rate of money wage, product wage and real wages has declined in the post-reform as compared to the pre - reform period. Some of the indicators of their study do commensurate with the findings of Unel (2003) and Gangopadhyay and Wadhwa (1998). But Goldar (2004) finds a deceleration growth in

Indian manufacturing during the post-reform periods as compared to the pre - reform period. He has compared his results with Unel (2003) and TSL (2003) and criticized their findings on the ground of measurement problems. Goldar's study also finds a negative employment growth in the Indian organized manufacturing sector after 1997-98. The study by Buddha and Kalirajan (2004) also shows a slower growth rate of employment in an organized manufacturing sector in the post - reform period as compare to the pre - reform period.

We have also reviewed some of the international literature pertaining to our study. Lindbeck (1983), Giersch and Wolter (1983) and others have examined the negative impact of inflation on labour productivity. The acceleration of inflation will push workers into higher tax brackets and it may have impaired work incentives. Since higher inflation rates can distort the price mechanism they can also reduce the economic efficiency, having a negative impact on capital accumulation and technological progress. Strauss and Wohar (2001) investigate the long-run relationship between prices and wage-adjusted productivity as well as between real wages and average labour productivity at the industry level for 459 US manufacturing industries over the period 1956-96. Their panel co-integration test results strongly reject the null of no co-integrated in the panel between both price and wage-adjusted productivity and between labour productivity and real wages.

While these policies enabled India to develop a widely-based industrial structure, and technical and professional manpower, they were allowed to continue for too long, they led to considerable inefficiency in the industrial sector (Bhagawati and Desai, 1970; and Bhagawati and Srinivasan 1975. Thus, Bhagawati and Srinivasan (1975) concluded that the Indian foreign trade regime, along with the industrial licensing policy which eliminated all forms of competition, had adversely affected incentives to reduce costs and prevented improvements in product quality, and sign and technology. Wolf (1982) notes by international standards, Indian industries were fragmented into many relatively small firms, hindering exploitation of scale economies and product development. He attributed the key cause of the above inefficiencies to policies relating to industrial licensing and imports. Bhagwati (1998), Jha (1976, pp. 99-106), and Ahluwalia (1985) has also concluded in the similar vein.

Several recent studies have attempted to empirically estimate the differences in outcomes of post- and pre-liberalization policies on the Indian manufacturing industries. Ahluwalia (1991) estimated the annual TFP from 1960 to 1986 and showed that there was an increase in TFP growth in the late 1970s, the initial period of liberalization. However, Balakrishnan and Pushpangandan (1994) and Rao (1996) challenged this result. Using the "double-deflation" method, they suggested a rapidly declining TFP growth for the manufacturing industries after 1983. Study by Hulten and Srinivasan (1999) shows that there is little evidence of any positive impact from the initial economic reforms on TFP growth of the Indian manufacturing industries. They, however, found that there were other positive impacts on investment, labour productivity and capital per worker from the economic reforms. Some of the studies have concentrated on examining the impact of economic reforms on the scale effects in the manufacturing industries in India.

Fikkert and Hasan (1998) analyzed the returns to scale for a panel of selected Indian manufacturing industries for the pre-liberalization period from 1976 to 1985 using a restricted cost function. Although they found a large number of firms operating with increasing returns to scale, the results suggested that most of them were operating close to constant returns to scale. They suggest that there might not be significant gains in scale efficiency from the tentative steps in economic liberalization in the 1980s. In a similar panel study using a production function from 1986 to 1993, Krishna and Mitra (1998) show that there are increasing returns to scale in electronics, transport equipment and non-electrical industries; and that there was an increase exploitation of the scale economies after the economic liberalization. In a related study using selected industry level data with Translog cost function, Jha et.al (1993) shows that there exists biased technological change and economies of scale in two of the four industries analyzed for the initial economic reform periods.

India moved from a growth rate of 3.5 per cent per annum during 1950/51 to 1979/80 to a growth rate of about 5.5 per cent per annum during the 1980s because of gradual trade and industrial liberalization and possible fiscal expansion. Following the BOP crisis of 1990-1991, India undertook a deep and wide ranging liberalization of domestic and external policies. However, the growth rate barely moved from the 5.5-5.8 per cent range, during the 1990s [Virmani (2004, 2005a 2006b)]. Many analysts pointed to this puzzle: How could the limited reforms of the 1980s raise the growth rate of the Indian economy by 2 percent points, while the relatively major reforms of the 1990s had virtually no measurable effect on the growth trend. This has been mirrored in manufacturing, with an intense debate on the effects of economic reforms on productivity growth in Indian organized manufacturing. A majority of the studies has found that productivity growth in the post reform period of 1990s decelerated from growth rates seen in the 1980s.

This has baffled economists and policy analysts, as the reform process was expected to accelerate productivity growth. Several studies have tried to provide an explanation for this unexpected outcome of the reform process. A few studies, instead of directly blaming the reforms for the slowdown, have held deteriorating capacity utilization responsible for the phenomena. They argued that owing to surge in investment activities and imports in the post reform period, unaccompanied by a commensurate expansion of demand, capacity utilization went on worsening in the manufacturing sector, thereby adversely affecting productivity growth [Uchikawa (2001); Goldar & Kumari (2003)]. Goldar&Kumari (2003) in their study provide numerous evidences of deteriorating capacity utilization in the 1990s.One piece of evidences they provide relates to the upward jump in the ratio of gross fixed capital formation to gross value added (at 1993/94 prices) in the organized manufacturing in the 1990s. According to them, the ratio was only 44 per cent during 1985-86 to 1989/90 but touched as high as 76 per cent during 1995-96 to 1997-98. The situation became worse from 1997 through 2001. The ratio of gross capital stock of gross value of output (at 1993-94 prices) increased from an average of 78.6 per cent between 1992/93 and 1997/98 to 83.7 per cent between 1998/99 and 2001-02. It, however, declined sharply to 61.2 per cent during 2002/03 to 2007/08. Thus, a correct comparison of productivity growth between 1980s and 1990s can be made only if the productivity growth is measured net of capacity utilization. Interestingly, even after adjusting for capacity utilization, Goldar & Kumari (2003) found that productivity growth in 1990s stayed at nearly the same level as during 1980s. But the question to answer remained as to why reforms failed to accelerate the productivity growth in the Indian manufacturing. In line with Athukorala & Rajapatirana (2000), they argued that such favorable productivity-enhancing effects of economic reforms may be manifested with a time lag and hence 4 expected an improvement in productivity growth in the years to come. However, this does not explain a decline in productivity during the reform process. Virmani (2009) showed that the pattern of productivity growth at the macro level resulting from the 1990s reforms was in line with the prediction of the J-curve hypothesis (see appendix). Estimates of productivity in Indian organized manufacturing by Virmani and Hashim (2009) and Hashim et.al. (2009) supported these conclusions within the limitations of data used. While the earlier study could provide the analysis for data up to 2001/02, the latter study could not include the pre-reforms period of the 1980s in the analysis.

The J curve has also been illustrated at an economic level by the experience of Eastern European countries and Russia after the fall of the Berlin wall Blanchard (1997), Kvintradze (2010). However, these countries were subjected to a systemic shock that transformed virtually the entire political, administrative system and fundamental economic institutions. The dramatic liberalization that followed complemented the decline in productivity and growth, but the conflation of the two may make it harder to separate the effects of institutional change from that of policy change. The trade liberalization initiated in June 1991 was a part of the overall reform of the Indian Economy was very different from the piecemeal approach to trade reforms of the 1980s. There is a widely held view, largely due to the studies by Bhagawati and Desai (1970) and Bhagawati and Srinivasan (1975) that the inward looking development strategy based on the policies of import control and domestic licensing have led to considerable inefficiency in the industrial sector. Further studies by Goldar (1986 a, b) and Ahluwalia (1991) have investigated the impact of trade orientation on the productivity for the Indian industry during the 1970s and 1980s. Their studies conclude that the prevailing trade policies did play a role in the observed TFP growth rates of Indian industries. Both these researches were at best a first attempt in investing the trade policy changes in relation to the productivity growth in the Indian manufacturing sector.

The TFP growth rates for the sample industries are documented for three different phases of trade reforms. The three different phases of trade reforms are identified as a slow trade liberalization period ranging from 1980-85, moderate trade liberalization period from 1986-91 and rapid liberalization period ranging from 1991-97. The cutoff years have been chosen as 1986 and 1991 respectively because for the first time the government announced an export-import policy in 1986 for a period of three years in continuity breaking away from the earlier tradition of yearly announcing. This continuity has been treated as the beginning of attempts at reforming the trade regime. And trade liberalization in June 1991 was unique in every sense. In one step the government eliminated the restrictive and complex system for imports of intermediates and capital goods. The removal of quantitative restrictions on imports has been accompanied by a gradual lowering of tariffs. In addition, the government also liberalized the foreign exchange regime. Unlike earlier studies, this study uses the growth accounting framework introduced by Harberger (1991) to calculate productivity growth rates and then using the TFP Sunrise/Sunset diagrams introduced by Harberger (1998), the entire scenario in the manufacturing sector is explained.

A feature of both B-P (1994) and Rao (1996) is that their intermediate input price deflator uses fixed base weights, derived from one single year of input-output information for the Indian economy. This is equivalent to a fixed-base weighting scheme, and thus subject to the criticisms that apply to such indices. Specifically, fixed weights derived from only one year of information on the flow of goods may miss out on changes in the underlying structure of inputs and outputs over time. To get around this problem, using state-level manufacturing data, HBS (2006) constructed a price deflator that varies by time and state, and find that TP growth remained more or less unchanged in the pre and post-reforms periods. They derive implicit input prices at the 2-digit industry group level by assuming that within each industry group, the ratio of real input to real output is constant, and given this constant and the price of the output, the implicit price of intermediate inputs at each industry group level can be determined, and aggregated to the all-manufacturing level using the relative weights of intermediate consumption in the given industry groups.

Hence, the spectrum of results covers acceleration, stagnation, and deceleration in manufacturing TFP in the 1980s relative to the 1970s and earlier. A big boost to liberalization efforts came in 1991, in the wake of a balance of payments crisis, leading to a bigger push towards market oriented economic policies, including widespread de-licensing and deregulation of industry, and further liberalization of the current account. A fresh literature emerged re-examining the timing of growth question, and again, while new methodological issues came to light, the results as to trends in productivity growth in manufacturing were inconclusive. For example, Unel (2003) uses the value added framework and finds manufacturing TFP growth to have accelerated in the 1990s compared to the 1980s. On the other, Goldar (2007), and Banga and Goldar (2007), using the gross output framework, find the opposite trend. Notwithstanding the mixed results, the potential importance of the role of services as an intermediate input was brought to light as a methodological issue. In previous studies, services, prices were not included in measures of intermediate input prices, but over time, services have gained in importance as intermediate inputs and therefore pricing intermediate inputs accurately requires that the weight of services be factored in. Banga and Goldar (2007) show that if the contribution of services is not taken into account, this leads to an overstatement of productivity growth in the post-1990s period, perhaps on account of the fast growth of services-use in the 1990s relative to the 1980s. The results discussed above are confined to the registered or formal sector within manufacturing, consisting of firms registered under the Factories Act of 1948, which are subject to reporting requirements. Bosworth, Collins and Virmani (2007) point out that although this sector accounted for 60 percent of manufacturing output in 1999-00, bulk of manufacturing sector employment lies within the unorganized or informal sector, accounting for as high as 98 percent of manufacturing employment. For the manufacturing sector as a whole (including both registered and unregistered manufacturing), they find that TFPG is distinctly higher over 1980-2004, compared to Bosworth et.al (2007) assumes fixed shares of capital and labour in value added, according to proportions that are observed in OECD countries (60:40 share for labour and capital respectively). This is important, since the growth rates of capital and labour may differ significantly in different periods, the choice of factor shares can have a strong influence on measured TFPG. Their choice may be justified owing to their coverage of both the organized and unorganized sector, as reliable data are difficult to find in the latter. In our case, we do not make this fixed shares assumption, since we deal only with registered manufacturing, which presumably has better quality data.

At the level of the aggregate economy, the consumption of intermediate goods is equal to their output, and thus intermediate flows cancel out. From the national income accounting identity, GDP equals gross domestic income (GDI), which equals the income of labour and capital. Hence TFP, which measures the excess of real value added growth over the income-share weighted growth of primary inputs, is appropriate at the level of the aggregate economy. However, at the industry/sector level, it is not necessary that purchases of intermediate inputs equal to sales of intermediate outputs. Thus the appropriate underlying production is a gross output function that includes intermediate inputs. Moreover, the efficiency parameter in the gross-output framework is typically modeled as augmenting, not only primary inputs, but also intermediate inputs, which can also be a significant source of efficiency. For a detailed discussion on this issue, see Hulten (2009).

There are several studies on productivity growth in the Indian manufacturing sector, but one could find that these estimates vary widely depending upon the methodology used and the period covered. One of the pioneer studies (researchers) in the field of productivity, Fare et al. (1994) analyzed the productivity growth of 17 OECD countries over the period of 1979 to 1988 using non parametric programming methods and concluded that productivity growth of the United States is slightly higher than average growth and this is due to technological progress. They also concluded that Japan's productivity growth is the highest in the sample with almost half due to efficiency change.

Among the post 1980 studies, the study of Ahluwalia (1991) is considered as a significant one. The main objective of the study was to calculate the growth rate of TFP in Indian manufacturing industries covering a period from 1964-65 to 1985-86.The study based on the Annual Survey of Industry (ASI) data, found a marked increase in the growth rate of TFP at 3.4 per cent per annum of Indian manufacturing. The estimates of trans-log production function using pooled cross-section and time series data also showed a marked improvement in the rate of TFP growth. She attributed this observed "turnaround" in productivity growth in Indian manufacturing in the 1980s to liberalization of economic policies. Misra (2006) focused on the impact of India's economic reforms on industry structure and productivity. The discussion used the ASI data and covered both the two-digit and three-digit level of industries. The study has shown very low performance of Indian manufacturing sector and the reason for such a bad performance was the consequences of the type of policies being followed under the reforms.

Leachmanet *al*. (2005) used data from eight major automobile manufacturers and adopted a two stage model to study the performance of manufacturing units. They considered R&D intensity (ratio of expenditure on R&D and sales) as one of the explanatory variables, while determining the level of efficiency of manufacturing and thus demonstrated that a strong R&D commitment and capability to reduce production time. Jajri et al. (2006) in their attempt analyzed trend of technical efficiency, technological change and TFPG in the Malaysian manufacturing sector and concluded that during the period under study, TFPG increased and the major contribution for the growth is technical efficiency. The study by Manjappa and Majesha (2008) examined the TFPG and its components in ten manufacturing industries. He classified them into capital-intensive and labour-intensive industries (five in each segment) using annual time series data for the period of 1994 to 2004. The study applied MPI to panel data and concluded that the average TFPG in the capital-intensive industry segment grew moderately at 1.7 per cent per annum, whereas, in its counterpart, selected labour-intensive industries have shown a productivity regress over the period of study.

Heshmati and Kumbhakar (2010) in their study used panel data on Chinese provinces and identified a number of key technology shifters and their effect on technical change and TFPG. Mahadevan (2001, 2002) used both stochastic frontier approach and DEA separately to calculate the TFPG of Malaysian manufacturing industries during 1981-1996. He used the same data set to make comparison between the two approaches and concluded that both methods demonstrated a decline of TFPG after 1990, increasing contribution of technology progress and declining contribution of technical efficiency change.

Joshi and Singh (2010) measured the TFP and identifies its sources through applying a non-parametric DEA-based MPI approach. Through this approach, the productivity growth was decomposed into technical efficiency change and technological change. Further, an attempt had also been made to study the variation in the productivity growth rates across location, scale-size and type of garments.

There are very few other studies as well, which have estimated the productivity at regional level. Seth and Goldar (1989) have studied trends in industrial output in 12 states of India during the period 1960-61 to 1985-86. Confined to organize manufacturing sector, the growth rates in industrial output have been estimated for 3 sub periods using a kinked exponential model. According to the study, after the 1960s, all states experienced a decline in the rates of industrial growth measured in terms of net value added per capita in organized manufacturing (at 1970-71 prices) though the extent of deceleration varied from state to state. Further, Goldar and Veeramani (2005) studied the relationship of investment climate with the level of TFP for selected states of the country. Another attempt is made by Trivedi (2004) to interpret interstate differences in productivity movements in organized manufacturing sectors, in a larger perspective of employment and output trends. With the time span of 1980-81 to 2000-01 in case of 10 major states of India, the study empirically confirmed the existence of interstate differences in productivity levels and growth rates. It points out that states, such as, Bihar and West Bengal are diverging away rather than converging to the growth rates of output of organized manufacturing sector at national level.

Kumar (2004) measured total factor productivity growth in the industrial manufacturing sector of 15 major states of India for the period 1982-83 to 2000-01 using non-parametric linear programming approach. The analysis has also been done to measure the sources of TFPG and level of business in technical change. The findings of the study signified improvement in TFP. The study pointed out that regional differences in TFP persist in India, although the magnitude of variation has declined in the post reform period. Moreover, it is also found that there is a tendency of convergence in terms of the TFP growth rate among Indian states during the post reform period and only the states that were technically efficient at the beginning of the reforms remain innovative. Norsworthy and Jang (1992) found mixed results for Indian manufacturing industries across the states. They found that Indian heavy industry exhibited a higher growth potential in terms of TFP. There are many studies on productivity growth in the Indian manufacturing sector, but one could find that these estimates vary widely depending upon the methodology. Studies conducted so far to measure the productivity performance of Indian industry, both at aggregate and disaggregate level (Ahulwalia, 1991; Goldar, 1986; Unel, 2003; Misra, 2006; Manjappa&Majesha, 2008). On the other hand, there are few studies that tried to analysis the interstate variations with respect to productivity performance (Ray, 1997; Ray, 2002; Trivedi, 2004; Kumar, 2004; Goldar&Veeramani, 2005).

Goldar (2004), analyses the wage and productivity relationship in the organized manufacturing in India. The author had taken into account the factors expected to influence the wages. The growth rate of labour productivity and than of wage went hand in hand during the period 1975-76 to mid 80's. But since then the wage growth had been lagging behind. Weakening bargaining power, the decline of the public sector had been lagging behind. Weakening bargaining power, the decline of the public sector are starting to be the caused for these divergences. A state wise examination of the relationship between the growth rate of labour productivity and that of wage rate revealed that the former had an influence on the latter as there exists a significant positive correlation (r=0-5) but the regression coefficient between the two was lower than unity which implies a hike in a labour productivity would lead to a wage that is much less than the proportionate hike in real wages. The author tries to look into other economic variables that might influence wage setting. The number of contract labour, women workers, unionization of labour, and size of firm, labour market flexibility and investment climate were the factors those contributed significantly to the wage productivity gap.

Bhatacharya et.al (2010) investigated the long run relationship between labour productivity and real wages in case of Indian manufacturing. They use the panel data considering of 17 2-digit industries for the period 1973-74 to -2000-01. For the study of the long run relationship of the two the authors used the Pedroni's co-integration method. Before establishing, any relation it was confirms that both in a uni-variate and a panel sense the data were stationary at first difference and the variables as integration of order one. Based on the tests proposed by Pedroni it was found that productivity and wage were co-integrations, for the panel of 17 manufacturing industries. The individual industry-wise test for the relationship of productivity and real wage by fully modified ordinary least square (FMOLS) method confirms that except for; leather and wood industries. In all manufacturing industries, real wages had a positive impact on labour productivity. The speed of adjustment parameters was very slow and occurred through changes in wages to labour productivity. The speed also varied from industry to industry. In the long run real wages were approved to be a boost to productivity growth. After the liberalization the competition from the Asian countries had increased the real wages. The open up had scrutinized the rigid labour market and the competitiveness, real wages and employment would rise, which is fact resulted in a productivity growth.

At international level, studies that examine the interrelationship between employment, productivity and real wages include Alexander (1993), Darby and Wiren-Lewis (1993), Bender and Theodossiou (1999), Wakeford (2004) and Yusof (2007). Alexander, using the VAR approach to cointegration on the UK data, shows that from 1955 to 1979 unemployment was the most significant variable, being cointegrated with wages and separately with productivity. He studies further observed that during the Thatcher period (1979-91), there exists a bi-directional causality linkage between productivity and real wages with unemployment playing no significant role. Similarly, Darby and Wiren-Lewis's paper also focuses on the UK data to determine if there is a cointegrating vector for wages. Using the GDP deflator to measure real earnings, they found no cointegration of real wages to productivity, unemployment, union power and other variables. The link between real wages and productivity has also been studied by Huh and Trehan (1995), show that real wages and productivity are cointegrated for US. Bender and Theodossiou (1999) on the other hand, provide evidence of cointegration between wages and productivity for Denmark, Norway, The Netherlands, Sweden and the UK. Their result also substantiates the existence of cointegration between employment and productivity for US and Canada, while both cointegrating relations apply to Italy. However, for ten OECD countries, he found no relationship between wages and employment. These results were consistent with those found by Wakeford (2004), who found a long term equilibrium relationship between real wages and productivity for South Africa. Yusof (2007) studied the long-run and dynamic relationship between real wages, productivity and employment for Malaysian manufacturing by applying time series econometric technique. He considers quarterly manufacturing industry data from 1992 to 2005 and shows the existence of a long-run relationship between the three variables. He found employment and productivity to be exogenous while real wages are the variable that adjusts to maintain cointegration.

2.4 Conclusion:

In the light of the above discussion, we found that productivity analysis is diverse in nature and so its findings and outcomes. Past literatures on productivity can broadly divide into two groups, first, studies on advanced or developed economies, second, literatures analyzing productivity dynamics in emerging or developing economies. However, this segregation does not bring any clarity on the findings. We understand and acknowledge that due to different available methodology and data sources spanning over different time periods under consideration can be a plausible explanation in the significant divergence in the productivity growth. Moreover, productivity studies on Indian manufacturing sector also experienced diverse findings that contradict each other, mainly because of methodological and data constraints. However, the majority of the studies found to see a rising productivity growth in Indian manufacturing during the post-reform period comparable to the pre-reform period. Similar findings from the existing literatures on productivity, employment and wage relationships are mixed. Moreover, we observed that the best suit studies are well discussed some of the issues and the constrains of measurement, methodology and data point of view that Indian manufacturing is facing. We also need to understand these constraints were highly significant to the result of the above discussed studies. The aggregate and disaggregate level of studies along with regional and state-wise dis-aggregation also provide enough challenges and explore the different aspect of productivity analysis. Therefore, we would like to acknowledge that the existing literatures were being a guiding influence to carry out and refined the present analysis of manufacturing productivity in Indian context. Thus, the present study is an endeavour in this direction.

Chapter-III

Labour Productivity in Indian Manufacturing Sector

3.1 Introduction:

Productivity is much more than a word. As a policy instrument for development economist, it has both curiosity and concern. The persistence of income disparities in real incomes, growth rates, standard of living, export and price competitiveness have been attributed to differences in productivity performance. Industry level productivity is one of the key determinants of cost and price competitiveness, which led the firms and industries to become highly competitive in the global market. It also has the influence over the conduct of monetary and exchange rate policies.

Historically, the concept of productivity growth has been regarded as a contributory factor to economic growth. The credit goes to the Solow (1957) for popularizing this concept in his paper "Technical Change and Aggregate Production Function", which is published in *Review of Economics and Statistics*. Solow provides a framework in which the growth emanating from an increased application of factor inputs could be separated from that due to the residual factor. This residual has been designated as productivity factor. Since then the productivity growth has been recognized as a key feature of economic dynamism. Earlier in the classical period, it is the capital accumulation which is taken as the driving force behind the process of development. However, with the increasing recognition of the productivity growth at the policy level in recent years, paved way to a balanced perception (equal importance to productivity growth along with capital accumulation). Whether we take the structural view of development[1] or the classical one[2], productivity performance is crucial to the outcome. As Kuznet pointed out in 1966, rapid growth in industrial productivity was an essential element in the development and structural transformation of the developed economies.

From the above discussion, it is now clear that the measurement of both, the level of productivity and its growth rate, assumes critical importance. Despite this, there is hardly any consensus among different researchers on the magnitudes of level and the growth rates of productivity obtained. The measurement of capital stock as input and

[1] Which suggest the shift of labour and capital from less productive sectors to productive sectors can accelerate growth.
[2] In which growth takes place as a result of the long-term effects of capital accumulation, labour force expansion and total factor productivity growth, which include technical change under condition of competitive equilibrium.

the methodological differences make comparisons of productivity a difficult task. Hulten (2000) mentions two limitations in the estimation of productivity. *Firstly* comparison of productivity over time may not be very useful if the product composition of national income undergoes a major change. It has been argued in the recent literature that, the new knowledge based economy cannot be compared to the old tangible product based economy. *Secondly,* productivity estimates may overstate economic performance by ignoring the environmental degradation which itself can limit the growth process in future[3].

Our present attempt, not only updates the estimates of productivity growth provided by the earlier studies, but also it analyses the issues and methodological inadequacies at industry level critically. The study considers only the manufacturing sector of the Indian economy. The justification for this could be explained as, the manufacturing sector has figured prominently in India's development strategy and accounts for about three fourth of India's merchandise export[4] earnings (including software export). It is to be kept in mind that the present research is a modest attempt to empirically estimate productivity trends in the ASI two-digit manufacturing industries and for the aggregate manufacturing sector. The chapter attempts to provide a clear picture of the trend and growth of labour productivity in Indian Manufacturing (Organised/Registered) sector over past four decades (1973-74 to 2007-08). We also analyse the possible factors that determine the productivity growth followed by a brief conclusion.

3.2 Methodology:

Most of the empirical studies on productivity analysis, focus conventional approach of growth accounting and production function. In the productivity literature, there are different approaches to quantify the productivity growth. However, as discussed, the study is based on the framework of an alternative approach, which completely different from the conventional way of looking at productivity dynamics. Therefore, the basic nature of the methodology here is growth and trend analysis. For this, we have estimated both Simple Annual Growth (SAG) and Compound Annual Growth Rate

[3] See Pushpa Trivedi & Others, study on Productivity, RBI.
[4] Manufacturing exports constitute the lion's share of the merchandise exports in India. It accounts for 76.1% of total merchandise exports in 2000-01. However, its share has declined significantly then after and in FY2012, it accounts for 61% of total merchandised exports.

(CAGR). Further, to understand factor that associated and determinants the growth of labour productivity in Indian manufacturing, we also use Ordinary Least Square (OLS) both bivariate and multivariate analysis. The simple way to understand the association of different variables is correlation co-efficient. However, the time series nature of the variables under study may raise the viability of correlation coefficient measure to understand the degree of association. In view of the time series nature of the variables, it is required to be tested for Stationarity. In this direction the next section presents the various time series techniques, i.e., Unit Root test (test of Stationarity), and OLS technique is used in the present chapter.

3.2.1 Test of Stationarity:

Before employing any time series model to examine the relationship between the different variables under study, one has to test the stationary properties of the time series variables. This study applies unit root tests to examine the stationary properties of the variant. A stochastic process $\{y_t\}$ is said to be stationary if for all t and k ,

(i) $E[y_t] = E[y_{t+k}] = \mu$ For all t

(ii) $Var(y_t) = Var(y_{t+k}) = \delta^2$

or, $E[(y_t - \mu)^2] = E[(y_{t+k} - \mu)^2] = {\delta_y}^2 = \gamma_0$

(iii) $Cov(y_t, y_{t+k}) = Cov(y_{t+j}, y_{t+j+k})$

or, $E[(y_t - \mu)(y_{t+k} - \mu)] = E[(y_{t+j} - \mu)(y_{t+j+k} - \mu)] = \gamma_k$

Where, $\mu, {\delta_y}^2$ and all γ_k are constants. The covariance may depend on *k*, the lag length. The above conditions are also referred as conditions of weak Stationarity, second order stationary or wide sense stationary. A strongly stationary process need not have finite mean and variance (i.e. μ and/or γ_0 need not be finite).

A simple first order autoregressive process can be expressed by the following general equation:

$$y_t = \mu_0 + \mu_1 t + \alpha y_{t-1} + \varepsilon_t \qquad (3.1)$$

Where, $\{y_t\}$ is the stochastic process, μ_0, μ_1 and α are parameters and ε_t is a random disturbance term with white noise properties. μ_0 is called drift or constant or intercept.The nature of the time series described by the equation (3.1) depends on the parameter values. If $\mu_1 \neq 0$ and $|\alpha| < 1$, then y_t follows a deterministic trend. The presence of autoregressive component, αy_{t-1}, will mean that there may be short-run deviations, but the series will return to trend eventually. A series of this sort is known as a trend stationary (TS) process, as the residuals from the regression of y_t on a constant and a trend will be stationary. If $\mu_0 = 0$, $\mu_1 = 0$ and $\alpha = 1$, the series is said to follow a simple random walk, a unit root process. If $\mu_0 \neq 0$, $\mu_1 = 0$ and $\alpha = 1$, the series is said to follow a random walk with drift. Any stochastic process, which becomes stationary after differencing once, is called a difference stationary (DS) process, for e.g. a simple random walk process is a DS process. Likewise, any time series, which becomes stationary after de-trending is called a TS process.

In time series literature, there are both formal and informal tests of stationarity. The informal tests include time series plots and use of correlogram. Statistical packages use Box-Pierce Q-statistics and Ljung-Box (LB) Q-statistics for testing Stationarity of a series. These two statistics are based on autocorrelation coefficients of several lag lengths. The formal tests of non-Stationarity are also known as unit root tests or test of random walk series. These include the Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to check the presence of a unit root in the data. These tests are necessitated because the usual Student's t-test is inappropriate to test the null hypothesis.

3.2.1.1 Dickey-Fuller and Augmented Dickey-Fuller Tests:

The basic Dickey-Fuller (DF) test examines whether the value of the parameter $\alpha = 1$ in equation (3.1), in other words, whether the underlying first order difference equation has a unit root. Specifically, assuming the absence of trend term in equation (3.1) and rewriting it in a modified form as below:

$$\Delta y_t = \mu_0 + \delta y_{t-1} + \varepsilon_t \qquad (3.2)$$

where, $\Delta y_t = y_t - y_{t-1}$. The null hypothesis is that the { y_t } process has a unit root, i.e. H_0: $\delta = \alpha - 1 = 0$. Since –1 ≤α≤ 1, it follows that –2 ≤δ≤ 0.

More generally, if the given time series follows a pthorder autoregressive process [AR(p)] or even autoregressive moving average process [ARMA(p,q)], an extended Dickey-Fuller test called augmented Dickey-Fuller (ADF) test. Specifically, if the original time series follows AR (p), it can be represented as,

$$y_t = \mu_0 + \sum_{i=1}^{p} \alpha_i y_{t-i} + \varepsilon_t \qquad (3.3)$$

After suitable mathematical manipulation, Equation (3.3) can be rewritten as,

$$\Delta y_t = \mu_0 + \delta y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_t \qquad (3.4)$$

where $\delta = -(1 - \sum_{i=1}^{p} \alpha_i)$ and $\beta_i = \sum_{j=i}^{p} \alpha_j$.

Equation (3.4) is also recommended if the residuals sequence, $\{\varepsilon_t\}$ in equation (3.2), is not a white noise, for e.g. when ε_ts are autocorrelated. There are different forms of DF and ADF tests, which are possible by including trend terms in equations (3.2) and (3.4), and also excluding drift (intercept or constant) term, μ_0, from these equations. The DF test is a special case of the ADF test when $p = 1$. To test the significance of δ in equations (3.2) and (3.4), the usual Student's t-statistic critical values cannot be used. Initially, Dickey-Fuller and later MacKinnon have developed the appropriate test statistic, known as τ-statistic, and its critical values using Monte Carlo simulations. The critical values of τ-statistic are made available under alternative assumptions of drift, trend, sample size and level of significance. They are abbreviated as τ (no drift and no trend), τ_μ (only drift) and τ_τ (with both drift and trend). Dickey-Fuller have also provided the critical F-test values, known as Φ_1, Φ_2, and Φ_3, for pairwise joint tests of significance for μ_0 and μ_1.Thus, the null hypothesis that $\delta = 0$ can be rejected if the computed t-value for the coefficient δ is greater than the critical τ-value in absolute magnitude. It has been shown that the same DF test critical values are valid for the ADF test as well.

3.2.1.2 Phillips-Perron Test:

One of the important assumptions of DF test is that error terms are uncorrelated, homoscedastic as well as identically and independently distributed (iid). Phillips and Perron (1988) have modified the DF test, known as PP test, which can be applied to situations where the above assumptions may not be valid. Another advantage of PP test is that it can also be applied to frequency domain approach, which is more recent, and an alternative to the usual time domain approach, to time series analysis. The derivation of the PP test statistic is quite involved and hence not given here. The PP test has been shown to follow the same critical values as that of DF test, but has greater power to reject the null hypothesis of a unit root. However, the PP test seems to be biased towards rejecting the null hypothesis of a unit root, when the error series follows a negative moving average process. In such situations, it is recommended to use the ADF test, rather than the PP test.

3.2.2 Ordinary Least Square Test:

In statistics, ordinary least squares (OLS) or linear least squares is a method for estimating the unknown parameters in a linear regression model. This method minimizes the sum of squared vertical distances between the observed responses in the dataset and the responses predicted by the linear approximation. The resulting estimator can be expressed by a simple formula, especially in the case of a single regressor on the right-hand side. The OLS estimator is consistent when the regressors are exogenous and there is no perfect multicollinearity, and optimal in the class of linear unbiased estimators when the errors are homoscedastic and serially uncorrelated. Under these conditions, the method of OLS provides minimum-variance mean-unbiased estimation when the errors have finite variances. Under the additional assumption that the errors be normally distributed, OLS is the maximum likelihood estimator.

The relationship between growth of output to growth of labour productivity (Verdoorn's Law) and growth of capital-labour ratio (capital intensity) to growth of labour productivity (Kaldor's Technological Progress Function) is tested through the technique of OLS. This can be expressed by the following general equations:

$$\Delta LP_t = \mu_1 + \beta_1 \Delta O_t + \varepsilon_t \qquad (3.5)$$

$$\Delta LP_t = \mu_2 + \beta_2 \Delta CI_t + \varepsilon_t \qquad (3.6)$$

To understand better, we modified these two well established laws of economics and tested the relationship by combining both Verdoorn's and Kaldor's Technological Progress Function (TPF). In the equation form, it can be written as:

$$\Delta LP_t = \mu_3 + \beta_3 \Delta O_t + \beta_4 \Delta CI_t + \varepsilon_t \qquad (3.7)$$

Where ΔLP_t, ΔO_t and ΔCI_tstand for growth of labour productivity, output and capital intensity. μ is the intercept term and β represents co-efficients. ε is the error term in the equation.

3.2.3 Growth Rates:

An estimation of the growth rate of output, labour input and capital is the first step towards the analysis of productivity. We have used the conventional approach of the ratio between outputs to labour as productivity ratio. The present study also uses the method of annual growth rate to understand the trend of the labour productivity along with other variables such as labour and capital input.

The annual growth rate has been estimated with the formula;

$$\left(\frac{LP_t - LP_{t-1}}{LP_{t-1}} \right) \times 100 \qquad (3.8)$$

As we are interested to understand the trend of the labour productivity in different sub-periods, we employ the method of Compound Annual Growth Rate (CAGR) by fitting a semi-log equation with time 'T' as the independent variable.

$$Ln(LP) = \mu_1 + \beta_1 T + \varepsilon \qquad (3.9)$$

Where LP stands for labour productivity as the dependent variable

T is the time variable

μ is the constant term

β is the co-efficient

and, ε is the error term

Then to arrive at the annual average rate of growth of the *'LP'*, we need to deduct '1' from the antilogarithm of the 'β' co-efficient and then multiply with 100 to arrive at the CAGR for each sub period. In equation form this can be explained as below:

$$CAGR\ of\ LP = \{Antilog\,(\beta) - 1\} \times 100$$

3.3 Description of Variables and Data Sources:

The present study uses annual data spanning the period from 1973-74 to 2007-08. The variables considered in the above model are labour productivity (LP), real gross value added (O), capital-labour ratio (CI). In order to measure the variables, we have used the following data: gross value added, number of workers (E_1), total person engaged (E_2) and real capital stock (K). Annual Survey of Industries (ASI), provide the information on value added and capital concepts in nominal values. The study uses different price deflators to arrive at the real value of variables such as gross value added and capital stocks series. For this we have used WPI series (1993-94 base) at industry level index as price deflator for gross value added. The method of Perpetual Inventory Accumulation Method (PIAM) has been used to arrive at the capital stock series with a WPI of machine and machine tools (WPI_{mmt}) at 1993-94 as investment deflator.

The data and variables used in the present study are obtained from the Annual Survey of Industries (ASI). It is needless to mention here that ASI is the premier database on the organized manufacturing sector in India. Central Statistical Organisation (CSO), Ministry of Statistics and Program Implementation publishes it on an annual basis. Due to changes in National Industrial classifications (NIC) over the study period[5], we have used the Economic and Political Weekly (EPW) Research Foundation[6] concordance and consistent time series data. The present study mainly relies on both these databases for its majority of need. The second volume that provides concordance and consistent series over 1973-74 to 2003-04 has been used, while for the rest of the period i.e. 20004-05 to 2007-08, data are collected from the summery result of the ASI available in the website of the Ministry of Statistics and ProgrammeImplementation (MOSPI). As both these data sets are available with different National Industrial Classification (NIC), while collaborating, due care and diligence has been assigned to make the full time series (1973-74 to 2007-08) more compatible and represented by reducing the error related different NIC methodology.

3.4 Analyzing the Productivity Trends in Indian Manufacturing:

Productivity in the manufacturing sector has a long history. The evolution of productivity measurement, which is measured through the concept of Total Factor Productivity (TFP) growth, dates back to the work of Tinbergen (1942)[7], Abramovitz (1956), Solow (1957) & Griliches & Jorgenson (1966) among many others. In Indian scenario, the literature on productivity measurement is dominated by a production function approach over the other existing approaches. Even when a production function is not exclusively estimated, it is invoked implicitly as in the growth accounting approach. The present study, while measuring productivity, stands apart from the methodology followed in the past in the productivity literature. From the critical assessment of both the approaches (Production Function & Growth Accounting) discussed earlier, the existence of the well-behaved production function is a necessary condition, which is still a question. Therefore, we take resort to do a very different and alternative approach to access the productivity trend in Indian manufacturing.

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[5] The study spanning over the period of 35 year (1973-74 to 2007-08) that can further devided into four sub-period. Over this period, the data on Indian manufacturing has seen four different National Industrial Classification (NIC) 1987, 1998, 2004 and 2008.

[6] The EPW research foundation has prepared two volume of concordance time series data base on ASI for the period 1973-74 to 1998 and 1973-74 to 2003-04, respectively. The first series follows NIC-87, while the second volume of the data are made concordance and consistent according to the NIC-98.

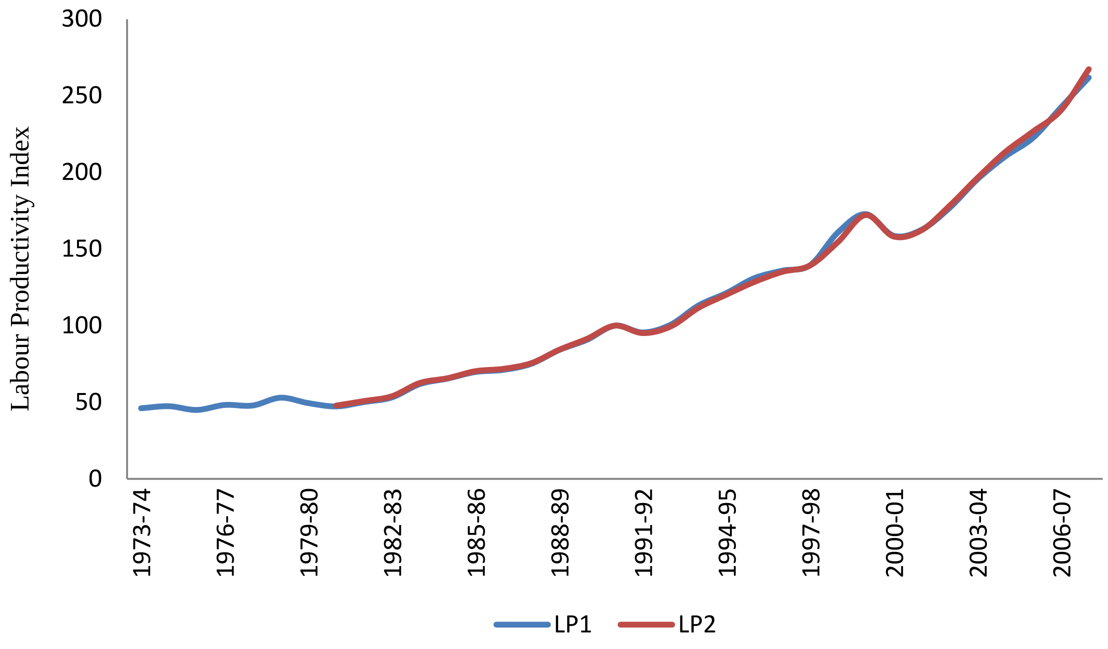
[7] Tinbergen's paper was first written in German and was not published in English until 1959.

In the present study, we analyse the trend and growth of labour productivity in the Indian manufacturing sector at both in aggregate and disaggregated (2-digit) level. Here we estimate labour productivity by considering the real gross value added (O) as a measure of output, while total workers (E_1) and total person engaged (E_2) as labour inputs. Thus we have two pairs of labour productivity measures in the present study, such as real gross value added per workers (LP_1: O/E_1) and real gross value added per person engaged (LP_2: O/E_2). In this section, we analyses their trend and growth over the full study period, four different sub-periods and as well compare labour productivity growth over pre and post reform period. By using these labour productivity combinations, we start the analysis with the help of ratio analysis, linear growth rate, trend growth rate and compound growth rate technique, to assess the trend and growth of labour productivity for the Indian manufacturing sector both at aggregate and dis-aggregated 2-digit industry group level. We briefly touch upon the factors that affect labour productivity, without going into the detail investigations in the next section.We also analyse labour productivity growth by considering 2-way classification based of 'Employment Size' and 'Size of Capital'. Moreover, the present study also validates Verdoorn's law and Kaldor's Technological Progress Functions (TPF) of Indian manufacturing sector through Ordinary Least Square (OLS) technique in the -subsequent section before concluding this chapter with major findings.

3.4.1 Trends of Labour Productivity in Indian Manufacturing:

We observed from figure 3.1 that trend of labour productivity in Indian manufacturing is rising consistently over the sample period. Figure 3.1, present the index for two different combinations of labour productivity (LP_1 and LP_2) of Indian manufacturing sector for 35 years spanning over the period 1973-74 to 2007-08. Both the indexes of labour productivity ratios for the Indian manufacturing sector has been increasing consistently throughout the study period. From Figure 3.1, we observed that both the index line moved together and aligned to each other. Moreover, in the beginning of the study period index for LP_1 that represents real value added per workers was below 50, which accelerated to reach above 250 at the end of the study period. The trend of both the index lines revealed that labour productivity was remain stagnant during the seventies while gradually improve over eighties. However, it is during the nineties, both the index has seen some momentum in its trend, while from 2000-01 onwards both the labour productivity index has seen a sharp upward trend. This suggests that Indian manufacturing has experienced with rising labour productivity during the post reform period, which is significantly higher compared to pre-reform phase.

Figure 3.1: Trends of Labour Productivity in Indian Manufacturing



Note: LP_1 and LP_2 refers to gross value added (1993-94=100) per workers and per person engaged respectively.
Source: Author's compilation from Annual Survey of Industries, CSO, *EPW* Research Foundation

For aggregate manufacturing the real gross value added (O) per workers (E_1) and per person engaged[8] (E_2) was 0.6 and 0.48 lakh rupees respectively at the beginning of the study period (1973-74 and 1980-81)[9] and grew up to 3.39 and 2.67 lakh rupees respectively at the end of the study period 2007-08. As the study period spanning for 35 years that cover four decades, we will be interested to know at which period of the study, productivity performance is better. However to know during which period of the study the labour productivity gather momentum, we divide the 35 years into four sub-periods[10]. The present analysis also validates the labour productivity growth and trend over the pre and post-liberalisation periods. It is clear from the Table 3.1, that the

[8] Total person engaged data on Indian manufacturing is available from 1980-81, so the labour productivity based on total person engaged (LP_2) is estimated for 1980-81 to 2007-08.
[9] Please refer to the appendix Tables 3.1a to 3.8b for details presented at the end of the chapter
[10] The explanation for choosing this four sub-periods are provided in Chapter-I.

average labour productivity during 1990-91 to 1999-2000 and 2000-01 to 2007-08, is higher than a full period average when the number of workers is considered as labour input. While considering the total person engaged as labour input, we observed thatlabour productivity was higher than the full period average only during the period 2000-01 to 2007-08. Thus, this finding suggests that productivity growth was significantly accelerated during the nineties and during 2000-01 to 2007-08 in comparison to the seventies and eighties. Similarly the average labour productivity for both the productivity ratios is significantly higher than its full period average during the post-reform era compare to sub-par labour productivity during the pre-reform period. These findings validate the argument that the policy reform (during 1991) has positive consequence on rise of labour productivity.

Table 3.1: Labour Productivity in Indian Manufacturing

(Rs. Lakh)

Times Period	LP_1 (O/E_1)	LP_2 (O/E_2)
1973-74 to 2007-08	1.44	1.27
1973-74 to 1979-80	0.62	–
1980-81 to 1989-90	0.87	0.67
1990-91 to 1999-00	1.64	1.25
2000-01 to 2007-08	2.64	2.05
1973-74 to 1989-90	0.77	0.67
1990-91 to 2007-08	2.09	1.61

Note: Figures represent the average value of labour productivity over the period
Source:Author’s compilation from Annual Survey of Industries, CSO, EPW Research Foundation

In the disaggregated level, labour productivity of the manufacturing industries like petroleum products (23), Chemical Products (24), Rubber & plastic products (25), Basic metals (29), Machinery &Equipments (29), Electrical Machineries (31), Communication Equipments (32), Medical Precision & Optical Instruments (33) and Motor Vehicles, Trailers & semitrailer (34)realized a higher labour productivity over the period of the study than the overall average. Precisely, these industries have higher productivity growth in the post-liberalization period, though in general, they also maintain a higher productivity level over the period of study. These industries by nature are rely on heavy capital investment and thus highly capital intensive. These industries have an advantage due to forward linkage and its output being used as input in other sector of the economy. Due to the intermediary nature of its output, these industries experienced a high rate of growth of its gross value added and gross value of output even in real term during the study period.

Other industrial group at 2-digit level, such as, Food products& beverages (15), Tobacco & related products (16), Textile products (17), Wearing apparel (18), Leather & Related products (19), Wood & wood products (20), Paper &paper products (21), Publishing, printing & related activities (22), nonmetallic mineral products (26), Fabricated metal products (28), Office accounting & computing machines (30), Other Transport equipments (35) and Furniture and other manufacturing (36) are the 2-digit manufacturing industries with lower labour productivity than the overall average. We observe that these industries were labour intensive by nature and liberalisation and globalization has limited implication on its overall process transformation. During the study period of the study, it is observed that the productivity of these industries were very weak in comparison to the manufacturing as a whole. These industries experienced low productivity growth because of slow output growth due to low capital investment and high employment growth due to its inherent labour intensity nature.

From disaggregated (2-digit) level analysis of labour productivity trends, we observed high degree of disparities among different manufacturing groups. This also varies from period to period and industries to industries. There emerges a question on efficiency of labour input across industries. The best way to inspect this perception is to analyse the relative labour productivity index[11] for different industry groups. This might help to provide a fair idea about the role of labour efficiency and may explain its role in difference in labour productivity across industries. It is observed from Appendix Table A3.7a, A3.7b, A3.8a and A3.8b, that industries with high productivity ratio (from the above trend analysis) represent relative productivity value equal to unity or more. In our analysis, the relative productivity of Food product and beverages (15), Tobacco & related products (16), Textile products (17), Wearing apparel (18), Leather & leather products (19), Wood and wood products (20) and Non-metalic mineral products (26) are

[11] The relative labour productivity index can be derived by dividing labour productivity of different 2-digit industries to that of aggregate manufacturing. The index can take any value between 0 to ∞. When the index is greater than unity for any industry groups, we consider labour in that particular industry is more efficient.

less efficient over the study period as they retain the value less than one. Moreover Other transport equipments (35) were less efficient at the initial period of the study, while seeing significant improvement in labor efficiency during 2000-01 -2007-08. Meanwhile, industry groups like Paper products (21), Fabricated metal products (28) and Furniture and other manufacturing (36) have shown a falling efficiency level in labour during 2000-01 to 2007-08 period. Higher labour productivity represented by capital intensive industries like Petroleum product & nuclear fuel (23), Chemical & chemical products (24), Basic metals (27), Machinery &equipments (29), Office accounting & computing machines (30), Electrical machinery & apparatus (31), Radio, television & communication equipment (32), Medical, precision & optical instruments (33), Motor vehicles, trailers & semi-trailer (34), are enjoying a greater labour efficiency. From labour productivity and efficiency analysis, it is observed that industries with higher labour efficiency are also enjoying greater labour productivity and vice versa.

3.4.2 Growth of Labour Productivity in Indian Manufacturing:

In this section, we analyse the growth trend of labour productivity at aggregate and disaggregated 2-digit level groups over the sample period of 35 years, four sub-periods and over pre and post reforms periods. The Compound Annual Growth Rate (CAGR) rate of both the labour productivity (LP_1 and LP_2) measure is estimated for seven different time periods and presented in Table 3.2. This provides a fair idea about the trend of labor productivity growth in the Indian manufacturing sector. Moreover, we also present the simple annual growth rate[12] of labour productivity to understand the annual rate at which labour productivity changes.

Table 3.2, revealed that both the measure of labor productivity LP_1 and LP_2 has seen a consistent rise in its growth over the four sub-periods. To analysis the growth and trend of LP_1 and LP_2, we have estimated both annual and compound rate of growth. If we analyse the average annual rate at which labour productivity grew during the four decades, i.e.during 1973-74 to 1979-8), eighties (1980-81 to 1989-90), nineties (1990-91 to 1999-2000) and during 2000-01 to 2007-08, we observed that labour productivity

[12] Refer to Appendix Table A3.9a, A3.9b, A3.10a and A3.10b at the end of this chapter.

is accelerated mostly during the eighties and nineties in comparison to the first sub-period (1973-74 to 1979-80). Though eighties has seen a sharp jump in productivity growth over the previous decade, however, it is during the nineties and over 2000-01 to 2007-08, productivity growth is remarkably high and continues to improve across manufacturing.

Table 3.2: Labour Productivity Growth in Indian Manufacturing

(Growth, CAGR)

Times Period	LP_1 (O/E_1)	LP_2 (O/E_2)
1973-74 to 2007-08	5.73	6.16
1973-74 to 1979-80	2.00	-
1980-81 to 1989-90	7.28	7.16
1990-91 to 1999-00	7.44	7.33
2000-01 to 2007-08	8.14	8.34
1973-74 to 1989-90	4.58	7.16
1990-91 to 2007-08	5.98	6.17

Note: Figures represent the compound growth rate of labour productivity in Indian manufacturing. Figures are estimated by taking the antilogarithms of the relevant regression co-efficient minus one, when the equations are of the form $\ln(LP) = \alpha + \beta T + \varepsilon$ and 'T' refers to time. To estimate labour productivity (LP), we used a real gross value added (O) and number of workers (E1)) and total person engaged (E2). Data on Total Person Engaged is available from 1980-81 onwards for Indian manufacturing,, so the productivity growth with "total person engaged" as labour input was estimated from 1980-81.

Source: Author's compilation from Annual Survey of Industries, CSO, EPW Research Foundation

From Table 3.2, it is observed that over the full period, the labour productivity growth was 5.73% and 6.16% per annum (CAGR) for LP_1 and LP_2 respectively. Table 3.2, revealed that both LP_1 and LP_2 has seen a consistent rise in the growth over the four sub periods. The labour productivity LP_1, has seen the slowest growth of 2.0% per annum (CAGR) during the seventies, which has risen sharply during 80s to 7.28%. With the implementation of reform the growth rate rises further to 7.44%, which is accelerated to register the highest ever growth of 8.14% per annum (CAGR) during 2000-01 to 2007-08. The other measure of labour productivity (LP_2) does follow the same growth trend. This shows that introduction of reform during nineties have seen modest improvement in labour productivity, which helps to achieve the highest ever growth in labour productivity in Indian manufacturing. However, from Table-3.2, it is clear that 80's being the period in which significant improvement in productivity growth has taken place which sustained during 90s due to implementation of globalizations that opened the industrial sector for private players to participate. While we cannot discard the accelerating growth in overall labour productivity in post 90's. It is also observed that productivity growth during 2000-01 and 2007-08 is the higher relative to the other sub - period under study.

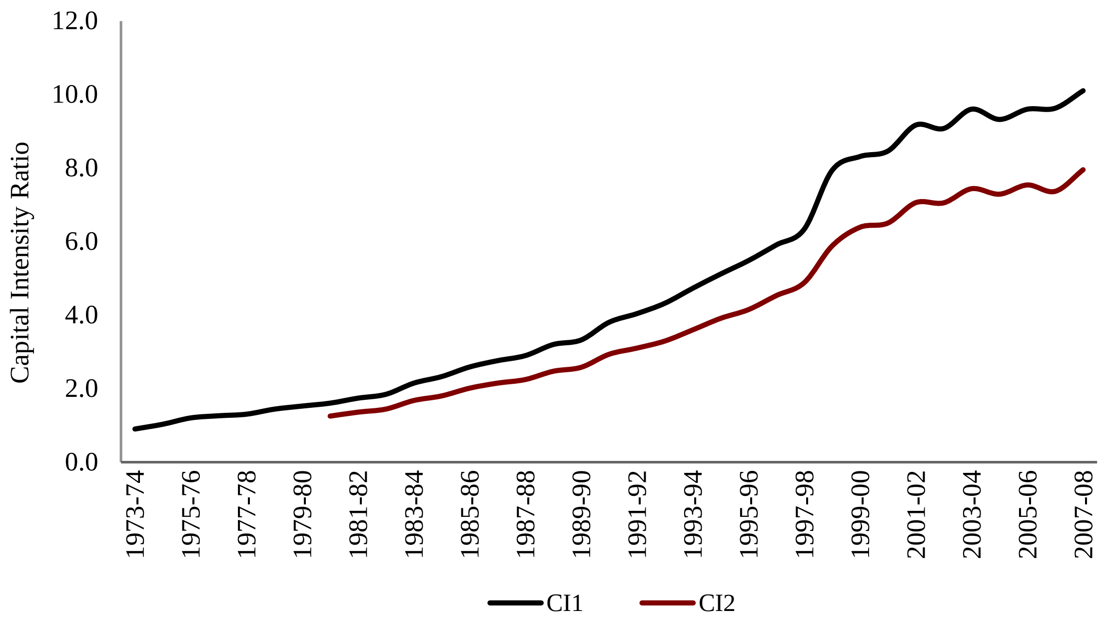
Moreover, growth of labour productivity has seen a considerable rise during the post reform period, compared to that of the pre - reform era. Table 3.2, shows that LP_1has registered a sharp rise in its growth from 4.58% to 5.98% during the post reform era. However $LP_2$is, contradict the trend observed in LP_1 possibly because of the unavailability of the data during 1973-74 to 1979-80. However, real gross value added per person engaged, (LP_2) grew at 6.17% per annum (CAGR) during the post liberalisation period, better than the growth of LP_1. This clearly suggests, above trend productivity growth since 80's, mainly attributed to factors like policy changes that allowed more and more private player to participate in manufacturing activity. In turn, this leads to more capital accumulation through rising investment in capital stock. Thus, it has directly led to the enhancement of productivity growth of labor. As rightly observed by Adam Smith (1776), over a period, labour efficiency improves as they become more specialized due to division of labour and learning by doing. As industries enlarge along with the expansion of the market, it becomes inevitable for industries to become more efficient to face the rising competition. This further needs more investment, both in plant and labour. As expansion of the market demand for more skilled workers, a rising competency can be achieved through more vocational and skill based training.

Annual growth rate (Appendix Table A3.9 and A3.10) shows a modest rising trend over the full period[13] and a mixed trend during the four sub-periods. It is observed that over the full period of study labour productivity grew at an average rate of 5.4 percent (LP_1), and 6.7 percent (LP_2) respectively. However, it is only in the 80's we seeing a considerable improvement in labour productivity growth. Moreover, in case of Indian manufacturing, we have observed an above average growth in labor productivity since eighties with the partial reform measures during the Prime-ministership of late Shri

[13] Refer Figure in Appendix

Rajiv Gandhi. However, with the implementation of reform in the early nineties has improved labour productivity both at the aggregate and disaggregated 2-digit industrial groups. The sharp rise in labour productivity during the eighties is associated with the policy of heavy industrialization during and partial open up of domestic industries to modern technical known that have a positive effect on rising productivity growth. Moreover, with the introduction of Liberalisation Privatization and Globalization (LPG) in 1991, the labour productivity has seen considerable improvement since then. The rising output growth and increasing capital-labour (Capital Intensity) ratio also helps to enhance labour productivity in Indian manufacturing during the post-reform period. Figure 3.2 represents the capital intensity ratio of aggregate manufacturing over the entire sample period. Both the ratios (CI_1: K/E_1 and CI_2: K/E_2) revealed an increasing trend. However, from Figure 3.2 it is evident that capital intensity ratio has observed a sharp acceleration during the post reform period. Moreover, with the 1991 reform measures, as an effort to open up the economy, productivity growth in highly capital-intensive industries increases in comparison to labor-intensive one.

Figure 3.2:Capital Intensity in Indian Manufacturing

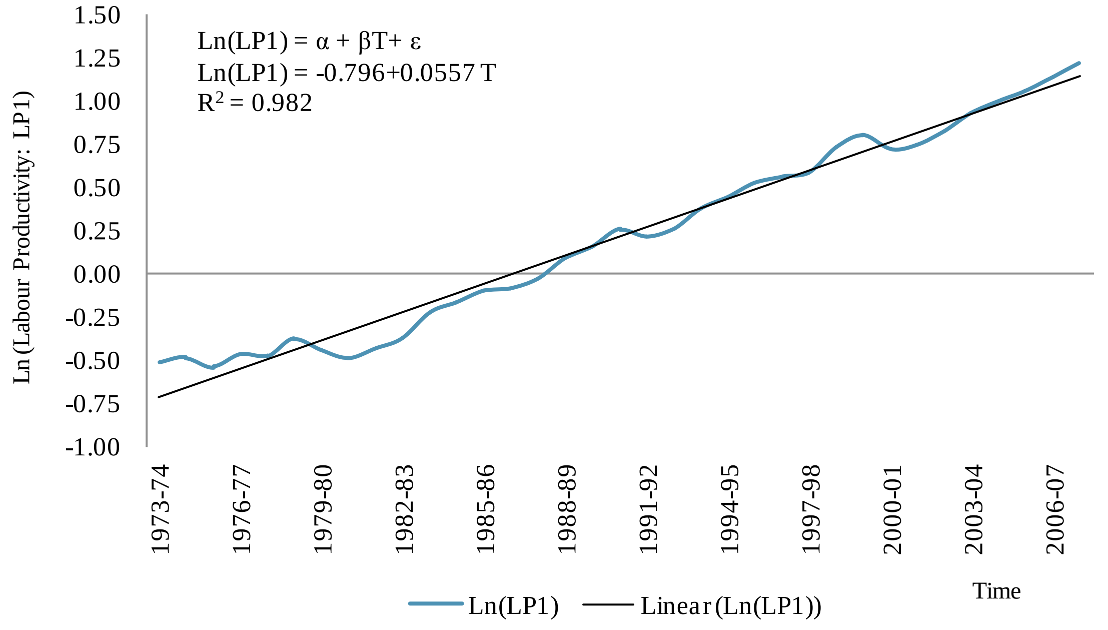


Note: CI1 and CI2 refers to capital-labour ratios

Source: Author's compilation from Annual Survey of Industries, CSO and EPW Research Foundation

In order to examine the growth trend in labour productivity for overall manufacturing industries over the entire sample period (1973-74 to 2007-08), we analyse the time trend growth for both gross value added per workers and gross value added per person engaged in 1993-94 prices[14]. From the Figures 3.3 and 3.4, we observed that over the entire sample period of the study, labour productivity has increased significantly and in the majority of the cases (disaggregated 2-digit level), it was the post-liberalisation era in which the labour productivity has maintained a strong growth. It is more clear by fitting the linear trend line to the Figure that validate further our observation of rising productivity growth over the period of study independent of any measure of labour input.

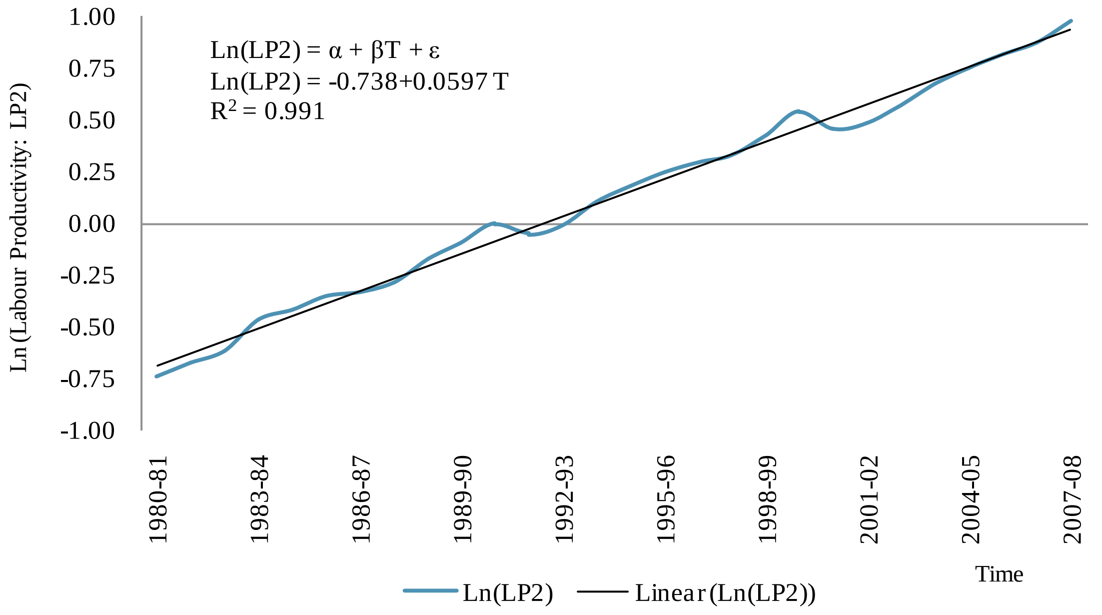
Figure 3.3: Growth of Labour Productivity LP_1 (O/E1)



Note: LP1 (O/E1) refers to a real gross value added per workers
Source: Author's compilation from Annual Survey of Industries, CSO, EPW Research Foundation

[14] The study uses WPI and CPI (industrial workers) as price deflator with the base 1993-94=100. Over the entire sample period of study, we have both WPI and CPI indexes available in different base years. The latest base available for WPI is 2004-05=100 and for CPI industrial workers it is 2001=100. However, with these latest base neither WPI nor CPI has fully cover the entire study period. Therefore, the present study is considering 1993-94 as the base year, which in its orginal form has covered majority of the years under the entire study period. Secondly, to get the deflator series for the entire period of study, the adjustment of the base shift is required for the minimum number of years with 1993-94 as the base, that also minimize any error that is associated with the base shift method.

Figure 3.4: Growth of Labour Productivity LP_2 (O/E2)



Note: LP2 (O/E2) refers to a real gross value added per person engaged
Source: Author's compilation from Annual Survey of Industries, CSO, EPW Research Foundation

From dis-aggregated (2-digit) level analysis of labour productivity trends, we come across high degree of disparities among different manufacturing groups. This also varies from period to period and industries to industries. As labour productivity over the period and across industrial groups directly relate to its efficiency, therefore, the question of efficiency of labour input across industries has to be analysed. The best way to inspect this perception is to analyse the relative labour productivity index[15] for different industry groups. This might helps to provide a fair idea about the role of labor efficiency and may explain its role in difference in labour productivity across industries. It is observed from Appendix Table 3.7a-3.8b that industries with high productivity ratio (from the above trend analysis) represent relative productivity value equal to unity or more. In our analysis, the relative productivity of Food product and beverages (15), Tobacco & related products (16), Textile products (17), Wearing Apparel (18), Leather & leather products (19), Wood and wood products (20) and nonmetallic mineral products (26) are less efficient over the study period as they retain the value which is less than unity. Moreover, Other transport equipments (35) were less efficient at the

[15] The relative labour productivity index can be derived by dividing labour productivity of different 2-digit industries to that of aggregate manufacturing. The index can take any value between 0 to ∞. When the index is greater than unity for any industry groups, we consider labour in that particular industry is more efficient.

beginning of the study period, while seeing significant improvement in labour efficiency during 2000-01 to 2007-08. Meanwhile, industry groups like Paper & paper products (21), Fabricated metal products (28) and Furniture and other manufacturing (36) have shown a falling efficiency level in labour during 2000-01 to 2007-08 period. Higher labour productivity represented by capital intensive industries like Petroleum product & nuclear fuel (23), Chemical & chemical products (24), Basic metals (27), Machinery &equipments (29), Office accounting & computing machines (30), Electrical machinery & apparatus (31), Radio, television & communication equipment (32), Medical, precision & optical instruments (33), Motor vehicles, trailers & semi-trailer (34), are enjoying a greater labour efficiency as shown in the relative labour productivity index. The efficiency of labour in these 2-digit industrial groups has been enhanced to increase in skilled based training and vocational training. From labour productivity and efficiency analysis[16], it is observed that industries with higher labour efficiency are also enjoying greater labour productivity and vice versa.

3.5 Factors Explaining Labour Productivity Growth:

3.5.1 Division of Labour:

The major improvement in the productive powers of labour, and the greater part of the skill, precision, and judgment with which it is any where directed, or applied, seem to have the effects of the division of labour as explained by Smith in his work 1976[17]. So the division of labour is the main cause of growth in the labour productivity which ensures higher economic growth. This was also applicable to Indian manufacturing industries both at the aggregate and dis-aggregates levels. The division of labour in the Indian economy can be viewed from the continuously reviewed 'National Industrial Classification' (NIC) for Indian industries. The NIC has been modified in regular interval for Indian manufacturing to incorporate possible changes in the division of labour. NIC has been modified several times since its initiation and since 80's NIC classification has been modified four times so far. For the period under study, 'Annual Survey of Industries (ASI)' has been using NIC' 87 (1990-91 to 1993-94), NIC' 94

[16] Refer to the Appendix Table A3.4a to A3.5b on 'Relative Labour Productivity Index'

[17] Smith A. (1976) in his seminal work "An Enquiry into the Nature and Causes of Wealth of Nations" discuss the significance of division of labour and rising output growth.

(1994-95 to 1997-98), NIC’ 98 (1998-99 to 2003-04), NIC’ 04 (2004-05 to 2007-08) and NIC’ 08 for the period 2008-09 onwards. Under NIC classification, we have industries into two-digit, three-digit and even at five-digit levels to take into consideration and facilitate the greater division of labour in the industrial data base of India. The division at different level provides room to encompass the better division of labour in Indian manufacturing based on various activities. Thus, in Indian case as well greater division of labour has been held true and this facilitates the enhancement of labour productivity.

3.5.2 Rising Capital Intensity:

Over the time period along with the division of labour, industries become specialized in a specific process of production activity. This divides the whole production activity in the simplified small processes (as explained by Smith, in its pin making example) which further leads to the introduction of rising capital investment in these small processes. With more specialized activity in each level, it required higher investment in capital to reduce the time required in the process. This in turn increases the capital per labour (capital intensity) ratio and enhances productivity in the activity. This preposition holds true in Indian case as we have seen a rising capital intensity for all those industry groups which has seen a rising productivity growth in the Indian manufacturing sector. For the aggregate manufacturing the capital intensity has been consistently improved over the study period to enhance the level and growth of productivity.

3.5.3 Technological Progress:

With the advancement of technology, rising capital investment, and policy changes during 80’s and 90’s Indian manufacturing experienced a great deal of change in technological know-how. The introduction of liberalization and globalization during 90’s helps Indian industry to avail the best existing technology. This not only facilitate a better and efficient way to carry out production, but also provide a platform to make the workers more specialized and skilled to handle this advance technology. This improvisation over a period of time incorporate in productive activity and lead to higher efficiency and enhancement of labour productivity in Indian manufacturing.

3.5.4 Increasing Returns to Scale:

The above discussed factor lead to higher efficiency level of labourer in the production activity, which directly affect the higher output growth. The growth of per capita output depends upon the growth of productivity and the growth of the share of the working population in the total population. The demand for the labour is very much associated with the technique of production and the type of capital used. If the technique of production is labour-intensive then the share will be high and there will be a rise in the output growth. So, the output growth is caused directly by the growth of labour productivity. In the pursuit of explaining the causes of growth of labour productivity, Adam Smith has given a chain of cumulative causation in his literatures[18]. He has attributed division of labour as the prime cause of labour productivity growth. In the whole literature of economics, division of labour is treated as the spitting up of occupations and advancement of specialized activities. Smith (1776) suggested that the division of labour leads to invention because the labour engaged in a specialized operation finds smoother and time-saving ways of generating the same results. In this process of division of labour, a group of complex process is changed into a succession of simpler process. The use of machinery and the adoption of the roundabout process, facilitate the further division of labor and the economies of scale are in operation.

Kaldor identified several facts such as the oligopolistic structure of manufacturing, spatial concentration of the industrial activity, sustained difference between the rate of output and productivity growth. These facts are well explained by increasing returns. Kaldor has also argued that the manufacturing sector is subjected to the increasing returns. The increasing returns arise within the plant and enterprise. Average plant cost per unit of output decreases with the size of the operation. The large multi-product firms across from their capacity to capture the growing market. The oligopolistic nature of the manufacturing does not allow the market to become competitive when size increases. Moreover an increase in the level of aggregate output permits the greater division of labour at different level of production activity and also the use of capital-intensive technology. The circular and cumulative relation between increasing returns and growth of output has been the basis of persistent income disparity. The learning by doing

[18] The example of 'pin making' is a great demonstration of how the division of labour helps in raising the production.

encompasses both incremental improvements in efficiency and generation of new technology. The technological changes are taken as by-product and are endogenously introduced through new capital in contrast to the neo-classical proposition where these are treated as exogenous.

In case of India, during the post-liberalisation period, the distribution of factories according to the employment size has remained biased towards the low range employment factories. From Table 3.3, it is observed that Indian manufacturing are biased towards low employment density as 77.1% of the total manufacturing factories employs up to 49 labourers, which hold at this level over the study period. Factories with employment size of 50-499 constitute only 20.9% of the total factories, considered as medium range factories. In the higher employment size the share of factories was about 2% of the manufacturing factories. Moreover, the total employment in the low employment size factories was about 17.1% of the total manufacturing employment which was marginally increased to 20.5% in the year 2002-03. The employment share of the medium employment size factories and large employment size factories was 37.3% and 45.6% of the total employment, respectively in the manufacturing sector at the beginning of the study period. However, the share of the medium range factories increased, whereas the share of the high range factories declined.

A look into the share of contribution of different size factories in the Real Gross Value Added (RGVA) suggests that the low employment size factories contributed just about 8.0% to 9.2%. The share of the medium range factories with 28.7% at the beginning of the liberalisation period, while increased to 35.9% in the year 2002-03. The contribution of the large employment size factories to the total RGVA declined from 63.4% in the year 1989-90 to 55% in the year 2002-03. From the above discussion, it is observed that the distribution of factories favors the low employment size factories while the employment share and gross value added share favors the high employment size factories. The medium size factories contribution to the employment share and gross value added share is observed to increase over the period 1989-90 to 2002-03.

Table 3.3: Indian Manufacturing Productivity by Size of Employment

(In Percentage)

	Year	0-49	50-99	100-199	200-499	500-1999	2000-5000 & above
Share in Employment (Percentage)	1989-90	17.1	11.2	12.7	13.4	21.3	24.3
	2002-03	20.5	14.7	15.3	17.4	15.1	17.0
Share in RGVA (Percentage)	1989-90	7.9	9.1	9.3	10.3	29.7	33.7
	2002-03	9.1	10.8	11.6	13.5	26.4	28.6
Labour Productivity (Rupees Lakh)	1989-90	0.54	0.89	0.93	0.97	1.57	1.63
	2002-03	0.86	1.37	1.47	1.69	24.7	28.3
Share in No. of Factories	1989-90	73.4	9.6	8.7	7.1	1.1	1.0
	2002-03	77.1	7.6	6.8	6.5	1.0	1.0

Note: The data are compiled from ASI for available years. The data on 'Size of Employment' is available till 2002-03.
Source: Author's compilation from Annual Survey of Industries, CSO, and EPW Research Foundation.

As far as size of employment is concerned in the manufacturing sector, labour productivity is high in factories with high employment size bycomparing to the low employment size factories. The trend of the productivity shows that labour productivity is biased towards the higher size of employment as can be observed from Table 3.3. The labour productivity of the low employment, factories was 0.54 lakh rupees in the year 1989-90, which increased to 0.86 lakh rupees in 2002-03. While medium employment size factories with employment size of 50-99, 100-199 and 200-499 has seen improvement in labour productivity to 1.37, 1.47 and 1.69 from 0.89, 0.93 and 0.97 lakh rupees respectively over the same period. The labour productivity for large employment, factories with employment size 500-1999 and 2000 and above were significantly accelerated to 24.7 and 28.3 lakh rupees from a mere 1.57 and 1.63 lakh rupees in 2002-03 from 1989-90. Thus, the productivity level of the large employment, factories was higher than the total manufacturing and the growth of the productivity in the larger employment plants (employment size of 500-1999 and 2000 & above) was high.

Table 3.4: Indian Manufacturing Productivity by Size of Capital

(In Percentage)

	Year	0-100	100-500	500-1000	1000-10000 & above
Share in Employment (Percentage)	1989-90	39.8	12.5	14.7	33
	2002-03	47.5	9.7	10.1	32.7
Share in RGVA (Percentage)	1989-90	19.2	11.1	14.1	55.6
	2002-03	17.6	6.9	7.7	67.7
Labour Productivity (Rupees Lakh)	1989-90	0.57	0.97	1.03	1.93
	2002-03	0.72	1.21	1.52	3.94
Share in No. of Factories	1989-90	84.9	7.8	6.3	1.0
	2002-03	87	6.4	5.6	1.0

Note: The data are compiled from ASI for available years. The data on 'Size of Capital' is available till 2002-03
Source: Author's compilation from Annual Survey of Industries, CSO, Government of India, and EPW Research Foundation.

To have a better understanding of the productivity trend we also consider investigating the effect of "Size of Capital' on productivity growth. The distribution of factories according to the size of capital used was biased towards the low capital size factories. About 87% of the total manufacturing factories came under the low capital size industries. The medium size, industry with capital size ranging between 100-1000 crore account for 14.1% of total factories in 1989-90 that has declined to 12% in 2002-03. The high capital size factories constituted a very small proportion of the total factories that remain constant at 1% at over the period. The employment share of the factories according to the size of capital favored the low capital size factories. In the low capital size factories, 39.8% of the total organized manufacturing labour were employed at the start of the liberalization period, which increased to 47.5% in the year 2002-03. While the medium size factories by size of capital has seen a significant fall in employment share from 27.2% in 1989-90 to 19.8 in 2002-03. The employment base in the high capital size factories remained almost stagnant at 33% during the study period. The share of RGVA contributed by the low capital size factories declined from 19.2% in the year 1989-90 to 17.6% in the year 2002-03. The major part of the contribution came from the high capital using factories. They constituted around 55.6% of the total RGVA which increased to 67.7% in the year 2002-03. The share of contribution of the medium capital using factories, on the other hand, declined from 11.1% to 6.9% and from 14.1% to 7.7% of the capital size of 100-500 and 500-1000 respectively in the year 2002-03.

It is observed from Table 3.4 that the labour productivity of the manufacturing industry, according to the size of capital provides evidence of increasing returns to scale. The productivity of the elite capital employed factories were continuously higher than the low-capital size factories over the years. The higher capital size factories had a labour productivity of 1.93 lakh rupees in the beginning of the data period, 1989-90 that increased to 3.94 lakh rupees in the year 2002-03. The higher capital invested industries enjoyed a favorable regime and higher capital intensity. Due to liberalisation and globalization in the beginning of nineties, the Indian manufacturing sector was encouraged and foreign capitals were also flowing into the Indian manufacturing sector. Due to relaxed norms on external borrowing, investment in modern and prudent capitals were encouraged. Firms with high capital size have had larger productivity due to the operation of increasing returns to scale that supported by extension, of the market due to introduction of LPG policies. During this period the low and medium capital size firms also experienced rising labour productivity, but they did not match the level of larger firms by size of the capital. In small and medium factories, the productivity did not grow as rapidly as the highest capital size factories due to their upper hand in taking the advantage of returns to scale.

3.6Empirical Findings:

In this section we applied time series econometric techniques to validate the Verdoorn's Law and Kaldor'e Technological Progress Function for Indian manufacturing sector. Both the laws are well established in the economic theory and validated for many advanced capitalist economies[19]. We make an attempt to examine the existence of the relationship between growth of output to the growth of labour productivity, and growth of the capital labor ratio to the growth of labor productivity. The empirical analysis of the present section includes correlation analysis, unit root test and bivariate and multivariate time series regression analysis.

[19]Kaldor (1966), Cripps &Tarling (1973) and Rowthorn (1979) are few studies.

3.6.1 Growth of Output and Labour Productivity Relationship:

The Verdoorn's law is named after Dutch economist, *Petrus Johannes Verdoorn*. In economics, this law pertains to the relationship between the growth of output and the growth of productivity discussed by Verdoornin*1949*[20].According to the law, faster growth in output increases productivity due to increasing returns."The important implication of this law is that, a substantial part of productivity growth is endogenous to the growth process being determined by the rate of expansion of output through the effect of economies of scale"[21]. In its simplest form the law states that there is a close relationship between the long run rate of growth of manufacturing productivity and that of the output, as evidence of substantial economies of scale[22]. Even though it was Verdoorn who innovated the law, the development of this approach to the theory of economic growth owes much to the writings of Lord Kaldor[23]. *Kaldor* was the first person to discuss broadly the implications of the law for economic growth in his 1966 lecture.

The verdoorn'slaw therefore describe a positive relationship between productivity growth and output growth. As the output growth rises, labour productivity also increases due to learning by doing. Thus the rising labour productivity is due to the operation of increasing returns to scale. There are other factors, that also explain this dynamic relation such as the higher use of productive capital and raising capital to labour ratio. Higher productivity and the availability of more productive capital goods are dependent upon the cumulative output. High growth rate of output and productivity can take place only if new products are introduced and the demand for them increases significantly. In case there is positive feedback from output (growth of output) to meet rising demand, it results in higher productivity and gets reflected on competitiveness and specialization. But the productivity growth can only be enhanced if the new product could find its end user in the extended market. The expansion in the demand of the market is backed by the growth of output. The Verdoorn's law is defined as,

[20] The article was published in Italy in 1949, but was largely escaped notice, with the notable exception of Colin Clark (1957), until Kaldor drew attention to it in 1966.
[21] Verdoorn's Law, *Palgrave Dictionary*, Palgrave, p-804
[22]Bairam E.I. (1987): "The Verdoorn's Law, Returns to Scale and Industrial Growth: A Review of Literature", *Australian Economic Papers*, Vol. 26, Issue 48, Page 20-42, June.
[23] See, in particular, Kaldor, 1978a and 1978b, and the symposium on Kaldor's growth laws published in the 1983 edition of the *Journal of Post Keynesian Economics*.

'Productivity levels are higher in those sectors and activities, which are experiencing faster growth of output. In this regard, we can summarize the classical causation, as growth occurs when the per capital income rise. The total income is the multiplication of productivity and the total labour employed. So, labour productivity is the direct cause of growth.

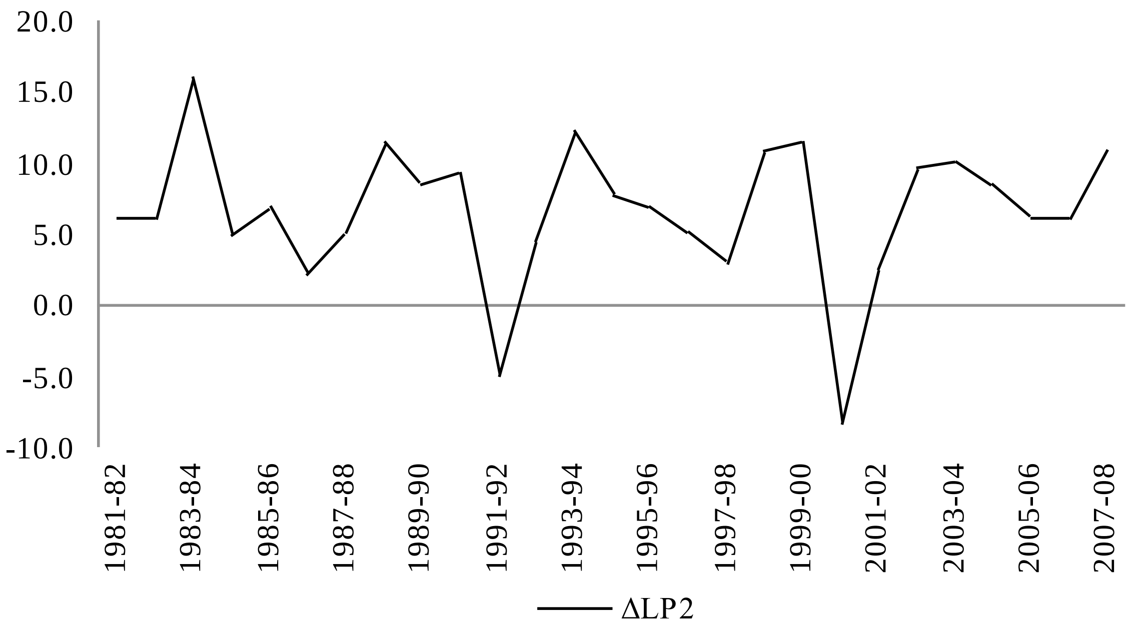
From the above discussion, we summarize that growth of output leads to higher growth in labour productivity. In this regard, an attempt has been made in the coming section to empirically validate the relationship between the growth of output and growth of labour productivity by employing time series regression analysis. Moreover, we also interested to examine empirically the existence of Kaldor's Technological Progress Function (TPF) in case of Indian manufacturing sector too. The variables that we use in the empirical time series regression analysis are labour productivity growth, the growth of output and growth of capital intensity. These variables can be defined as; by labour productivity, we mean growth of real gross value added per workers (ΔLP_1) and growth of real gross value added per person engaged (ΔLP_2). Similarly the growth of output refers to growth of real gross value added (ΔO) and growth of capital intensity can be explained as the growth of real capital stock per workers (ΔCI_1) and growth of real capital stock per person engaged (ΔCI_2). All the variables are expressed in simple annual growth terms.

Before undertaking any time series econometric analysis of the data, it would be useful to understand the broad trends and behavior of the variables, which may assist in interpreting the results latter. For this purpose, time series plots are generated for all the variables that we consider for further time series analysis. Figure 3.5 and Figure 3.6represent the time series plot of growth of both labor productivity variables ΔLP_1 and ΔLP_2, respectively. Figure 3.7 presents the time series plot of the growth of real gross value added (ΔO). The time series plot of capital-labour ratio ΔCI_1 and ΔCI_2 is plotted in the Figure 3.8 and Figure 3.9 respectively. It is quite clear from these Figures that, except capital-labour ration on of the variables reveals any specific trend.

Figure 3.5: Time Series Plot of Growth of Labour Productivity (LP_1)

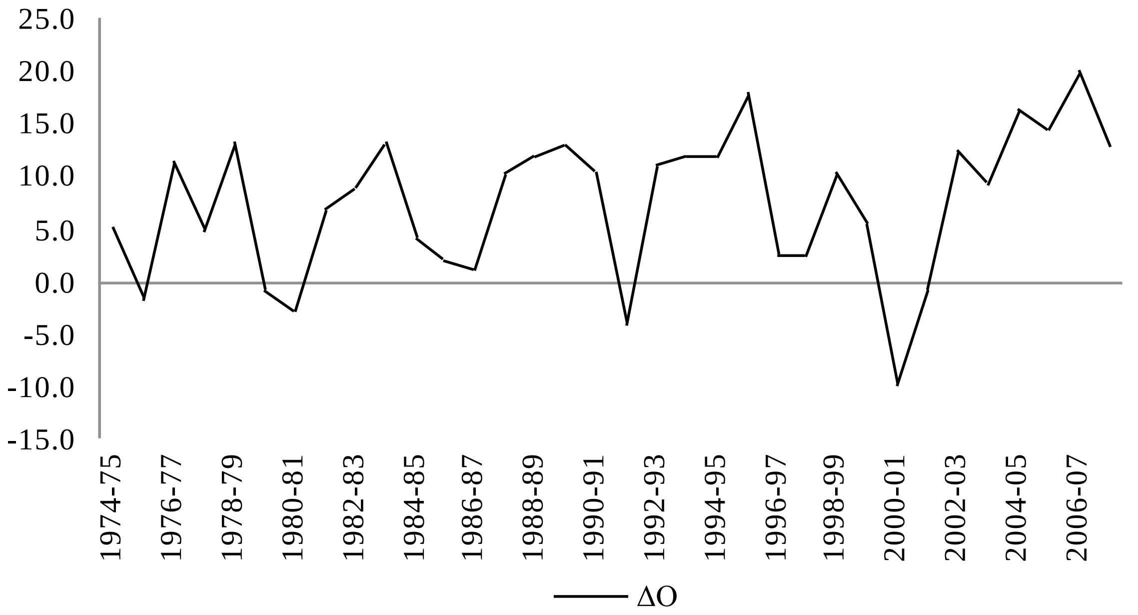
Source: Author's compilation

Figure 3.6: Time Series Plot of Growth of Labour Productivity (LP_2)



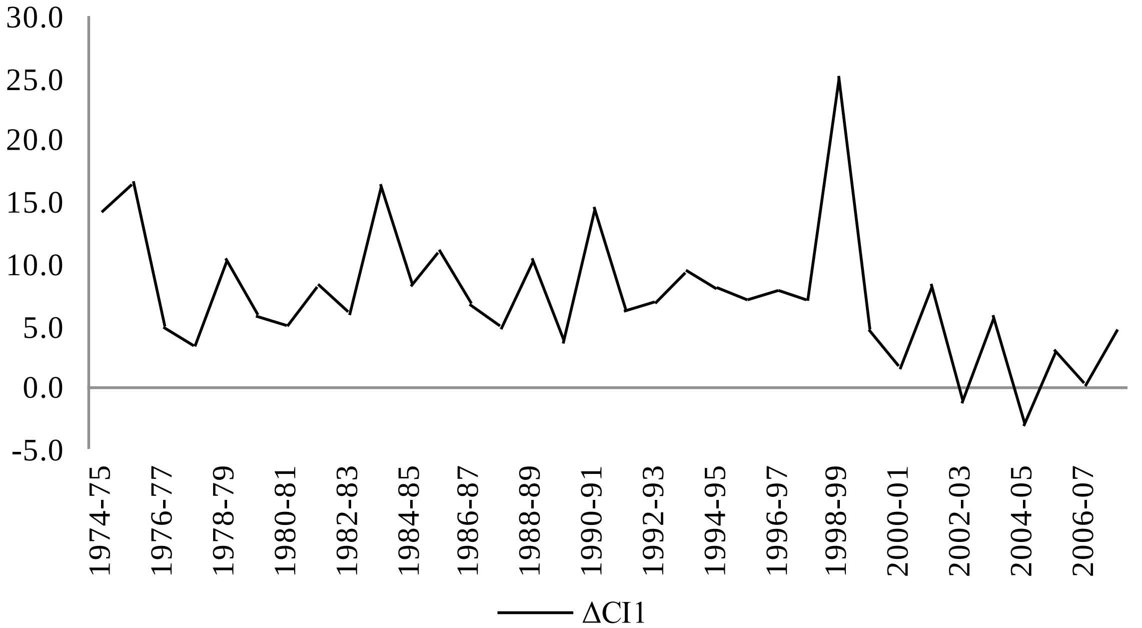
Source: Author's compilation

Figure 3.7: Time Series Plot of Growth of Real Gross Value Added (O)



Source: Author's compilation

Figure 3.8: Time Series Plot of Growth of Capital-Labour Ratio (CI_1)



Source: Author's compilation

Figure 3.9: Time Series Plot of Growth of Capital-Labour Ratio (CI_2)

Source: Author's compilation

The summary statistics of the concerned variables are presented in the Table 3.5 and the correlation matrix is presented in Table 3.6 respectively.

Table 3.5: Descriptive Statistics of Variables

Statistics	ΔCI_1	ΔCI_2	ΔLP_1	ΔLP_2	ΔO
Mean	7.5	7.2	5.41	6.7	7.53
Median	6.8	7.46	6.27	6.89	9.8
Maximum	25.25	20.46	16.34	16.03	20.1
Minimum	-2.9	-2.29	-8.16	-8.15	-9.9
Std. Dev.	5.44	4.96	5.92	5.03	6.87
Skewness	1.01	0.38	-0.62	-1.1	-0.49
Kurtosis	5.01	3.9	3.0	4.88	2.69
Jarque-Bera	11.46	1.57	2.15	9.42	1.52
Probability	0.0	0.46	0.34	0.01	0.47
Sum	255.16	194.47	183.8	180.77	256.1
Sum Sq. Dev.	974.99	638.86	1156.91	656.58	1559.51
Observations	34	27	34	27	34

Table 3.6: Correlation Coefficient Matrix

	ΔCI$_1$	**ΔCI$_2$**	**ΔLP$_1$**	**ΔLP$_2$**	**ΔO**
ΔCI$_1$	1				
	(29.57)				
ΔCI$_2$	0.9621*	1			
	(25.45)	(23.66)			
ΔLP$_1$	0.4556*	0.4344*	1		
	(12.50)	(-10.66)	(25.47)		
ΔLP$_2$	0.3208*	0.3785*	0.9540*	1	
	(8.60)	(9.08)	(23.74)	(24.32)	
ΔO	-0.0601	-0.1206*	0.7572*	0.7219*	1
	(-2.20)	(-3.94)	(25.68)	(23.92)	(45.16)

Note: *- significance at the 1 % level, the figures in the parentheses shows t-statistics value

Table 3.5 represents the summary statistics of the variable under consideration for time series regression. The kurtosis co-efficient, a measure of the thickness of the tail of the distribution, which is higher than three in all cases except for one (growth of real gross value added) output variables. A Gaussian (normal) distribution has kurtosis equal to three, and hence, this implies that the assumption of Gauuianity cannot be made from the distribution of their respective growth level. This finding is further strengthened by Jarque-Bera test for normality which in our case yields high values –much greater than for a normal distribution, and, this rejects the null hypothesis of normality of labour productivity as well as their respective growth distributions at any conventional confidence level.

In order to discover the pairwise degree of association between the labour productivity, real gross value added and capital intensity variables, the correlation matrix is constructed and presented in the Table 3.6. From Table 3.6, it can be understood that there is a high positive correlation between the growth rate of labour productivity and growth of gross value added. Correspondingly, Table 3.6 displays a high degree of positive correlation between capital intensity and labor productivity growth. However, there is a very low negative correlation exists between growth of capital intensity and output growth. From the above table it is found that there is a positive correlation between capital intensity and labour productivity, which as per *Kaldor's* technological progress function.

Table 3.7: Unit Root Test

	With Intercept		*With Trend and Intercept*	
	ADF	**PP**	**ADF**	**PP**
ΔLP1	4.68 (1)	-5.30 (3)	-4.82 (1)	-5.62 (3)
ΔLP2	-5.15 (1)	-5.00 (2)	-5.05 (1)	-4.87 (2)
ΔO	-3.72 (1)	-4.12 (3)	-3.86 (1)	-4.34 (3)
ΔCI1	-3.60 (1)	-5.38 (3)	-3.83 (1)	-5.86 (3)
ΔCI2	-2.05 (1)	-4.65 (2)	-5.28 (1)	-5.47 (2)

Note: The figures in the parentheses show the number of lags and the Mackinnon critical values for ADF and PP test with intercept at 1%, 5% and 10% level of significance are -3.72, -2.98 and -2.63 respectively. Similarly, Mackinnon critical values for ADF and PP test with trend and intercept at 1%, 5% and 10% level of significance are -4.27, -3.55 and -3.21 respectively.

To start with, the unit root test is conducted at the growth level of variables as requirement of time series analysis. This is because, when the data have unit root characteristics, such analysis may lead to spurious results and misleading conclusions. Hence, the time series result is reported in Table 3.7. From the Augmented Dickey Fuller (ADF) test and Phillips Peron (PP) test, it is concluded that growth of labour productivity, growth of output and growth of capital-labour ratio variables are non-stationary at their level at one percent, five percent and ten percent level of significance. The time series plot of all these variables at their growth level shows that there is absolutely no stochastic or deterministic trend at the growth level.

In the beginning of the analysis, we have run the time series regression model by assuming the labour productivity as the dependent variable. The regression results are presented as follows.

Equation: $\Delta LP_1 = \alpha_1 + \beta_1 \Delta O + \varepsilon_1$ *(3.10)*

$\Delta LP_1 = 0.1898 + 0.6925^* \Delta O$

(0.9170) (0.0905)

R^2= 0.6464, F-Statistic = 58.5009, Prob (F-Statistic) =0. 0000, DW = 1.6826, DF = 34

*- significance at 1 % level, figures in parentheses ( ) represents standard error.

The above estimated equation (3.10) reveals that the co-efficient of the explanatory variables preserves expected sign. The estimated labour productivity equation has the R^2 value of 64 percent of goodness of fit and statistically highly significance, F-statistics values indicating that the chosen determinant could explain the variation in the dependent variable adequately. Thus, a 10 percent increase in gross value added growth leads to increase in labour productivity by 6.9 percent at one percent statistical significance level. However, unfortunately, the estimated 'Durbin-Watson' statistics in the above equation is lower than the critical upper limit either at one percent or five percent level of significance, meaning the presence of autocorrelation in the estimated residuals. As a result of which t-statistics of the co-efficients and the F-values are likely to be overestimated. To correct the autocorrelation problem in the above equation, we have re-estimated this labour productivity equation by using 'Cochran-Orcutt' procedure. The result of the revised estimated equation is reported in the equation-3.11 below.

Equation: $\Delta LP_1 = \alpha_2 + \beta_2 \Delta O + \beta_3 AR\ (1) + \varepsilon_2$ *(3.11)*

ΔLP_1 = -0.0646 + 0.7289*ΔO + 0.1843 AR (1)

(1.0833) (0.0986) (0.1856)

R^2= 0.6552, F-Statistic = 28.5031, Prob (F-Statistic) =0. 0000, DW = 2.0561, DF = 33

*- significance at 1 % level, figures in parentheses ( ) represents standard error.

The AR (1) regression as an alternative to the previous regression, provides a better outcome. In this equation R^2has improved to 65 percent. The co-efficient of gross value added (O) is improved to 7.2 percent. The DW statistics in this equation surmised that the autocorrelation problem is removed.

Equation: $\Delta LP_2 = \alpha_3 + \beta_4 \Delta O + \varepsilon_3$ *(3.12)*

ΔLP_2 = 2.2458** + 0.5297*ΔO

(1.0925) (0.1016)

R^2= 0.5211, F-Statistic = 27.1999, Prob (F-Statistic) =0. 0000, DW = 2.1458, DF = 27

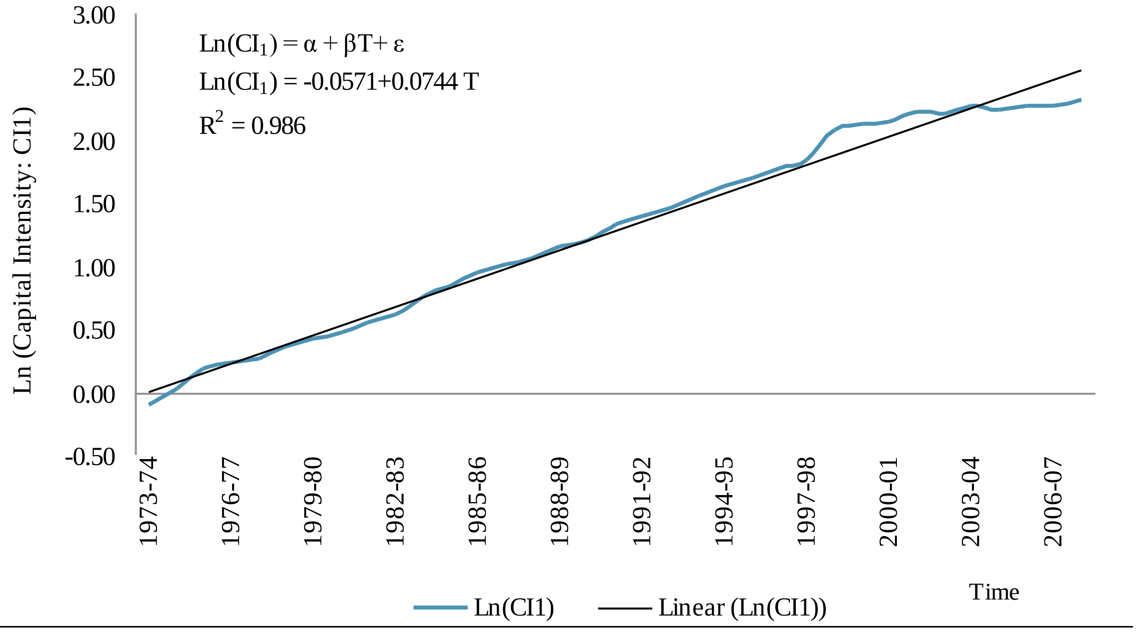
*- significance at 1 % level, **-significance at 5% level, figures in parentheses ( ) represents standard error.

The above estimated equation (3.12) reveals that the co-efficient of the explanatory variables preserves expected signs. The estimated labour productivity equation has the R^2 value of 52 percent of goodness of fit and statistically highly significance, F-statistics values indicating that the chosen determinant could explain the variation in the dependent variable adequately. Thus, a 10% increment in the gross value added (ΔO) growth will explain 7.3 and 5.3 percent rise in labour productivity growth of ΔLP_1 and ΔLP_2 respectively (see equation 3.11 and 3.12) in Indian manufacturing sector.Moreover, the estimated 'Durbin-Watson' 'd'statistics in the above equation is higher than the critical upper limit either at 1 percent or 5 percent level of significance, meaning there is no autocorrelation problem presence in the estimated residuals.This indicates that the growth of gross value added has the direct and positive relationship with labour productivity in Indian manufacturing over the study period 1973-74 to 2007-08.We also have examined the Verdoorn's law for disaggregated NIC 2-digit industrial groups and presented the result of all the equation in the Appendix Table – A3.12, A3.13 and A3.14.

3.6.2 Kaldor's Technological Progress Function:

The Technical Progress Function (TPF) is a concept developed by Nicholas Kaldor (1960) to explain the rate of growth of labour productivity as a measure of technical progress. Technological progress can have a significant positive impact on the growth rate of output and the utilisation of labour employed. One approach is through additional demand for labour generated by higher growth rate driven by technological progress (Solow, 1956; Swan, 1956; Arow; 1962 and Romer, 1982). The other possibility is through the embodied technical progress (found in new capital equipment) that directly affect labour utilisation more efficiently.

Figure 3.10: Trend of Growth of Capital Intensity in Indian Manufacturing



Note: Capital Intensity here refers to capital stock per workers

Source: Author's compilation from Annual Survey of Industries, CSO, EPW Research Foundation

Therefore, it's the growth of capital intensity (capital-labour ratio) that determine the growth in labour productivity due to technical progress. In trend of capital intensity in Indian organised manufacturing is rising substantially. The capital per unit of workers (K/E) has increased more than 10 fold in the case of aggregate manufacturing during the sample period of 35 years (1973-74 to 2007-08). The capital-labour ratio grew at an average rate of 7.73% y/y per annum for the entire sample period for the aggregate manufacturing sector. The capital intensity measured as real capital stock per unit of workers has recorded a growth from Rs. 0.9 lakh in 1973-74 to Rs. 10.1 lakh in 2007-08 in aggregate manufacturing sector. We observed that the trend pick up the momentum in the post-liberalisation era, when it has increased from Rs. 3.8 lakh in 1990-91 to Rs. 10.1 in 2007-08. In the dis-aggregate 2-digit industry groups the trend of capital intensity has shown an overwhelming increase during the study period (see Figure 3.2). This shows that the rising capital accumulation in Indian manufacturing. 2-digit industrial groups such as Petroleum products (23), Chemical products (24), Basic metals (27), Office accounting & computing machines (30), Radio, television & communication equipments (32) and Motor vehicles (34) are showing high capital-labour ratio[24]. These industries were highly capital intensive and have experienced a sharp upswing in the capital labour ratio. Industry groups such as Food products (15), Tobacco products (16), Wearing apparel (18), Leather products (19) Wood products (20), Fabricated metal products (28) and Furniture & other manufacturing (36) have considerably low capital-labour ration than the average manufacturing over the entire period. These industries defined to be labour intensive industries. Throughout the period of study all, the manufacturing industries have reached a greater capital-labour ratio.

With the implementation of the new capital technique and know how, workers learn to know how to use the embodied technical progress more efficiently. Thus, advances will made in the existing method of production, which in turn increases labour productivity, leading to an expansion in output and employment. This suggests, with the introduction of new capital and technology, worker efficiency also enhanced over the period so leads to higher labour productivity. Briefly, Kaldor (1960) proposed that the rate of growth of

[24] Refers to Appendix at the end of this chapter, capital intensity ratio figures of all 2-digit industriall groups is presented.

output per worker is a function of the rate of growth of capital per workers, as described by the equation

$$Y = f\left(\frac{K}{L}\right) \tag{3.13}$$

$$\Psi = \frac{K}{L}$$

Where, ψ is the rate of technological progress

Accordingly, technological progress requires investment and investment normally represents new knowledge that enhances labour productivity. The shape of the Kaldor's technical progress functions much dependent upon the degree at which capital accumulation embodies new techniques, which improve labour productivity. AfterwardsKaldor and Mirrlees (1962), in the revised version showed that technological progress is driven by the rate of improvement in the design of newly produced capital goods. The rate of productivity growth or technological progress is primarily determined by the capital-output ratio on new capital.

The equation describes as the larger the rate of growth of capital/input per labour (CI), the larger the rate of growth of output per labour (LP) or labour productivity. Kaldor's TPF argues that the greater the growth of capital-labour ratio, the faster will be the growth of labour productivity. The recognition of the existence of a functional relationship between growth of labour productivity, and growth of capital intensity is due to the movement in the capital-output ratio. Thus, we will examine the existence of the this relationship by running a regression model[25] by assuming the growth of labour productivity as the dependent variable and growth of capital-labour ratio as independent variables. The regression result is presented as follows.

[25] As we have two of labour productivity ratio (LP1 and LP2) and two pair of capital intensity (CI1 and CI2), we will be examine Kaldor's technological progress function in combination

Equation: $\Delta LP_1 = \alpha_4 + \beta_5 \Delta CI_1 + \beta_6 AR\ (1) + \varepsilon_4$ *(3.14)*

ΔLP_1 = 2.5449 + 0.4117**ΔCI_1 + 0.1945 AR (1)

(1.8629) (0.1918) (0.1798)

R^2= 0.1197, F-Statistic = 2.0397, Prob (F-Statistic) =0.1477, DW = 1.9234, DF = 33

*- significance at 1 % level, **-significance at 5% level, ***-significance at 10% level, figures in parentheses ( ) represents standard error.

Equation: $\Delta LP_2 = \alpha_5 + \beta_7 \Delta CI_2 + \beta_8 AR\ (1) + \varepsilon_5$ *(3.15)*

ΔLP_2 = 3.4965*** + 0.4564**ΔCI_2 + 0.1725 AR (1)

(1.8077) (0.1958) (0.2117)

R^2= 0.1648, F-Statistic = 2.2696, Prob (F-Statistic) =0.1260, DW = 1.8803, DF = 26

*- significance at 1 % level, **-significance at 5% level, ***-significance at 10% level, figures in parentheses ( ) represents standard error.

The above equations (Equation 3.14 and 3.15), represents the final regression result between the growth of labour productivity and growth of capital intensity. From the above equation of the regression result, it is observed that Kaldor's technological progress function does not hold good for Indian manufacturing. In equation 3.14 and 3.15, the co-efficient of the explanatory variables is preserves expected signs. In both the estimated equations (Kaldor's TPF) has very low R^2 value shows that the models are not a good fit. The statistically highly insignificant F-statistics values indicates that the chosen determinants could not explain the variation in the dependent variables adequately. Though the estimated 'Durbin-Watson' statistics in these equations (with and without AR term) are close to the critical value of 2.0, however the very low F-statistics suggest that the model is insignificant itself.

After testing both Verdoorn's Law and Kaldoor's technological progress function separately, we observed that Verdoorn's law is holding good while the latter one does not hold for the Indian manufacturing sector. However, from the trend analysis, we have observed that both labour productivity and capital-labour ratio is rising consistently during the sample period. As classical economist mentioned that with introduction of increasing capital and openness to new technology, the efficiency of the labour rises. This in turn leads to higher labour productivity. Kaldor technological progress function is based on this principle, which suggests that labour productivity growth moves along with rising capital deepening. Thus, it is clear that both output growth and growth in capital intensity leads to higher growth of labour productivity. Therefore, in the coming section we attempt to validate this argument (relationship of growth of output and capital intensity to that of growth of productivity) for the Indian manufacturing sector. To better enlighten the reason of labour productivity growth, we have modified the regression equation by combining both Verdoorn's law and Kaldor's TPF in a multivariate regression framework presented as follows.

$$\Delta LP = \alpha + \beta\Delta O + \delta\Delta CI + \varepsilon \qquad (3.16)$$

Here, LP, O and CI refer to labour productivity, output and capital intensity

'Δ' denotes growth rate (simple annual rate of y-o-y growth)

α is the intercept term

β and δare the co-efficients of the explanatory variables

and ε is the error term

In this case, we have to test the above-mentioned relationship for both the pair (LP_1 and LP_2) of labour productivity ratio. The regression result is presented as follows.

Equation: $\Delta LP_1 = \alpha_6 + \beta_9\Delta O + \beta_{10}\Delta CI_1 + \beta_{11}AR(1) + \varepsilon_6$ *(3.17)*

ΔLP_1 = -3.2227* + 0.7462*ΔO + 0.4227*ΔCI_1 + 0.3384** AR (1)

(1.1153) (0.0739) (0.0893) (0.1717)

R^2= 0.8026, F-Statistic = 39.3066, Prob (F-Statistic) =0.0000, DW = 2.0751, DF = 33

*- significance at 1 % level, **-significance at 5% level, figures in parentheses ( ) represents standard error.

Equation: $\Delta LP_2 = \alpha_7 + \beta_{12}\Delta O + \beta_{13}\Delta CI_2 + \varepsilon_7$ *(3.18)*

ΔLP_2 = -1.5552 + 0.5715*ΔO + 0.4790*ΔCI_2

(1.1751) (0.0768)(0.1061)

R^2= 0.7410, F-Statistic = 34.3413, Prob (F-Statistic) =0.0000, DW = 1.9469, DF = 27

*- significance at 1 % level, **-significance at 5% level, figures in parentheses ( ) represents standard error.

In the above, we have presented the final result of modified least square equation for Indian aggregate manufacturing. In case of equation 3.17 and 3.18, the co-efficient of the explanatory variables preserves expected signs with high level of significance at one percent. The estimated labour productivity equations (3.17 and 3.18) has very high R^2 value, shows 75 and 80 percent of goodness of fit respectively. Moreover, the statistically highly significance, F-statistics values indicating that the chosen determinant could explain the variation in the dependent variable adequately. Thus, a 10 percent increase in gross value added and output growth leads to increase in labour productivity by 7.5and 5.7 percent at one percent statistical significance level for equtions6 and 7. Similarly a 10 percent increase in the growth of capital-labour can contribute 4.2 to 4.8 percent increase in labour productivity respectively at 1 percent statistical significance. In both the above cases, we have the problem of autocorrelation, where the estimated 'Durbin-Watson' 'd' statistics in the equations is lower than the critical upper limit either at 1 percent or 5 percent level of significance, meaning the presence of autocorrelation in the estimated residuals. As a result of which t-statistics of the co-efficients and the F-values are likely to be overestimated. To correct the autocorrelation problem in the above equation, we have reestimated these labour productivity equations by using 'Cochran-Orcutt' procedure. The result of the revised estimated equation is reported in the equations 3.17 and 3.18above were provides a better outcome. After the introduction of AR (1) term the R^2 is improved. The DW statistics after introduction of AR (1) term surmised that the autocorrelation problem is removed. This possibly explains that the rise in labor productivity in the current period can also be explained as a function of labour productivity in the previous year as we get statistical significant AR (1) term. The learning by doing and improve in the skill set and efficiency over the period determine the labour productivity of the present period.

In the light of the above discussion, we observed that the modified least square model yields better outcomes that justified direct and significant relationship between growth of output and capital-labour ratio to that of growth of labour productivity. Over a long period manufacturing industry is subjected to the increasing returns to scale, that increases output growth and labour productivity. The basic proposition of Verdoorn's law is based on this concept of increasing returns to scale, which we examine and found it holds good for the Indian manufacturing sector. We also found that Kaldor's TPF also holds good for Indian manufacturing in the modified model, and the possible explanation is the introduction of output variable, which can possibly affect the capital-labour ratio through capital-output ratio. Thus, the regression result confirms that both the Verdoorn's law and Kaldor's proposition of Technological Progress Function together holds for the Indian manufacturing sector.

3.7 Conclusion:

In this chapter, we attempt to explain the trends and growth of labour productivity in Indian manufacturing both at aggregate and disaggregate level. We analyse the trends and growth of labour productivity by using the theoretical framework on economies of scale, technical progress, linear growth analysis and productivity differences and its factors. The trend of the labour productivity was analysed over the full period of 35 years and over four sub-periods, from which we observed that labour productivity trend has been increasing over the period. The sub-period analysis revealed that the seventies was experienced subdued growth while eighties was the best period to observe the sharp rise in labour productivity growth. Meanwhile the preposition of rising labour productivity over the post-liberalization period hold well with a resilient growth during the 90's, that compared stronger and better to the eighties. However, the strongest growth in labour productivity was experienced during the post nineties, i.e., during 2000-01 to 2007-08. The analysis has shown that productivity gains are not evenly distributed across 2-digit industries during the period of study. Some industries experience very high rates of productivity growth as they are in the process of adopting new technology, new methods of production at the onset of economic liberalization. On the other hand, during the same period, many industries has experienced sluggish labour productivity growth, as they are still using the incompetent technique of production because of lack of adoption capabilities. At two-digit level, industry groups like Petroleum product & nuclear fuel (23), Chemical & chemical products (24), Basic metals (27), Machinery &equipments (29), Office accounting & computing machines (30), Electrical machinery & apparatus (31), Radio, television & communication equipment (32), Medical, precision & optical instruments (33) and Motor vehicles, trailers & semi-trailer (34) are the industries where the labour productivity is growing very high. These industries are mainly capital-intensive industries. The roundabout methods of production and higher demand for these products have been the driving force behind the labour productivity growth in these industries. The increasing returns to scale, the use of roundabout production process, and introduction of new machinery, demand dependency, privatization and inflow of investments are the main causes affecting productivity growth. The operation of the increasing returns to scale in the factor employment has played a significant role in determining the size of productivity. The elite industries employing large labour or larger capital has enjoyed an upper hand in the productivity rise. These elite industries have a larger increase in productivity compared to their other counterpart. Moreover, due to globalization and liberalisation, post-liberalisation period has experienced rising employment along with productivity to push up the overall output growth in Indian manufacturing.

From the two-way classification analysis, by size of employment, we observed that manufacturing labour productivity is high in factories with high employment size compare to low employment size factories. Thus, labour productivity is biased toward higher size of employment. Similarly, by size of capital, we observed that labour productivity of the manufacturing industry by size of capital provides evidence of increasing returns to scale. Thus, industries with high capital size have had larger productivity due to the operation of increasing returns to scale that supported by extension of the market due to introduction of LPG policies.

The empirical analysis substantiates the above argument, where we observed that higher output growth is directly and significantly explain growth in labour productivity. Thus, Verdoorn’s law does hold good in Indian manufacturing and this state that the existence of returns to scale. However, from the empirical analysis, it is clear that Kaldor’s technological progress functions for Indian manufacturing, does not hold well. The findings of our modified model by considering both growth of output and growth of capital-labour ratio as independent variables revealed a much better outcome. This suggests both output growth and capital intensity growth together explain growth in labour productivity in a much better and a significant way in the Indian manufacturing sector. Thus, we can conclude that both returns to scale (as a necessary condition for Verdoorn’s law to hold good) and rising capital accumulation has a positive effect on labour productivity growth.

Table A3.1: Description of Industrial Groups According to National Industrial Classification 1998

NIC Code	Description of Industries
15	Manufacture of Food Products and Beverages
16	Manufacture of Tobacco Products
17	Manufacture of Textiles
18	Manufacture of Wearing Apparel Dressing and Dyeing of Fur
19	Tanning and Dressing of Leather Manufacture of Luggage, Handsbages, Saddlery, Harness and Footwear
20	Manufacture of Wood and Products of Wood and Cork, Except Furniture, Manufacture of Articles of Straw and Plating Materials
21	Manufacture of Paper and Paper Products
22	Publishing, Printing and Reproduction of Recorded Media
23	Manufacture of Coke, Refined Petroleum Products and Nuclear Fuel
24	Manufacture of Chemicals and Products
25	Manufacture of Rubber and Plastic Products
26	Manufacture of Other Non-Metallic Mineral Products
27	Manufacture of Basic Metals
28	Manufacture of Fabricated Metal Products, Except Machinery and Equipments
29	Manufacture of Machinery and Equipments N.E.C
30	Manufacture of Office, Accounting and Computing Machinery
31	Manufacture of Electrical Machinery and Apparatus N.E.C.
32	Manufacture of Radio, Television and Communication Equipments and Apparatus
33	Manufacture of Medical, Precision and Optical Instruments, Watches and Clocks
34	Manufacture of Motor Vehicles, Trailers and Semi-Trailers
35	Manufacture of Other Transport Equipment
36	Manufacture of Furniture; Manufacturing N.E.C.

Note: The 2-Digit Industry Codes represented in the above Table follows the National Industrial Classification 1998.
Source: Annual Survey of Industries, Central Statistical Organisation.

Table A3.2: Variables Used in the Study

Sl. No.	Variables	Unit of Measure	Source
1	Gross Value Added	Rs. Lakh	ASI
2	Net Value Added	Rs. Lakh	ASI
3	Gross Value of Output	Rs. Lakh	ASI
4	Number of Workers	In Number	ASI
5	Number of Employees	In Number	ASI
6	Total Wages	Rs. Lakh	ASI
7	Total Emoluments	Rs. Lakh	ASI
8	Provident Fund & Other Benefits	Rs. Lakh	ASI
9	Rent Paid	Rs. Lakh	ASI
10	Interest Paid	Rs. Lakh	ASI
11	Profit	Rs. Lakh	ASI
12	Net Profit	Rs. Lakh	ASI
13	Gross Profit	Rs. Lakh	ASI
14	Depreciation	Rs. Lakh	ASI
15	Fixed Capital	Rs. Lakh	ASI
16	Invested Capital	Rs. Lakh	ASI
17	Real Capital Stock	Rs. Lakh	ASI
18	Net Capital Formation	Rs. Lakh	ASI
19	Gross Capital Formation	Rs. Lakh	ASI
20	Gross Fixed Capital Formation	Rs. Lakh	ASI
21	Wholesale Price Index	Index	CSO
22	Consumer Price Index	Index	CSO

Table A3.3: Sectoral growth and Share of GDP in India

	1950-51 to 2012-13	*1950-51 to 1959-60*	*1960-61 to 1969-70*	*1970-71 to 1979-80*	*1980-81 to 1989-90*	*1990-91 to 1999-00*	*2000-01 to 2012-13*
Annual Growth Rate (% Y/Y)							
GDP	4.97	3.59	3.96	2.94	5.58	5.84	7.13
Agriculture & Allied Services	2.85	2.72	2.51	1.26	4.41	3.24	2.93
Agriculture	2.98	2.98	2.52	1.41	4.67	3.29	3.01
Industry	5.83	5.69	6.47	3.54	5.97	5.74	7.14
Mining & Quarrying	5.12	4.65	6.19	3.05	8.70	4.87	3.65
Manufacturing	5.88	5.81	5.89	4.31	5.77	5.84	7.23
Services	6.14	3.97	4.78	4.41	6.62	7.57	8.57
Share of Total GDP, in 2004-05 prices							
Agriculture & Allied Services	34.03	50.43	42.93	38.44	32.99	26.70	17.63
Agriculture	28.16	41.29	35.06	31.45	27.75	22.53	14.90
Industry	24.59	17.51	23.03	24.65	26.22	27.44	27.74
Mining & Quarrying	2.59	1.95	2.42	2.37	2.99	3.28	2.55
Manufacturing	13.66	9.89	12.43	13.67	14.61	15.28	15.60
Services	40.37	29.67	32.51	35.43	40.03	45.68	54.63

Source: Central Statistical Organisation

Appendix Note: Measurement of Variables

The present section of the appendix will discuss in details the definition and measurement of variables used all through the study for the empirical analysis. The following discussion will give us an idea about the variables and how we construct them with the detailed methodology.

A 1.1 Measurement of Output.

Annual Survey of Industries publishes three different concepts of output; these are Gross Value of Output, Gross Value Added and Net Value Added. So definitely there arises a choice in the measurement of output. Among the three, we need to choose one between the first two. The question is whether to choose 'real output' or 'real value added' as the measure of numerator of the multi-factor productivity ratio. If we take the first measure, there arises a specification of the production function in terms of labour, capital and materials. It is the second concept that has been used more often in the productivity literatures.

Among studies on the Indian manufacturing sector, it is Rao (1996a, 1996b) who first technically labelled the estimate of productivity based on gross output and real value-added as 'Total Productivity' (TP) and 'Total Factor Productivity' (TFP), respectively. This is still followed by others till date. Studies on productivity in Indian economy, viz, Brahmananda (1982) and Mohanty (1992) used Net Domestic Product (NDP) to measure production. However the national income accounts are prepared by using the value-added approach and real NDP is obtained by single deflation. Studies on productivity in Indian manufacturing industries have used real value-added as the measure of output, except for the study done by Rao (1996a, 1996b) and Pradhan &Barik (1998).

It was Rao, who first addressed the question of whether productivity should be measured by gross output or real value-added. As long as material inputs are separable from the other factors, it does not matter as to which of the two above-mentioned measures of production are used for the measurement of productivity. Mohan Rao in his study justifies that if material inputs are not separable, then TP should be preferred to TFP. He reasons, if firms reap economies of scale by combining material inputs with factor inputs, then material input conversion efficiency is included along with the 'efficiency in value-added' in the concept of TP. Therefore, measuring TFP is desirable on the grounds that it is the final measure of the value of production[26].

If we consider output as the gross production, then it leads to the notion of total productivity (TP) on the other case. Again, if we recognize the value added at the output, then it gives rise to the widely accepted measure of total factor productivity (TFP). The choice between gross output and value added hinges on whether one believes the production function to be separable in material inputs and factor input. Further, we encounter empirical difficulty because the choice requires an identification of an engineering or econometric production function – a task which is not practically possible. Therefore, when production function is not known the choice basically theoretical and may be difficult to refute empirically.

Proper Deflation of Value Added: this question was first rose by Balakrishnan&Pushpangadan (BP hereafter) in their excellent paper[27]. They argued that there should be separate deflation of the output and material input components[28] of value added by their respective price indices and their line of argument is against the use of a common output price deflator, which most of the earlier studies employed including Ahluwalia (1985, 1991) &Goldar (1986). The methodology followed by BP was critical enough that Ahluwalia's conclusion of a turnaround in productivity growth during 80's was reversed.

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[26] See Rao (1996a), *EPW*, November 2.

[27] Total Factor-Productivity Growth in Manufacturing Industry: A Fresh Look by Balakrishnan and Pushpangadan, *EPW*, July 30, 1994.

[28] See Appendix for the list of inputs group used by BP.

If we have taken into account, only the real value-added as a measure of production, then, there arises a choice in front of us, whether the conversion from nominal value-added to real value-added can be done with single (SD) or double deflation (DD) method. In the single deflation method the nominal value added is deflated by the output price index only.

Bruno (1984) in the past explained the role of increasing relative price of raw materials to output and its effect on the productivity slowdown. Then Goldar (1986) addresses the issue by arguing that the SD method of estimating the real value added may not be appropriate, but due to the difficulty of compiling a material price index required for double-deflation method, he estimates the TFP by only SD method. Similarly Ahluwalia (1991) also addresses the problem associated with the use of the single-deflation approach in the context of measurement. The study made by BP (1994) was the first of its kind to use the double-deflation method and highlight the importance of the changing relative price in the estimation of the TFP growth. This study refuted the finding of the Ahluwalia (1991) and says that the turnaround in TFPG in the Indian manufacturing sector in the 1980-81 is because of the overestimation due to the method of SD used by Ahluwalia (1991) in her study. Even though the argument put forward by BP in 1994, attract the attention of the policy makers as well as researchers, the unavailability of adequate and appropriate data to construct the raw material price index practically leaves us with no option except relying on a single deflation method of value added.

A 1.2 Measurement of Labour.

The measurement of labour is four fold, man-hour work, number of workers, number of employees and the total person engaged. In the context of Indian manufacturing, the man-hour works in the ASI is not preferred to be an appropriate representative of the measurement of labour input. Rather, it has been done by multiplying the number of workers in a shift by eight (a normal working hour per day) and aggregating such products across the factories to arrive at the man-hours work figure for an industry. Therefore the resultant series thus does not actually measure man-hours worked. The important point is the man-hour series published in ASI that covers only workers on labour class and leaves out the persons other than workers like supervisor, clerical staff, managerial personnel, etc. The concept of number of employees cannot be considered because of non-availability of data since 1998-99.

The other two concepts like number of workers and total person engaged in, which ASI published data annually. Workers are defined to include all those persons employed directly or through contracts, whether for wage or not, and engage in any manufacturing process. This broadly covers the laborers class who are directly connected to the manufacturing process. On the other hand a total person engaged include all the workers as defined above, along with persons receiving wages and holding supervisory or managerial positions engaged in the administrative office, store keeping section and welfaresections, sales department as also those engaged in the purchase of raw materials, or purchase of fixed assets for the factory and watch and ward staff. The latter category of employees includes supervisors, technicians, managers, clerks and other similar types of employees. Thus total person engaged is considered as the broader concept of labour, measure among the three concepts (for which the data are available for Indian manufacturing) that truly represent the measurement of labour inputs.

Corresponding to the last two concepts of the measurement of labour inputs, there exist two different concepts of the remuneration made to workers and total person engaged, this is Wages and Emoluments respectively. Total wage to workers is directly available in ASI, while the remuneration to total person engaged which is the broader concept of labour input have been estimated separately. This is because the workers as well as non-workers are those engaged directly or indirectly in the manufacturing process are subject to avail the provident fund and other benefits (PF&OB), therefore we have estimated the extended form of emoluments (EMOLT+), which includes PF & OB, with that of total emoluments (as defined in ASI), which in true sense represent the total remuneration paid to total person engaged.

A 1.3 Measurement of Capital.

Measurement of capital, involves a lot of controversy among other inputs. In productivity literature, the deflated value of fixed capital was used during the 60s. The studies on productivity in Indian manufacturing during the 60s and 70s did not give a lot of importance to the measurement of capital. In fact, the differences in the TFP estimates between studies may be attributed largely to the differences in the capital estimates. Goldar's study in 1986 is the first of its kind to give importance to the measurement of capital.

The question of correcting the capital stock series for Indian manufacturing is associated with several other complications. To arrive at real capital stock series, the depreciation that should be deducted from fixed assets does not adequately represent the actual consumption. These arguments are discussed by Benerji (1975). It has also been argued that the use of gross figures is justified in less developed countries. It is so because the capital stock is often used at approximately constant level of efficiency for a period beyond the accounting life measured by normal depreciation until it is eventually discarded or sold for scrap. Hashim and Dadi (1973) in their study pointed out the fact that a large amount of expenditure is incurred by business firms for repair and maintenance, whose objective is to keep the assets in more or less a similar productive capacity.

The real capital stock is derived by following the Perpetual Inventory Method (PIM). For the present study, we have prepared the real capital stock series for Indian manufacturing, both at aggregate as well as disaggregate level in 1981-82 prices. The measure of the perpetual inventory method is most often used in productivity analysis to construct the capital stock series. Banerji (1975), Goldar (1986), Balakrishnan&Pushpangadan (1994), Sharma and Upadhyay (2003) etc. followed the same procedure to arrive at the capital stock series. The formula is;

Capital Stock Series for the period 't': $K_{t} = K_{t-1} - (0.05*K_{t-1}) + I_t$

Where, K_t stands for real capital stock series for the year't'

K_{t-1} refers to value of previous year capital stock

I_t, refers to the gross investment

Further I_t, can be derived by the formula

$$I_t = \frac{(F_t - F_{t-1} + D_t)}{P_t}$$

Where, F_t, refers to book value of fixed assets in the year *t*

D_t, represent Depreciation in the year *t*.

P_t refers to the investment deflator (WPI_{mmt})

The WPI of machine and machine tools is used as the investment deflector in 1993-94prices to deflate the gross-investment series. The capital stock series for the initial or the benchmark year (K_0) can be derived, with by deflating the fixed capital with WPI_{mmt} as investment deflator.

$$K_0 = \frac{(F_{1973-74})}{P_{1973-74}}$$

A 1.4 The Ratios used in the study

Labour Productivity

We have used the most acceptable definition of the measure of labour productivity, i.e. output per labour. As we have two measure of output (real gross value added and real gross value of output) and to measure of labour input (number of workers and total person engaged. The ratio is adjusted for inflation by deflating the output series by respective WPI series at 1993-94 prices. Thus the study has four combinations of labour productivity ratio to understand the trend, growth and determinants of labour productivity in Indian manufacturing.

$$Labour\ Productivity\ (LP_1) = \frac{Real\ Gross Value\ Added\ O}{Number\ of\ Workers\ L_1}$$

$$Labour\ Productivity\ (LP_2) = \frac{Real\ Gross Value\ Added\ O}{Total\ Persons\ Engaged\ L_2}$$

Capital Intensity

The capital stock per unit of labour is used as the measure of capital intensity. The real capital stock series constructed in 1993-94 prices are divided by that of the number of workers and total person engaged to arrive at the capital per labour, which represent the capital deepening the Indian manufacturing. The capital stock used in the study is real as it is deflated by WPI $_{mmt}$ at 1993-94 prices.

$$Capital\ Intensity\ (CI_1) = \frac{Capital\ Stock\ K}{Number\ of\ Workers\ L_1}$$

$$Capital\ Intensity\ (CI_2) = \frac{Capital\ Stock\ K}{Total\ Persons\ Engaged\ L_2}$$

Capital Output Ratio

The capital per unit output is measured with the help of real capital stock per unit of value added. This measure tells us how much capital is required to produce a unit of output. We have simply taken the ratio between real capital stock to that of real value added, both at 1981-82 price.

$$Capital\ Output\ Ratio = \frac{Capital\ Stock\ (K)}{Real\ Gross Value\ Added\ (O)}$$

Real Wage

The present study used two concepts of labour compensations. Real wage per workers (LC1) and real emoluments per person engaged (LC2). The different wage concepts are based on the different concepts of the remunerations paid to the respective labour groups, such as workers, non-workers and total person engaged (workers + non-workers). The real wage per person engaged is calculated with the help of an extended form of total emoluments (LC2). LC2 is the total emoluments (as defined in ASI) with provident fund and other benefits (PF & OB). To get the real wage per employees, we used the consumer Price Index (CPI) of Industrial Workers (at 1993-94 prices) to deflate and get the real wage per labour. Three concepts of real wages have been calculated with the help of this formula

- Real Wage per Workers = {[TW/NOW]/CPI iw}*100
- Real Wage per Employees = {[TEE/TPE]/CPIiw}*100.

TW=Total Wages, NOW=Number of Workers
TEE=Total Extended Emoluments, TPE=Total Person Engaged

CPIiw=Consumer Price Index of Industrial Workers at 1993-94 prices.

Rate of Profit

Rate of profit is the ratio between profits and capital. We have estimated for two concepts of profit in the present purpose i.e. net rate of profit and gross rate of profit, both of which are estimated in nominal term. We have estimated the rate of profit as the ratio between the Gross Profit (GP) and Invested Capital (IC). Both GP and IC represent the broader sense of the variables; therefore they were chosen. The gross profit is the sum of Net Profit (NP) and depreciation. Further net profit is the sum of the value of Profit (as defined in the ASI) with that of Rent Paid (RP) and Interest Paid (IP). The rate of profit will show the share of profit in the capital. As both the numerator and denominator are available from 1979-80 onwards till 1997-98, therefore we have the series for rate of profit only for the same period. Similarly, when the numerator is taken as net profit instead of gross then we arrive at the nominal net rate of profit. Thus the formula to estimate nominal net (NNR) and gross rate of profits (NGR) are

Nominal Net Rate of Profits = [NP/IC]*100
Nominal Gross rate of Profits = [GP/IC]*100
NP = Profits (as defined in ASI) + Rent Paid + Interest Paid
GP = NP + Depreciation.

$$Gross\,Rate\ of\ \text{Pr}ofit = \frac{\text{Pr}ofit\ before\ \text{Re}nt\ paid, Interest\ paid\ and\ Depriciation\,(GP)}{Capital}$$

$$Net\ Rate\ of\ \text{Pr}ofit = \frac{\text{Pr}ofit\ before\ \text{Re}nt\ paid, Interest\ paid\ (NP)}{Capital}$$

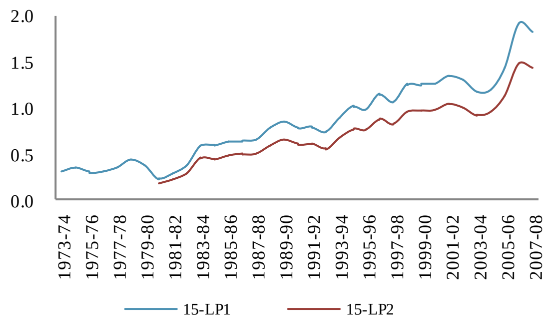
Rate of Interest

The rate of interest is estimated by the ratio of Interest Paid (as define in ASI) to that of Loans Outstanding. For the present study, we have an estimated nominal rate of interest (ROI) for eighteen 2-digit as well as for aggregate manufacturing. As both the numerator as well as the denominator is in rupee terms, the variable rate of interest is in terms of ratio and then we multiply this ratio by 100 to get the nominal rate of interest in percentage. The rate of interest series is only estimated for 29 years (1979-80 to 2007-08), as both the variables used to estimate ROI are available only for the said year. Thus the nominal rate of interest is estimated with the formula

$$No\min al\ Rate\ of\ Interest = \frac{\text{Re}nt\ paid}{Outs\tan ding\ Loans} \times 100$$

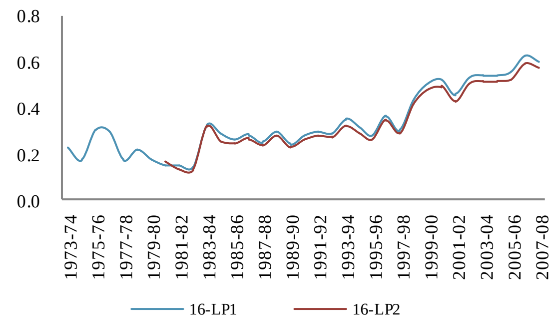
Apart from these basic ratios the study uses several other ratios as needed in the analysis in different chapters, in the respective chapter the details are explained as required.

Figure A3.1: Labour Productivity Ratios in NIC-15



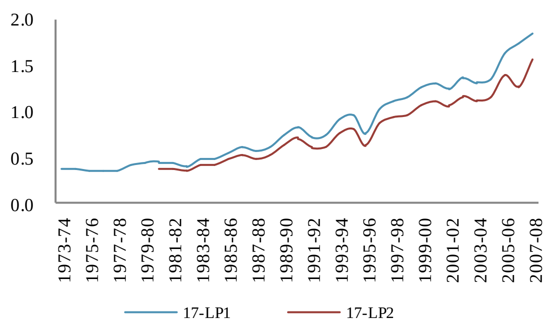
Source: ASI, CSO and EPW Research Foundation

Figure A3.2: Labour Productivity Ratios in NIC-16



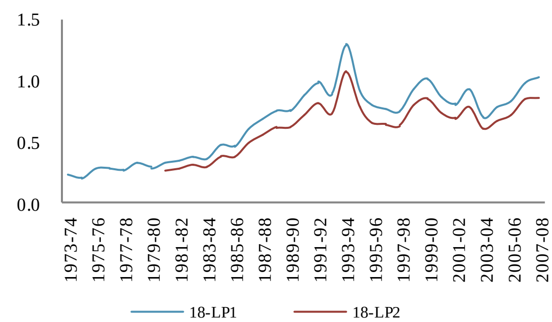
Source: ASI, CSO and EPW Research Foundation

Figure A3.3: Labour Productivity Ratios in NIC-17



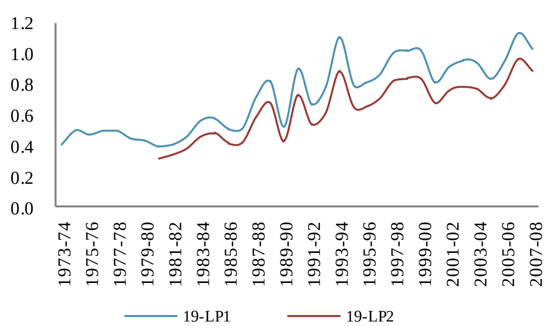
Source: ASI, CSO and EPW Research Foundation

Figure A3.4: Labour Productivity Ratios in NIC-18



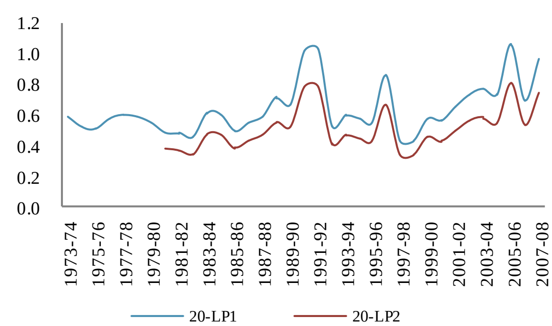
Source: ASI, CSO and EPW Research Foundation

Figure A3.5: Labour Productivity Ratios in NIC-19



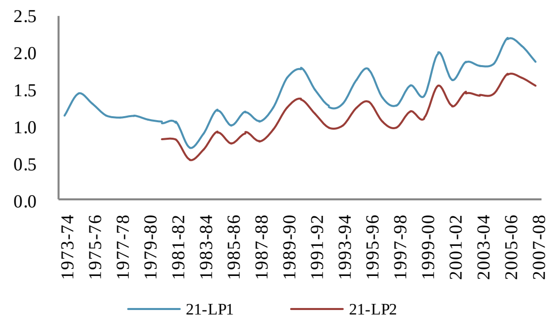
Source: ASI, CSO and EPW Research Foundation

Figure A3.6: Labour Productivity Ratios in NIC-20



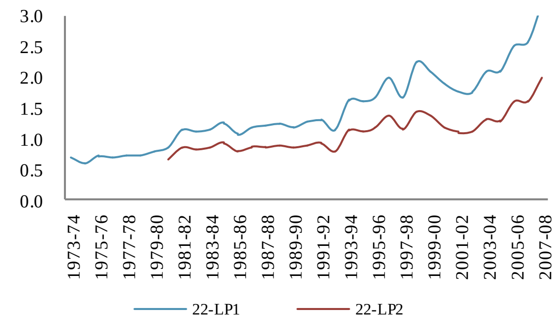
Source: ASI, CSO and EPW Research Foundation

Figure A3.7: Labour Productivity Ratios in NIC-21



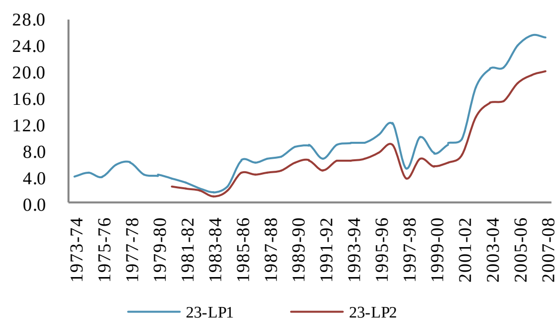
Source: ASI, CSO and EPW Research Foundation

Figure A3.8: Labour Productivity Ratios in NIC-22



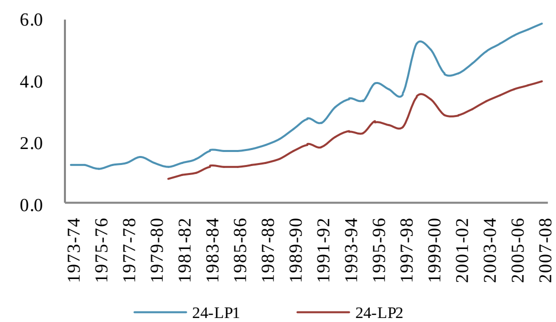
Source: ASI, CSO and EPW Research Foundation

Figure A3.9: Labour Productivity Ratios in NIC-23



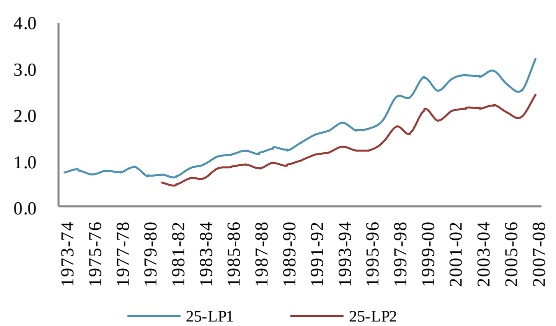
Source: ASI, CSO and EPW Research Foundation

Figure A3.10: Labour Productivity Ratios in NIC-24



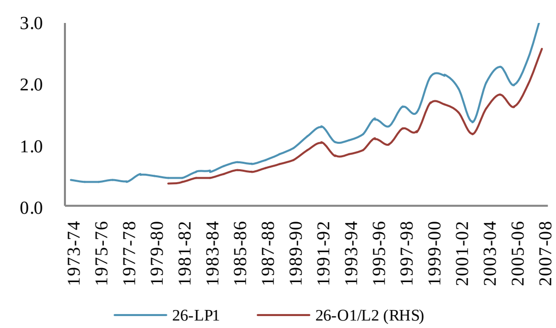
Source: ASI, CSO and EPW Research Foundation

Figure A3.11: Labour Productivity Ratios in NIC-25



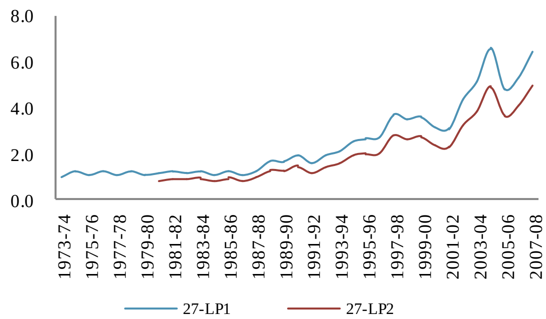
Source: ASI, CSO and EPW Research Foundation

Figure A3.12: Labour Productivity Ratios in NIC-26



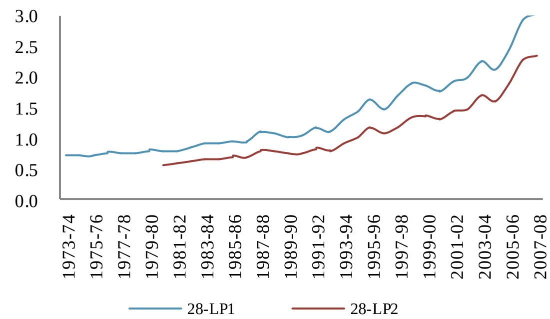
Source: ASI, CSO and EPW Research Foundation

Figure A3.13: Labour Productivity Ratios in NIC-27



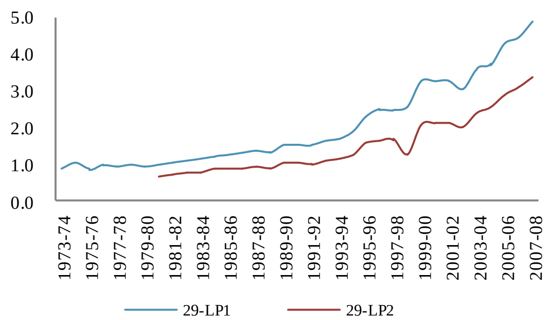
Source: ASI, CSO and EPW Research Foundation

Figure A3.14: Labour Productivity Ratios in NIC-28



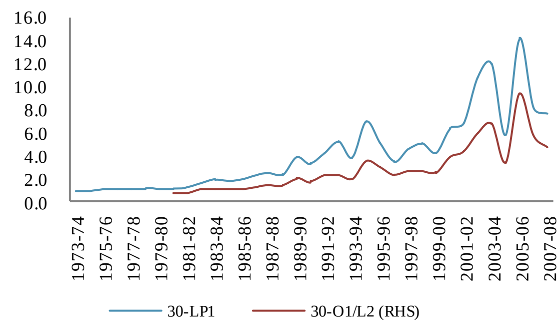
Source: ASI, CSO and EPW Research Foundation

Figure A3.15: Labour Productivity Ratios in NIC-29



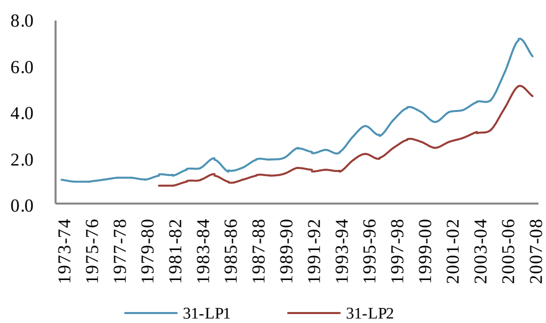
Source: ASI, CSO and EPW Research Foundation

Figure A3.16: Labour Productivity Ratios in NIC-30



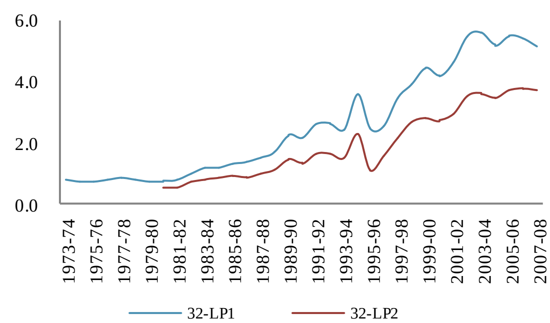
Source: ASI, CSO and EPW Research Foundation

Figure A3.17: Labour Productivity Ratios in NIC-31



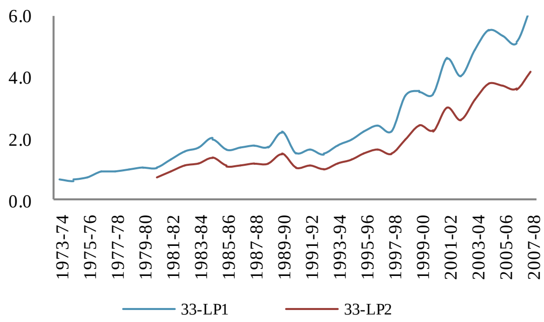
Source: ASI, CSO and EPW Research Foundation

Figure A3.18: Labour Productivity Ratios in NIC-32



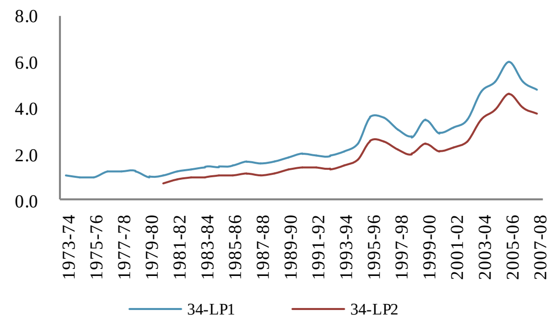
Source: ASI, CSO and EPW Research Foundation

Figure A3.19: Labour Productivity Ratios in NIC-33



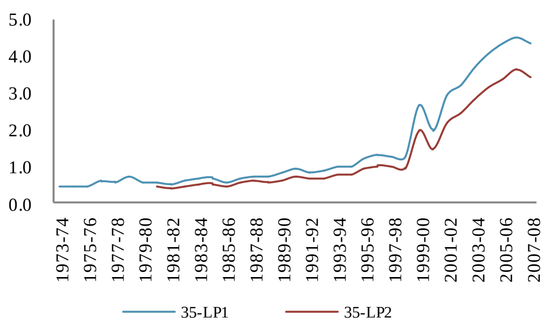
Source: ASI, CSO and EPW Research Foundation

Figure A3.20: Labour Productivity Ratios in NIC-34



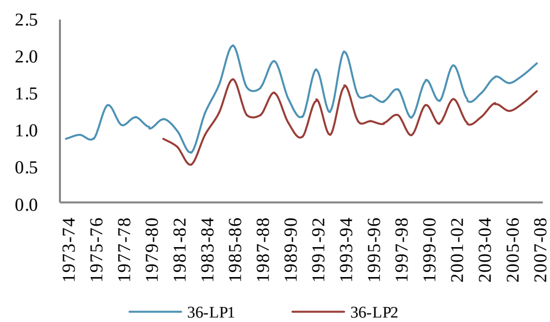
Source: ASI, CSO and EPW Research Foundation

Figure A3.21: Labour Productivity Ratios in NIC-35



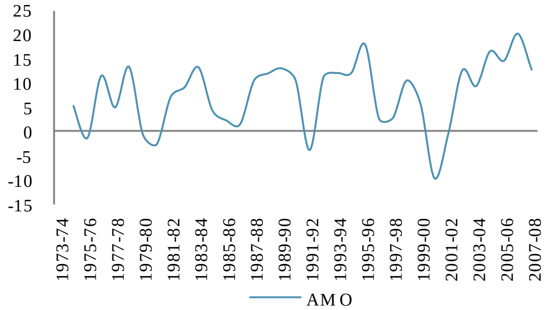
Source: ASI, CSO and EPW Research Foundation

Figure A3.22: Labour Productivity Ratios in NIC-36



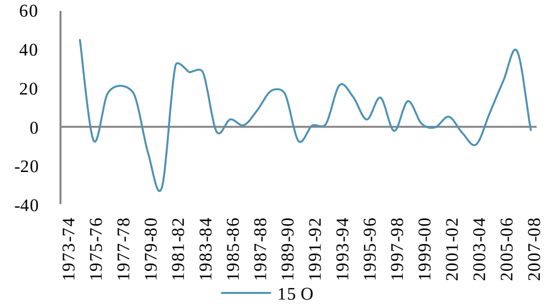
Source: ASI, CSO and EPW Research Foundation

Figure A3.23: Growth of Gross Value Added in Indian Manufacturing



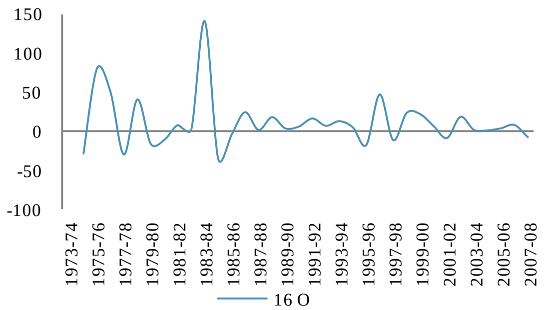
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.24: Growth of Gross Value Added in NIC-15



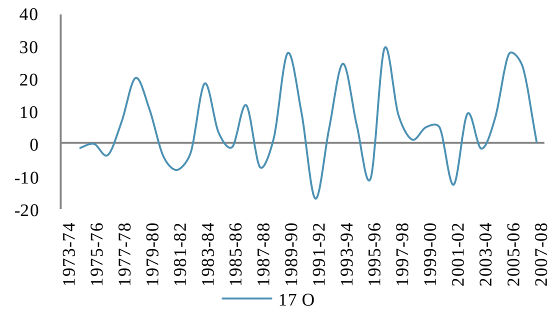
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.25: Growth of Gross Value Added in NIC-16



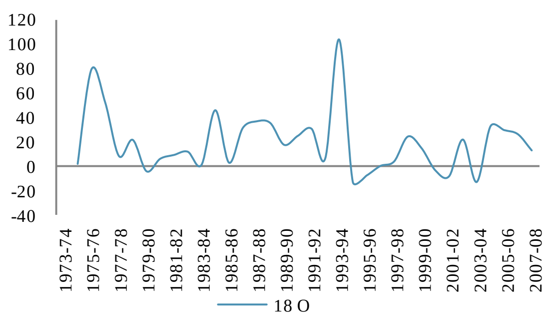
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.26: Growth of Gross Value Added in NIC-17



Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.27: Growth of Gross Value Added in NIC-18



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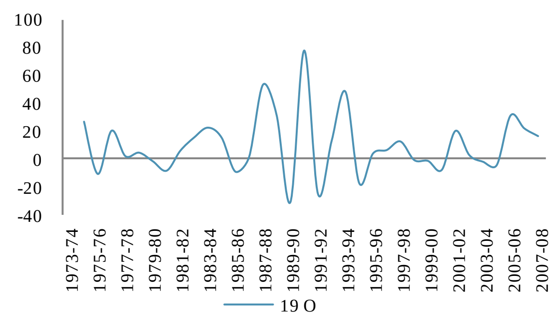
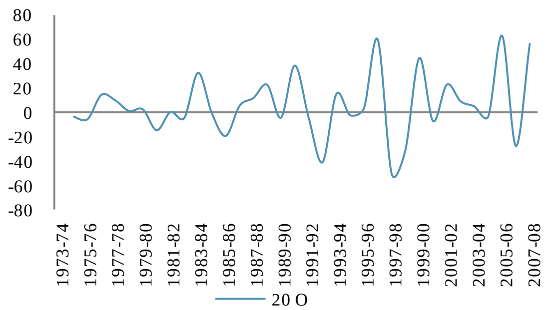
Source: ASI, CSO and EPW Research Foundation.

Figure A3.28: Growth of Gross Value Added in NIC-19



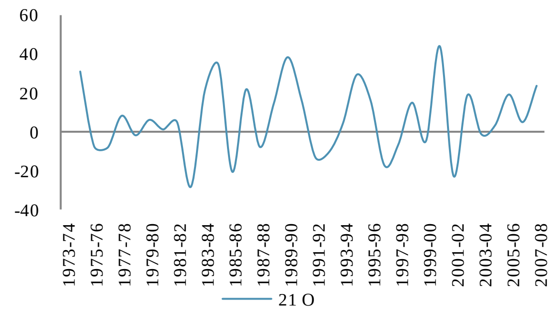
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.29: Growth of Gross Value Added in NIC-20



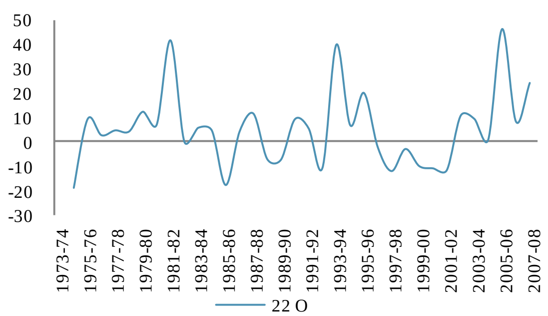
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.30: Growth of Gross Value Added in NIC-21



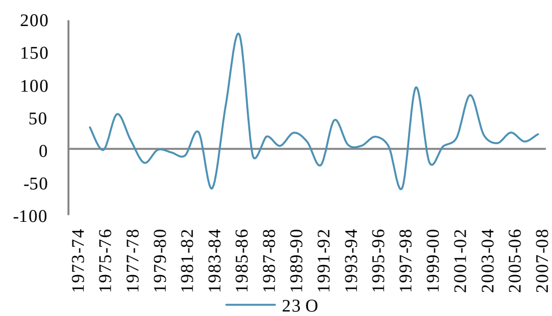
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.31: Growth of Gross Value Added in NIC-22



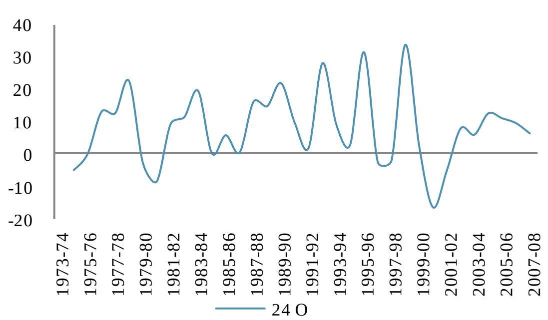
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.32: Growth of Gross Value Added in NIC-23



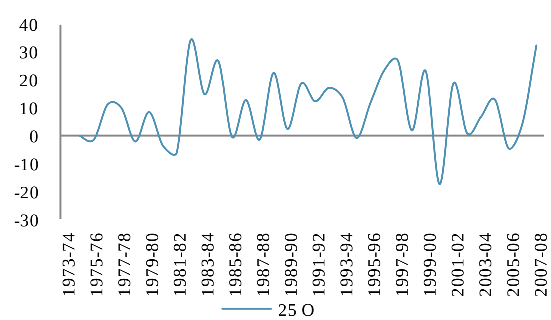
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.33: Growth of Gross Value Added in NIC-24



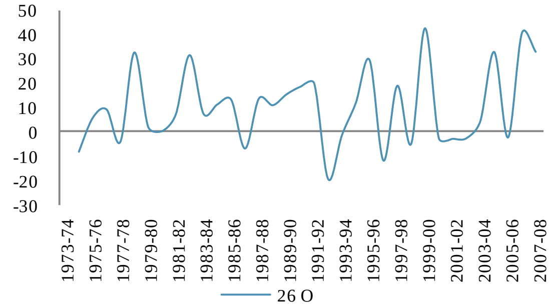
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.34: Growth of Gross Value Added in NIC-25



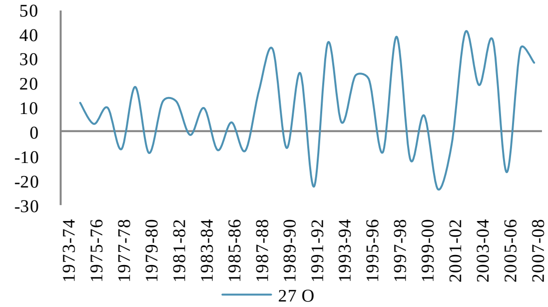
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.35: Growth of Gross Value Added in NIC-26



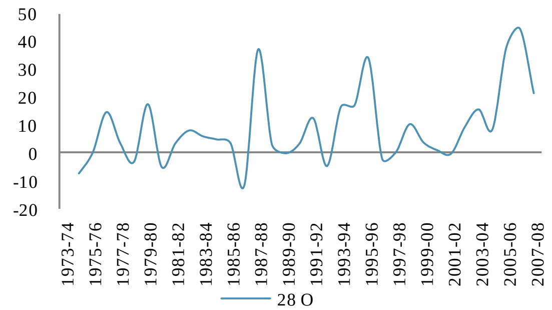
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.36: Growth of Gross Value Added in NIC-27



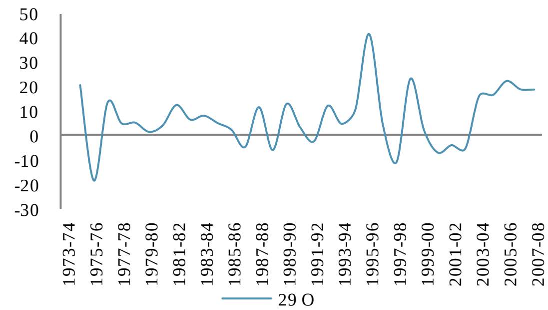
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.37: Growth of Gross Value Added in NIC-28



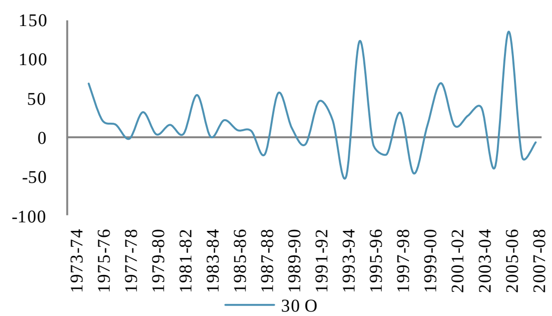
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.38: Growth of Gross Value Added in NIC-29



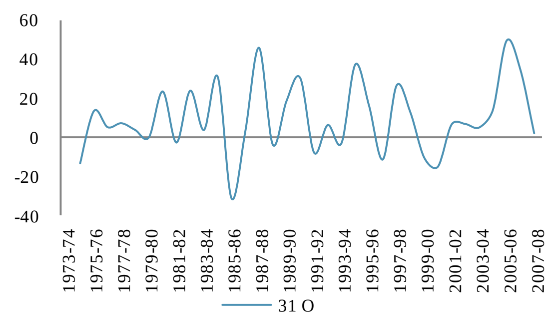
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.39: Growth of Gross Value Added in NIC-30



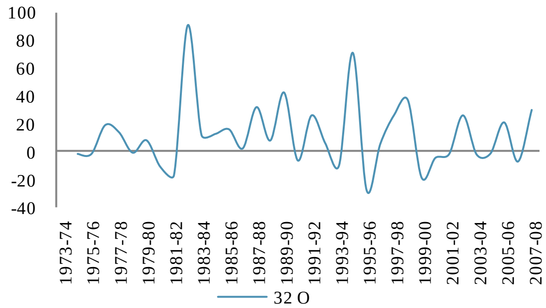
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.40: Growth of Gross Value Added in NIC-31



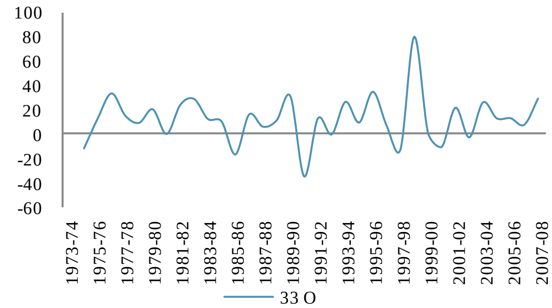
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.41: Growth of Gross Value Added in NIC-32



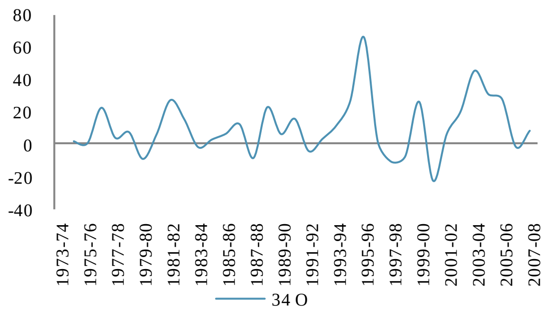
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.42: Growth of Gross Value Added in NIC-33



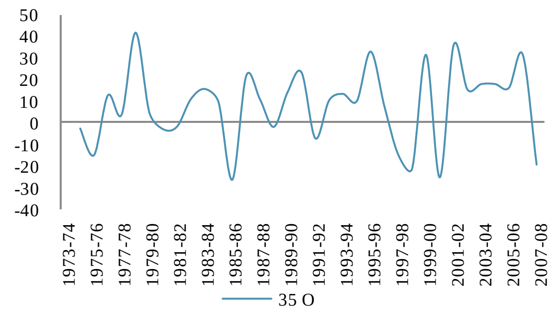
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.43: Growth of Gross Value Added in NIC-34



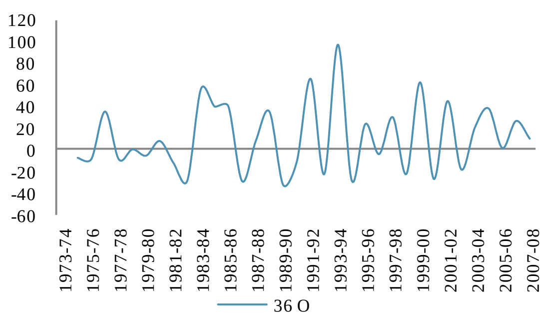
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.44: Growth of Gross Value Added in NIC-35



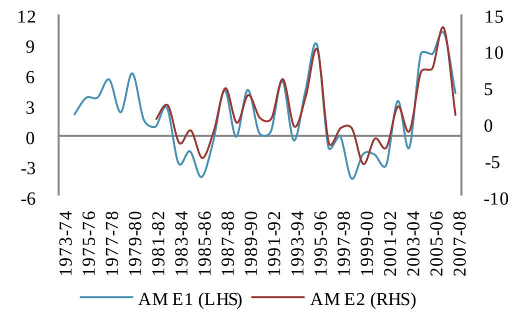
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.45: Growth of Gross Value Added in NIC-36



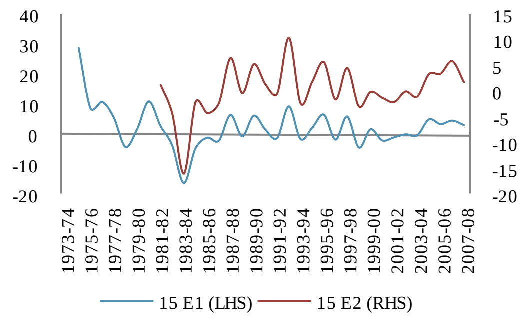
Note: 'O'refer to gross value added at 1993-94 prices.
Source: ASI, CSO and EPW Research Foundation.

Figure A3.46: Employment growth in Indian Manufacturing



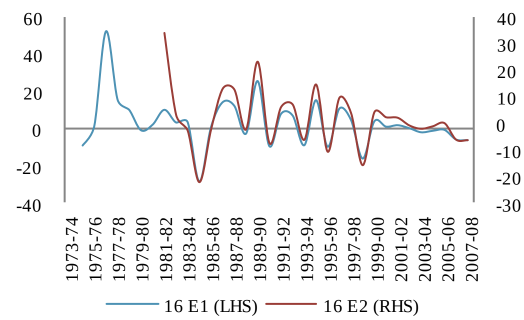
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.47: Employment growth in NIC-15



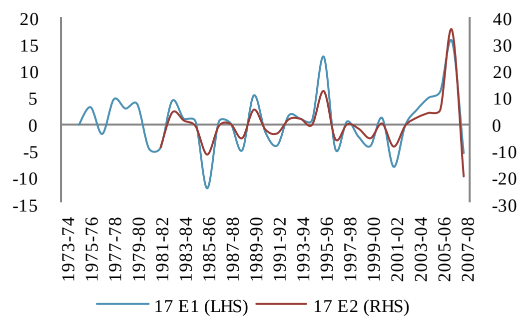
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.48: Employment growth in NIC-16



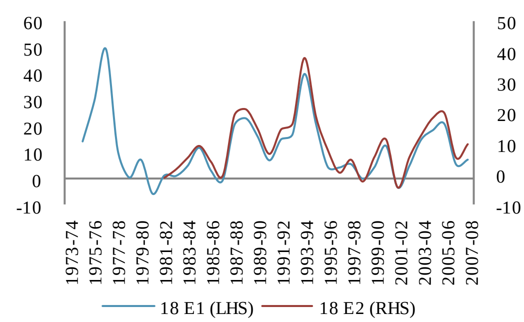
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.49: Employment growth in NIC-17



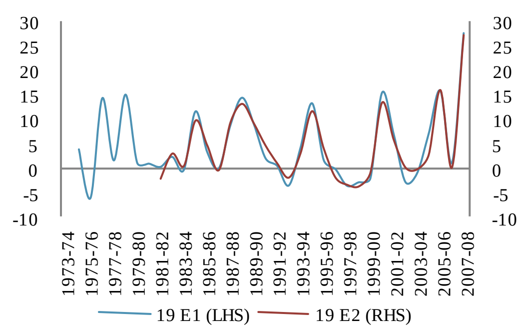
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.50: Employment growth in NIC-18



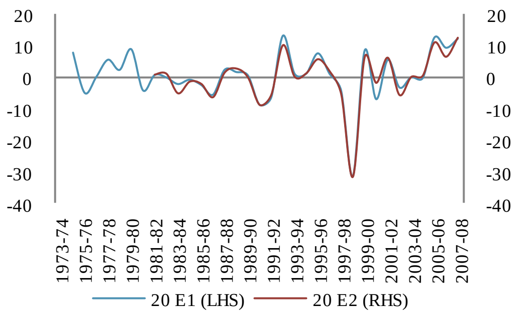
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.51: Employment growth in NIC-19



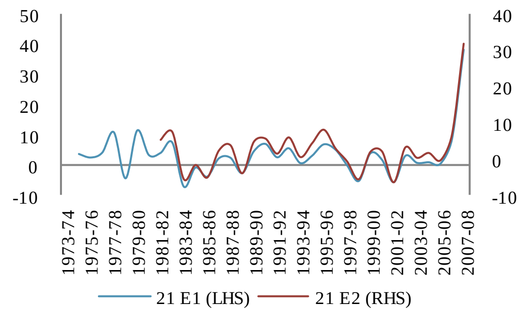
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.52: Employment growth in NIC-20



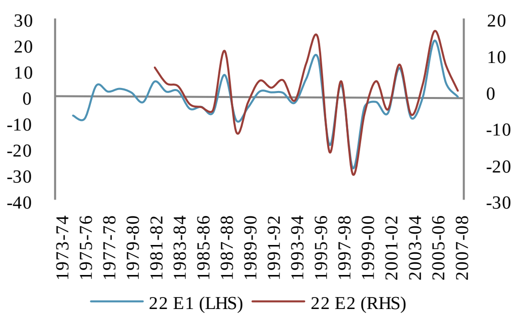
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.53: Employment growth in NIC-21



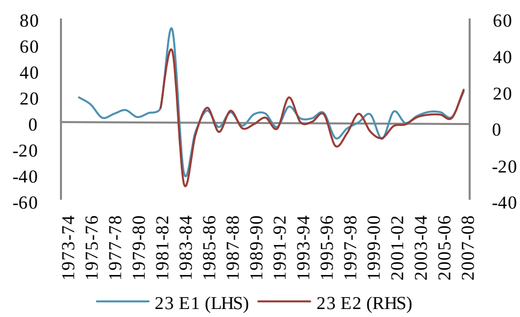
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.54: Employment growth in NIC-22



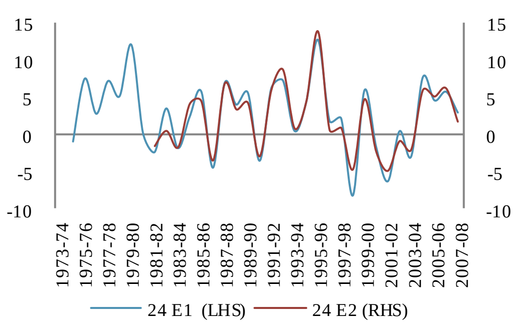
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.55: Employment growth in NIC-23



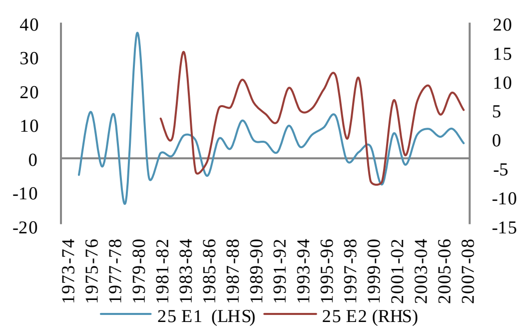
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.56: Employment growth in NIC-24



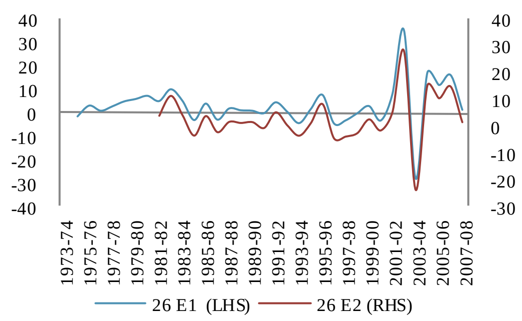
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.57: Employment growth in NIC-25



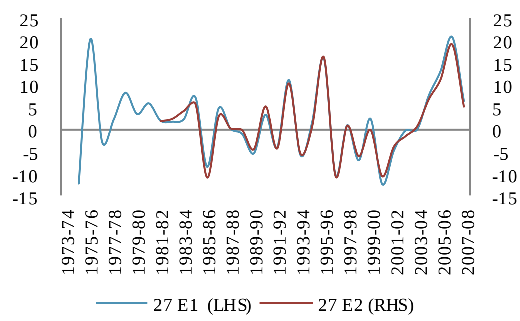
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.58: Employment growth in NIC-26



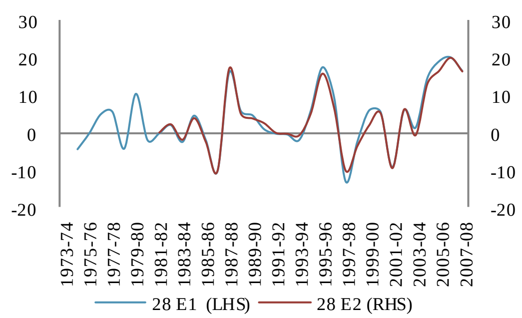
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.59: Employment growth in NIC-27



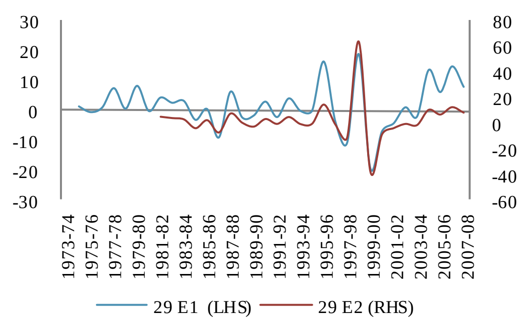
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.60: Employment growth in NIC-28



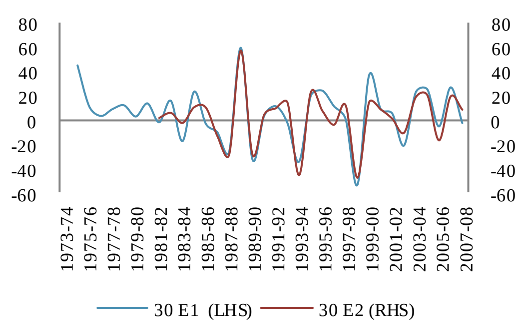
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.61: Employment growth in NIC-29



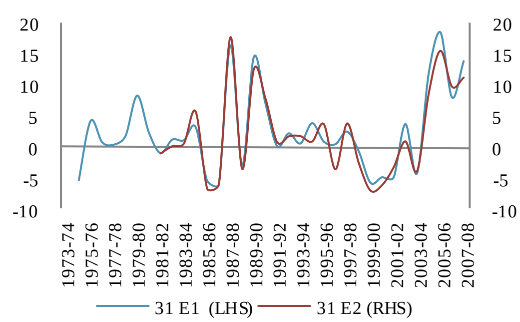
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.62: Employment growth in NIC-30



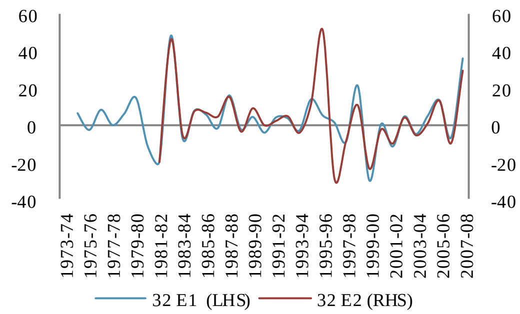
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.63: Employment growth in NIC-31



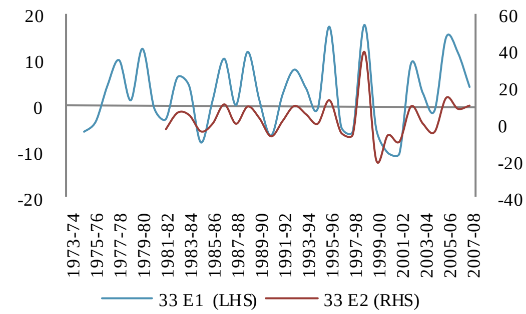
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.64: Employment growth in NIC-32



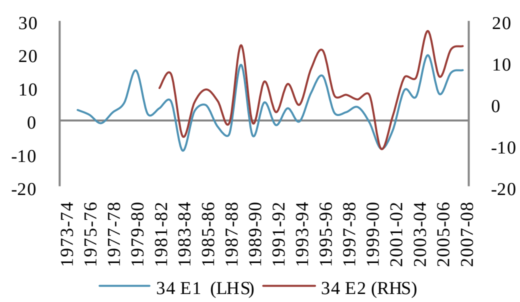
Note: E_1: Number of workers and E_2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.65: Employment growth in NIC-33



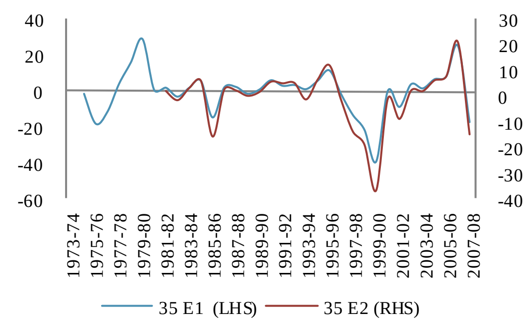
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.66: Employment growth in NIC-34



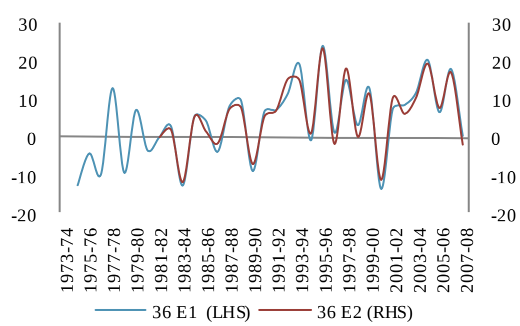
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.67: Employment growth in NIC-35



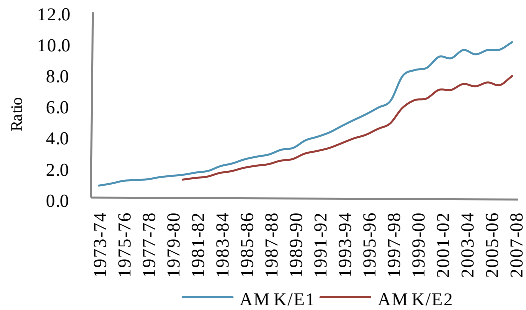
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.68: Employment growth in NIC-36



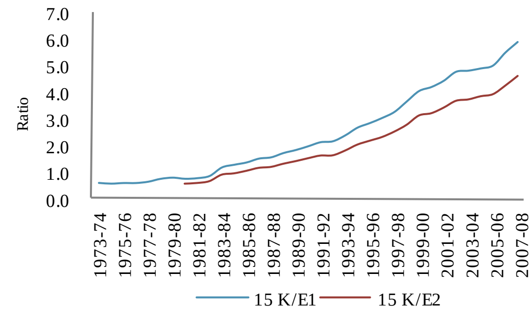
Note: E1: Number of workers and E2: Person engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.69: Capital Intensity in Indian Manufacturing



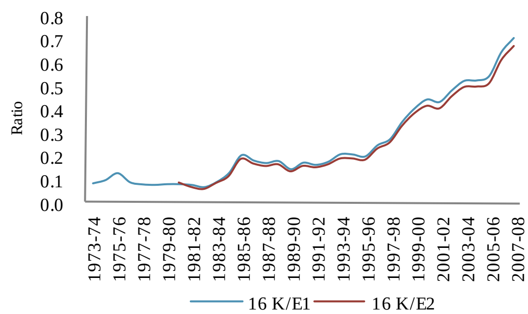
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.70: Capital Intensity in NIC-15



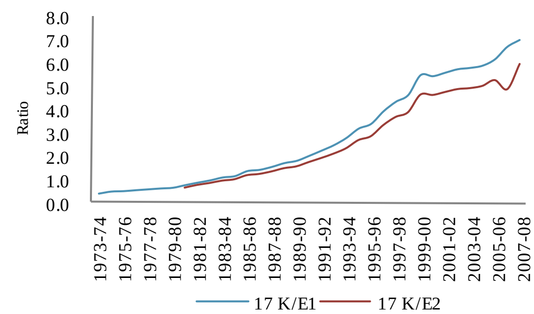
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.71: Capital Intensity in NIC-16



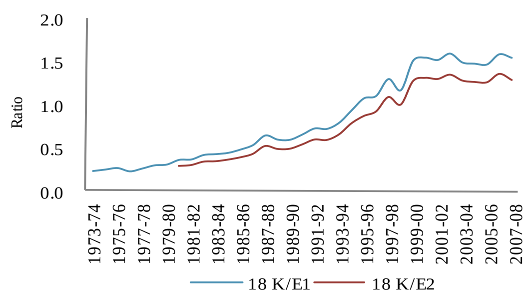
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.72: Capital Intensity in NIC-17



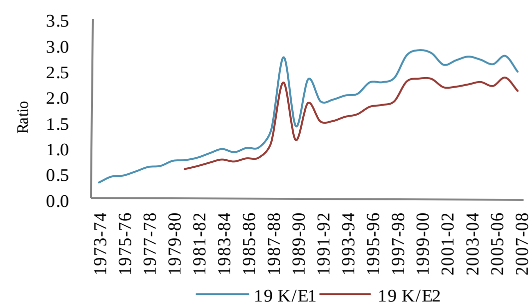
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.73: Capital Intensity in NIC-18



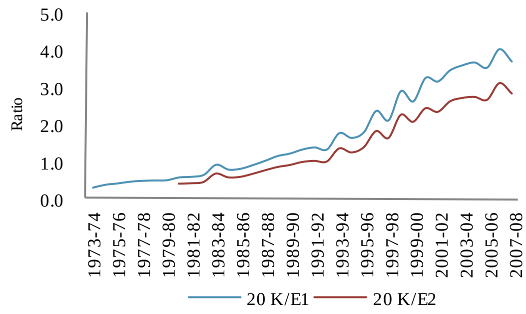
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.74: Capital Intensity in NIC-19



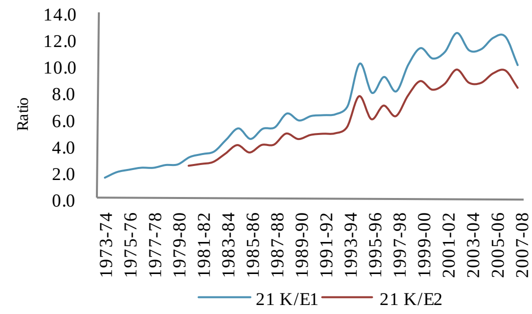
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.75: Capital Intensity in NIC-20



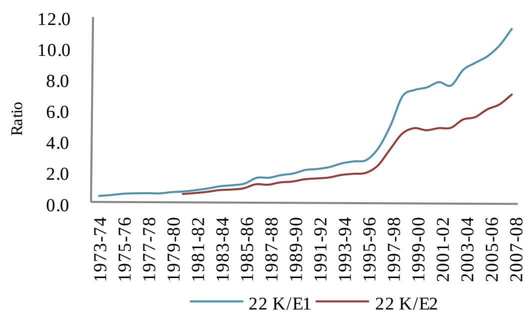
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author’s own calculation, ASI &EPWRF

Figure A3.76: Capital Intensity in NIC-21



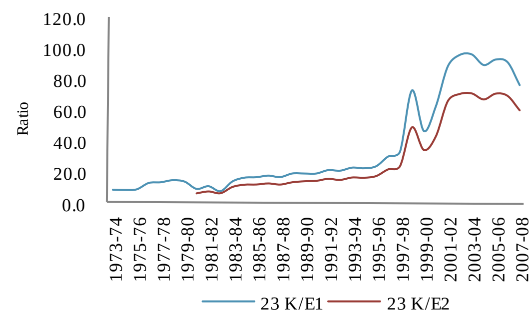
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author’s own calculation, ASI &EPWRF

Figure A3.77: Capital Intensity in NIC-22



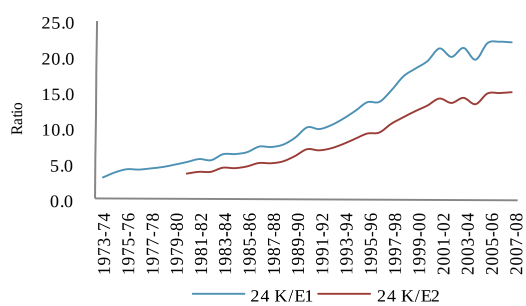
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author’s own calculation, ASI &EPWRF

Figure A3.78: Capital Intensity in NIC-23



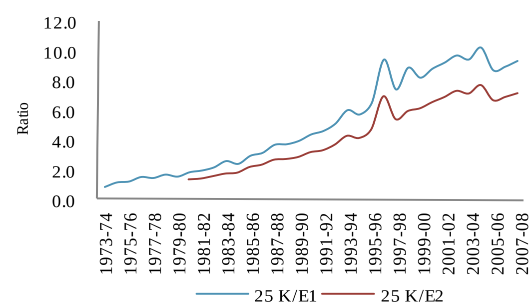
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author’s own calculation, ASI &EPWRF

Figure A3.79: Capital Intensity in NIC-24



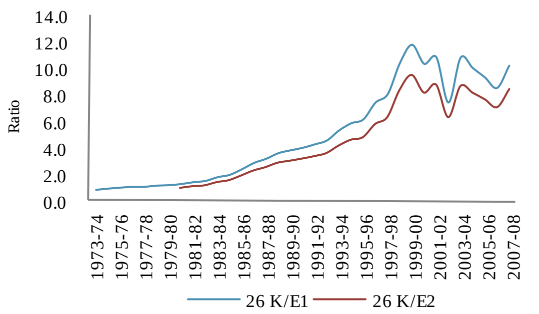
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author’s own calculation, ASI &EPWRF

Figure A3.80: Capital Intensity in NIC-25



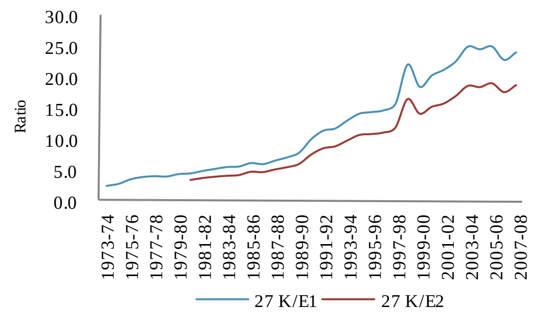
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author’s own calculation, ASI &EPWRF

Figure A3.81: Capital Intensity in NIC-26



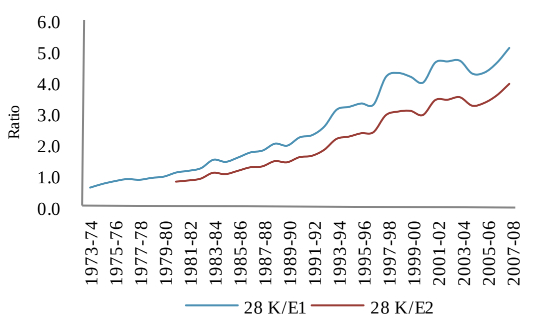
Note: K is Real Capital Stock, L1 and L2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.82: Capital Intensity in NIC-27



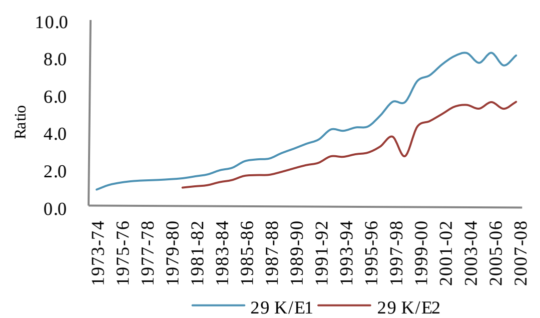
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.83: Capital Intensity in NIC-28



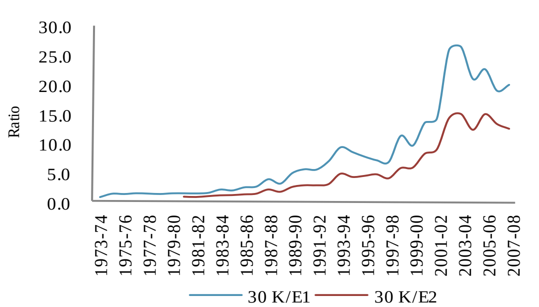
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.84: Capital Intensity in NIC-29



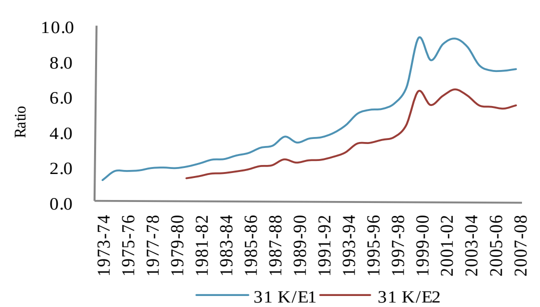
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.85: Capital Intensity in NIC-30



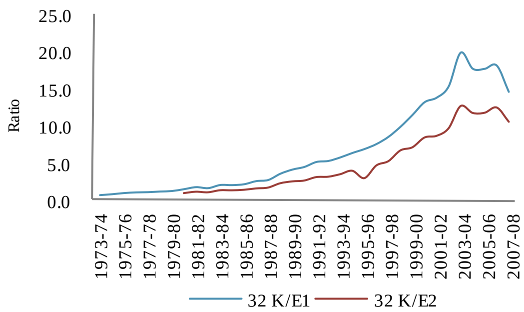
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.86: Capital Intensity in NIC-31



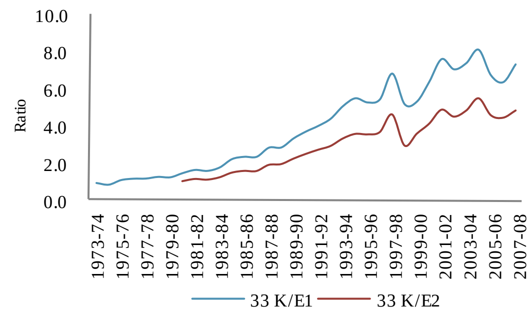
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.87: Capital Intensity in NIC-32



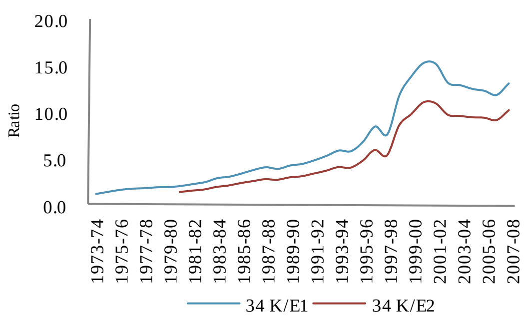
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.88: Capital Intensity in NIC-33



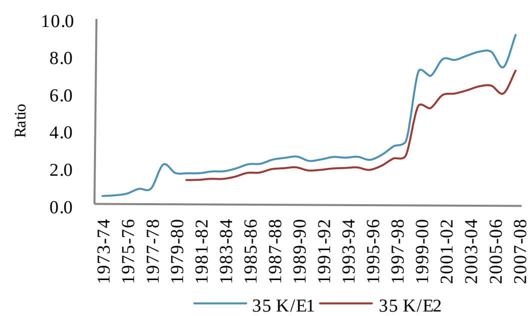
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.89: Capital Intensity in NIC-34



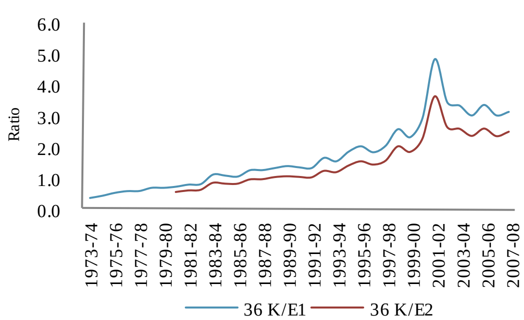
Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.90: Capital Intensity in NIC-35



Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Figure A3.91: Capital Intensity in NIC-36



Note: K is Real Capital Stock, E1 and E2 refers to Number of Workers and Total Person Engaged
Source: Author's own calculation, ASI &EPWRF

Table A3.4a: Labour Productivity (LP_1): O/E_1 - Real gross value added per workers

(Rs. Lakh)

Year	AM	15	16	17	18	19	20	21	22	23	24	25
1973-74	0.60	0.31	0.22	0.36	0.22	0.41	0.58	1.15	0.68	3.96	1.26	0.75
1974-75	0.61	0.34	0.17	0.36	0.20	0.49	0.52	1.44	0.59	4.42	1.20	0.79
1975-76	0.58	0.29	0.30	0.35	0.27	0.47	0.51	1.30	0.71	3.83	1.12	0.68
1976-77	0.62	0.31	0.29	0.34	0.28	0.49	0.58	1.14	0.69	5.66	1.23	0.78
1977-78	0.62	0.35	0.17	0.35	0.27	0.49	0.60	1.11	0.71	6.04	1.29	0.75
1978-79	0.69	0.43	0.22	0.41	0.32	0.44	0.58	1.13	0.71	4.37	1.50	0.85
1979-80	0.64	0.36	0.18	0.44	0.28	0.43	0.55	1.07	0.78	4.15	1.30	0.67
1980-81	0.61	0.22	0.15	0.44	0.32	0.39	0.48	1.04	0.85	3.67	1.18	0.68
1981-82	0.65	0.28	0.14	0.43	0.34	0.41	0.47	1.05	1.13	2.97	1.31	0.63
1982-83	0.69	0.38	0.14	0.40	0.37	0.46	0.45	0.69	1.11	2.18	1.41	0.84
1983-84	0.80	0.58	0.32	0.47	0.36	0.56	0.61	0.90	1.14	1.43	1.72	0.90
1984-85	0.85	0.59	0.28	0.48	0.46	0.58	0.60	1.21	1.24	2.57	1.67	1.08
1985-86	0.90	0.62	0.26	0.54	0.46	0.50	0.49	1.00	1.06	6.44	1.67	1.13
1986-87	0.92	0.63	0.28	0.61	0.60	0.51	0.54	1.18	1.17	5.99	1.75	1.21
1987-88	0.97	0.65	0.25	0.56	0.68	0.71	0.59	1.06	1.20	6.60	1.90	1.15
1988-89	1.09	0.77	0.30	0.60	0.75	0.82	0.71	1.24	1.22	7.10	2.09	1.27
1989-90	1.18	0.85	0.24	0.73	0.75	0.51	0.67	1.64	1.18	8.34	2.42	1.23
1990-91	1.29	0.77	0.28	0.81	0.87	0.89	1.01	1.77	1.25	8.67	2.74	1.39
1991-92	1.24	0.78	0.29	0.71	0.98	0.66	1.02	1.49	1.29	6.80	2.62	1.54
1992-93	1.30	0.73	0.29	0.73	0.89	0.77	0.52	1.26	1.13	8.72	3.13	1.64
1993-94	1.46	0.89	0.35	0.90	1.29	1.10	0.59	1.30	1.62	9.02	3.39	1.80
1994-95	1.57	1.01	0.31	0.94	0.92	0.80	0.57	1.63	1.61	9.17	3.33	1.66
1995-96	1.69	0.98	0.28	0.75	0.80	0.81	0.54	1.76	1.67	10.15	3.88	1.70
1996-97	1.76	1.14	0.36	1.02	0.76	0.86	0.85	1.37	1.99	11.97	3.71	1.85
1997-98	1.80	1.05	0.30	1.10	0.74	1.00	0.43	1.28	1.67	5.19	3.55	2.37
1998-99	2.08	1.25	0.43	1.15	0.92	1.02	0.43	1.54	2.23	10.02	5.17	2.36
1999-00	2.24	1.24	0.50	1.26	1.00	1.02	0.57	1.41	2.08	7.52	4.98	2.81
2000-01	2.05	1.26	0.52	1.30	0.85	0.81	0.56	1.99	1.88	8.93	4.20	2.51
2001-02	2.10	1.34	0.46	1.24	0.80	0.91	0.65	1.62	1.77	9.65	4.24	2.77
2002-03	2.29	1.29	0.53	1.36	0.92	0.95	0.73	1.85	1.75	17.60	4.54	2.84
2003-04	2.53	1.18	0.54	1.30	0.69	0.94	0.76	1.81	2.08	20.38	4.95	2.83
2004-05	2.72	1.20	0.54	1.34	0.77	0.84	0.73	1.84	2.09	20.55	5.16	2.94
2005-06	2.88	1.43	0.55	1.61	0.82	0.94	1.06	2.18	2.50	23.81	5.47	2.63
2006-07	3.14	1.90	0.62	1.73	0.98	1.13	0.69	2.10	2.56	25.46	5.66	2.52
2007-08	3.39	1.81	0.60	1.84	1.02	1.03	0.96	1.86	3.17	25.22	5.83	3.19

Note: O and E_1 stands for real gross value added (1993-94=100) and number of workers.
Source: Author's own calculation, Annual Survey of Industries, CSO, EPW Research Foundation.

Table A3.4b: Labour Productivity (LP_1): O/E_1- Real gross value added per workers

(Rs. Lakh)

Year	AM	26	27	28	29	30	31	32	33	34	35	36
1973-74	0.60	0.42	0.97	0.73	0.87	0.80	1.00	0.77	0.67	1.01	0.45	0.88
1974-75	0.61	0.39	1.24	0.70	1.04	0.92	0.91	0.70	0.62	0.99	0.44	0.93
1975-76	0.58	0.40	1.06	0.70	0.85	0.99	0.99	0.70	0.71	0.97	0.45	0.88
1976-77	0.62	0.43	1.19	0.76	0.95	1.09	1.03	0.76	0.90	1.20	0.57	1.31
1977-78	0.62	0.40	1.07	0.74	0.93	0.97	1.10	0.86	0.93	1.21	0.57	1.05
1978-79	0.69	0.51	1.17	0.75	0.97	1.12	1.12	0.80	0.99	1.23	0.69	1.16
1979-80	0.64	0.49	1.03	0.79	0.91	1.11	1.03	0.74	1.05	0.96	0.55	1.02
1980-81	0.61	0.46	1.09	0.77	0.95	1.11	1.25	0.74	1.04	1.00	0.53	1.13
1981-82	0.65	0.47	1.19	0.79	1.03	1.16	1.22	0.76	1.31	1.22	0.51	0.99
1982-83	0.69	0.56	1.15	0.83	1.07	1.52	1.50	0.97	1.57	1.33	0.57	0.68
1983-84	0.80	0.57	1.23	0.90	1.12	1.82	1.54	1.16	1.67	1.43	0.65	1.21
1984-85	0.85	0.65	1.06	0.90	1.21	1.77	1.95	1.20	1.98	1.42	0.66	1.60
1985-86	0.90	0.71	1.19	0.95	1.23	1.95	1.41	1.30	1.60	1.44	0.57	2.14
1986-87	0.92	0.68	1.04	0.93	1.29	2.31	1.54	1.34	1.66	1.64	0.67	1.57
1987-88	0.97	0.76	1.21	1.09	1.36	2.39	1.93	1.51	1.74	1.55	0.72	1.56
1988-89	1.09	0.83	1.64	1.06	1.30	2.32	1.92	1.66	1.71	1.63	0.71	1.91
1989-90	1.18	0.95	1.61	1.01	1.50	3.78	1.98	2.24	2.18	1.80	0.80	1.41
1990-91	1.29	1.13	1.93	1.03	1.50	3.26	2.41	2.16	1.49	1.97	0.92	1.17
1991-92	1.24	1.30	1.54	1.16	1.50	4.21	2.22	2.59	1.62	1.90	0.82	1.80
1992-93	1.30	1.04	1.89	1.10	1.62	5.19	2.31	2.62	1.48	1.89	0.87	1.24
1993-94	1.46	1.07	2.08	1.30	1.69	3.78	2.22	2.41	1.78	2.10	0.97	2.05
1994-95	1.57	1.18	2.51	1.44	1.87	6.96	2.94	3.58	1.93	2.45	1.00	1.47
1995-96	1.69	1.42	2.61	1.64	2.29	5.01	3.38	2.44	2.20	3.58	1.18	1.46
1996-97	1.76	1.31	2.65	1.46	2.48	3.44	2.98	2.51	2.42	3.54	1.28	1.37
1997-98	1.80	1.61	3.65	1.67	2.47	4.43	3.67	3.45	2.20	3.05	1.24	1.54
1998-99	2.08	1.53	3.45	1.88	2.57	4.99	4.17	3.87	3.35	2.70	1.24	1.15
1999-00	2.24	2.12	3.58	1.84	3.24	4.12	3.96	4.44	3.50	3.42	2.66	1.65
2000-01	2.05	2.13	3.09	1.75	3.23	6.30	3.53	4.17	3.43	2.87	1.97	1.39
2001-02	2.10	1.91	3.06	1.92	3.24	6.77	3.95	4.59	4.60	3.13	2.91	1.86
2002-03	2.29	1.38	4.32	1.97	3.03	10.79	4.06	5.47	4.03	3.44	3.21	1.40
2003-04	2.53	2.00	5.13	2.24	3.60	11.92	4.45	5.57	4.89	4.66	3.69	1.50
2004-05	2.72	2.27	6.54	2.11	3.70	5.74	4.53	5.18	5.51	5.09	4.05	1.71
2005-06	2.88	1.98	4.79	2.43	4.26	14.09	5.72	5.47	5.35	6.00	4.32	1.62
2006-07	3.14	2.40	5.30	2.91	4.43	8.08	7.12	5.39	5.10	5.13	4.49	1.74
2007-08	3.39	3.15	6.38	3.02	4.88	7.60	6.38	5.10	6.25	4.80	4.34	1.90

Note: O and E_1 stands for real gross value added (1993-94=100) and number of workers.
Source: Author's own calculation from Annual Survey of Industries, CSO, EPW Research Foundation.

Table A3.5a: Labour Productivity (LP_2): O/E_2 -Real gross value added per person engaged

(Rs. Lakh)

Year	AM	15	16	17	18	19	20	21	22	23	24	25
1973-74	-	-	-	-	-	-	-	-	-	-	-	-
1974-75	-	-	-	-	-	-	-	-	-	-	-	-
1975-76	-	-	-	-	-	-	-	-	-	-	-	-
1976-77	-	-	-	-	-	-	-	-	-	-	-	-
1977-78	-	-	-	-	-	-	-	-	-	-	-	-
1978-79	-	-	-	-	-	-	-	-	-	-	-	-
1979-80	-	-	-	-	-	-	-	-	-	-	-	-
1980-81	0.48	0.17	0.17	0.37	0.26	0.31	0.37	0.81	0.64	2.45	0.81	0.51
1981-82	0.51	0.22	0.13	0.37	0.28	0.33	0.37	0.80	0.84	2.01	0.89	0.46
1982-83	0.54	0.29	0.13	0.34	0.30	0.37	0.34	0.53	0.82	1.79	0.99	0.61
1983-84	0.62	0.44	0.32	0.40	0.29	0.45	0.47	0.68	0.85	1.06	1.20	0.61
1984-85	0.66	0.44	0.25	0.42	0.38	0.48	0.47	0.92	0.91	1.84	1.15	0.82
1985-86	0.70	0.48	0.24	0.47	0.37	0.41	0.38	0.76	0.78	4.59	1.16	0.85
1986-87	0.72	0.49	0.26	0.52	0.49	0.42	0.42	0.90	0.85	4.26	1.20	0.90
1987-88	0.75	0.50	0.23	0.48	0.55	0.58	0.46	0.80	0.85	4.68	1.31	0.84
1988-89	0.84	0.59	0.28	0.52	0.61	0.68	0.55	0.94	0.89	4.96	1.45	0.93
1989-90	0.91	0.65	0.23	0.63	0.62	0.43	0.52	1.24	0.84	6.13	1.69	0.90
1990-91	1.00	0.60	0.26	0.70	0.72	0.72	0.78	1.36	0.89	6.51	1.90	1.02
1991-92	0.95	0.60	0.28	0.60	0.81	0.53	0.78	1.16	0.92	4.99	1.83	1.11
1992-93	0.99	0.55	0.27	0.62	0.73	0.61	0.41	0.97	0.79	6.22	2.15	1.19
1993-94	1.11	0.68	0.32	0.75	1.07	0.88	0.46	1.00	1.13	6.49	2.32	1.28
1994-95	1.20	0.77	0.29	0.79	0.77	0.65	0.44	1.23	1.11	6.66	2.28	1.20
1995-96	1.28	0.75	0.26	0.63	0.65	0.65	0.43	1.32	1.16	7.44	2.63	1.23
1996-97	1.35	0.87	0.34	0.86	0.64	0.70	0.66	1.05	1.35	8.67	2.54	1.37
1997-98	1.39	0.82	0.29	0.93	0.63	0.81	0.34	0.98	1.15	3.73	2.46	1.73
1998-99	1.54	0.95	0.41	0.96	0.79	0.83	0.34	1.19	1.44	6.77	3.45	1.59
1999-00	1.72	0.96	0.48	1.06	0.85	0.83	0.46	1.10	1.37	5.57	3.37	2.10
2000-01	1.58	0.97	0.49	1.11	0.73	0.67	0.42	1.54	1.18	6.19	2.86	1.87
2001-02	1.62	1.04	0.43	1.05	0.69	0.76	0.49	1.26	1.09	7.24	2.84	2.07
2002-03	1.78	1.00	0.50	1.15	0.79	0.78	0.56	1.45	1.12	13.05	3.08	2.14
2003-04	1.96	0.91	0.51	1.11	0.60	0.76	0.58	1.42	1.30	15.13	3.32	2.14
2004-05	2.13	0.94	0.51	1.14	0.66	0.71	0.55	1.43	1.28	15.53	3.53	2.21
2005-06	2.26	1.13	0.52	1.38	0.71	0.80	0.80	1.70	1.59	18.28	3.72	2.01
2006-07	2.40	1.47	0.59	1.25	0.84	0.97	0.53	1.66	1.60	19.51	3.83	1.94
2007-08	2.67	1.42	0.57	1.56	0.86	0.88	0.74	1.55	1.97	19.96	3.99	2.44

Note:- refers to non-availability of data. O and E_2 stand for real gross value added (1993-94=100) and total person engaged.
Source: Author's own calculation from Annual Survey of Industries, CSO, EPW Research Foundation.

Table A3.5b: Labour Productivity (LP_2): O/E_2: Real gross value added per person engaged *(Rs. Lakh)*

Year	AM	26	27	28	29	30	31	32	33	34	35	36
1973-74	-	-	-	-	-	-	-	-	-	-	-	-
1974-75	-	-	-	-	-	-	-	-	-	-	-	-
1975-76	-	-	-	-	-	-	-	-	-	-	-	-
1976-77	-	-	-	-	-	-	-	-	-	-	-	-
1977-78	-	-	-	-	-	-	-	-	-	-	-	-
1978-79	-	-	-	-	-	-	-	-	-	-	-	-
1979-80	-	-	-	-	-	-	-	-	-	-	-	-
1980-81	0.48	0.37	0.81	0.57	0.67	0.69	0.81	0.52	0.74	0.71	0.42	0.87
1981-82	0.51	0.38	0.89	0.58	0.72	0.69	0.80	0.53	0.93	0.87	0.40	0.75
1982-83	0.54	0.45	0.86	0.61	0.74	0.99	0.98	0.69	1.11	0.93	0.45	0.52
1983-84	0.62	0.46	0.90	0.66	0.78	0.99	1.01	0.81	1.18	0.98	0.50	0.92
1984-85	0.66	0.53	0.78	0.66	0.86	1.07	1.25	0.84	1.34	1.00	0.51	1.22
1985-86	0.70	0.58	0.90	0.70	0.86	1.03	0.92	0.90	1.09	1.03	0.45	1.67
1986-87	0.72	0.55	0.80	0.68	0.89	1.26	1.01	0.88	1.13	1.14	0.53	1.20
1987-88	0.75	0.61	0.93	0.79	0.92	1.32	1.24	0.99	1.18	1.08	0.57	1.20
1988-89	0.84	0.67	1.25	0.77	0.86	1.30	1.24	1.10	1.18	1.16	0.55	1.49
1989-90	0.91	0.76	1.21	0.74	1.01	1.97	1.30	1.43	1.48	1.28	0.62	1.07
1990-91	1.00	0.90	1.43	0.74	1.01	1.67	1.57	1.32	1.01	1.40	0.72	0.90
1991-92	0.95	1.03	1.15	0.83	0.99	2.18	1.44	1.61	1.11	1.36	0.63	1.39
1992-93	0.99	0.82	1.41	0.79	1.06	2.28	1.50	1.62	0.99	1.33	0.66	0.93
1993-94	1.11	0.84	1.55	0.92	1.13	1.96	1.43	1.50	1.18	1.48	0.76	1.58
1994-95	1.20	0.92	1.88	1.01	1.25	3.50	1.94	2.29	1.27	1.72	0.78	1.11
1995-96	1.28	1.10	1.95	1.17	1.55	2.90	2.17	1.08	1.49	2.52	0.92	1.11
1996-97	1.35	1.01	1.99	1.07	1.65	2.28	1.99	1.59	1.65	2.50	1.00	1.08
1997-98	1.39	1.25	2.74	1.18	1.66	2.63	2.42	2.17	1.51	2.16	0.98	1.18
1998-99	1.54	1.22	2.56	1.35	1.25	2.55	2.79	2.66	1.92	1.96	0.95	0.91
1999-00	1.72	1.69	2.72	1.36	2.06	2.51	2.69	2.79	2.39	2.42	1.96	1.32
2000-01	1.58	1.67	2.31	1.30	2.11	3.83	2.43	2.70	2.24	2.08	1.47	1.07
2001-02	1.62	1.53	2.26	1.42	2.11	4.26	2.67	2.92	2.97	2.27	2.18	1.40
2002-03	1.78	1.16	3.23	1.46	2.01	5.93	2.82	3.50	2.60	2.55	2.45	1.07
2003-04	1.96	1.59	3.81	1.68	2.38	6.74	3.08	3.59	3.23	3.47	2.82	1.17
2004-05	2.13	1.83	4.89	1.61	2.52	3.36	3.22	3.47	3.76	3.85	3.12	1.34
2005-06	2.26	1.61	3.63	1.89	2.89	9.30	4.16	3.68	3.67	4.60	3.35	1.26
2006-07	2.40	1.97	4.07	2.26	3.07	5.64	5.09	3.75	3.60	3.97	3.62	1.35
2007-08	2.67	2.58	4.95	2.35	3.38	4.74	4.66	3.73	4.17	3.75	3.41	1.51

Note:- refers to non-availability of data. O and E_2 stands for real gross value added and total person engaged.
Source: Author's own calculation from Annual Survey of Industries, CSO, EPW Research Foundation.

Table A3.6 Labour Productivity Growth (CAGR)

NIC 2-digit	1973-74 to 2007-08		1973-74 to 1979-80		1973-74 to 1979-80		1990-91 to 1999-00		2000-01 to 2007-08	
	O/E_1	O/E_2	O/E_1	O/E_2	O/E_1	O/E_2	O/E_1	O/E_2	O/E_1	O/E_2
15	5.74	5.45	4.38		12.05	12.10	6.76	6.94	6.90	7.13
16	3.78	4.70	-3.54		6.48	6.74	5.59	5.81	4.24	4.35
17	5.33	5.49	4.34		6.87	6.76	7.18	7.12	6.92	5.77
18	4.50	3.31	6.76		11.97	12.06	-1.78	-1.34	3.67	3.47
19	3.04	3.19	-2.44		5.20	5.31	4.12	4.43	2.63	3.34
20	1.14	1.29	2.17		4.39	4.51	-5.13	-4.76	4.99	5.46
21	2.04	3.17	-5.36		6.60	6.51	0.28	0.34	3.11	3.87
22	4.21	2.83	4.14		0.79	0.26	7.27	6.22	10.11	10.09
23	5.95	8.58	0.42		21.28	20.78	-0.03	-0.26	14.44	15.50
24	5.68	5.85	6.65		6.65	6.77	2.81	7.06	5.49	5.76
25	5.28	5.77	7.84		7.84	8.06	7.19	7.17	0.37	0.85
26	6.31	6.44	8.15		8.15	7.89	6.95	7.02	9.68	9.83
27	5.94	7.51	3.74		3.74	4.22	11.15	11.34	9.52	10.38
28	4.41	5.20	3.59		3.59	3.46	6.83	7.21	8.31	9.36
29	5.46	6.05	4.34		4.34	3.60	9.63	7.71	8.00	9.17
30	8.05	8.23	3.41		12.01	10.02	-0.99	1.78	-0.23	1.96
31	6.02	6.59	3.13		4.95	4.86	8.89	9.53	10.56	11.94
32	7.58	7.58	2.30		11.60	10.20	6.32	6.99	0.96	3.25
33	6.14	5.68	11.08		3.73	3.17	10.89	10.18	5.44	6.61
34	5.48	6.34	1.67		4.23	4.32	7.86	7.96	8.69	10.06
35	7.35	9.28	7.02		4.61	4.58	11.43	11.18	7.52	8.52
36	1.59	1.25	3.15		8.71	8.83	8.71	-1.48	2.04	2.76
AM	5.73	6.16	2.00		7.28	7.17	7.44	7.33	8.14	8.34

Note: Compound growth rate estimated from Appendix table 3.1a-3.2b. The compound growth rate is estimated with semi-log format, by taking antilogarithms of the relevant regression coefficient minus one when the equation is of the form $\text{Ln } Y = \alpha + \beta T$ and T refers to 'Time'.
O: Real gross value added, E_1: Number of workers, E_2: Total person engaged. E_2 data is available only from 1980-81 onwards.
Source: Author's own calculation from Annual Survey of Industries and *EPW* Research Foundation.

Table A3.7a: Relative Labour Productivity (LP_1) Ratio: O/E_1 - Real gross value added per workers)

Year	15	16	17	18	19	20	21	22	23	24	25
1973-74	0.51	0.37	0.61	0.37	0.68	0.97	1.92	1.14	6.63	2.11	1.26
1974-75	0.56	0.27	0.59	0.32	0.81	0.84	2.35	0.97	7.19	1.96	1.29
1975-76	0.50	0.51	0.60	0.47	0.80	0.87	2.22	1.21	6.58	1.92	1.17
1976-77	0.49	0.47	0.55	0.44	0.78	0.92	1.82	1.11	9.06	1.96	1.24
1977-78	0.57	0.28	0.57	0.43	0.79	0.96	1.78	1.14	9.74	2.08	1.21
1978-79	0.62	0.32	0.60	0.47	0.65	0.85	1.65	1.04	6.37	2.18	1.24
1979-80	0.56	0.28	0.69	0.44	0.67	0.85	1.67	1.22	6.48	2.02	1.04
1980-81	0.36	0.25	0.72	0.52	0.63	0.78	1.70	1.39	5.99	1.92	1.11
1981-82	0.44	0.22	0.66	0.52	0.63	0.73	1.61	1.75	4.57	2.02	0.97
1982-83	0.55	0.20	0.58	0.54	0.66	0.65	1.01	1.61	3.17	2.05	1.22
1983-84	0.72	0.40	0.58	0.45	0.70	0.76	1.12	1.42	1.79	2.14	1.12
1984-85	0.69	0.33	0.57	0.55	0.68	0.71	1.43	1.47	3.03	1.98	1.27
1985-86	0.68	0.29	0.60	0.51	0.56	0.54	1.10	1.17	7.12	1.85	1.26
1986-87	0.69	0.30	0.66	0.65	0.55	0.59	1.29	1.27	6.50	1.90	1.31
1987-88	0.66	0.26	0.58	0.70	0.73	0.61	1.09	1.23	6.79	1.95	1.19
1988-89	0.71	0.27	0.55	0.68	0.75	0.65	1.14	1.12	6.52	1.92	1.17
1989-90	0.72	0.20	0.62	0.64	0.44	0.57	1.39	1.00	7.10	2.06	1.05
1990-91	0.60	0.21	0.63	0.67	0.69	0.78	1.37	0.97	6.70	2.11	1.08
1991-92	0.63	0.24	0.57	0.79	0.54	0.83	1.21	1.05	5.50	2.12	1.24
1992-93	0.56	0.22	0.56	0.68	0.59	0.40	0.97	0.87	6.70	2.40	1.26
1993-94	0.61	0.24	0.61	0.88	0.75	0.40	0.89	1.10	6.16	2.31	1.23
1994-95	0.64	0.20	0.60	0.58	0.51	0.36	1.04	1.02	5.85	2.12	1.06
1995-96	0.58	0.16	0.44	0.47	0.48	0.32	1.04	0.98	5.99	2.29	1.00
1996-97	0.65	0.21	0.58	0.43	0.49	0.48	0.78	1.13	6.81	2.11	1.05
1997-98	0.58	0.17	0.61	0.41	0.55	0.24	0.71	0.92	2.88	1.97	1.31
1998-99	0.60	0.21	0.55	0.44	0.49	0.21	0.74	1.07	4.81	2.48	1.14
1999-00	0.56	0.22	0.56	0.45	0.46	0.25	0.63	0.93	3.36	2.23	1.25
2000-01	0.62	0.25	0.64	0.42	0.39	0.27	0.97	0.92	4.35	2.05	1.22
2001-02	0.64	0.22	0.59	0.38	0.43	0.31	0.77	0.84	4.59	2.02	1.32
2002-03	0.57	0.23	0.59	0.40	0.42	0.32	0.81	0.77	7.70	1.99	1.24
2003-04	0.47	0.21	0.52	0.27	0.37	0.30	0.72	0.82	8.06	1.96	1.12
2004-05	0.44	0.20	0.49	0.28	0.31	0.27	0.68	0.77	7.55	1.90	1.08
2005-06	0.50	0.19	0.56	0.29	0.33	0.37	0.76	0.87	8.27	1.90	0.91
2006-07	0.61	0.20	0.55	0.31	0.36	0.22	0.67	0.82	8.12	1.80	0.80
2007-08	0.53	0.18	0.54	0.30	0.30	0.28	0.55	0.94	7.44	1.72	0.94

Note: O and E_1 stands for real gross value added (1993-94=100) and number of workers.
Source: Author's own calculation from Annual Survey of Industries, CSO, EPW Research Foundation.

Table A3.7b: Relative Labour Productivity (LP_1) Ratio: O/E_1 - Real gross value added per workers

Year	26	27	28	29	30	31	32	33	34	35	36
1973-74	0.70	1.63	1.22	1.46	1.35	1.67	1.29	1.12	1.69	0.75	1.47
1974-75	0.63	2.01	1.14	1.69	1.50	1.48	1.14	1.00	1.61	0.72	1.51
1975-76	0.68	1.81	1.20	1.45	1.70	1.70	1.21	1.22	1.67	0.78	1.51
1976-77	0.69	1.90	1.22	1.53	1.75	1.65	1.22	1.44	1.92	0.92	2.10
1977-78	0.65	1.73	1.20	1.50	1.56	1.78	1.39	1.50	1.95	0.92	1.70
1978-79	0.74	1.71	1.09	1.42	1.63	1.63	1.16	1.45	1.79	1.00	1.69
1979-80	0.76	1.60	1.24	1.43	1.73	1.62	1.16	1.64	1.50	0.87	1.59
1980-81	0.74	1.77	1.25	1.56	1.81	2.04	1.21	1.70	1.63	0.86	1.85
1981-82	0.72	1.84	1.22	1.58	1.78	1.88	1.17	2.02	1.88	0.78	1.52
1982-83	0.81	1.67	1.21	1.55	2.21	2.17	1.41	2.28	1.93	0.83	0.99
1983-84	0.71	1.54	1.13	1.40	2.27	1.92	1.45	2.09	1.78	0.81	1.51
1984-85	0.77	1.24	1.06	1.43	2.08	2.30	1.41	2.33	1.68	0.78	1.89
1985-86	0.79	1.32	1.05	1.37	2.16	1.56	1.44	1.77	1.59	0.63	2.37
1986-87	0.74	1.13	1.01	1.40	2.51	1.68	1.46	1.81	1.78	0.73	1.70
1987-88	0.78	1.25	1.13	1.40	2.46	1.99	1.56	1.79	1.60	0.74	1.60
1988-89	0.76	1.50	0.98	1.20	2.13	1.76	1.52	1.57	1.50	0.65	1.76
1989-90	0.81	1.37	0.86	1.27	3.21	1.69	1.91	1.86	1.54	0.68	1.20
1990-91	0.87	1.49	0.79	1.16	2.52	1.87	1.67	1.15	1.52	0.71	0.90
1991-92	1.05	1.25	0.93	1.21	3.40	1.79	2.10	1.31	1.54	0.67	1.45
1992-93	0.80	1.45	0.85	1.24	3.98	1.77	2.01	1.13	1.45	0.67	0.95
1993-94	0.73	1.42	0.89	1.16	2.58	1.52	1.65	1.21	1.43	0.66	1.40
1994-95	0.75	1.60	0.92	1.19	4.44	1.87	2.28	1.23	1.56	0.64	0.94
1995-96	0.84	1.54	0.96	1.35	2.95	1.99	1.44	1.30	2.11	0.70	0.86
1996-97	0.74	1.51	0.83	1.41	1.96	1.69	1.43	1.38	2.01	0.73	0.78
1997-98	0.89	2.02	0.93	1.37	2.45	2.04	1.91	1.22	1.69	0.69	0.86
1998-99	0.73	1.66	0.90	1.23	2.40	2.00	1.86	1.61	1.30	0.59	0.55
1999-00	0.95	1.60	0.82	1.45	1.84	1.77	1.98	1.57	1.53	1.19	0.74
2000-01	1.04	1.51	0.85	1.57	3.07	1.72	2.03	1.67	1.40	0.96	0.67
2001-02	0.91	1.46	0.91	1.54	3.22	1.88	2.18	2.18	1.49	1.38	0.89
2002-03	0.60	1.89	0.86	1.33	4.72	1.78	2.39	1.76	1.50	1.40	0.61
2003-04	0.79	2.03	0.88	1.42	4.71	1.76	2.20	1.93	1.84	1.46	0.59
2004-05	0.83	2.40	0.77	1.36	2.11	1.67	1.90	2.02	1.87	1.49	0.63
2005-06	0.69	1.66	0.84	1.48	4.89	1.99	1.90	1.86	2.08	1.50	0.56
2006-07	0.76	1.69	0.93	1.41	2.57	2.27	1.72	1.63	1.64	1.43	0.55
2007-08	0.93	1.88	0.89	1.44	2.24	1.88	1.50	1.85	1.42	1.28	0.56

Note: O and E_1 stands for real gross value added (1993-94=100) and number of workers.
Source: Author's own calculation from Annual Survey of Industries, CSO, EPW Research Foundation.

Table A3.8a: Relative Labour Productivity (LP_2) Ratio: O/E_2 - Real gross value added per person engaged

Year	15	16	17	18	19	20	21	22	23	24	25
1973-74	-	-	-	-	-	-	-	-	-	-	-
1974-75	-	-	-	-	-	-	-	-	-	-	-
1975-76	-	-	-	-	-	-	-	-	-	-	-
1976-77	-	-	-	-	-	-	-	-	-	-	-
1977-78	-	-	-	-	-	-	-	-	-	-	-
1978-79	-	-	-	-	-	-	-	-	-	-	-
1979-80	-	-	-	-	-	-	-	-	-	-	-
1980-81	0.35	0.35	0.77	0.53	0.65	0.78	1.69	1.34	5.13	1.69	1.06
1981-82	0.43	0.26	0.73	0.55	0.66	0.72	1.58	1.66	3.96	1.76	0.91
1982-83	0.54	0.24	0.64	0.56	0.69	0.63	0.99	1.52	3.33	1.83	1.14
1983-84	0.71	0.51	0.64	0.46	0.73	0.76	1.08	1.36	1.70	1.92	0.98
1984-85	0.67	0.39	0.64	0.58	0.73	0.72	1.40	1.39	2.81	1.75	1.25
1985-86	0.68	0.35	0.67	0.53	0.59	0.54	1.09	1.11	6.54	1.65	1.21
1986-87	0.68	0.37	0.73	0.68	0.58	0.59	1.26	1.19	5.94	1.68	1.26
1987-88	0.66	0.31	0.64	0.73	0.77	0.61	1.06	1.13	6.20	1.73	1.12
1988-89	0.70	0.33	0.62	0.73	0.80	0.65	1.12	1.05	5.90	1.72	1.11
1989-90	0.72	0.25	0.69	0.68	0.47	0.57	1.36	0.92	6.72	1.85	0.98
1990-91	0.60	0.26	0.70	0.72	0.72	0.78	1.36	0.89	6.52	1.91	1.02
1991-92	0.63	0.29	0.63	0.85	0.56	0.82	1.22	0.97	5.26	1.92	1.16
1992-93	0.55	0.27	0.62	0.74	0.62	0.41	0.98	0.80	6.26	2.17	1.20
1993-94	0.61	0.29	0.67	0.96	0.79	0.42	0.90	1.01	5.83	2.08	1.15
1994-95	0.64	0.24	0.66	0.64	0.54	0.37	1.03	0.93	5.55	1.90	1.00
1995-96	0.59	0.20	0.49	0.51	0.50	0.33	1.03	0.90	5.80	2.05	0.96
1996-97	0.65	0.26	0.64	0.48	0.52	0.49	0.78	1.00	6.43	1.88	1.01
1997-98	0.59	0.21	0.67	0.45	0.58	0.24	0.70	0.83	2.69	1.77	1.24
1998-99	0.61	0.27	0.62	0.51	0.54	0.22	0.77	0.93	4.39	2.24	1.03
1999-00	0.56	0.28	0.62	0.50	0.48	0.27	0.64	0.80	3.24	1.96	1.22
2000-01	0.61	0.31	0.70	0.46	0.42	0.27	0.98	0.75	3.92	1.81	1.18
2001-02	0.64	0.26	0.65	0.43	0.47	0.30	0.78	0.67	4.47	1.75	1.28
2002-03	0.56	0.28	0.65	0.44	0.44	0.31	0.81	0.63	7.34	1.73	1.20
2003-04	0.47	0.26	0.56	0.31	0.39	0.29	0.72	0.66	7.72	1.70	1.09
2004-05	0.44	0.24	0.54	0.31	0.33	0.26	0.67	0.60	7.30	1.66	1.04
2005-06	0.50	0.23	0.61	0.31	0.35	0.35	0.75	0.70	8.08	1.64	0.89
2006-07	0.61	0.25	0.52	0.35	0.40	0.22	0.69	0.67	8.13	1.59	0.81
2007-08	0.53	0.21	0.59	0.32	0.33	0.28	0.58	0.74	7.48	1.50	0.91

Note:- refers to non-availability of data. O and E_2 stands for real gross value added (1993-94=100) and total person engaged.
Source: Author’s own calculation from Annual Survey of Industries, CSO, EPW Research Foundation.

Table A3.8b: Relative Labour Productivity (LP_2) Ratio: O/E_2- Real gross value added per person engaged

Year	26	27	28	29	30	31	32	33	34	35	36
1973-74	-	-	-	-	-	-	-	-	-	-	-
1974-75	-	-	-	-	-	-	-	-	-	-	-
1975-76	-	-	-	-	-	-	-	-	-	-	-
1976-77	-	-	-	-	-	-	-	-	-	-	-
1977-78	-	-	-	-	-	-	-	-	-	-	-
1978-79	-	-	-	-	-	-	-	-	-	-	-
1979-80	-	-	-	-	-	-	-	-	-	-	-
1980-81	0.77	1.70	1.19	1.41	1.45	1.70	1.08	1.54	1.49	0.87	1.81
1981-82	0.75	1.76	1.15	1.43	1.37	1.57	1.05	1.83	1.71	0.79	1.48
1982-83	0.83	1.59	1.14	1.38	1.84	1.83	1.28	2.07	1.73	0.83	0.97
1983-84	0.74	1.44	1.05	1.25	1.59	1.62	1.29	1.88	1.58	0.80	1.48
1984-85	0.81	1.19	1.00	1.31	1.63	1.91	1.28	2.04	1.53	0.78	1.86
1985-86	0.82	1.29	0.99	1.23	1.47	1.31	1.29	1.55	1.46	0.64	2.38
1986-87	0.77	1.12	0.95	1.24	1.76	1.40	1.22	1.57	1.59	0.73	1.67
1987-88	0.81	1.24	1.05	1.22	1.76	1.65	1.32	1.56	1.44	0.75	1.59
1988-89	0.80	1.49	0.92	1.03	1.55	1.47	1.31	1.40	1.38	0.66	1.78
1989-90	0.83	1.33	0.81	1.10	2.16	1.43	1.56	1.62	1.41	0.68	1.18
1990-91	0.91	1.43	0.74	1.01	1.68	1.58	1.33	1.02	1.40	0.72	0.90
1991-92	1.08	1.21	0.87	1.04	2.30	1.51	1.70	1.17	1.43	0.67	1.46
1992-93	0.83	1.42	0.79	1.07	2.30	1.51	1.63	1.00	1.34	0.67	0.93
1993-94	0.75	1.39	0.82	1.01	1.76	1.28	1.35	1.06	1.33	0.68	1.42
1994-95	0.77	1.57	0.85	1.04	2.92	1.61	1.91	1.06	1.43	0.65	0.93
1995-96	0.86	1.52	0.91	1.21	2.26	1.69	0.85	1.16	1.97	0.72	0.87
1996-97	0.75	1.48	0.79	1.22	1.69	1.47	1.18	1.22	1.85	0.74	0.80
1997-98	0.90	1.97	0.85	1.19	1.89	1.74	1.56	1.08	1.55	0.70	0.85
1998-99	0.79	1.66	0.87	0.81	1.66	1.81	1.73	1.25	1.27	0.61	0.59
1999-00	0.98	1.58	0.79	1.20	1.46	1.56	1.63	1.39	1.41	1.14	0.77
2000-01	1.06	1.46	0.82	1.33	2.42	1.54	1.71	1.42	1.32	0.93	0.68
2001-02	0.95	1.40	0.88	1.30	2.63	1.65	1.80	1.84	1.40	1.35	0.87
2002-03	0.65	1.82	0.82	1.13	3.33	1.59	1.97	1.46	1.43	1.38	0.60
2003-04	0.81	1.94	0.86	1.21	3.44	1.57	1.83	1.65	1.77	1.44	0.59
2004-05	0.86	2.30	0.75	1.18	1.58	1.51	1.63	1.77	1.81	1.47	0.63
2005-06	0.71	1.61	0.84	1.28	4.11	1.84	1.63	1.62	2.04	1.48	0.56
2006-07	0.82	1.70	0.94	1.28	2.35	2.12	1.56	1.50	1.66	1.51	0.56
2007-08	0.97	1.86	0.88	1.27	1.78	1.75	1.40	1.56	1.41	1.28	0.57

Note:- refers to non-availability of data. O and E_2 stands for real gross value added (1993-94=100) and total person engaged.
Source: Author's own calculation from Annual Survey of Industries, CSO, EPW Research Foundation.

Table A3.9a: Labour Productivity Growth (LP_1) *(% y/y Change)*

Year	AM	15	16	17	18	19	20	21	22	23	24	25
1973-74												
1974-75	2.89	12.13	-24.10	-1.11	-11.56	21.51	-11.24	25.82	-12.98	11.57	-4.47	5.02
1975-76	-5.14	-14.83	76.86	-3.09	38.01	-5.51	-1.51	-10.11	18.87	-13.16	-7.23	-13.60
1976-77	7.24	5.07	-2.33	-1.60	1.39	4.84	13.61	-12.16	-2.05	47.59	9.79	13.81
1977-78	-0.77	14.49	-41.39	2.16	-3.29	0.00	3.43	-2.87	2.16	6.71	4.91	-3.02
1978-79	10.64	21.16	26.39	16.97	20.29	-9.50	-1.95	2.23	0.62	-27.63	16.47	12.71
1979-80	-6.63	-15.56	-17.92	6.77	-11.47	-3.19	-6.56	-5.30	10.03	-5.06	-13.48	-21.25
1980-81	-4.35	-38.45	-15.24	0.92	11.68	-9.72	-11.99	-2.53	8.79	-11.59	-9.11	1.99
1981-82	6.01	27.91	-3.96	-3.77	7.07	5.13	-1.24	0.48	33.18	-19.02	11.56	-7.56
1982-83	6.01	32.93	-3.56	-6.65	9.88	12.29	-5.29	-33.79	-2.33	-26.64	7.42	33.07
1983-84	16.34	53.06	132.58	17.49	-4.53	22.34	34.96	29.64	2.88	-34.26	21.57	7.37
1984-85	5.86	2.13	-12.77	3.05	29.87	2.89	-0.94	35.03	9.09	79.05	-2.45	20.05
1985-86	6.53	4.78	-7.38	12.76	-1.06	-12.46	-18.34	-17.88	-14.84	150.83	-0.22	4.91
1986-87	1.97	2.82	7.25	11.48	31.40	1.00	10.75	18.68	10.58	-6.93	4.81	6.37
1987-88	5.57	1.87	-11.39	-7.37	13.00	40.27	8.57	-10.50	2.40	10.28	8.49	-4.28
1988-89	11.97	19.19	19.42	7.19	9.47	14.40	20.06	17.25	1.78	7.54	10.19	9.92
1989-90	7.95	9.97	-19.24	21.49	0.56	-36.98	-5.70	31.80	-3.70	17.41	15.36	-2.93
1990-91	10.13	-8.95	14.93	11.42	15.95	73.52	51.26	8.29	6.59	3.97	13.26	13.17
1991-92	-4.43	1.68	6.03	-13.41	12.97	-25.75	1.17	-15.76	3.22	-21.60	-4.27	10.25
1992-93	5.29	-7.50	-1.95	3.15	-9.75	16.66	-48.92	-15.58	-12.47	28.32	19.38	6.57
1993-94	12.47	23.23	21.88	23.55	45.33	41.79	13.13	3.24	42.65	3.36	8.37	9.70
1994-95	7.14	12.71	-10.77	4.93	-28.80	-27.32	-4.26	24.96	-0.57	1.75	-1.72	-7.50
1995-96	8.01	-2.90	-11.38	-20.75	-12.57	1.75	-4.62	8.04	3.77	10.64	16.66	2.09
1996-97	3.74	16.94	31.38	36.02	-4.81	6.09	57.81	-21.83	19.66	17.96	-4.60	9.27
1997-98	2.60	-7.90	-17.42	8.57	-2.40	16.16	-49.29	-7.01	-16.33	-56.64	-4.32	27.61
1998-99	15.36	18.32	45.02	3.86	23.55	1.62	-0.90	20.91	33.56	92.98	45.67	-0.12
1999-00	7.44	-0.22	15.58	9.70	9.12	0.18	33.14	-8.84	-6.71	-24.90	-3.61	18.69
2000-01	-8.16	1.60	3.58	3.76	-15.06	-20.51	-1.17	41.02	-9.51	18.75	-15.56	-10.51
2001-02	2.43	6.11	-12.54	-4.95	-5.98	11.91	15.83	-18.62	-6.07	7.99	0.83	10.33
2002-03	8.71	-3.48	16.35	9.55	15.37	5.24	12.01	14.81	-0.84	82.45	7.16	2.67
2003-04	10.56	-9.10	1.65	-4.09	-25.07	-1.45	4.04	-2.42	18.56	15.77	8.92	-0.36
2004-05	7.65	1.87	0.16	2.88	11.32	-11.07	-3.89	1.89	0.55	0.84	4.35	3.68
2005-06	5.82	19.59	2.35	20.34	6.53	12.83	44.51	18.17	19.64	15.86	5.98	-10.48
2006-07	8.88	32.79	12.66	7.02	18.95	20.01	-34.77	-3.85	2.54	6.94	3.41	-4.18
2007-08	8.05	-4.91	-3.82	6.43	4.50	-9.07	39.12	-11.09	23.67	-0.95	3.09	26.47

Note: Figures in the Table represent simple annual growth rates. LP_1 refers to a real gross value added per workers at 1993-94 prices.
Source: Author's own calculation from Annual Survey of Industries, CSO, EPW Research Foundation.

Table A3.9b: Labour Productivity Growth (LP_1) *(% y/y Change)*

Year	26	27	28	29	30	31	32	33	34	35	36
1973-74											
1974-75	-6.88	26.98	-3.52	19.07	14.64	-8.62	-8.50	-8.06	-1.85	-2.04	5.41
1975-76	2.52	-14.60	-0.14	-18.21	7.71	8.78	-0.03	15.41	-1.58	2.99	-5.08
1976-77	8.18	12.56	8.83	12.46	10.44	4.27	8.85	26.42	23.12	26.33	49.40
1977-78	-6.79	-9.68	-2.37	-2.22	-11.74	6.68	12.85	3.42	1.02	-1.11	-19.76
1978-79	26.52	9.03	0.73	4.60	16.00	1.82	-7.49	6.46	1.48	21.31	10.09
1979-80	-3.71	-12.25	6.04	-6.21	-1.09	-7.75	-6.67	5.81	-21.53	-19.55	-12.26
1980-81	-6.62	5.75	-3.54	4.28	0.12	20.55	-0.51	-0.95	3.64	-4.48	11.38
1981-82	1.98	9.79	3.22	7.87	4.41	-1.83	2.47	26.14	22.41	-4.45	-12.92
1982-83	19.56	-3.47	5.48	3.83	31.02	22.32	27.44	19.92	8.63	13.49	-31.20
1983-84	2.13	6.87	8.21	4.76	19.80	2.54	19.62	6.36	7.41	12.63	78.47
1984-85	14.80	-14.26	-0.14	8.41	-2.97	26.77	3.56	18.20	-0.31	2.76	32.21
1985-86	8.88	12.91	5.12	1.80	10.50	-27.41	8.69	-19.09	1.25	-14.52	33.74
1986-87	-4.19	-12.53	-1.91	4.58	18.33	9.20	3.07	4.05	13.98	18.20	-26.78
1987-88	11.59	16.38	17.75	5.07	3.68	25.30	12.66	4.45	-5.31	7.39	-0.57
1988-89	9.71	34.96	-3.00	-3.88	-3.26	-0.91	9.48	-1.65	4.85	-1.31	22.73
1989-90	14.39	-1.82	-4.98	14.83	63.09	3.55	35.16	27.88	10.81	12.37	-26.56
1990-91	18.72	19.79	1.95	0.25	-13.67	21.72	-3.39	-31.78	9.26	15.31	-16.90
1991-92	14.71	-19.83	12.34	-0.27	29.11	-8.05	19.83	8.65	-3.44	-10.66	54.03
1992-93	-19.89	22.59	-4.67	7.87	23.29	3.89	1.18	-8.86	-0.89	5.84	-31.00
1993-94	3.03	9.74	18.42	4.89	-27.06	-3.59	-8.10	20.42	11.37	11.19	64.75
1994-95	10.07	20.70	10.22	10.57	83.98	32.13	48.66	8.70	16.41	3.12	-28.22
1995-96	20.27	4.25	13.70	22.00	-28.08	15.01	-32.03	13.79	46.36	18.24	-0.69
1996-97	-7.74	1.46	-11.01	8.49	-31.34	-11.88	3.10	10.14	-1.14	8.36	-5.81
1997-98	22.92	37.50	14.91	-0.32	28.76	23.36	37.60	-8.95	-13.71	-2.80	12.48
1998-99	-4.98	-5.42	12.57	3.90	12.65	13.46	11.88	51.81	-11.47	-0.52	-25.23
1999-00	38.72	3.76	-2.46	26.29	-17.48	-4.98	14.76	4.69	26.52	114.99	43.22
2000-01	0.59	-13.53	-4.70	-0.26	53.01	-10.84	-5.94	-2.01	-16.12	-26.02	-16.19
2001-02	-10.14	-1.06	9.44	0.19	7.52	11.85	9.96	33.87	9.19	47.87	34.43
2002-03	-28.13	41.08	2.73	-6.42	59.34	2.90	19.26	-12.25	9.82	10.15	-25.10
2003-04	45.37	18.81	13.64	18.58	10.45	9.50	1.84	21.26	35.42	15.15	7.48
2004-05	13.43	27.45	-5.76	2.81	-51.87	1.85	-7.07	12.63	9.14	9.69	14.26
2005-06	-12.82	-26.76	15.24	15.35	145.66	26.16	5.59	-2.85	18.04	6.58	-5.23
2006-07	21.11	10.74	19.91	3.83	-42.69	24.56	-1.44	-4.71	-14.54	4.12	6.81
2007-08	31.31	20.33	3.84	10.24	-5.89	-10.41	-5.38	22.67	-6.37	-3.41	9.24

Note:Figures in the Table represents simple annual growth rates. LP_1 refers to real gross value added per workers at 1993-94 prices.
Source: Author's own calculation from Annual Survey of Industries, CSO, EPW Research Foundation.

Table A3.10a: Labour Productivity Growth (LP_2) *(% y/y Change)*

Year	AM	15	16	17	18	19	20	21	22	23	24	25
1973-74	-	-	-	-	-	-	-	-	-	-	-	-
1974-75	-	-	-	-	-	-	-	-	-	-	-	-
1975-76	-	-	-	-	-	-	-	-	-	-	-	-
1976-77	-	-	-	-	-	-	-	-	-	-	-	-
1977-78	-	-	-	-	-	-	-	-	-	-	-	-
1978-79	-	-	-	-	-	-	-	-	-	-	-	-
1979-80	-	-	-	-	-	-	-	-	-	-	-	-
1980-81	-	-	-	-	-	-	-	-	-	-	-	-
1981-82	6.13	29.73	-21.22	0.35	9.28	7.95	-1.74	-0.90	32.09	-17.97	10.62	-9.49
1982-83	6.17	33.69	-3.42	-7.01	8.92	11.72	-6.76	-33.87	-2.73	-10.78	10.60	33.65
1983-84	16.03	52.36	147.90	16.67	-5.33	21.56	38.64	27.31	3.59	-40.87	21.41	-0.48
1984-85	5.03	-0.79	-19.71	4.03	32.41	4.68	-0.72	35.97	7.71	74.02	-4.10	33.93
1985-86	6.98	8.05	-4.36	11.48	-2.32	-13.47	-18.93	-16.92	-14.58	148.88	1.01	3.27
1986-87	2.16	2.80	8.35	12.30	30.73	1.57	11.28	18.33	9.19	-7.21	3.72	6.73
1987-88	5.13	1.73	-11.73	-7.58	13.54	39.59	9.08	-11.81	-0.27	9.80	8.56	-6.81
1988-89	11.56	18.64	19.01	7.11	10.63	15.68	18.30	18.62	4.06	6.17	10.84	10.76
1989-90	8.49	10.80	-17.69	21.01	1.29	-37.01	-5.45	31.31	-5.02	23.47	16.83	-3.90
1990-91	9.39	-8.92	12.51	11.59	15.92	69.49	50.74	9.56	5.47	6.19	12.53	13.48
1991-92	-4.85	0.64	7.88	-14.25	12.85	-26.00	-0.07	-14.98	3.77	-23.28	-4.07	8.81
1992-93	4.53	-8.56	-1.96	2.56	-9.84	15.00	-47.75	-16.03	-13.93	24.48	17.78	7.27
1993-94	12.22	24.01	18.44	21.90	46.69	43.51	13.74	3.19	42.71	4.46	7.97	7.96
1994-95	7.70	12.88	-10.24	5.54	-27.88	-26.25	-4.74	23.25	-1.48	2.63	-1.80	-6.13
1995-96	6.89	-2.24	-10.28	-20.84	-15.67	-0.42	-3.34	6.65	3.95	11.61	15.50	2.52
1996-97	5.13	16.52	32.83	36.92	-1.58	8.14	55.90	-20.29	16.83	16.61	-3.47	10.75
1997-98	3.09	-6.78	-16.77	8.76	-2.01	16.18	-48.88	-6.60	-14.97	-56.97	-3.16	26.37
1998-99	10.95	16.31	44.66	2.74	26.15	2.76	-0.89	21.10	25.22	81.27	40.30	-8.14
1999-00	11.44	1.43	15.33	10.65	7.39	-0.81	35.21	-7.27	-4.73	-17.69	-2.52	32.36
2000-01	-8.15	0.60	2.39	4.35	-14.50	-19.08	-6.73	40.32	-13.92	11.14	-15.06	-11.09
2001-02	2.60	7.07	-12.71	-4.92	-5.31	13.23	14.66	-18.09	-7.55	17.03	-0.69	10.93
2002-03	9.76	-3.62	17.63	9.49	14.23	2.31	14.43	14.45	2.43	80.17	8.57	3.47
2003-04	10.20	-8.61	1.82	-4.21	-23.94	-2.07	3.58	-2.16	16.16	15.95	7.87	-0.01
2004-05	8.65	3.33	0.18	3.23	10.96	-7.20	-4.95	0.99	-1.71	2.64	6.05	3.09
2005-06	6.28	19.39	1.65	20.67	6.89	12.69	45.96	18.95	24.64	17.71	5.44	-8.72
2006-07	6.09	30.95	13.12	-8.94	18.56	21.39	-33.29	-2.34	0.52	6.71	2.94	-3.61
2007-08	11.17	-3.83	-3.56	24.75	1.67	-8.89	38.13	-6.88	23.20	2.33	4.29	25.65

Note:Figures in the Table represents simple annual growth rates. - refers to non-availability of data and LP_2 stand for real gross value added per person engaged.
Source: Author's own calculation, Annual Survey of Industries, CSO, EPW Research Foundation.

Table A3.10b: Labour Productivity Growth (LP_2)

(% y/y Change)

Year	26	27	28	29	30	31	32	33	34	35	36
1973-74	-	-	-	-	-	-	-	-	-	-	-
1974-75	-	-	-	-	-	-	-	-	-	-	-
1975-76	-	-	-	-	-	-	-	-	-	-	-
1976-77	-	-	-	-	-	-	-	-	-	-	-
1977-78	-	-	-	-	-	-	-	-	-	-	-
1978-79	-	-	-	-	-	-	-	-	-	-	-
1979-80	-	-	-	-	-	-	-	-	-	-	-
1980-81	-	-	-	-	-	-	-	-	-	-	-
1981-82	2.86	9.83	2.79	7.39	0.01	-1.87	2.57	26.08	22.09	-4.16	-13.00
1982-83	17.95	-4.15	5.07	2.69	42.59	23.49	29.42	19.86	7.11	12.16	-30.60
1983-84	2.91	4.82	7.32	5.28	0.41	2.98	17.54	5.76	5.84	11.55	76.37
1984-85	15.01	-13.11	0.32	9.65	7.73	23.65	3.87	13.46	1.89	2.93	32.22
1985-86	8.80	16.02	5.50	0.21	-3.43	-26.42	7.72	-18.37	2.23	-13.08	37.35
1986-87	-5.10	-11.12	-2.33	2.96	21.67	9.13	-3.08	3.45	10.99	17.95	-28.49
1987-88	11.59	16.24	16.50	4.04	5.25	23.62	13.56	4.45	-4.95	7.92	-0.03
1988-89	9.32	33.73	-2.46	-6.15	-1.86	-0.39	10.79	0.16	7.12	-2.52	24.80
1989-90	13.41	-2.83	-4.39	16.33	51.75	5.14	29.45	25.48	10.74	11.91	-28.11
1990-91	19.04	17.48	0.16	0.20	-15.14	20.69	-7.25	-31.54	9.18	16.18	-15.95
1991-92	13.69	-19.67	11.85	-1.64	30.32	-8.71	22.03	9.43	-2.97	-12.09	54.11
1992-93	-19.98	23.23	-5.06	7.33	4.53	4.28	0.15	-10.64	-2.08	4.44	-33.39
1993-94	1.86	9.41	16.67	5.77	-14.08	-4.80	-6.93	18.64	11.12	14.28	70.72
1994-95	10.31	21.68	10.81	11.27	78.87	35.85	52.00	7.82	16.07	2.80	-29.62
1995-96	19.35	3.88	15.20	24.10	-17.33	11.78	-52.60	17.81	46.87	18.11	-0.23
1996-97	-7.98	1.78	-8.74	5.88	-21.14	-8.26	46.42	10.49	-0.97	8.61	-3.02
1997-98	23.46	37.53	10.95	0.61	14.99	21.66	36.75	-8.73	-13.57	-1.80	9.54
1998-99	-2.84	-6.33	13.71	-24.54	-2.76	15.58	22.60	27.71	-8.99	-3.35	-23.05
1999-00	38.86	6.29	1.17	65.28	-1.88	-3.72	5.02	24.02	23.02	107.11	45.07
2000-01	-1.39	-15.20	-4.58	1.98	52.69	-9.68	-3.22	-6.17	-14.00	-24.94	-18.54
2001-02	-7.99	-2.03	9.45	0.08	11.28	9.93	7.93	32.91	9.01	48.51	30.77
2002-03	-24.21	42.79	2.37	-4.64	39.17	5.63	19.98	-12.69	12.52	12.33	-23.57
2003-04	36.62	17.86	15.72	18.26	13.73	9.05	2.55	24.30	36.29	15.06	8.66
2004-05	15.15	28.30	-4.62	5.87	-50.15	4.77	-3.33	16.55	10.94	10.55	15.11
2005-06	-11.86	-25.64	17.61	14.92	176.72	29.16	5.96	-2.50	19.45	7.36	-6.31
2006-07	22.25	12.07	19.86	6.02	-39.31	22.40	1.83	-1.96	-13.72	8.10	7.58
2007-08	30.72	21.63	3.79	10.13	-16.04	-8.44	-0.39	15.92	-5.48	-5.76	11.72

Note: Figures in the Table represents simple annual growth rates. - refers to non-availability of data. LP_2 refers to real gross value added per person engaged at 1993-94 prices.
Source: Author’s own calculation from Annual Survey of Industries, CSO, EPW Research Foundation

Table A3.11a: Capital-Labour Ratio (CI_1)

Year	AM	15	16	17	18	19	20	21	22	23	24	25
1973-74	0.90	0.56	0.08	0.36	0.22	0.31	0.27	1.58	0.51	8.02	3.09	0.89
1974-75	1.03	0.54	0.10	0.45	0.24	0.42	0.35	2.00	0.57	7.83	3.81	1.20
1975-76	1.20	0.56	0.13	0.47	0.26	0.45	0.38	2.18	0.66	8.26	4.26	1.26
1976-77	1.26	0.56	0.09	0.51	0.22	0.53	0.43	2.33	0.68	12.41	4.20	1.57
1977-78	1.30	0.61	0.08	0.54	0.25	0.62	0.46	2.33	0.69	12.86	4.37	1.50
1978-79	1.44	0.72	0.08	0.58	0.29	0.64	0.46	2.54	0.68	14.21	4.58	1.73
1979-80	1.52	0.76	0.08	0.61	0.30	0.74	0.47	2.58	0.76	13.29	4.91	1.59
1980-81	1.60	0.72	0.08	0.73	0.35	0.75	0.55	3.14	0.80	8.54	5.28	1.89
1981-82	1.74	0.74	0.08	0.83	0.36	0.80	0.56	3.36	0.89	10.29	5.69	2.00
1982-83	1.84	0.83	0.07	0.93	0.41	0.89	0.62	3.56	1.00	7.05	5.53	2.22
1983-84	2.15	1.15	0.09	1.06	0.42	0.97	0.89	4.46	1.14	13.41	6.38	2.64
1984-85	2.33	1.25	0.13	1.12	0.44	0.91	0.76	5.31	1.21	15.86	6.40	2.45
1985-86	2.59	1.34	0.21	1.34	0.48	0.99	0.78	4.51	1.31	16.16	6.67	3.00
1986-87	2.76	1.48	0.18	1.39	0.53	1.00	0.88	5.28	1.69	17.20	7.46	3.20
1987-88	2.90	1.53	0.17	1.52	0.64	1.35	1.00	5.39	1.69	16.24	7.40	3.75
1988-89	3.20	1.70	0.18	1.68	0.59	2.77	1.13	6.44	1.86	18.59	7.74	3.78
1989-90	3.32	1.81	0.15	1.78	0.59	1.42	1.19	5.91	1.97	18.57	8.73	4.01
1990-91	3.80	1.95	0.17	2.00	0.65	2.34	1.30	6.25	2.20	18.56	10.18	4.44
1991-92	4.04	2.11	0.16	2.22	0.72	1.91	1.36	6.31	2.26	20.77	9.93	4.68
1992-93	4.32	2.14	0.18	2.46	0.72	1.94	1.30	6.38	2.39	20.42	10.49	5.17
1993-94	4.73	2.36	0.21	2.77	0.79	2.02	1.74	7.01	2.62	22.42	11.41	6.09
1994-95	5.11	2.66	0.21	3.18	0.93	2.05	1.61	10.21	2.75	21.99	12.52	5.80
1995-96	5.48	2.83	0.20	3.38	1.07	2.28	1.77	8.00	2.83	23.29	13.73	6.59
1996-97	5.91	3.03	0.25	3.93	1.10	2.28	2.34	9.20	3.60	29.61	13.79	9.52
1997-98	6.33	3.26	0.27	4.34	1.30	2.37	2.09	8.11	5.05	32.85	15.42	7.49
1998-99	7.93	3.65	0.35	4.63	1.17	2.81	2.88	10.14	6.98	72.74	17.40	8.97
1999-00	8.31	4.05	0.41	5.50	1.51	2.91	2.60	11.38	7.39	46.26	18.49	8.29
2000-01	8.46	4.20	0.45	5.45	1.55	2.85	3.23	10.60	7.55	62.47	19.55	8.90
2001-02	9.17	4.44	0.44	5.60	1.52	2.62	3.14	11.09	7.89	88.48	21.34	9.31
2002-03	9.07	4.78	0.49	5.75	1.59	2.71	3.44	12.53	7.68	95.91	20.14	9.79
2003-04	9.60	4.82	0.53	5.81	1.49	2.79	3.57	11.22	8.69	96.20	21.41	9.52
2004-05	9.32	4.91	0.53	5.91	1.48	2.72	3.65	11.30	9.15	89.30	19.75	10.33
2005-06	9.60	5.02	0.55	6.18	1.47	2.64	3.51	12.17	9.58	92.87	22.10	8.80
2006-07	9.63	5.51	0.65	6.72	1.59	2.80	4.01	12.24	10.28	91.08	22.28	9.04
2007-08	10.10	5.91	0.71	7.02	1.54	2.49	3.68	10.10	11.35	76.21	22.20	9.42

Note:CI_1 refers to capital intensity, i.e. real capital stock per number of workers.
Source: Author's own calculation from Annual Survey of Industries, CSO, EPW Research Foundation.

Table A3.11b: Capital-Labour Ratio (CI_1)

Year	26	27	28	29	30	31	32	33	34	35	36
1973-74	0.78	2.40	0.58	0.88	0.86	1.29	0.69	0.92	1.17	0.53	0.34
1974-75	0.87	2.73	0.70	1.13	1.44	1.79	0.81	0.83	1.40	0.56	0.41
1975-76	0.95	3.48	0.79	1.27	1.38	1.80	0.97	1.08	1.61	0.65	0.51
1976-77	1.01	3.85	0.86	1.35	1.52	1.83	1.06	1.15	1.74	0.91	0.56
1977-78	1.01	3.98	0.84	1.38	1.46	1.96	1.09	1.16	1.79	0.93	0.57
1978-79	1.10	3.93	0.90	1.41	1.39	2.00	1.17	1.25	1.89	2.23	0.67
1979-80	1.13	4.33	0.94	1.45	1.51	1.96	1.24	1.23	1.91	1.77	0.67
1980-81	1.22	4.45	1.07	1.50	1.51	2.06	1.49	1.45	2.03	1.75	0.71
1981-82	1.36	4.85	1.13	1.60	1.49	2.23	1.76	1.62	2.24	1.76	0.77
1982-83	1.46	5.17	1.21	1.71	1.59	2.44	1.62	1.57	2.45	1.85	0.79
1983-84	1.75	5.48	1.48	1.93	2.15	2.47	2.05	1.76	2.88	1.86	1.10
1984-85	1.93	5.56	1.42	2.07	2.00	2.67	2.03	2.21	3.04	2.02	1.06
1985-86	2.35	6.13	1.56	2.42	2.53	2.81	2.15	2.33	3.38	2.24	1.03
1986-87	2.84	5.96	1.72	2.52	2.66	3.11	2.57	2.33	3.77	2.27	1.24
1987-88	3.16	6.53	1.78	2.57	3.92	3.23	2.72	2.82	4.05	2.49	1.24
1988-89	3.58	7.06	2.00	2.87	3.17	3.74	3.55	2.83	3.88	2.59	1.31
1989-90	3.80	7.84	1.94	3.11	5.00	3.40	4.11	3.32	4.24	2.66	1.37
1990-91	3.99	10.04	2.21	3.37	5.63	3.63	4.47	3.69	4.41	2.42	1.33
1991-92	4.26	11.41	2.28	3.60	5.57	3.70	5.13	3.99	4.80	2.50	1.31
1992-93	4.56	11.79	2.56	4.15	7.00	3.95	5.27	4.38	5.28	2.64	1.64
1993-94	5.33	13.10	3.10	4.08	9.39	4.38	5.75	5.06	5.85	2.60	1.53
1994-95	5.87	14.20	3.19	4.26	8.56	5.05	6.34	5.48	5.78	2.65	1.84
1995-96	6.17	14.45	3.30	4.31	7.78	5.25	6.86	5.25	6.80	2.48	2.01
1996-97	7.46	14.74	3.27	4.91	7.16	5.30	7.53	5.42	8.44	2.76	1.82
1997-98	8.10	15.85	4.17	5.65	6.88	5.61	8.50	6.80	7.60	3.23	2.03
1998-99	10.47	22.23	4.29	5.63	11.37	6.52	9.85	5.16	11.83	3.54	2.57
1999-00	11.88	18.57	4.17	6.78	9.69	9.32	11.44	5.30	13.88	7.25	2.31
2000-01	10.42	20.42	3.98	7.09	13.62	8.05	13.13	6.37	15.29	7.01	2.93
2001-02	10.93	21.36	4.63	7.68	14.33	8.96	13.74	7.58	15.16	7.92	4.84
2002-03	7.46	22.75	4.66	8.13	26.05	9.27	15.24	7.04	13.13	7.88	3.44
2003-04	10.89	25.15	4.69	8.30	26.62	8.81	19.77	7.37	12.89	8.11	3.33
2004-05	10.10	24.72	4.27	7.77	21.09	7.75	17.63	8.09	12.49	8.32	3.01
2005-06	9.38	25.17	4.31	8.31	22.78	7.46	17.61	6.71	12.28	8.31	3.35
2006-07	8.58	22.99	4.62	7.63	19.08	7.45	18.04	6.35	11.84	7.49	3.01
2007-08	10.28	24.22	5.10	8.17	20.10	7.55	14.52	7.30	13.08	9.23	3.13

Note:CI_1 refers to capital intensity, i.e. real stock of capital per workers.
Source: Author's own calculation from Annual Survey of Industries, CSO, EPW Research Foundation.

Table A3.12: Verdoorn's Law –Disaggregated 2-digit Industry Groups

NIC 2-digit	Constant	β	t (Cons)	t (β)	AR	R square	DW Stat	DF	F-Stat	Prob. (F)
15	-1.4924	1.0827	-0.9960	14.5345	1	0.8764	1.99	33	106.3700	0.0000
16	-1.5338	0.8596	-0.6855	13.0681	-	0.8422	2.09	34	170.7800	0.0000
17	0.7846	0.8228	0.7850	10.7227	-	0.7823	2.36	34	114.9800	0.0000
18	-4.8455	0.6126	-2.0291	9.7842	1	0.7124	2.01	33	37.1610	0.0000
19	-3.8272	0.9042	-2.8935	16.0976	-	0.8900	1.86	34	259.1300	0.0000
20	0.1104	0.8671	0.0799	16.6200	-	0.8962	2.15	34	276.2300	0.0000
21	-2.7489	0.9326	-2.1278	13.6174	-	0.8528	1.26	34	185.4300	0.0000
22	0.2627	0.6827	1.3288	6.3769	-	0.5596	2.78	34	40.6640	0.0000
23	-4.7229	0.8887	-2.0008	17.2858	-	0.9033	2.09	34	298.8000	0.0000
24	-2.0489	0.9069	-1.8368	11.1929	-	0.7965	2.22	34	125.2800	0.0000
25	-2.3506	0.7817	-1.4370	7.2345	-	0.6206	3.05	34	52.3400	0.0000
26	-0.6549	0.8083	-0.3190	7.2170	-	0.6194	2.73	34	52.0900	0.0000
27	-0.3805	0.8149	-0.2536	11.0617	-	0.7927	2.01	34	122.3600	0.0000
28	0.7832	0.4535	0.6876	6.2157	-	0.5469	2.31	34	38.6347	0.0000
29	1.8315	0.5224	1.4144	5.4638	-	0.4826	2.79	34	229.8534	0.0000
30	0.2560	0.7299	0.0597	7.3717	-	0.6293	2.74	34	54.3422	0.0000
31	-0.3696	0.7191	-0.3690	14.5382	-	0.8685	2.19	34	211.3600	0.0000
32	1.5875	0.4722	0.7963	6.2071	-	0.5463	2.48	34	38.5300	0.0000
33	-0.3271	0.7481	-0.2305	11.7517	-	0.8118	2.32	34	138.1038	0.0000
34	-2.1548	0.7587	-1.7700	12.4752	-	0.8295	1.95	34	155.6300	0.0000
35	1.6217	0.9779	0.3667	5.6287	1	0.4115	1.98	33	10.4900	0.0000
36	-2.7963	0.8358	-1.4454	14.4950	-	0.8678	1.95	34	210.1100	0.0000

Note: Estimated values of the parameter, when the equation is of the form $\Delta LP = \alpha + \beta \Delta O + \varepsilon$, ΔLP and ΔO refers to growth of labour productivity and output respectively.
Source: Author's own calculation, data collected from Annual Survey of Industries, CSO and EPW Research Foundation

Table A3.13: Kaldor's Technological Progress Function –Disaggregated 2-digit Industry Groups

NIC 2-digit	Constant	β	t (Cons)	t (β)	AR	R square	DW Stat	DF	F-Stat	Prob. (F)
15	-4.0376	1.4555	-1.2348	4.6236	-	0.4005	1.94	34	20.3773	0.0000
16	0.6474	0.0726	0.1201	2.6111	-	0.1756	2.49	34	6.8170	0.0136
17	3.0536	0.2558	0.8448	0.7752	-	0.0184	2.27	34	0.6009	0.4439
18	4.8250	0.1683	1.3823	0.5468	-	0.0092	2.63	34	0.2989	0.5883
19	0.3219	0.5012	0.1028	4.3334	-	0.3480	2.40	34	17.0854	0.0002
20	1.1649	0.3707	0.2393	1.2563	-	0.0470	2.63	34	1.5784	0.2180
21	-0.0089	0.4626	-0.0027	2.1639	-	0.1277	2.42	34	4.6827	0.0380
22	2.0036	0.3490	0.5937	1.4501	-	0.0616	2.59	34	2.1029	0.1568
23	7.7867	0.3575	1.1003	1.6153	-	0.0753	2.02	34	2.6091	0.1160
24	3.6448	0.2510	1.3364	0.8322	-	0.0211	2.17	34	0.6950	0.4115
25	4.5508	0.0560	1.8708	0.3531	-	0.0039	2.42	34	0.1247	0.7262
26	2.9139	0.5054	0.9461	2.5613	-	0.1701	2.36	34	6.5605	0.0153
27	7.5756	-0.0761	2.0517	-0.2559	-	0.0020	2.45	34	0.0655	0.7996
28	2.8661	0.2495	1.6095	1.5283	-	0.0680	2.31	34	2.3357	0.1363
29	3.9872	0.2244	1.8953	1.0684	-	0.0344	2.44	34	1.1415	0.2933
30	6.2914	0.4793	0.9277	2.0486	-	0.1159	3.00	34	4.1971	0.0488
31	6.7379	-0.0359	2.4537	-0.1656	-	0.0009	2.58	34	0.0274	0.8694
32	4.8587	0.1958	1.3258	0.7676	-	0.0181	2.52	34	0.5890	0.4483
33	8.0437	-0.0063	2.4501	-0.0269	-	0.0000	2.71	34	0.0070	0.9787
34	6.2059	-0.0709	2.0364	-0.3299	-	0.0033	1.98	34	0.1089	0.7436
35	3.5386	0.4544	1.0138	4.1318	-	0.3480	2.38	34	17.0700	0.0002
36	5.1970	0.0882	0.9301	0.7700	-	0.0027	2.92	34	0.0870	0.7700

Note: Estimated values of the parameter, when the equation is of the form $\Delta LP = \alpha + \beta \Delta CI + \varepsilon$, ΔLP and ΔCI refers to growth of labour productivity and capital intensity respectively.

Source: Author's own calculation, data collected from Annual Survey of Industries, CSO and EPW Research Foundation.

Table A3.14: Modified Model –Disaggregated 2-digit Industry Groups

NIC 2-digit	Constant	β1	β2	t (Cons)	t (β1)	t (β2)	AR	Adj-R Squr	DW Stat	DF	F-Stat	Prob. (F)
15	-6.5497	0.9275	0.7831	-6.2549	19.3708	7.9264	1	0.9568	2.34	33	237.2435	0.0000
16	-5.0894	0.819	0.4978	-2.9794	17.3242	5.6912	-	0.9178	2.33	34	185.3401	0.0000
17	-2.5263	0.8325	0.3503	-1.5238	11.6207	2.4144	-	0.8049	2.09	34	69.0793	0.0000
18	-6.4905	0.6166	0.2574	-2.5737	10.2268	1.7058	1	0.7119	2.03	33	27.3538	0.0000
19	-3.8776	0.889	0.0222	-2.8774	12.3939	0.3486	-	0.8835	1.85	34	126.0700	0.0000
20	-2.6972	0.8664	0.3562	-2.0367	21.3659	4.8976	2	0.9287	2.01	32	101.7100	0.0000
21	-3.9652	0.8963	0.2291	-3.1341	13.9887	2.6913	-	0.873	1.45	34	114.4280	0.0000
22	-3.3849	0.7409	0.5390	-1.6594	8.1742	3.8611	-	0.6834	2.96	34	36.6234	0.0000
23	-6.4743	0.8702	0.2347	-3.0237	18.7865	3.7726	1	0.9327	1.96	33	148.7279	0.0000
24	-3.7215	0.9087	0.2686	-2.7753	11.7611	2.0484	-	0.8092	2.03	34	70.9942	0.0000
25	-3.6351	0.7996	0.1399	-1.9772	7.4736	1.4435	-	0.6215	2.98	34	28.0971	0.0000
26	-6.1036	0.846	0.5834	-3.9111	11.6058	6.7071	-	0.8347	2.32	34	84.3328	0.0000
27	-2.1034	0.8354	0.2056	-1.1334	11.3747	1.5220	-	0.7947	2.15	34	64.8565	0.0000
28	-2.2691	0.4881	0.4411	-1.9946	8.0620	4.5082	2	0.7077	2.07	32	26.0294	0.0000
29	-1.8595	0.5916	0.4565	-1.1668	6.8615	3.2918	-	0.5919	2.62	34	24.9333	0.0000
30	-8.2879	0.8318	0.7400	-3.2174	14.2702	8.0294	1	0.8865	2.05	33	84.3184	0.0000
31	-1.7696	0.7437	0.1976	-1.6807	16.1167	2.6951	-	0.8865	2.18	34	129.9984	0.0000
32	-4.5014	0.5391	0.5415	-1.8355	7.8919	3.4789	-	0.6526	2.76	34	31.9998	0.0000
33	-4.2369	0.8325	0.4256	-3.3289	16.8859	5.3600	-	0.8956	1.96	34	142.5717	0.0000
34	-3.2557	0.7726	0.1205	-2.2438	12.6833	1.3541	-	0.8285	1.99	34	80.7595	0.0000
35	-0.433	0.7446	0.3246	-0.1177	4.5335	3.3690	1	0.5359	2.01	33	13.3213	0.0000
36	-5.1466	0.8524	0.2728	-2.6204	16.0955	2.7282	-	0.8865	2.01	34	129.9269	0.0000

Note: Estimated values of the parameter, when the equation is of the form $\Delta LP = \alpha + \beta 1 \Delta O + \beta 2 \Delta CI + \varepsilon$, ΔLP, ΔO and ΔCI refers to growth of labour productivity, output and capital intensity respectively.

Source: Author's own calculation, data collected from Annual Survey of Industries, CSO and EPW Research Foundation.

Chapter-IV

Employment, Wages and Productivity Nexus in Indian Manufacturing Sector

4.1 Introduction:

This chapter discusses the relationship between employment, real wages, and labour productivity of Indian manufacturing sector. The relationship between real wages, employment and productivity are considered as the key variables in labour economics and have received substantial amount of attention in the economic literature. Moreover, we should also acknowledge the significance of the relationship between these three variables from a policy perspective to realize the state of full employment. Economic theories have been put forward to explain the interrelationships among these variables. The Classical, Neoclassical and Keynesian theories of employment postulates a close relationship between real wages and employment level where it is hypothesized that there exists a long-run inverse relationship between real wages and employment[1] levels in the economy. However, the theories differ in terms of direction of causal flow. Classical and neoclassical models assume that the causal mechanism runs from wages to employment, while in the Keynesian version, the causality runs towards wages from employment (Mazumdar, 2003)[2].

The efficiency wage theory postulates the relationship between productivity and real wages, but presumes that the causal relationship runs from wages to productivity (Akerlof and Yellen, 1986). Moreover the performance based pay scheme, on the other hand, predicts higher real wages for higher productivity. Besides, changes in productivity may affect employment in two opposite ways. First, although the impact of an increase in productivity is to reduce the demand for labour as workers are more efficient. Secondly, the increase in productivity generates more employment, though the expansion of the market. The level of labourers efficiency is directly related to the wage received from a higher pay allows workers to improve their physical ability to work through improved nutrition and health. In addition, an increase in real wages likely to stimulate greater work effort and higher morals among employees that further enhances productivity. Nevertheless, the increase in real wages may have a negative effect on

[1] Say's law of market is the core of Classical theory of employment. Classical economists believed in the existence of full employment in the economy. In case of unemployment, a general wage cut in money wages would take the economy to the full employment situation.

[2]Mazumdar, D. (2003), "Trends in employment and the employment elasticity in manufacturing, 1971-92: an international comparison", *Cambridge Journal of Economics*, Vol. 27, No. 4, pp. 563-82.

employment through a higher cost of labour that in turn may result in capital is being substituted for labour.

It has been widely accepted that one of the major determinant of the wage rate is productivity. From the previous chapter, we have confirmed that the high growth of manufacturing output along with a sluggish employment growth have been contributing to the labour productivity growth in the Indian manufacturing sector. The growth of the number of workers and total person engaged is as low as 1.31% and 1.29% respectively in comparison to the productivity growth of 5.73% (gross value added per workers) and 6.16% (gross value added per person engaged) per annum during 1973-74 to 2007-08.The slow rate of employment growth in the post liberalization period is a matter of concern that raises the questions about the presence of jobless growth in the Indian economy. This may be because of increasing use of capital deepening technology. Thus, the present chapter is intended to investigate the nexus between real wages, employment and productivity of Indian manufacturing sector.

This chapter is organized as follows. The next section highlights the theoretical arguments that have emerged from the classical school of thought. Third section discusses the methodology followed by the description of variables and data sources in the section Four. In the fifth section, we have presented the growth and trend analysis of employment, wage and productivity of Indian manufacturing sector. Finally, the sixth section presents the empirical findings followed by the conclusions.

4.2 Theoretical Underpinnings:

Wages and employment are two important variables, which affect the standard of living of the people to a larger extent. The importance attached to these leads, so many economists propose different underlying theories and laws in the economic history. Though, the present analysis deals with the establishment of the empirical relationship between employment, wage and labour productivity, it's worth to review some of the major school of economic thoughts on this doctrine before proceeding towards examining the empirical relationship among these variables.

To start with, the relationship between wage and employment has been discussed first by the classical economist. It is Adam Smith (1776)[3] and Ricardo (1815, 1817)[4], who believed the existence of substantial levels of wages. According to them, this substantial level of wage in the long-term remains fixed. However, the term subsistence level of wage is not lucidly defined in their analysis. During the latter period, it was Ricardo, who believes, wages are viewed as a part of interaction between the long-term dynamics of growth of the economy and distribution of total product among different classes such as labour, capital and landowners. With the expansion of the economy, the total wage expands in proportion to the growing absorption of labour in the production process. At the same time, Ricardo has also emphasized that the rate of profit, which is the important constituent of the national product has squished as the competition among the capitalist and landlord goes on and the cultivation is expanded from more fertile lands to lands of lower fertility, with the expansion of population. From this, it is clear that the share of profit is declining as a part of the national product. However, having said that, the share of wages keeps on rising only in proportion to the labour employed. Wages can thus be viewed as being determined essentially by the needs of human existence, with some temporary variations around it.

The wages under the classical thought is quite positive, which used as an instrument to arrive at the full employment level. They assume the existence of full employment without inflation, which is based on wage-price flexibility. In the classical thoughts, there are automatic forces[5] in the economic system that tends to maintain full

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[3]*TheWealth of Nation*, first published in 1776, touches upon broad topics such as division of labour, productivity, wages of labour and free market

[4] In his *Essay on the Influence of a Low Price of Corn on the Profits of Stock* (1815), Ricardo articulated what came to be known as the law of diminishing returns. In 1817 David Ricardo published *Principles of Political Economy and Taxation.* In this text Ricardo integrated a theory of value into his theory of distribution. David Ricardo's attempts to answer important economic issues took economics to an unprecedented degree of theoretical sophistication. He outlined the Classical system more clearly and consistently than anyone before had done. His ideas became known as the "Classical" or "Ricardian" School. Economists consider that Ricardo is the source of th concepts behind the so called "*Iron Law of Wages*", according to this, wages naturally tend to a subsistence level. In his *Theory of Profit*, Ricardo stated that as real wages increases, real profits decreases because the revenue from the sale of manufactured goods is split between profits and wages.

[5]Know as 'Invisible hand', a term coined by economist Adam Smith in his 1776 bookto describe the self-regulating behavior of the marketplace.

employment[6]. In the classical model of employment, changes in money wages and real wages are directly and proportionally relate to each other[7]. The relationship between the wage and employment is based on the argument that, in a competitive economy a reduction in the money wage reduces the cost of production so the price of the products, thereby raising their demand. In order to meet the increasing demand for the products, more workers are employed to produce them.

In the employment front, classical economist believes the existence of full employment in the economy as a normal situation. The famous Say's Law of Market[8], is the core of the classical theory, which postulate that "supply creates its own demand". In Say's words:

> "*It is production which creates markets for goods. A product is no sooner created than it, from that instant affords a market for other products to the full extent of its own value. Nothing is more favorable to the demand of one product, than the supply of another*[9]."

Through this mechanism, where supply creates its own demand, would result in automatic achievement of full employment barring minor deviations on account of aberrations like frictional unemployment. James Mill (1808)[10] supported Say's in this front and he argues that, consumption is co-extensive with production and production is the cause, and the sole cause of demand it never furnishes supply without furnishing demand, both at the same time and both to an equal extent.Whatever the amount annually produced, can never exceed the amount of annual demand. Thus, the argument

[6] According to classical economist, full employment is a normal situation and any deviation from this level is something abnormal which automatically tends towards full employment.

[7] The classical model of employment postulates direct and proportional relationship between money and real wage. When there is a cut in the money wage, the real wage is also reduced to the same extent which reduced unemployment and ultimately brings full employment in the economic system.

[8] The 19th century French Economist, Jean Baptiste Say postulates this proposition.

[9] In its original form, the law is applicable to a barter economy where goods are ultimately exchange for goods. According to Say, work being unpleasant, no person will work to make a product unless he wants to exchange it for some other product which he desires. Therefore the very act of supplying gods implies a demand for them.

[10] James Mill, basing himself largely on what he found in the Wealth of Nations, by 1808 had presented a full and balanced discussion of the Law of Markets. Mill stated that income received from the production process would indeed be spent on commodities

put forward by James Mill, support that, supply creates its own demand and there cannot be general overproduction and hence general unemployment. However, Say's formulation of supply creates its own demand does not appear to be in exact conformity with Ricardo's conclusion of the long-term path of employment expansion would be governed by surplus generated in the hands of the capitalist, who are believed to be the only class which undertakes capital accumulation.

Some of the uniqueness of the classical school of thoughts are also replicated in Marx School of thoughts that incorporate the features like wages paid to labour and profits goes to the hands of the capitalist class. Marx considers labour as the basic source of all value, but when it engages in the production process, it produces more than what it needed for its own subsistence does. Therefore, there remains a surplus, which is called as "Surplus Value". The capitalist appropriates this surplus value to enable capital accumulation. Hence, there is an incentive to generate more surplus value by incorporating capital-using technologies. Since this type of technological change needs less labour than before to complete the work, so there emerges an 'industrial reserve army of labour'. The existence of this reserve army enables wages to de driven down to the minimum subsistence level. Thus, like classical thought, wages are driven down here as well, but through a very different mechanism. Here technological change is viewed as forcing wages to remain low while simultaneously bring about a decline in the rate of profit through the rise in the organic composition of capital. Once the technology start-replacing labourers in the production process, the surplus value is consistently declining, which in turn affect profit negatively. Thus, according to Marx, the decay of capitalism is followed by the declining rate of profit. In one hand the mechanism achieves the full employment through the emergence of the 'reserve army', on the other hand, it pegged the wages to the subsistence level. Although, the Marxian system results in bringing the wages to the subsistence level as in the Classical theory, but in respect of the level of employment the two system deviate from each other. Unlike Classical economist, Marxian does not believe in the permanent existence of the full employment, rather Marxian dynamics keeps full employment permanently in abeyance.

The neoclassical approach to wages is very different from that of the Classical and Marxian theory. As we have discussed above wage is determined by some factors, which are exogenous and related to sustenance of labour. Under neoclassical production framework, labour is considered to be a commodity, whose price (wage) is determined by the interaction between the demand for and supply of labour in the product market. Where the supply of labour is dependent upon disutility of labour which is to be overcome by the payment of wages as an incentive. On the other hand, demand for labourers dependent upon, the marginal productivity of labour, which declines with application of every successive unit of labour. This interaction brings out the equilibrium wage rate, which clears the labour market. Although, the interaction between the demand and supply schedule has taken place in the micro-level, but in the neoclassical theory, it has been generalized for the whole economy and the market demand schedule and market supply schedule determined the market clearing or equilibrium wage rate where, aggregate supply of labour is supposed to get fully absorbed. The equilibrium level of employment is taken to be a point at which there is automatic realization of full employment.

John Maynard Keynes in his General Theory of Employment, Interest and Money (1936), made a frontal attack on the classical and neoclassical postulates on wage and employment. *The General Theory* is written against the backdrop of Classical thoughts[11]. This shows the disagreements by Keynes to that of the view propounded by the other two schools. He developed a new economic thought and policy that stand apart from the view developed over a century and which dominated economic thought and policy before and during the Great Depression. The major deviation of Keynesian economics from that of Classical and Neoclassical School is that, unlike the latter two schools of thought who believe in the principle of automatic adjustment in the system that brings the full employment, Keynes does not believe on account of 'frictions[12]' within the economy, which occurs in respect of employment determination at the macro-level. The Keynesian analytical framework goes along with the Say's Law to some extent, since the latter can be valid only if the marginal propensity to consume is

[11] By the 'Classicalist' Keynes meant the followers of Ricardo and all those, who adopted and preferred the theory of Ricardian Economics. They include in particular, J.S. Mill, Marshall, and Pigou.

[12] Keynes vehemently criticized the classical theory of employment for its unrealistic assumptions. He argued that, the characteristics of the special case assumed by the Classical theory happen not to be those of the economic society in which we actually live, with the result that its teaching is misleading and disastrous if we try to apply it to the facts of experience.

taken to be one and whatever is saved is automatically invested. However, practically both of these assumptions are neither viable nor valid. Keynes rejects the fundamental classical assumption of full employment as a normal situation, rather he mentioned that the existence of involuntary unemployment (or underemployment) in the capitalist economy is a normal situation and full employment equilibrium is abnormal or a special situation. He also disagrees with the Classical postulates of wage rate as a mechanism to determine the employment, rather level of employment is depend upon aggregate demand, which can generate full employment only if the gap between the full employment level of income and consumption is filled up by an equivalent level of investment[13.]

Moreover, the Keynesian are also disagreed with the viewpoint of the neoclassical formulation that states that the automatic achievement of full employment through wage adjustment. In Keynesian arguments, the full employment is automatically achieved through wage adjustment only if the demand for labour schedule is given. This condition is possible in the case of micro-level, but while dealing with the macro-economic level, demand for labour scheduled cannot assume the level of income as a satirist previous condition. If we pursue, the neoclassical mechanism to arrive at the full employment by fixing the wage rate little lower, than at the macroeconomic level, the aggregate level of income and demand scheduled for the labour in the economy is shifting downwards. This in turn brings down the equilibrium point, which means a new equilibrium wage rate and employment level below the earlier one is achieved. This new equilibrium cannot in any meaningful sense be considered as the level of full employment.

In the Keynesian analysis, the importance given to the determination of wage rate is not as much as the importance attached for employment. However, the wage rate does occupy an important part in his formulation. He totally disagrees with the Classical

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[13] Keynes refuted Say's Law of Market, that supply always creates its own demand. He rather believe that all income earned by the labour class would not spent in buying products which they helped t produced. He maintained that part of the earning is saved and is not automatically invested because; saving and investment are two different functions, which are decided by two different groups. Therefore, the disequilibrium between saving and investment leads to the deficiency in the aggregate demand. This in turn leads to general overproduction because all that is produced is not sold and as a result, general unemployment.

school that money wage and real wages are directly related and proportion, he rather maintained that money wages are, by and large remains constant up to full employment. The classical notion of the subsistence wage, which they believe to remain fixed in the long-term, is refuted by Keynes and the money wage is taken to be at a reasonable level consistent with a decent level of living. Keynes mentioned that the money wage is supposed to rise beyond the full employment, where the labour market is becoming tight. Keynes is not fully agreed with the determination of wages by the marginal productivity of labour, but at the same time he is not disassociated with the marginal productivity of labour. He maintained that after the attainment of the full employment level, there persists a tendency for money wages to rise, the real wage level is supposed to be brought back into equality with marginal productivity through a rise in price level generated by the pressure of a rise in wages.

The behaviour of wage and price mentioned above in the Keynesian framework, where we come across a situation of persistent increase in the money wage rate beyond the full employment. On the other hand, with the increasing money wage, the real wage is about to stabilize at a level of the neutralizing effect of rising prices. The behaviour of wages and prices in the near full employment zone led to the development of the famous Post-Keynesian concept of the Phillips Curve. A.W. Phillips (1958)[14] tries to empirically establish the relationship between the nominal wage rate and the level of employment. He found that the nominal wage rate started rising as the level of employment increased substantially to a high level, by analyzing a century of data pertaining to the British Economy. Unemployment rate as a counterpart of the level of employment, Phillips observed a negative relationship between the level of unemployment and the rate of increase of wage level.

The above review vindicates the fact thatvariousschools of thought in the economic literatures differently represent the relationship between wage-employment and productivity. The empirical evidence as reviewed in the second chapter on the wage-

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[14] Phillips, A.W. wrote a paper in 1958 titled *The Relation between Unemployment and the Rate of Change of Money Wage Rates in the United Kingdom, 1861-1957*, which was published in the quarterly journal *Economica*. In the paper Phillips describes how he observed an inverse relationship between money wage changes and unemployment in the British economy over the period examined. Similar patterns were found in other countries and in 1960 Paul Samuelson and Robert Solow took Phillips' work and made explicit the link between inflation and unemployment: when inflation was high, unemployment was low, and vice-versa.

employment-productivity relationship has been mixed, inconclusive and contradicting. This chapter is particularly interested in finding out whether Indian manufacturing data support any of the economic theories discussed previously. However, it is important to mention over here that our intention here is not to establish or estimate the relationship in the line of the different school of thoughts, rather we are interested to find out the empirical relationship between labour productivity, employment and real wages by employing various sophisticated time series econometric models. The findings of this relationship between labour productivity, employment and real wages may be useful in providing some observations to Indian policy makers in their implementations and evaluation of labour policies.

4.3 Methodology:

Most of the empirical studies on the nexus of labourproductivity, employment and real wages focus on the existence of long-run equilibrium relationship between them. There are different approaches available in the literature to empirically examine thisbehaviour. One simple way of addressing this issue is using the correlation coefficient. However, the use of correlation coefficient does not explain the existence of any long run and dynamic relationship between the variables in view of non-stationary nature of the time series variables. In this direction the next section presents the various time series techniques i.e., Unit Root test (test of stationarity), Granger's Non-Causality test in Vector Auto Regression Block Exogeneity form, Johansen Maximum Likelihood Procedure for co-integration test, Impulse Response Function, and forecasting Variance Decomposition test that are employed to address the nexus between labour productivity, employment and real wages.

4.3.1 Test of Stationarity:

Before employing any time series model to examine the interlinkages between the different variables under study, one has to test the stationarity properties of the time series variables. This study applies unit root tests to examine the stationarity properties of the variables. A stochastic process $\{y_t\}$ is said to be stationary if for all t and k,

(i) $E[y_t] = E[y_{t+k}] = \mu$ for all t

(ii) $Var(y_t) = Var(y_{t+k}) = \delta^2$

or, $E[(y_t - \mu)^2] = E[(y_{t+k} - \mu)^2] = \delta_y{}^2 = \gamma_0$

(iii) $Cov(y_t, y_{t+k}) = Cov(y_{t+j}, y_{t+j+k})$

or, $E[(y_t - \mu)(y_{t+k} - \mu)] = E[(y_{t+j} - \mu)(y_{t+j+k} - \mu)] = \gamma_k$

Where, $\mu, \delta_y{}^2$ and all γ_k are constants. The covariance may depend on *k*, the lag length. The above conditions are also referred as conditions of weak stationarity, second order stationarity or wide sense stationarity. A strongly stationary process need not have finite mean and variance (i.e. μ and/or γ_0 need not be finite).

A simple first order autoregressive process can be expressed by the following general equation:

$$y_t = \mu_0 + \mu_1 t + \alpha y_{t-1} + \varepsilon_t \qquad (4.1)$$

Where, $\{y_t\}$ is the stochastic process, μ_0, μ_1 and α are parameters and ε_t is a random disturbance term with white noise properties. μ_0 is called drift or constant or intercept.The nature of the time series described by the equation (4.1) depends on the parameter values. If $\mu_1 \neq 0$ and $|\alpha|<1$, then y_t follows a deterministic trend. The presence of autoregressive component, αy_{t-1}, will mean that there may be short-run deviations, but the series will return to trend eventually. A series of this sort is known as a trend stationary (TS) process, as the residuals from the regression of y_t on a constant and a trend will be stationary. If $\mu_0 = 0$, $\mu_1 = 0$ and $\alpha = 1$, the series is said to follow a simple random walk, a unit root process. If $\mu_0 \neq 0$, $\mu_1 = 0$ and $\alpha = 1$, the series is said to follow a random walk with drift. Any stochastic process, which becomes stationary after differencing once, is called a difference stationary (DS) process, for e.g. a simple random walk process is a DS process. Likewise, any time series, which becomes stationary after de-trending is called a TS process.

In time series literature, there are both formal and informal tests of stationarity. The informal tests include time series plots and use of Correlogram. Statistical packages use

Box-Pierce Q-statistics and Ljung-Box (LB) Q-statistics for testing stationarity of a series. These two statistics are based on autocorrelation coefficients of several lag lengths. The formal tests of nonstationarity are also known as unit root tests or test of random walk series. These include the Dickey-Fuller (DF), Augmented Dickey-Fuller (ADF) and Phillips-Perron (PP) tests to check the presence of unit root in the data. These tests are necessitated because the usual Student's t-test is inappropriate to test the null hypothesis.

4.3.1.1 Dickey-Fuller and Augmented Dickey-Fuller Tests:

The basic Dickey-Fuller (DF) test examines whether the value of the parameter $\alpha = 1$ in equation (4.1), in other words, whether the underlying first order difference equation has a unit root. Specifically, assuming the absence of trend term in equation (4.1) and rewriting it in a modified form as below:

$$\Delta y_t = \mu_0 + \delta y_{t-1} + \varepsilon_t \qquad (4.2)$$

where, $\Delta y_t = y_t - y_{t-1}$. The null hypothesis is that the { y_t } process has a unit root, i.e. H_0: $\delta = \alpha - 1 = 0$. Since $-1 \leq \alpha \leq 1$, it follows that $-2 \leq \delta \leq 0$.

More generally, if the given time series follows a p^{th}order autoregressive process [AR(p)] or even autoregressive moving average process [ARMA(p,q)], an extended Dickey-Fuller test called augmented Dickey-Fuller (ADF) test. Specifically, if the original time series follows AR(p), it can be represented as,

$$y_t = \mu_0 + \sum_{i=1}^{p} \alpha_i y_{t-i} + \varepsilon_t \qquad (4.3)$$

After suitable mathematical manipulation, Equation (4.3) can be rewritten as,

$$\Delta y_t = \mu_0 + \delta y_{t-1} + \sum_{i=2}^{p} \beta_i \Delta y_{t-i+1} + \varepsilon_t \qquad (4.4)$$

Where, $\delta = -(1 - \sum_{i=1}^{p} \alpha_i)$ and $\beta_i = \sum_{j=i}^{p} \alpha_j$.

Equation (4.4) is also recommended if the residuals sequence, $\{\varepsilon_t\}$ in equation (4.2), is not a white noise, for e.g. when ε_ts are autocorrelated. There are different forms of DF and ADF tests, which are possible by including trend terms in equations (4.2) and (4.4), and also excluding drift (intercept or constant) term, μ_0, from these equations. The DF test is a special case of the ADF test when p = 1. To test the significance of δ in equations (4.2) and (4.4), the usual Student's t-statistic critical values cannot be used. Initially, Dickey-Fuller and later MacKinnon have developed the appropriate test statistic, known as τ-statistic, and its critical values using Monte Carlo simulations. The critical values of τ-statistic are made available under alternative assumptions of drift, trend, sample size and level of significance. They are abbreviated as τ (no drift and no trend), τ_μ (only drift) and τ_τ (with both drift and trend). Dickey-Fuller have also provided the critical F-test values, known as Φ_1, Φ_2, and Φ_3, for pair-wise joint tests of significance for μ_0 and μ_1.Thus, the null hypothesis that $\delta = 0$ can be rejected if the computed t-value for the coefficient δ is greater than the critical τ-value in absolute magnitude. It has been shown that the same DF test critical values are valid for the ADF test as well.

4.3.1.2 Phillips-Perron Test:

One of the important assumptions of DF test is that error terms are uncorrelated, homoscedastic as well as identically and independently distributed (iid). Phillips and Perron (1988) have modified the DF test, known as PP test, which can be applied to situations where the above assumptions may not be valid. Another advantage of PP test is that it can also be applied to frequency domain approach, which is more recent and an alternative to the usual time domain approach, to time series analysis.The derivation of the PP test statistic is quite involved and hence not given here. The PP test has been shown to follow the same critical values as that of DF test, but has greater power to reject the null hypothesis of unit root. However, the PP test seems to be biased towards rejecting the null hypothesis of a unit root, when the error series follows a negative moving average process. In such situations, it is recommended to use the ADF test, rather than the PP test.

4.3.2 Johansen Maximum Likelihood Procedure:

Engel-Granger co-integration procedure will have a problem if there is more than one co-integrating vector present in a vector of variables.If the number of variables exceeds two, we cannot rule out the possibility of more than one co-integrating vector. So in a multivariate system, the Engel-Granger approach will not be the appropriate method to use. Johansen (1988) Maximum Likelihood Procedure is the appropriate method to test co-integration among a vector of variables. This procedure estimates co-integrating relationship in a system of equations unlike single equation method of Engel-Granger. Thus, it makes use of all the available information in the long run and short run fluctuations of each variable and allows for testing of more than one co-integrating vector.

Like Engel-Granger technique, it requires that the variables should be integrated of same order. Although forms of the Johansen tests can detect differing orders of integration, it is wise not to mix variables with different orders of integration. The second important requirement is selection of lag length as Johansen procedure is quite sensitive to the lag length. One can use Likelihood Ratio test to select lag length. Alternatively, lag length can be selected using multivariate generalization of the AIC or SBC.

The Johansen test for co-integration begins by considering the unrestricted reduced form of a system of variables, which by assumption can be represented as a finite order Vector Auto Regression (VAR) model.

$$X_t = A_0 + A_1 x_{t-1} + A_2 x_{t-2} + \dots\dots\dots + A_p x_{t-p} + \varepsilon_t \qquad (4.5)$$

where, x_t = the (n×1) vector $(x_{1t}, x_{2t}, \dots\dots, x_{nt})'$

A0 = an (n×1) vector of constants.

Ai = an (n×n) matrix of parameters.

ε_t = an independently and identically distributed n-dimensional vector with mean 0 and variance Σ_ε.

The equation (4.5) can be reformulated into a Vector Error Correction Model (VECM) form:

$$\Delta x_t = A_0 + \sum_{i-1}^{p-1} \pi_i \, \Delta x_{t-i} + \pi \, x_{t-p} + \varepsilon_t \qquad (4.6)$$

$$\pi = -\left[I - \sum_{i=1}^{p} A_i \right]$$
$$\pi_i = -\left[I - \sum_{j=1}^{k} A_j \right]$$

Where I = an (n×n) identity matrix.

The equation (4.6) contains information on both the short run and long run adjustment to change in x_t, via the estimates of π_i and π respectively. As it is shown in Johansen (1988), $\pi = \alpha\beta'$, where α represents the speed of adjustment to disequilibrium, while β is a matrix of long run coefficients such that the term $\beta' x_{t-k}$ embedded in (4.6) represents up to n-1 co-integrating relationship in the multivariate model which ensure that the x_t converge to their long run steady state solutions. Hence the matrix β is the matrix of co-integrating parameters and α is the matrix of the speed of adjustment parameters.

The key feature to note in (4.6) is the rank of π; the rank of π is equal to the number of independent co-integrating vectors. If rank (π) = 0, the matrix is null, so there is no co-integration among the set of n variables, that means, there is no linear combination of variables that is stationary. Hence the equation (4.6) will become a usual VAR model in first differences. Instead, if rank (π) = n, the vector process is stationary, that means there are 'n' linear independent combinations of x_t that are stationary. So in this case all the variables are stationary. In the intermediate case, if rank (π) = 1, there is a single co-integrating vector and the expression πx_{t-p} is the error correction factor. For other cases in which 1< rank (π) < n, there are multiple co-integrating vectors.

The number of distinct co-integrating vectors can be obtained by checking the significance of the characteristic roots of π. The number of co-integrating vectors is equal to the rank of the matrix π and the rank of the matrix is equal to the number of characteristic roots that differ from zero. The Johansen methodology allows determining the number of characteristic roots that are statistically different from zero. If the variables in x_t are not co-integrated, the rank of π is zero and all the characteristic roots (λ_i) will equal to zero. In practice, one can obtain only estimates of π and the characteristic roots. The test for the number of characteristic roots that are insignificantly different from unity can be conducted using the following two test statistics:

$$\lambda_{trace}(r) = -T\sum_{i=r+1}^{n}\ln(1-\hat{\lambda}_i)$$

$$\lambda_{\max}(r, r+1) = -T\ln(1-\hat{\lambda}_{r+1})$$

where, $\hat{\lambda}_i$ = the estimated value of the characteristic roots (also called eigen values) obtained from the estimated π matrix.

T = the number of usable observation.

r = the number of co-integrating vectors.

When the appropriate values of 'r' are clear, these statistics are simply referred to as 'λtrace' and 'λmax'. The first statistic tests the null hypothesis that the number of distinct co-integrating vectors is less than or equal to 'r' against a general alternative. It is clear that λtrace equals zero when all $\lambda_i = 0$. The second statistic tests the null hypothesis that the number of co-integrating vectors is r against the alternative of r+1 co-integrating vectors. Johansen and Juselius (1990) provide the critical values of the λtrace and λmax statistics. The estimated values of the above two statistics are compared with the Johansen and Juselius critical value to determine the number of co-integrating vectors exist among the variables. One of the most interesting aspects of the Johansen procedure is that it allows for testing restricted forms of the co-integrating vector (s). One can impose restrictions on the co-integrating vectors or adjustment coefficients, and accordingly conclude whether restrictions are binding or not by using a statistic, which is proposed by Johansen.

4.3.3 Vector Auto Regression Model:

Both univariate single equation model and multivariate models such as intervention analysis and transfer function analysis shows the dynamic relationships among variables by allowing the time path of the 'dependent' variable to be influenced by the time path of an ' independent' or ' exogenous' variable. If it is known that there is no feedback, these analyses can be very effective tools for forecasting and hypothesis testing. But the major limitation of these analyses is that many economic systems do exhibit feedback. In Practice, it is not always known if the time path of a series designated to be 'independent' variable has been unaffected by the time path of the so-called 'dependent' variable. And if one is not confident that a variable is actually exogenous, the natural way is to treat each variable symmetrically. That is where the importance of VAR lies. By the very construction, a VAR system consists of a set of variables, each of which is related to lags of itself, and of all other variables in the system. In other words, a VAR system consists of a set of regression equations, each of which has an adjustment mechanism such that even small changes in one variable component in the system may be accounted for automatically by possible adjustments in the rest of the variables in the system. Thus VAR provide a fairly unrestrictive approximation to a reduced form structural model without assuming beforehand any of the variables as exogenous. Thus, by avoiding the imposition of *a priori* restrictions on the model the VAR add significantly to the flexibility of the model. Furthermore, by incorporating the lagged terms of the variables, the VAR become useful in capturing the empirical regularities embedded in the data, which consequently enables one to obtain deeper insights into the channels through which the macro policy variables such as demand for money and interest rates percolate the system in establishing the relationship between stock and foreign exchange market.

Let the present wage rate $\{W_t\}$ sequence be affected by current and past realization of the employment rate i.e. $\{E_t\}$ sequence and let the time path of employment rate $\{E_t\}$

sequence be affected by current and past realizations of the wage rate {W_t}. Now the unrestricted VAR system can be written as:

$$W_t = b_{10} + b_{12}\, E_t + \gamma_{11}\, W_{t-1} + \gamma_{12}\, E_{t-1} + \varepsilon_{Wt} \qquad (4.7)$$

$$E_t = b_{20} + b_{21}\, W_t + \gamma_{21}\, W_{t-1} + \gamma_{22}\, E_{t-1} + \varepsilon_{Et} \qquad (4.8)$$

Where, it is assumed that (i) {W_t} and {E_t} are stationary, (ii) ε_{Wt} and ε_{Et} are white-noise disturbances with standard deviations of σ_S and σ_E respectively, and (iii) {ε_{Wt}} and {ε_{Et}} are uncorrelated white-noise disturbances.

The structure of the system incorporates feedback since W_t and E_t are allowed to affect each other. For example, $+b_{12}$ is the contemporaneous effect of a unit change of E_t on $W_t$and γ_{12} is the effect of a unit change in E_{t-1} on W_t. The terms ε_{Wt} and ε_{Et} are pure innovations (or shocks) in W_t and E_t respectively. If b_{21} is not equal to zero, ε_{Wt} has an indirect contemporaneous effect on E_t and if b_{12} is not equal to zero, ε_{Et} has an indirect contemporaneous effect on W_t.

Now equation (4.7) and (4.8) are not reduced form equations since W_t has a contemporaneous effect on E_t and E_t has a contemporaneous effect on W_t. But using the matrix algebra, the system of equations can be transformed into more usable and compact form. Rewriting the system of equations in matrix form we get,

$$Bx_t = \Gamma_0 + \Gamma_1 x_{t-1} + \varepsilon_t \qquad (4.9)$$

Where,

$$B = \begin{bmatrix} 1 & -b_{12} \\ -b_{21} & 1 \end{bmatrix}; \quad x_t = \begin{bmatrix} W_t \\ E_t \end{bmatrix}; \quad \Gamma_0 = \begin{bmatrix} b_{10} \\ b_{20} \end{bmatrix}; \Gamma_1 = \begin{bmatrix} \gamma_{11} & \gamma_{12} \\ \gamma_{21} & \gamma_{22} \end{bmatrix}$$

and,

$$\varepsilon_t = \begin{bmatrix} \varepsilon_{Wt} \\ \varepsilon_{Et} \end{bmatrix}$$

Equation (4.9) represents a VAR in primitive form. Premultiplication of B^{-1} in Equation (4.9) give us the Vector Autoregressive (VAR) model in standard form:

$$x_t = A_0 + A_1 x_{t-1} + e_t \quad \textit{(4.10)}$$

Where,

$A_0 = B^{-1}\Gamma_0$; $A_1 = B^{-1}\Gamma_1$; and $e_t = B^{-1}\varepsilon_t$

The process in equation 4.10 looks like an auto regressive process but with a difference that x_t, A_0 and e_t are now vectors i.e. all the variables and the disturbance terms are now in vector form.

For notational purposes, we can define a_{i0} as element i of the vector A_0; a_{ij} as the element in row i and column j of the matrix A_1; and e_{it} as the element i of the vector e_t. Using this notation, the equation 4.10 can be rewritten in the equivalent form:

$$W_t = a_{10} + a_{11}W_{t-1} + a_{12}E_{t-1} + e_{1t} \quad \textit{(4.11)}$$

$$E_t = a_{20} + a_{21}W_{t-1} + a_{22}E_{t-1} + e_{2t} \quad \textit{(4.12)}$$

It is important to note that the error terms (i.e. e_{1t} and e_{2t}) are composites of the two shocks ε_{Wt} and ε_{Et}.. Since $e_t = B^{-1}\varepsilon_t$, e_{1t} and e_{2t} can be computed as:

$$e_{1t} = (\varepsilon_{Wt} + b_{12}\varepsilon_{Et})/(1 - b_{12}b_{21}) \quad \textit{(4.13)}$$

$$e_{2t} = (\varepsilon_{Et} + b_{21}\varepsilon_{Wt})/(1 - b_{12}b_{21}) \quad \textit{(4.14)}$$

Since ε_{Wt} and ε_{Et} are white noise processes, it follows that both e_{1t} and e_{2t} have zero means, constant variances and are individually serially un-correlated. However, the critical point to be noted is that the covariance between e_{1t} and e_{2t} will not be zero so that two shocks will be correlated. In the special case where $b_{12} = b_{21} = 0$ (i.e. if there are no contemporaneous effects of W_t on E_t and E_t on W_t) the shocks will be uncorrelated. It is useful to determine the variance and covariance matrix of the e_{1t} and e_{2t} shocks as:

$$\Sigma = \begin{bmatrix} \text{var}(e_{1t}) & \text{cov}(e_{1t}, e_{2t}) \\ \text{cov}(e_{1t}, e_{2t}) & \text{var}(e_{2t}) \end{bmatrix}$$

Since all elements of Σ is time independent, we can use the more compact form:

$$\Sigma = \begin{bmatrix} \sigma_1^2 & \sigma_{12} \\ \sigma_{21} & \sigma_2^2 \end{bmatrix}$$

Where var (e_{it}) = σ_i^2 and $\sigma_{12} = \sigma_{21} = \text{cov}(e_{1t}, e_{2t})$.

Now let me discuss the different steps that are associated with the computation of VAR models:

4.3.3.1 Selection of Variables in the System:

The variables to be included in the VAR are selected according to the relevant economic model. Otherwise, no explicit attempt is made to 'pare down' the number of parameter estimates. Suppose a multivariate VAR is given as follows:

$$X_t = A_0 + A_1 X_{t-1} + A_2 X_{t-2} + \dots\dots\dots\dots\dots + A_p X_{t-p} + e_t \qquad (4.15)$$

Where,

X_t = an (n x 1) vector containing each of the n variables included in the VAR

A_0 = an (n x 1) vector of intercept terms

A_i= (n x n) matrices of coefficient, and

e_t = an (n x 1) vector of error terms.

In the above example, the matrix A_0 contains n intercept term and each matrix A_i contains n^2 coefficients, hence $n+pn^2$ terms need to be estimated.

4.3.3.2 Test of Stationarity:

Before estimating the VAR, Unit Root tests will be applied to examine the stationary properties of the variables. Here in the study, two Unit Root tests *viz.* Augmented

Dickey-Fuller (ADF) test and Phillips- Perron (PP) test have been conducted to examine the stationary properties of the variables. The detailed discussions regarding these tests have already been discussed in the previous section.

4.3.3.3 Choice of Lag Length:

To check lag length, first, a longest plausible length or the longest feasible length is chosen given degrees of freedom considerations. For example, using quarterly data, lag length of 12 is chosen. Second, the VAR is estimated and variance and covariance matrix of residuals is formed. Variance and covariance matrix of residuals from the 12-lag model can be called as $\sum_{12}$. Now suppose we want to determine if 8 lag is appropriate. After all restricting the model from 12 to 8 lags would reduce the number of estimated parameters by 4n in each equation.

Since the goal is to determine whether lag 8 is appropriate for all equations, an equation by equation F-test on lags 9 through 12 is not appropriate. Instead the proper test for this cross equation restriction is a likelihood ratio test. Now the VAR is re-estimated over the sample using eight lags and variance and covariance matrix of residuals $\sum_8$ is obtained. The likely-hood ratio statistic is:

$$(T)\,(\log|\Sigma_8| - \log|\Sigma_{12}|\,)$$

Sims (1980) recommends using

$$(T-c)\,(\log|\Sigma_8| - \log|\Sigma_{12}|\,)$$

Where, T = number of usable observations, c = number of parameters estimated in each equation of the unrestricted system; and $\log|\Sigma_n| =$ is the natural logarithm of the determinant of $\sum_n$. In the example given above c = 12n+1, since each of the equations of the unrestricted model has 12 lags for each variable plus an intercept term.

This statistic has the asymptotic χ^2 distribution with degrees of freedom equal to the number of restrictions in the system. Clearly, if the restriction of a reduced number of lags is not binding, then $\log|\Sigma_8|$ will be equal to $\log|\Sigma_{12}|$. Large values of this sample statistic would mean the restriction of only lag 8 is binding, hence we can reject the null hypothesis that lag length = 8. If the calculated value of the statistics less than χ^2 at a specified significance level, then null of only 8 lags cannot be rejected. In this way lag length of a VAR model gets determined and once it is determined, the model can be estimated by applying the Ordinary Least Square (OLS) method.

4.3.3.4 Exogeneity in VAR Model:

A necessary condition for the erogeneity of W_t is that current and past values of E_t do not affect W_t. The sequence $\{W_t\}$ may not be exogenous to $\{E_t\}$ even though $\{E_t\}$ does not Granger cause $\{W_t\}$. Because pure shocks to $\{E_t\}$ i.e. ε_{Et} may affect the value of $\{W_t\}$ though $\{E_t\}$ sequence does not Granger cause the $\{W_t\}$ sequence.

A block erogeneity test is useful for detecting whether to incorporate a variable into a VAR. Given the above distinction between causality and exogenity, the multivariate generalization of the Granger causality test should be called a ‘block causality’ test. In any event the issue is to determine whether lags of one variable say W_t Granger cause any of the variables in the system. In the three variable case with W_t, E_t and L_t, the test whether lags of W_t Granger cause either E_t or L_t. In essence, the block exogenity restricts all lags of W_t in the L_t and E_t equations to be equal to zero. This cross equation restriction is properly tested using the likely hood ratio test given as follows:

$$(T-c)\,(\log|\Sigma_r| - \log|\Sigma_u|)$$

Where, Σ_u and Σ_r are the variance and covariance matrixes of the unrestricted and restricted systems respectively.

4.3.3.5 Impulse Response Function (IRF):

An essential tool to analyze the dynamic interrelationships among variables in a VAR is the vector moving average (VMA) representation. Just as an auto regression has a moving average representation, a VAR can be written as a VMA.

Recalling the equation (4.9) we have,

$Bx_t = \Gamma_0 + \Gamma_1 x_{t-1} + \varepsilon_t$, which represents a VAR in primitive form. The VMA representation of an equation (4.9) expresses the variables W_t and E_t in terms of current and past values of the two shocks ε_{St} and ε_{Et}.

Writing (4.10) and (4.11) in matrix form; we get

$$\begin{bmatrix} W_t \\ E_t \end{bmatrix} = \begin{bmatrix} a_{10} \\ a_{20} \end{bmatrix} + \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix} + \begin{bmatrix} W_{t-1} \\ E_{t-1} \end{bmatrix} + \begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} \tag{4.16}$$

Now, recalling the VAR model in standard form i.e. equation (4.10) we have,

$x_t = A_0 + A_1 x_{t-1} + e_t$

If we iterate backwards and assume that stability condition is met, then the particular solution for x_t is:

$$x_t = \mu + \sum_{i=o}^{\infty} A_1^i e_{t-i} \tag{4.17}$$

Where $\mu = [\overline{W}, \overline{E}]$

Using equation (4.16) we can rewrite equation (4.15) as

$$\begin{bmatrix} W_t \\ E_t \end{bmatrix} = \begin{bmatrix} \overline{W} \\ \overline{E} \end{bmatrix} + \sum_{I=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}^i \begin{bmatrix} e_{1t-i} \\ e_{2t-i} \end{bmatrix} \tag{4.18}$$

Equation (4.16) expresses W_t and E_t in terms of the $\{e_{1t}\}$ and $\{e_{2t}\}$ sequences. However it is insightful to rewrite (4.17) in terms of $\{\varepsilon_{Wt}\}$ and $\{\varepsilon_{Et}\}$ sequences. From equation (4.12) and (4.13) the vector of error terms can be written as:

$$\begin{bmatrix} e_{1t} \\ e_{2t} \end{bmatrix} = (1/1 - b_{12} b_{21}) \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{Wt} \\ \varepsilon_{Et} \end{bmatrix} \tag{4.19}$$

So that (4.17) and (4.18) can be combined to form:

$$\begin{bmatrix} S_t \\ E_t \end{bmatrix} = \begin{bmatrix} \overline{S} \\ \overline{E} \end{bmatrix} + (1/1 - b_{12} b_{21}) \sum_{i=0}^{\infty} \begin{bmatrix} a_{11} & a_{12} \\ a_{21} & a_{22} \end{bmatrix}^i \begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix} \begin{bmatrix} \varepsilon_{St} \\ \varepsilon_{Et} \end{bmatrix} \tag{4.20}$$

To simplify the above notation, now define the 2 x 2 matrix Φ_i with elements $\Phi_{jk}(i)$ such that:

$$\phi_i = [A_1^i /(1-b_{12}b_{21})]\begin{bmatrix} 1 & b_{12} \\ b_{21} & 1 \end{bmatrix}$$

Hence moving average representation of (4.18) and (4.19) can be written in terms of $\{\varepsilon_{Wt}\}$ and $\{\varepsilon_{Et}\}$ sequences:

$$\begin{bmatrix} W_t \\ E_t \end{bmatrix} = \begin{bmatrix} \overline{W} \\ \overline{E} \end{bmatrix} + \sum_{i=o}^{\infty} \begin{bmatrix} \phi_{11}(i) & \phi_{12}(i) \\ \phi_{21}(i) & \phi_{22}(i) \end{bmatrix} \begin{bmatrix} \varepsilon_{Wt-i} \\ \varepsilon_{Et-i} \end{bmatrix}$$

or more compactly:

$$X_t = \mu + \sum_{i=0}^{\infty} \phi_i \varepsilon_{t-i} \quad (4.21)$$

The moving average representation is an especially useful to examine the interaction between $\{W_t\}$ and $\{E_t\}$ sequences. The coefficients of ϕ_i can be used to generate the effects of ε_{Wt} and ε_{Et}shocks on the entire time paths of the $\{W_t\}$ and $\{E_t\}$ sequences. The four elements ϕ_{jk} (0) are called as impact multipliers. For example the coefficient ϕ_{12} (0) is the instantaneous impact of a one unit change in ε_{Et} on W_t. Similarly, the elements ϕ_{11} (1) and ϕ_{12} (1) are the one period response of unit changes in ε_{Wt-1} and ε_{Et-1} on W_t respectively.

The four sets of coefficients $\phi_{11}(i)$, $\phi_{12}(i)$, $\phi_{21}(i)$ and $\phi_{22}(i)$ are called impulse response function. Plotting the impulse response functions [i.e. plotting the coefficients of $\phi_{jk}(i)$ against i]is a practical way to visually represent the behaviour of the $\{W_t\}$ and $\{E_t\}$ series in response to the various shocks. With knowledge of knowing all the parameters of the primitive system (4.7)and (4.8) it is possible to trace out the time paths of the effects of pure ε_{Wt} or ε_{Et} shocks. However, this methodology is not applicable if the estimated VAR is under or over identified. Here in this example the estimated VAR is under identified, because primitive VAR systems contains 10 parameters but VAR in standard form contains only 9 parameters. So an additional restriction on the VAR system must be imposed in order to identify the impulse responses. One possible identification restriction is to use the *Choleski decomposition*. For example, it is possible to contain the system such that the contemporaneous value of W_t does not have a contemporaneous effect on E_t. Finally, this restriction is represented by setting $b_{21} = 0$ in the primitive system. In terms of (4.19) the error terms can be decomposed as follows:

$$e_{1t} = \varepsilon_{Wt} + b_{12}\varepsilon_{Et} \qquad (4.22)$$

$$e_{2t} = \varepsilon_{Et} \qquad (4.23)$$

Equation (4.22) shows all the observed errors from the $\{e_{2t}\}$ sequence are attributed to ε_{Et} shocks. Given the calculated $\{\varepsilon_{Et}\}$ sequence, knowledge of the values of the $\{e_{1t}\}$ sequence and the correlation coefficient between e_{1t} and e_{2t} allows for the calculation of the $\{\varepsilon_{Wt}\}$ sequences using (4.22). Although this decomposition contains the system such that anε_{Wt} shock has no direct effect on E_t, there is an indirect effect in that lagged values of W_t affect the contemporaneous value of E_t. The key point is that the decomposition forces potentially important asymmetry on the system since an ε_{Et} has contemporaneous effects on both W_t and E_t. For this reason equation (4.22) and (4.22) imply an ordering of variables. An ε_E shock directly affects e_{1t} and e_{2t} but a ε_{Wt}shocks does not affect e_{2t}. Hence,E_t is 'prior' to W_t. Alternatively by putting $b_{12} = 0$, the errors can be decomposed as:

$$e_{1t} = \varepsilon_{Wt}$$

$$e_{2t} = b_{21}\varepsilon_{Wt} + \varepsilon_{Et}$$

It is crucial to note that the importance of the ordering depends on the magnitude of the correlation coefficient between e_{1t} and e_{2t}. For example if the correlation coefficient is equal to zero, the ordering is immaterial. Finally, (4.22) and (4.23) can be replaced with $e_{1t} = \varepsilon_{Wt}$ and $e_{2t} = \varepsilon_{Et}$. On the other hand, if the correlation coefficient is unity (so that two shocks are equivalent), it is inappropriate to attribute the shock to a single source.

4.3.3.6Variance Decomposition:

Variance decomposition is used to detect the causal relation among the variables. It explains the extent to which a variable is explained by the shocks in all the variables in the system. The forecast error variance decomposition explains the proportion of the movements in a sequence due to its own shock versus shocks to the other variable. The VAR in standard form i.e. (4.14) is written as follows:

$$X_t = A_0 + A_1 X_{t-1} + e_t$$

Now suppose the coefficient A_0 and A_1 is known and we want to forecast the various values of X_{t+i} conditional on the observed value of X_t. Updating the above equation by one period (i.e. $X_{t+1} = A_0 + A_1X_t + e_{t+1}$) the conditional expectation of X_{t+1} is:

$$E_tX_{t+1} = A_0 + A_1X_t$$

Here one step ahead forecast error is $X_{t+1} - E_tX_{t+1} = e_{t+1}$. Similarly the two steps ahead forecast error of X_{t+2} are:

$$E_tX_{t+2} = [1 + A_1]\ A_0 + A_1^2X_t$$

The two steps ahead forecast error [i.e. the difference between the realization of X_{t+2} and the forecast] is $e_{t+2} + A_1e_{t+1}$. In general the n-step ahead forecast is:

$$E_tX_{t+n} = [1+A_1+A_1^2+ \ldots\ldots\ldots+A_1^{n-1}]A_0 + A_1^nX_t$$

And that the associated forecast error is:

$$e_{t+n} + A_1e_{t+n-1} + A_1^2\ e_{t+n-2} + \ldots\ldots\ldots\ldots + A_1^{n-1}e_{t+1}.$$

It is possible to write the forecast errors in terms of the ε_{St} and ε_{Et} shocks. The forecast error variance decomposition tells the proportion of the movements in a sequence due to its own shock versus shocks to the other variable. If ε_{yt} shocks explain none of the forecast error variance of ε_{St} at all forecast horizons, it can be said that $\{W_t\}$ sequence is exogenous. In such a circumstance, the $\{W_t\}$ sequence would evolve independently of the ε_{Et} shocks and of $\{E_t\}$ sequence. On the other hand if ε_{Et} shocks explain all of the forecast error variance in $\{W_t\}$ sequence at all forecast horizons then $\{W_t\}$ would be entirely endogenous.

4.4 Description of Variables and Data Source:

The variables considered in the above model are labour productivity (real gross value added per workers: LP_1), real wages (real wages paid to workers: RW_1) and employment (number of workers: E_1). In order to measure the variables, we have used the data on gross value added, number of workers, total wages to workers, WPI and CPI of industrial workers (CPI_{iw}).The labour productivity is defined as real gross value added per workers. Following Goldar (1986), we have preferred gross value added as an index of output in place of net value added because depreciation charges in the Indian industries are known to be highly arbitrary, fixed by income tax authorities and seldom represent actual consumption. The concepts those are published in the ASI on payments to labour are wages to a worker, total emoluments, and contribution to provident fund, other welfare expenses as labour compensation. The present chapter has taken total wages and extended emoluments (emoluments + provident funds and other benefits) as labour compensation corresponds to the number of workers and total person engaged. Similarly, the concepts on labour employments include workers, employees, total person engaged. The present study considers workers (E_1) and total person engaged (E_2) as labour variables. However, due to discontinuation of data since 1997-98, number of employees cannot be used as labour variable. As ASI provide value added and wage variables in nominal term, we have used the respective WPI and CPI_{iw}series to arrive at a real gross value added and real wages. For the empirical time series analysis, we have considered real value added per workers as labour productivity (LP_1), real wages (RW_1) as representative of real wage and total number of workers (E_1) as employment variables. This preference can have two justifications, first, to have a consistent time series data based on the uniformity of the approach of the variables, where the labour productivity, labour compensation is explained for the corresponding labour variables. Secondly, these series are consistently available over the entire study period over 1973-74 to 2007-08.

The present study uses annual data spanning the period from 1973-74 to 2007-08. The data are collected from Annual Survey of Industries (ASI) published by the Central Statistical Organization. Besides, the study has also relied on the Economic Political Weekly (EPW) Research Foundation, data base on Indian Manufacturing sector. The data on Wholesale Price Index (WPI) and Consumer Price Index of industrial workers (CPI_{iw}) have been collected from various issues of Handbook of Statistics on Indian Economy, published by the Reserve Bank of India (RBI). WPI deflector for respectively 2-digit industry groups with 1993-94 as the base is used to deflate output, while the CPI for industry workers at 1993-94 are used to adjust inflationary effect on the labour payment variable.

4.5 Growth and Trend Analysis:

In this section, we embark on growth and trend analysis of wage, employment and productivity. This facilitates to understand the broad trend of these variables. Further, this section tries to analyses the relationship between the wages and employment, wages with productivity and employment with productivity of Indian Manufacturing sector. The present analysis is carried on both at aggregate and disaggregated 2–digit industrial group level[15].Before proceed to our empirical part of this chapter, we first present the trends of number of factories, number of workers, number of non-workers, total persons engaged, labour compensation per workers, labour compensation per person engaged, productivity per workers, productivity per person engaged, average number of workers per factory, average number of non-workers per factory and average number of person engaged per factory of Indian manufacturing sector over the period of 35 years of the study.

Table-4.1: Trends of Wages, Employment and Productivity in Aggregate Manufacturing.

(In percentage and in numbers)

Variables	1973-07	1973-79	1980-89	1990-99	2000-07
Number of Factories	2.04	8.15	1.01	2.07	2.53
Number of Workers	1.31	4.28	-0.24	1.58	5.88
Number of Non-workers	1.34	-	0.26	1.93	5.02
Total Person Engaged	1.29	-	-0.13	1.67	5.70
Labour Compensation per Workers	1.37	5.43	3.56	0.04	0.08
Labour Compensation per Person Engaged	2.18	-	3.87	1.87	1.12
Productivity per Workers	5.73	2.00	7.28	7.44	8.14
Productivity per Person Engaged	6.16	-	7.17	7.33	8.34
Average No. of Workers per Factory	56	64	56	52	51
Average No. of Non-workers per Factory	16	-	16	16	15
Average No. of Person per Factory	69	-	73	68	66

- refers to non-availability of data.

Note: Figures in the table represents compound growth rates. The growth rates are showing the antilogarithms of the relevant regression co-efficient minus one when the equations estimated are of the form $LnY = \alpha + \beta T$, where LnY stands for Natural Logarithm of the dependent variable 'Y' and 'T' refers to time. Variables in row 9 -11, are in numbers.

[15] The present study only consider 2-digit NIC industrial groups for the analysis not only for convenience rather, with frequent change in NIC and methodology related to collect and compilation of data, it is not possible to get a time series data on further disaggregated NIC levels for such a long period.

Source:Author's compilation from Annual Survey of Industries, CSO, EPW Research Foundation and Handbook of Statistics on Indian Economy: Reserve Bank of India.

Table 4.1 represents the trends of the important variables, which provide information about the dynamics of labour productivity, employment and real wages in Indian manufacturing. The period of analysis spanning from 1973-74 to 2007-08, which is further divided into four sub-periods to better understand the trend of growth. The four sub-periods are (i) 1973-74 to 1979-80, which is considered to be the period of industrial recovery or pre-reform period, (ii) 1980-81 to 1989-90, represent by and large, the creeping liberalization phase, during this period most of the reforms have been initiated under Mr. Rajiv Gandhi's Prime-Ministership, (iii) 1990-91 to 1999-2000, the decade when India embarks liberalization lastly, 2000-01 to 2007-08, a period which has seen significant implications and advantages of the LPG policies implemented during the nineties.

From Table 4.1, it is observed that the trends of most of the variables are following one way or another. Number of factories in Indian manufacturing have registered the least rate of growth (1.01%) during the eighties, followed by the highest growth (8.15%) registeredduringinseventies. However, the growth of a number of factories has recovered during the post reform periods. Employment variables, such as the number of workers, number of non-workers and total person engaged during the period of the study, revealed a rising trend. With a negative growth registered during 80s, employment variables recovered gradually in the reform period and the employment growth has accelerated significantly during the period 2000-01 to 2007-08, with number of workers and total person engaged grew at an annual average rate of 5.88% and 5.70% respectively. While looking at productivity growth, we observed that growth of productivity per workers (LP_1) and productivity per person engaged (LP_2) are rising constantly. However, we do not observe the same trend in labour compensation. Though labour productivity has risen consistently since eighties labour compensation to workers (real wage per workers: RWW) and labour compensation to total person engaged (Extended emoluments per person engaged: RWP) were showing weak trend over the period. Real wage per workers is growing at an annual average rate of 1.37% over the entire study period (1973-74 to 2007-08), while it has registered a significantly high growth of 5.43% during the seventies, the period of industrial recovery when the highest numbers of factories were open up (the number of factories growth was 8.15% over the period). After which the growth of labour compensation per workers and per person engaged were eased to 3.56% and 3.87% respectively during eighties. The growth of labour compensation has decelerated since 80s and reached the all time low over the fourth sub-periods 2000-01 and 2007-08 at 0.08% and 1.12% for RWWandRWP respectively. Contrast to classical thought, rising labour productivity does not associated with rising labour compensation per labour in Indian registered manufacturing sector.

Similarly, if we compare the growth rate of labour compensation to that of their corresponding employment growth, we observe that growth rates of real wages to workers (RWW) and persons engaged (RWP) is consistently coming down over the four decades. In both the cases the growth rate has substantially decelerated from the creeping liberalization phase of the eighties to the full liberalisation period of the nineties and beyond that. Contrary to this, the growth rate of employment is substantially accelerated over the same period. Thus, we can conclude that, the employment growth has rebounded in the post reform period of negative growth during the eighties. This finding is contrary to the finding of Mathur and Mishra[16] (2007) work, where they found consistently declining rate of growth of the number of workers and number of employees. While our finding of successive decline trend of the growth rates of wage per workers, is consistent with Mathur& Mishra findings. The major departure of our findings in wage and employment front to that of Mathur and Mishra’s because of the fact that, the difference in the data set as they have taken all India ASI data to represent organized manufacturing while in our case the aggregate manufacturing only representing the sum of 22 two-digit industrial groups. Secondly, it is because of the difference in time periods under consideration to define four sub-periods decade wise. Third, the use of different price base. Moreover, our findings on labour productivity also differ from that of Mathur and Mishra (2007). The growth of labour productivity (LP_1) and LP_2) has consistently risen since the eighties, which Mathur and Mishra observed an easing labour productivity during the eighties that of the seventies and that has further slowed down in the nineties.

[16] Ashok Mathur and Sunil Kumar Mishra (2007), unpublished Paper, Wages, Employment and Productivity presented in the Labour Conference in Chennai.

4.5.1 Growth and Structure of Employment:

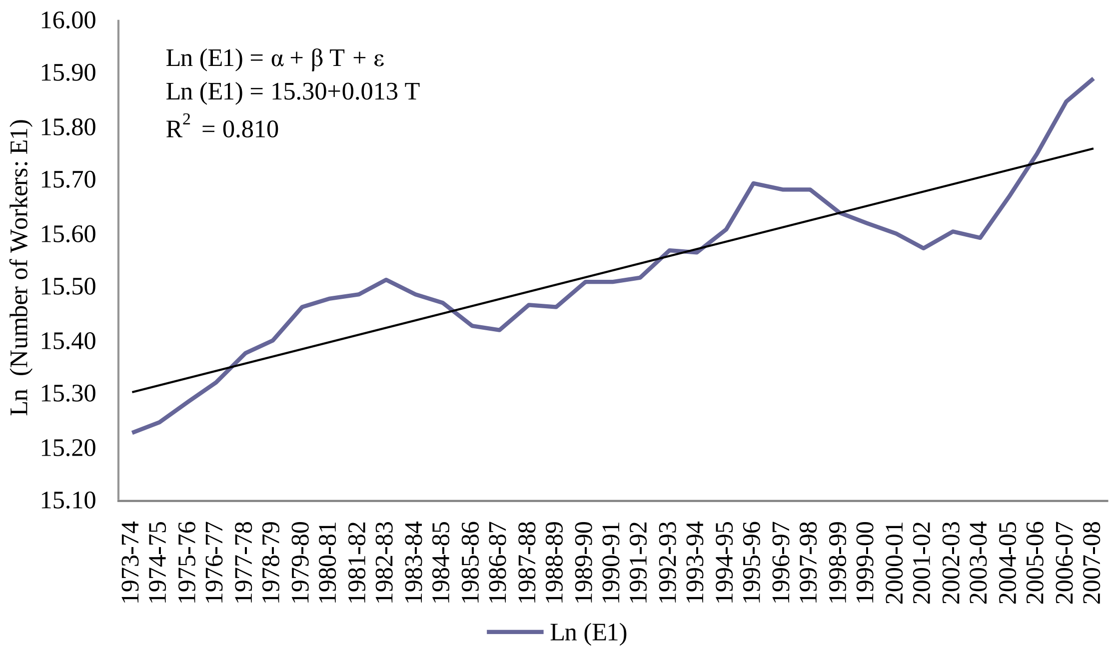
It is clear from the analysis that employment growth is significantly rising in Indian manufacturing. Moreover, from the analysis of the previous chapter, it was clear that the contribution of manufacturing (registered) sector for the employment generation has been very significant during the post liberalization period. In this section, we will elaborately discuss the employment growth and its composition in the organized manufacturing sector.

4.5.1.1 Growth of Employment:

Annual Survey of Industries (ASI) provides data on various labour input such as the number of workers, number of employees and total person engaged. To analyse the employment growth in the Indian manufacturing sector, we consider number of workers (E_1) and total person engaged (E_2) as our labour variables. However, for better understanding of the composition and growth of employment trend we estimate 'number of non-workers', which we derived by deducting the number of workers from total person engaged. In absolute term both number of workers and total person engaged are rising in the post liberalisation period. The total person engaged in the organized manufacturing sector has been rising in the post liberalization period. The trend of the employment growth in the manufacturing as a whole has not been uniform throughout the study period. The employment in terms of the number of workers and the total persons engaged revealed an increasing level of employment in the manufacturing sector up to the year 1995-96. In the next six years i.e. up to 2002-03, the percentage of the manufacturing employment declined. However, the manufacturing sector has experienced a steady rise in employment generation post 2002-03.Goldar (2000) had tried to analyze the pattern of growth in employment in organized manufacturing in the 1990's. The job security regulations were the main cause of the deceleration in the growth of employment. Another cause that came into view was the sharp hike of the real wage. The slowdown in employment growth was the result of capital deepening strategy. The composition of output of the manufacturing changed in favour of less labour intensive industries. There were faster growth in the low employment intensive industries and slow growth in the high employment intensive industries. The distribution of employment by employment size had shown a marked change in favour of small size firms. The firms with 50-500 employees gained very much while the firms with 2000-5000 plus lost significantly[17].

Figure 4.1 and 4.2, represents the growth of the number of workers (E_1) and total person engaged (E_2) are showing the rising trend over the entire period of the study. However, only during the first half of the 90s, employment growth has decelerated. Employment growth of workers and total person engaged was -0.24% and -0.13% respectively, during the eighties, which has recovered to 1.58% and 1.67% during the nineties. However, the growth of employment has significantly increased during 2000-01 to 2007-08, with number of workers and total person engaged growth rebounded to 5.88% and 5.70%. Figure 4.3 shows the growth rate of the number of non-workers was also followed similar trend like Figure 4.1 and 4.2.

Figure 4.1: Growth of Employment (Number of Workers: E1)

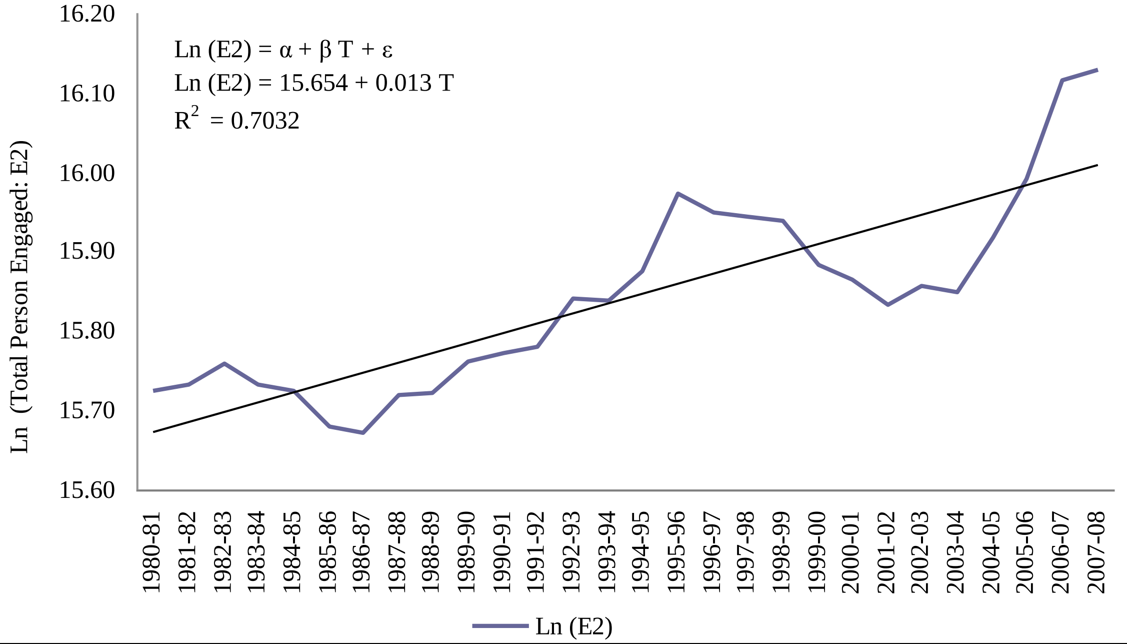


Source: Author's compilation from Annual Survey of Industries, CSO and EPW Research Foundation

[17] Refer the trend analysis of labour productivity by 'Size-of-Employment' in Chapter-III

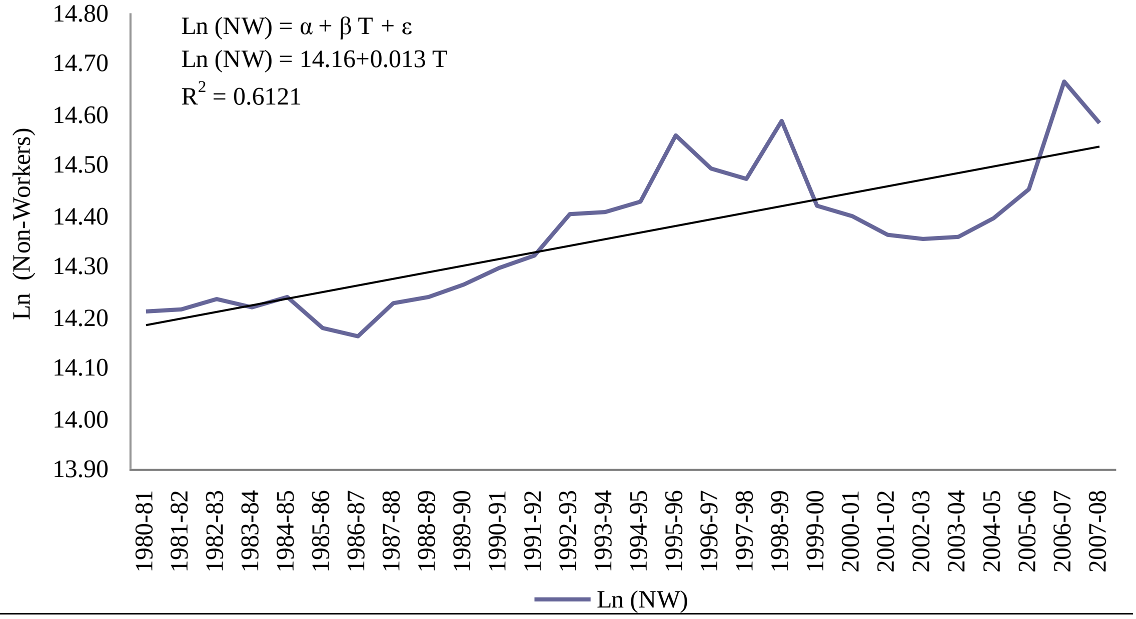
The growth of employment in the manufacturing for the post reform period from 1990-91 to 2007-08 was very much significant. The growth rate for the entire period was 1.31% and 1.29% per annum for number of workers and total person engaged respectively. However, the growth rate of the number of workers and the total person engaged showed a very augmenting growth of5. 88% and 5.70% per annum during the period 2000-01 to 2007-08. Goldar (2011) had tried to explain the discontinuity of unemployment growth in the last 15 years in the organized manufacturing sector. From 1995-96 to 2002-03, the employment had fallen at a rate of 1.5% per annum while in the next five years (2003-04 to 2007-08) it had accelerated at 7.5% per annum. Therefore, the argument of jobless growth is no longer a matter of concern. The recent repairs are due to the structural changes in favor of labour intensive technology. During this period the growth in employment was relatively faster among private companies. The labour intensive of private companies was higher than that of the aggregated level. The disappointing growth of employment is primarily due to labour market rigidities. The industrial disputes act caused nearly 3 million less jobs. However, the interest rate differentiates in the employment growth has proven the fact that the different degrees of relation given to the laws by the states contributing to the differentials.

Figure 4.2: Growth of Employment (Total Person Engaged: E2)



Source: Author's compilation from Annual Survey of Industries, CSO and EPW Research Foundation

Figure 4.3: Growth of Employment (Number of Non-workers)



Source: Author's compilation from Annual Survey of Industries, CSO and EPW Research Foundation

Table 4.2, represents the compound growth rate of employment and labour productivity of disaggregate 2-digit industry groups. At disaggregated 2-digit group level, the growth of employment varies across 2-digit industrial groups. Wearing apparel (18), Rubber & Plastic products (25), Fabricated Metal products (28) and Furniture manufacturing (36) are the groups with the highest growth rate during the entire period of study, Table 4.2. However, industrial groups such as Woods products (20), Publishing and printing (22), Non-metallic minerals (26), Accounting and computing machines (30) and Other transport equipments (35) have experienced negative employment growth for the entire period of study. Tobacco products (16), Leather products (19), Paper products (21), Petroleum products (23), Chemical products (24), Non-metallic products (26), Electrical machinery (31), Radio, television and communication (32), Medical precision and optical (33) and Motor vehicles

(34) have above average employment growth. These industries are capital-intensive in nature. Having said this, the high growth rate of employment in these 2-digit industry groups is recited either due to increased use of labour intensive technology or as a mere accumulation of capital. As a result of which, the demand for labour increases. The other industries have also registered growth, but the trend is very slow. The industries except electrical and transport industries, are supposed to be labour- intensive. These industries have a large employment base, which may be an important reason to report slow growth.

At 2-digit level the growth rates of employment in different industries in different sub-periods are entail a different story. During the seventies, the employment growth was above average for a majority of 2-digit groups, whereasduringeighties, we observed a weak employment growth. More than half of the 22 two-digit groups have negative or zero employment growth. However, with the introduction of LPG policy in the early 90s, the employment growth in the aggregate manufacturing, recovered to 1.58% (workers) and 1.67% (total person engaged) per annum from the negative growth of -0.24% and -0.13% respectively in 80s. In the post liberalization period Wearing apparel (18), Leather products (19), Non-metallic mineral products (26), Basic metals (27), Fabricated Metal products (28), Machinery Equipments (29), Office accounting & computing machinery (30), Electrical Machinery (31), Motor vehicles (34), Other transport equipments (35) and Furniture & other manufacturing (36) registered high growth rates. The government provides various incentives as a policy measures to support highly capital intensive industries. Moreover the financial support to acquire more advance machineries through import also encouraged along with rising FDI investment are the factors that have enhanced employment growth.

Table 4.2: Employment and Productivity Growth in Indian Manufacturing Sector

(In percentage)

2-Digit Code	1973-74/1980-81 to 2007-08				1973-74 to 1979-80				1980-81 to 1989-90				1990-91 to 1999-00				2000-01 to 2007-08			
	E_1	**E_2**	**O/E_1**	**O/E_2**	**E_1**	**E_2**	**O/E_1**	**O/E_2**	**E_1**	**E_2**	**O/E_1**	**O/E_2**	**E_1**	**E_2**	**O/E_1**	**O/E_2**	**E_1**	**E_2**	**O/E_1**	**O/E_2**
15	0.83	1.02	5.74	5.45	4.35		4.38		-2.31	-2.34	12.05	12.10	1.99	1.82	6.76	6.94	2.89	2.66	6.90	7.13
16	2.07	1.10	3.78	4.70	16.98		-3.54		0.90	0.66	6.48	6.74	0.42	0.21	5.59	5.81	-2.43	-2.53	4.24	4.35
17	-0.38	-0.02	5.33	5.49	2.24		4.34		-1.97	-1.87	6.87	6.76	0.86	0.92	7.18	7.12	4.73	5.86	6.92	5.77
18	10.04	10.70	4.50	3.31	18.02		6.76		9.16	9.07	11.97	12.06	10.76	10.26	-1.78	-1.34	13.05	13.26	3.67	3.47
19	3.93	3.72	3.04	3.19	6.20		-2.44		5.98	-1.23	5.20	5.31	1.44	1.81	4.12	4.43	7.27	6.53	2.63	3.34
20	-0.96	5.87	1.14	1.29	2.37		2.17		-1.24	-1.36	4.39	4.51	-2.07	-0.39	-5.13	-4.76	5.01	4.54	4.99	5.46
21	2.10	1.15	2.04	3.17	4.58		-5.36		-0.47	-2.44	6.60	6.51	2.48	2.42	0.28	0.34	5.89	5.11	3.11	3.87
22	-1.32	-1.12	4.21	2.83	1.13		4.14		-2.24	-1.72	0.79	0.26	-3.59	-2.63	7.27	6.22	4.78	4.81	10.11	10.09
23	3.51	2.36	5.95	8.58	8.36		0.42		-0.03	0.39	21.28	20.78	1.45	1.68	-0.03	-0.26	8.54	7.54	14.44	15.50
24	2.50	2.38	5.68	5.85	6.46		6.65		2.44	2.32	6.65	6.77	3.27	3.57	2.81	7.06	3.47	3.22	5.49	5.76
25	4.32	4.24	5.28	5.77	5.79		7.84		3.61	3.41	7.84	8.06	5.87	5.90	7.19	7.17	6.18	5.67	0.37	0.85
26	1.85	1.37	6.31	6.44	3.07		8.15		1.13	1.38	8.15	7.89	-0.37	-0.42	6.95	7.02	5.87	5.73	9.68	9.83
27	0.78	0.13	5.94	7.51	2.43		3.74		0.39	-0.11	3.74	4.22	0.45	0.29	11.15	11.34	8.65	7.81	9.52	10.38
28	5.06	2.72	4.41	5.20	2.83		3.59		3.24	1.61	3.59	3.46	2.74	2.38	6.83	7.21	13.17	12.09	8.31	9.36
29	0.34	0.21	5.46	6.05	1.49		4.34		-0.95	-0.24	4.34	3.60	0.92	2.71	9.63	7.71	7.14	6.01	8.00	9.17
30	-0.13	-1.49	8.05	8.23	8.05		3.41		-1.97	-0.19	12.01	10.02	-3.53	-6.15	-0.99	1.78	9.42	7.06	-0.23	1.96
31	1.94	1.49	6.02	6.59	2.46		3.13		1.60	1.68	4.95	4.86	0.94	0.35	8.89	9.53	8.80	7.46	10.56	11.94
32	2.13	1.61	7.58	7.58	5.37		2.30		6.40	7.75	11.60	10.20	1.86	1.22	6.32	6.99	6.05	3.70	0.96	3.25
33	2.40	2.40	6.14	5.68	5.08		11.08		3.02	3.59	3.73	3.17	3.61	4.28	10.89	10.18	6.90	5.73	5.44	6.61
34	3.28	3.13	5.48	6.34	4.11		1.67		1.14	1.06	4.23	4.32	4.94	4.84	7.86	7.96	12.45	11.05	8.69	10.06
35	-0.92	-2.38	7.35	9.28	2.77		7.02		-0.87	-0.86	4.61	4.58	-5.06	-4.84	11.43	11.18	6.25	5.27	7.52	8.52
36	4.65	6.36	1.59	1.25	-1.26		3.15		0.93	0.83	8.71	8.83	10.09	9.57	8.71	-1.48	11.68	10.91	2.04	2.76
AM	1.31	1.29	5.73	6.16	4.28		2.00		-0.24	-0.13	7.28	7.17	1.58	1.67	7.44	7.33	5.88	5.70	8.14	8.34

Note: Figures in the table represents compound growth rates. The growth rates are showing the antilogarithms of the relevant regression co-efficient minus one when the equations estimated are of the form $LnY = \alpha + \beta T$, where LnY stands for Natural Logarithm of the dependent variable 'Y' and 'T' refers to time.
*Source:*Author'scompilation from Annual Survey of Industries and EPW Research Foundation

From Table 4.2, it is observed that, during 2000-01 to 2007-08, Indian manufacturing experienced the highest employment growth. All the two-digit groups except Food products (15) and Tobacco products (16, registered a negative growth) have seen a sharp rebound in the employment growth. Amid open up of the world trade and rising domestic demand, employment growth has improved significantly to cater the rising market demand. Also the period from 2001-2004 during the NDA government, the employment growth in India was very high, which showed the glimpses of the positive effects of the new economic policy. As a result of which, the labour market rigidities were reduced. Thus, during this sub-period, the growth rate was highest among all the sub-periods and significantly higher than the average growth rate. Development policy favoring manufacturing rectifies an economic imbalance and gives a dynamic momentum. The manufacturing sector involved in the characteristics of increasing returns to scale and the economies of scale. These embodied characteristics of the manufacturing sector, have been proven operators in the case of India. The productivity of the Indian manufacturing sector is largely dependent upon the operation of economies of scale. It is found that in the large employment size factories the productivity is higher. This is only because of the use of the roundabout technology of production and greater division of labour. The greater division of labour raises the labour productivity. In the meantime, the large scale operation in the production and the use of specialized machinery invites more and more employment opportunity. Das (2007) examined the Kaldor’s hypothesis by linking the growth of output, employment and productivity for India in the pre and post reform phases. Kaldorargued for a highly significant relationship between capital intensity and rising productivity. However, he observed that output growth played an important role in determining productivity and employment growth. The faster the rate of output growth through capital intensity in manufacturing industry, the faster will be the rate of labour transference from outside manufacturing.

4.5.1.2 Structure of Manufacturing Employment:

After analyzing the employment growth and its trends in Indian manufacturing, now we examine the structure and composition of employment in the Indian manufacturing sector. As mentioned in the previous section, ASI provides many types of labour variables for Indian manufacturing such as the number of workers, number of employees and total person engaged. In this context, we are interested to analyse the pattern of employment composition in this section. In order to study the standard of living of the manufacturing labour it is always necessary to have information about the composition of the labour force. The labourers used in the manufacturing are either wage worker or marginal workers. The difference in the skill of wage workers and the managerial employees gets reflected in the difference of productivity and also in the compensation paid to the labour for the labour for the work they have produced with different skill set.

This analysis also throws light on the structure of employment in the 2-digit industrial groups and also helps to determine the different structure that labour and capital-intensive industries follows. It is important to mention over here that employment data on workers is available for the period 1973-74 to 2007-08, while the total person engaged data is only available from 1980-81 onwards. Thus, the structure of the employment in Indian manufacturing can only be analyzed over the coming period of 1980-81 to 2007-08 during which we have information on the number of workers, non-workers and total person engaged. The share of workers in the total person engaged was about 78%in the beginning of the period and it remained almost the same till the end of the 2007-08, (see Figure 4.4). Two-digit industries like Chemical products (24), Machinery and equipments (29), Office accounting & computing machines (30), Electrical Machinery (31), Radio, television & communication equipments (32) and Medical precision & optical instruments (33) has a relatively low share of workers in the total person engaged. These industries are basically capital intensive industries. However, the industrial groups such as Food products (15), Tobacco products (16), Textiles products (17), Wearing Apparel (18), Leather products (19), Paper products (21) and Non-metallic mineral products (26) have employed more than 80% of wage workers in their total labour force and hence are considered as labour intensive industries. The capital-labour ratios of these groups also support this argument. The composition of the workforce is also gradually changing in the Indian manufacturing sector. With the intensification of competition there is huge pressure on the profit margin. Therefore, manufacturing as a matter of fact and strategy prefer to hire more contractual workers than permanent labour, to minimize costs. Though the share of workers in the total employment may have remained stable, but the composition of the number of workers has accommodated an increasing share of contract labour.

Figure 4.4: Share of Workers in Total Person Engaged

Note: E1 and E2 stands for the number of workers and total person engaged

Source: Author's compilation, from Annual Survey of Industries, CSO and EPW Research Foundation

From Figure 4.5, it is surmised that, the share of non-workers (managers and supervisors) have also remained very steady. In the beginning the study year 1980-81, it was 22%, which rises as high as 26% in 1998-99. However, it has fallen down from there and settled at around 21.28% at the end of the study period i.e. 21.28%. From Figure 4.4 and 4.5 it can be concluded that the share of workers are accounted for 80% of the total person engaged. The share of workers in total person engaged is very steady over the period of 28 years under study spanning the period from 1980-81 to 2007-08.

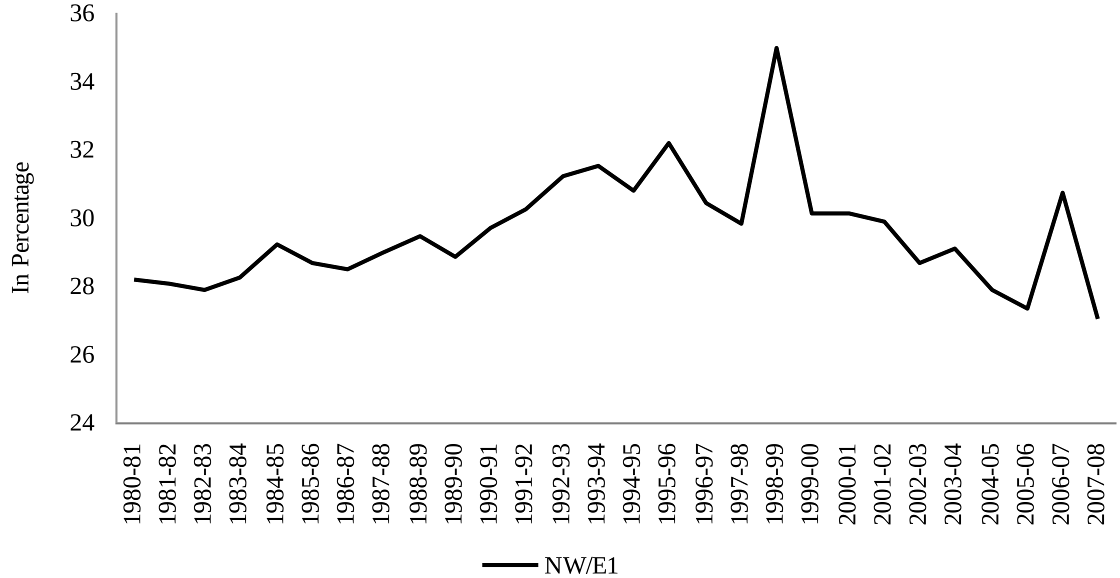
Figure 4.5: Share of Non-Workers in Total Person Engaged

Note: NW and E2 refers to non-workers and total person engaged

Source: Author's compilation, from Annual Survey of Industries, CSO and EPW Research Foundation

Figure 4.6 shows the ratio of non-workers to workers, which gives us an idea about the composition of employment in the Indian manufacturing sector. From this Figure it is observed that nonworkers as percentage of workers was 28% in the initial period of the study, and after that it rises consistently till 1998-99 to 35%. Then it falls down to 27% at the end of the study period in 2007-08. The share of workers in total person engaged remain steady over the study period. However, the number of permanent workers, who are eligible to get all the benefits included Provident Fund and Other Benefits (PF&OB) along with wages paid as their remuneration has not remained steady. In Indian manufacturing studies revealed that, the share of contract labour has been rising throughout the period in the post reforms.

Figure 4.6: Non-Workers to Number of Workers in Indian Manufacturing



Note: NW and E1 stands for non-workers and number of workers

Source: Author's compilation, from Annual Survey of Industries, CSO and EPW Research Foundation

The share of workers in the total person engaged is almost constant and the contract labour in the total workers are increasing. The manufacturing industries are using more and more contract labour toexploite the benefits of provident fund, pension fund, bonus and other special benefits. Therefore, the employers renew the contracts of the worker after the stipulated time period. The renewal of the contracts, labour is mainly given by the employers to better off by the less payments made to the contract workers in comparison to the regular payments of wages and salaries. This in other hand also means accumulation of more profit in these industries, of the less payments made to these contract workers.

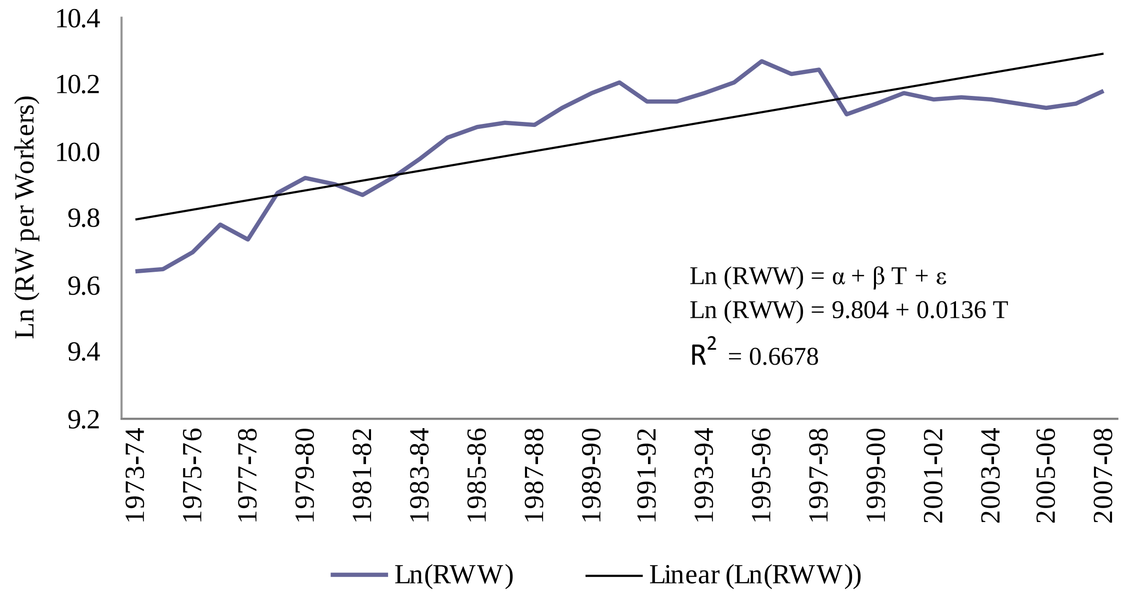
4.5.2 Growth of Labour Compensation in Indian Manufacturing:

After analyzing, the growth of employment and its composition in the Indian manufacturing sector, our main focus is to analyze the growth of labour compensation and its trend. Wage and other benefits paid to the labourers is the compensation paid to the worker and persons engaged in the work they have produced. The more the labors produce, the greater would be the compensation and vice-versa. The higher productivity of labour fetches higher wage. In the same way, the incentive effect of higher labour compensation encourages the worker to work more intensively. So there is always, a circular causation flows between the productivity and labour compensation. Indian manufacturing has seen a rising employment growth in the post reform period, along with the consistent rise in labour productivity.

For the present analysis, we consider a number of workers (E_1) and total person engaged (E_2) as to labour inputs and total real wages (RW_1) and real extended emoluments (RW_2) are considered as labour compensations. We have considered two different labour variables instead of one (in comparison to most research works in this case) to have a better understanding of its employment structure and to cover both micro and macro perspectives. This is also in line with our productivity and employment analysis that we would like to carry out the labour compensation to understand the growth trend of both labour variances. As ASI provides data on number of workers, total wages and total emoluments data for the full period of 35 years (1973-74 to 2007-08), the data on total person engaged is only available over the period of 28 years (1980-81 to 2007-08). Accordingly, our analysis is restricted to the common time period for which the data on different variables is available i.e. the period from 1980-81 to 2007-08.

Figure 4.7 and 4.8 represent the time trend growth of labour compensation per workers and total person engaged respectively. We observed a rising trend of growth for both the figures. However, compare to the seventies and eighties, the growth trend was moderated in the post-liberalisation period. Labour compensation to workers (RWW) has registered an average 1.37% per annum over the entire period of study (1973-74 to 2007-08). During the seventies, it registered the highest rate of growth of 5.43% and then slowed down, but remains resilient at 3.56% during the eighties. However, it is observed that during the post liberalisation period, the growth has significantly fallen down. During the nineties, there is hardly any growth in real wage per workers (0.04% CAGR) which remains weak even during 2000-01 to 2007-08 periods (0.08%).

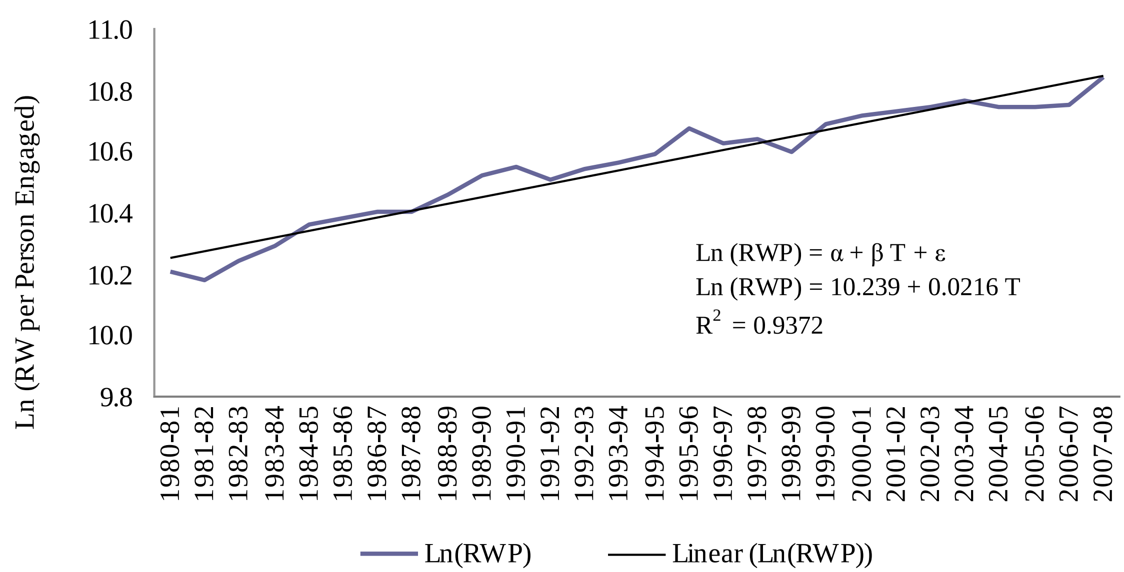
Figure 4.7: Growth of Labour Compensation per Workers (RWW)



Note: RWW refers to labour compensation (Real Wage) per workers

Source: Author's compilation, from Annual Survey of Industries, CSO and EPW Research Foundation

Figure 4.8: Growth of Labour Compensation per Person Engaged (RWP)



Note: RWP stands for labour compensation (Real Extended Emoluments) per person engaged

Source: Author's compilation, from Annual Survey of Industries, CSO and EPW Research Foundation

Similarly, we observed that real wage per person engaged (RWP), grew at an annual average rate of 2.18% over 1980-81 to 2007-08. However, it is only in 80s' it has above average growth of 3.87%, while the growth fell significantly to 1.87% during the 90s and further to 1.12% during 2000-01 to 2007-08. Therefore, it is quite clear now that though the introduction of reforms during early 90s has improved employment growth and productivity, but labour compensation has seen a falling trend over this period. This observation explains that classical postulate of rising labour productivity leads to higher labour compensation does not hold for Indian manufacturing. Moreover, from this, we observed an interesting fact that growth of labour compensation to persons engaged was always higher than that of the growth of labour compensation to workers. This suggests that the compensation to workers is not rising at the same rate to that of non-workers. There is rising disparities in Indian manufacturing and the growth of compensation to clerical, supervisors and managerial staff is much higher than that of workers. This leads to income inequality and in general affect their (industrial workers) overall standard of living.

If the wages were below productivity, firms would find it profitable to hire more workers. This would put upward pressure on wages and because of diminishing returns downward pressure on productivity. Conversely, if the wage was above productivity, firms would find it profitable to share of labour, putting downward pressure on wages and upward pressure on productivity. The equilibrium requires the wage of a worker equaling what that worker can produce. The analysis of per capita emoluments and productivity growth gives a view of a divergent trend between the two. For the full period of study, the RWW and RWPgrew at 1.37% and 2.18% per annum, whereas the productivity growth was 5.73% (per workers) and 6.16% (per person engaged) per annum. As argued, in Indian manufacturing, as the productivity is much higher than that of compensation made to labour, it is beneficial for industry to hire more and more workers to increase their bottom line. However, this does not support the growth rate of employment over the same period, which registered 1.31% and 1.29% per annum for workers and persons engaged respectively.

Table 4.3: Labour Compensation and Productivity Growth in Indian Registered Manufacturing

(In percentage)

2-Digit Code	1973-74/1980-81 to 2007-08				1973-74 to 1979-80				1980-81 to 1989-90				1990-91 to 1999-00				2000-01 to 2007-08			
	RWW	**RWP**	**O/E_1**	**O/E_2**	**RWW**	**RWP**	**O/E_1**	**O/E_2**	**RWW**	**RWP**	**O/E_1**	**O/E_2**	**RWW**	**RWP**	**O/E_1**	**O/E_2**	**RWW**	**RWP**	**O/E_1**	**O/E_2**
15	3.38	3.25	5.74	5.45	7.89		4.38		7.99	8.09	12.05	12.10	0.19	2.38	6.76	6.94	0.55	1.44	6.90	7.13
16	1.54	1.56	3.78	4.70	6.51		-3.54		5.30	2.08	6.48	6.74	0.42	1.26	5.59	5.81	0.50	2.82	4.24	4.35
17	0.25	0.47	5.33	5.49	5.10		4.34		2.22	2.48	6.87	6.76	-2.13	-0.18	7.18	7.12	-1.48	-2.08	6.92	5.77
18	1.49	2.51	4.50	3.31	6.21		6.76		2.38	2.76	11.97	12.06	0.32	1.97	-1.78	-1.34	2.68	2.66	3.67	3.47
19	0.18	0.79	3.04	3.19	5.01		-2.44		0.86	1.71	5.20	5.31	-1.61	0.84	4.12	4.43	1.97	1.34	2.63	3.34
20	1.81	2.47	1.14	1.29	5.72		2.17		3.59	3.56	4.39	4.51	0.90	2.92	-5.13	-4.76	2.03	2.54	4.99	5.46
21	1.30	1.76	2.04	3.17	7.54		-5.36		3.26	3.32	6.60	6.51	-0.63	0.77	0.28	0.34	-3.22	-2.17	3.11	3.87
22	1.77	3.44	4.21	2.83	5.48		4.14		3.62	3.59	0.79	0.26	-0.28	2.78	7.27	6.22	-0.61	2.46	10.11	10.09
23	2.95	4.48	5.95	8.58	4.05		0.42		6.74	6.72	21.28	20.78	3.40	5.15	-0.03	-0.26	-1.71	-1.26	14.44	15.50
24	1.37	2.11	5.68	5.85	7.12		6.65		3.42	3.08	6.65	6.77	-0.47	1.53	2.81	7.06	-0.34	1.34	5.49	5.76
25	0.99	1.35	5.28	5.77	4.84		7.84		2.86	3.14	7.84	8.06	-1.13	0.72	7.19	7.17	-0.07	1.26	0.37	0.85
26	1.50	2.32	6.31	6.44	6.32		8.15		2.63	3.02	8.15	7.89	0.88	3.04	6.95	7.02	-0.99	0.41	9.68	9.83
27	1.77	2.97	5.94	7.51	4.82		3.74		2.45	2.92	3.74	4.22	4.76	3.38	11.15	11.34	-2.22	0.99	9.52	10.38
28	2.38	2.21	4.41	5.20	8.30		3.59		2.86	3.02	3.59	3.46	1.30	2.54	6.83	7.21	-0.57	1.00	8.31	9.36
29	-0.58	3.08	5.46	6.05	1.75		4.34		6.52	3.82	4.34	3.60	3.90	2.45	9.63	7.71	0.59	1.23	8.00	9.17
30	0.64	2.32	8.05	8.23	6.08		3.41		2.95	4.62	12.01	10.02	-2.21	0.23	-0.99	1.78	1.56	-0.18	-0.23	1.96
31	0.99	1.70	6.02	6.59	7.52		3.13		3.24	3.74	4.95	4.86	-1.07	1.13	8.89	9.53	-2.02	-0.09	10.56	11.94
32	1.15	3.50	7.58	7.58	5.02		2.30		2.34	3.80	11.60	10.20	-0.41	2.73	6.32	6.99	-0.41	0.85	0.96	3.25
33	2.10	3.68	6.14	5.68	6.14		11.08		3.77	3.75	3.73	3.17	0.27	3.19	10.89	10.18	-0.09	1.23	5.44	6.61
34	1.64	2.27	5.48	6.34	5.19		1.67		3.95	3.69	4.23	4.32	-0.16	1.72	7.86	7.96	-1.61	-0.34	8.69	10.06
35	1.33	2.50	7.35	9.28	6.10		7.02		3.24	3.45	4.61	4.58	-0.83	1.80	11.43	11.18	0.55	1.08	7.52	8.52
36	1.31	1.56	1.59	1.25	9.63		3.15		4.63	4.10	8.71	8.83	0.19	2.33	8.71	-1.48	2.63	2.54	2.04	2.76
AM	1.37	2.18	5.73	6.16	5.43		2.00		3.56	3.87	7.28	7.17	0.04	1.87	7.44	7.33	0.08	1.12	8.14	8.34

Note: Figures in the table represents compound growth rates. The growth rates are showing the antilogarithms of the relevant regression co-efficient minus one when the equations estimated are of the form $LnY = \alpha + \beta T$, where LnY stands for Natural Logarithm of the dependent variable 'Y' and 'T' refers to time.

Source: Author's compilation from Annual Survey of Industries and EPW Research Foundation

The gap in the growth rates between labour productivity and its compensation was much more than the average manufacturing in the Tobacco products (16), Textile products (17), Chemical products (24), Rubber and plastic products (25), Non-metallic mineral product (26), Basic metals industries (27), Machinery and equipments (29), Office, accounting & computing machinery (30), Electrical machineries (31), Radio, television & communication (32), Motor vehicles, trailers (34) and Other transport equipments (35). In the remaining industries the gap was also increasing, but the divergence was not so fast. The test of the divergences in the four sub periods also presents the same picture, but the rates of divergence were much more in the two sub-periods in the post reform period.

There are various arguments regarding the divergence of productivity and compensation per head. One of the arguments is that the two variables are deflated by different indices and the growth of the two indices might be different. Thus, the gap between the growths of different deflector may contribute to the divergence. In our case, we have used the CPI to adjust labour compensation and GDP deflators for adjusting NVA. The test of growth rates of these two indices assured arguments to be right. The growth rates of these two deflators for different industries were very much different; in fact the CPI grew much faster than the GDP deflator. Balakrishanan and Babu (2003) had investigated the trajectory of growth and its relationship to the distribution in the 1990's. The declining share of wages in the value added also had the highest rate of growth and the improvement in productivity implies towards a shift of income away from workers to capital and land owners. So the increase in productivity had not been passed on to wages. The living standard of the worker, which is calculated as the wage deflator by CPI, had deteriorated and was a result of a rise in the relative price of food grain. The product-wage calculated as the wage deflated by PPI had improved, but were found to be neutralized by the state intervention on behalf of the surplus farmers.

4.5.3 Employment, Wages and Productivity Relationship:

In the previous section, we have discussed the growth trend of employment and labour compensation to that of labour productivity. This section analyses the relationship among these three variables. The present attempt to establishing the relationships between the variables are guided by theoretical approaches discussed earlier in this chapter. Moreover, this provides the impression that the relationship among these three variables differs based on the data, methodology, deflector and time period under consideration. For the purpose of examining the relevant relationship between these variable, two approaches is possible, the first one being with the time-series data. However, the problem associated with this technique is that, we likely to encounter with the auto - correlation problem. Therefore, before going to examine the relationship by using a time - series approach at the aggregate and disaggregate level, we start off the technique with a compound growth rate of labour productivity, real wages and employment over the period spanning from 1973-74 to 2007-08, as the alternative approach.

Moreover, we also need to recognise the problem associated with the data and methodology. The problem associated with the data is that, the figures on employment are available at all Indian level, which can best be converted to micro-level to test the relationship. At present context, we have reduced the 2-digit groups, industries macro-level figures to average wage per labour unit and average number of employed per factory, by considering each 2-digit groups represent as a unit of observation as it was a firm. At the same time we accept the flaws associated with such a methodology of converting data from macro-level to micro-level to establish the wage-employment and productivity relationship.

Table 4.4: Growth Rate of Employment, Labour Compensation and Productivity in Indian Manufacturing

(In percentage)

2-Digit Code	1973-74/1980-81 to 2007-08					
	E_1	E_2	RWW	RWP	O/E_1	O/E_2
15	0.83	1.02	3.38	3.25	5.74	5.45
16	2.07	1.10	1.54	1.56	3.78	4.70
17	-0.38	-0.02	0.25	0.47	5.33	5.49
18	10.04	10.70	1.49	2.51	4.50	3.31
19	3.93	3.72	0.18	0.79	3.04	3.19
20	-0.96	5.87	1.81	2.47	1.14	1.29
21	2.10	1.15	1.30	1.76	2.04	3.17
22	-1.32	-1.12	1.77	3.44	4.21	2.83
23	3.51	2.36	2.95	4.48	5.95	8.58
24	2.50	2.38	1.37	2.11	5.68	5.85
25	4.32	4.24	0.99	1.35	5.28	5.77
26	1.85	1.37	1.50	2.32	6.31	6.44
27	0.78	0.13	1.77	2.97	5.94	7.51
28	5.06	2.72	2.38	2.21	4.41	5.20
29	0.34	0.21	-0.58	3.08	5.46	6.05
30	-0.13	-1.49	0.64	2.32	8.05	8.23
31	1.94	1.49	0.99	1.70	6.02	6.59
32	2.13	1.61	1.15	3.50	7.58	7.58
33	2.40	2.40	2.10	3.68	6.14	5.68
34	3.28	3.13	1.64	2.27	5.48	6.34
35	-0.92	-2.38	1.33	2.50	7.35	9.28
36	4.65	6.36	1.31	1.56	1.59	1.25
AM	1.31	1.29	1.37	2.18	5.73	6.16

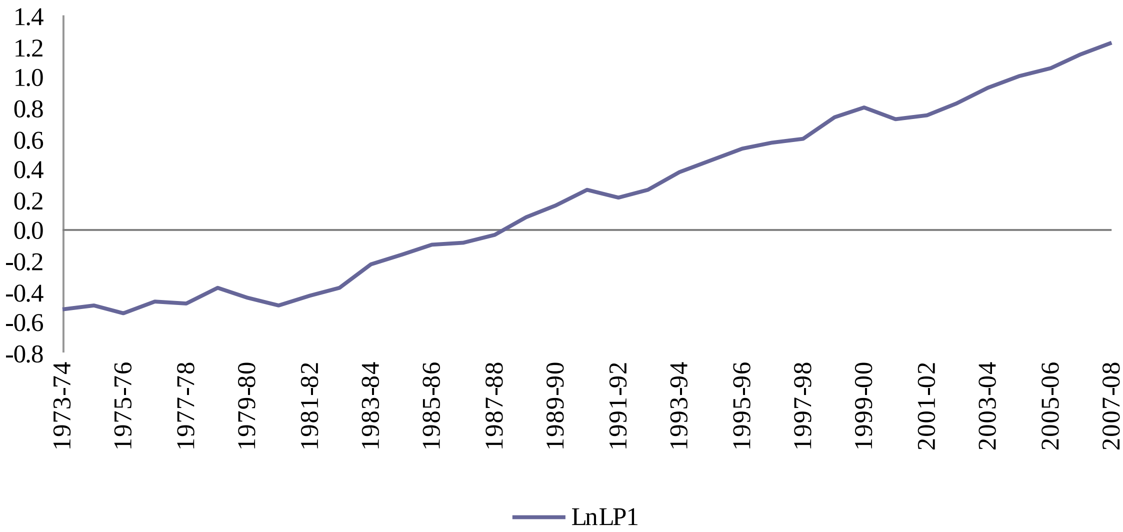
Note: Figures in the table represents compound growth rates. The growth rates are showing the antilogarithms of the relevant regression co-efficient minus one when the equations estimated are of the form $LnY = \alpha + \beta T$, where LnY stands for Natural Logarithm of the dependent variable 'Y' and 'T' refers to time.
The data on E_2, RWP and O/E_2 is only available from 1980-81 onwards, for rest the data is available from 1973-74 onwards.
Source: Author'scompilation from Annual survey of Industries, CSO, EPW Research Foundation

The above table illustrates that the compound growth rate of all the variables over 35 years of study period only, except for the total person engaged (E_2) and labour compensation per person engaged (RWP), for which the data is only available from 1980-81 onwards. From Table 4.4, it is observed that growth of productivity was significantly higher than that of growth of employment and labour compensation for the overall manufacturing. This trend in general also observed in majority of 2-digit industry group level of Indian manufacturing. We also observed that productivity of labour is high in case of capital intensive industries such as Petroleum products (23), Chemical products (24) Accounting and computing machines (30) Electrical machinery (31), Radio, television and communication equipments (32), Other transport equipments (35). However, growth of labour compensation does not follow this rising labour productivity in the Indian manufacturing sector. The employment growth was weak over the period with the introduction of capital deepening technology in the Indian manufacturing during this period.

4.6 Empirical Findings:

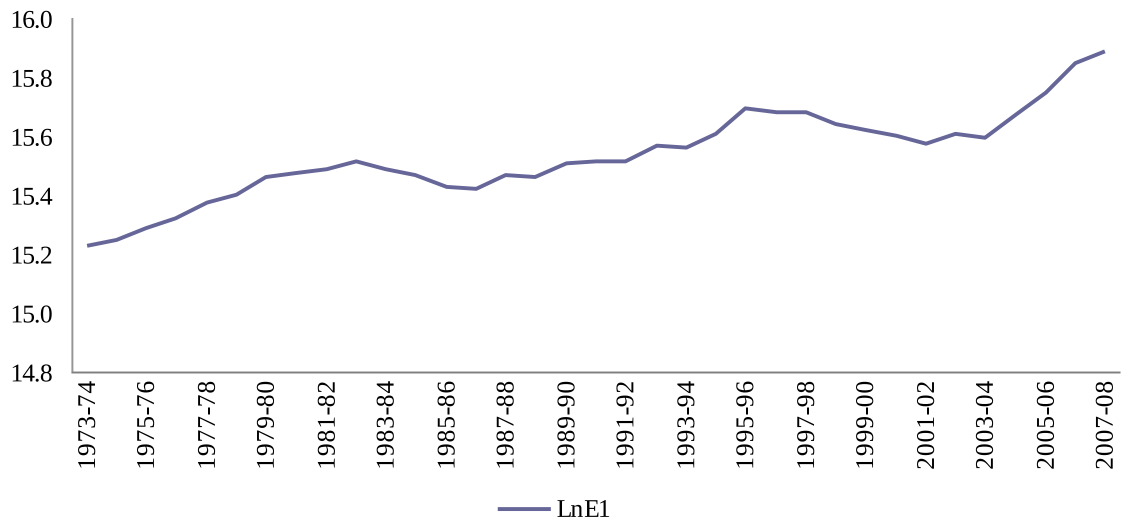
This section presents the time series analysis result of the nexus between labour productivity, employment and real wages in the context of Indian manufacturing sector. Before undertaking any time series econometric analysis of the data, it would be useful to understand the broad trends and behaviour of the variables, which may assist in interpreting the model results latter. For this purpose, time series plots are generated for all the variables that we consider for further time series analysis. It is needless to mention over here that we have converted all the variables into their respective natural logarithmic (Ln) values in order to take care of their scale and size. Time series plot of labour productivity (LP_1), employment (E_1) and real wages (RW_1) are presented in the figure 4.9, 4.10 and 4.11 respectively. It is quite clear from these Figures that natural logarithmic series of labour productivity and wages revealed a clear rising trend, while the natural logarithm of employment growth trend is rising in general but not as sharply as other two variables.

Figure 4.9: Time Series plot of Labour Productivity (LP1)



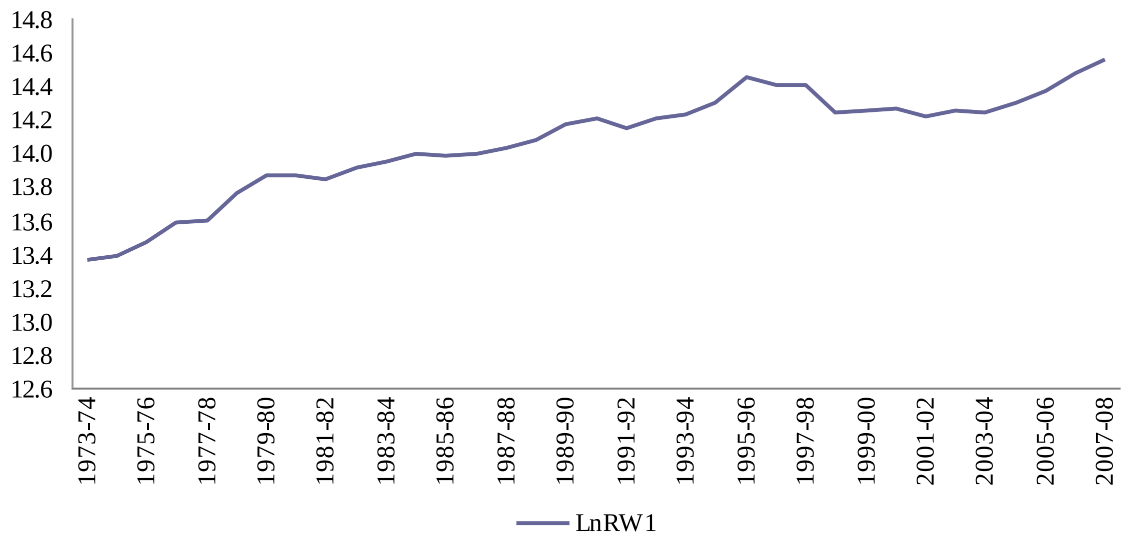
Source: Author’s compilation

Figure 4.10: Time Series Plot of Employment (E1)



Source: Author's compilation

Figure 4.11: Time Series Plot of Real Wages (RW1)



Source: Author's compilation

The summary statistics of the concerned variables are presented in the Table 4.5 and the correlation matrix is presented in Table 4.6 respectively. In Table 4.5, the kurtosis co-efficient, a measure of the thickness of the tail of the distribution is lower than 3 for labour productivity and real wages. A Gaussian (normal) distribution has kurtosis equal to three, and hence, this implies that the assumption of Gaussianity cannot be made from the distribution of their respective growth level. This finding is further strengthened by Jarque-Bera test for normality. However, the distribution for employment series is following the mesokurtic distribution. The real wage series is negatively skewed and the labour productivity and employment series are positively skewed.

Table 4.5: Summary Statistics of Variables

Statistics	$LnLP_1$	LnE_1	$LnRW_1$
Mean	0.21	15.53	14.06
Median	0.21	15.51	14.17
Maximum	1.22	15.89	14.56
Minimum	-0.54	15.23	13.37
Std. Dev.	0.57	0.15	0.31
Skewness	0.16	0.15	-0.73
Kurtosis	1.68	3.06	2.78
Jarque-Bera	2.69	0.13	3.20
Probability	0.26	0.94	0.20
Sum	7.47	543.63	492.27
Sum Sq. Dev.	10.88	0.78	3.29
Observations	35	35	35

Table 4.6: Correlation Coefficient Matrix

	$LnLP_1$	LnE_1	$LnRW_1$
$LnLP_1$	1		
LnE_1	0.8867*	1	
	(11.02)		
$LnRW_1$	0.8836*	0.9371*	1
	(10.84)	(15.42)	

Note: *- significance at 1 % level, figures in the parentheses ( ) shows t-statistics value

In order to discover the pairwise degree of association between the labour productivity, employment and real wage variables, the correlation matrix is constructed and presented in the Table 4.6. We observed that there is a high degree of positive correlation between labour productivity to employment and wages, which are statisticsignificant at one percent level. Similarly, there exists a high degree of positive correlation between employment and wages. From the above table it is apparent that labour productivity, employment and real wage are highly correlated with each other in case of Indian aggregate manufacturing sectors. This further suggests, from the policy perspective that wage and employment and labour productivity moves in tandem with each other and due caution has to be taken while formulating policies to achieve full employment.

Table 4.7: Unit Root Test

	With Trend and Intercept			
	ADF		PP	
Variables	***Level***	***First Difference***	***Level***	***First Difference***
$LnLP_1$	-2.95 (1)	-5.53 (1)	-2.89 (3)	-5.59 (3)
LnE_1	-2.49 (1)	-3.77 (1)	-2.16 (3)	-3.90 (3)
$LnRW_1$	-2.15 (1)	-4.92 (1)	-2.20 (3)	-4.95 (3)

Note: The figures in the parentheses ( ) indicate the lags considered for the respective variables and the Mackinnon critical values for ADF and PP test at both 1%, 5% and 10% level of significance are -4.25, -3.55 and -3.21 respectively

Table 4.8: Lag Length Selection Criterion

Lag	LogL	LR	FPE	AIC	SC	HQ
0	154.1152	NA*	1.17E-08*	-9.7495*	-9.6106*	-9.7041*
1	161.6115	13.0580	1.30E-08	-9.6523	-9.0973	-9.4714
2	164.0661	3.8007	2.02E-08	-9.2301	-8.2587	-8.9134
3	167.0025	3.9783	3.13E-08	-8.8389	-7.4511	-8.3865

Note: * indicates lag order selected by the criterion;
LR: sequential modified LR test statistics (each test at 5% level)
FPE: Final Prediction Error
AIC: Akaike Information Criterion
SC: Schwarz Information Criterion
HQ: Hannan-Quinn Information Criterion

Prior to reporting the results, as a beginning, the study reports unit root test to examine the time series properties of the concerned variables. This is because, when the data have unit root characteristics, such analysis may lead to spurious results and misleading conclusions. Hence, for the unit root test the present study employs Augmented Dickey Fuller (ADF) and Phillips-Perron (PP) test with trend and intercept and using the significance taste provided by Dicket and Fuller (1979). The ADF and PP test for all three variables are reported in Table 4.7. The optimum lag length in the case of ADF and PP is choosen in the basis of AIC and FPE criterion. Using the *'p'*-values of 0.01, 0.05 and 0.10 all the series reject the null hypothesis of a unit root and hence all the concerned variables are stationary at their corresponding first difference level.

Table 4.9: Co-integration Test between Employment, Labour Productivity and Rea Wages

Null Hypothesis	Alternative Hypothesis		Critical Values	
λ Trace Test	**λ Trace Test**	**λ Trace Value**	**5%**	**1%**
r = 0	r > 0	27.33	29.80	35.46
r ≤ 1	r > 1	12.48	15.49	19.94
r ≤ 2	r > 2	3.78	3.84	6.63
λ Max Test	**λ Max Test**	**λ Max Values**	**5%**	**1%**
r = 0	r = 1	14.85	21.13	25.86
r = 1	r = 2	8.70	14.26	18.52
r=2	r = 3	3.78	3.84	6.63

Note: 'r' is the co-integrating vector

In order to examine the long run equilibrium relationship between the labour productivity, employment and real wages of Indian manufacturing sector, we have employed Johansen's Maximum Likelihood procedure of cointegration test. The result of the cointegration test among the variables are presented in the Table 4.9. The test of trace statistics shows that the null hypothesis of the variables are not co-integrated (*r>0*). Since 27.33 is lower than both 5% as well as 1% critical value ofλ trace statistics (in the first panel of Table 4.10), we are fair to reject the null hypothesis of no-cointegrating vectors. If we use the λ max statistics. The null hypothesis of no cointegrating vectors (*r>0)* against the specific alternative hypothesis (*r=1)* is also not rejected. The calculated value λ max (0.1) = 14.85 is lower than both the 5% and 1% critical values. Hence, the null hypothesis is not rejected. Therefore, it can be concluded that there are no cointegrating vectors among these variables and hence, there is no long-run equilibrium relationship is found between the labour productivity, employment and real wages in the Indian manufacturing sector.

The result of no long-run equilibrium relationship among these variables motivated us to examine the dynamic relationship between labour productivity, employment and real wages through a three variables Vector Auto Regression (VAR) model.

Before analyzing the VAR results it is important to discuss the various steps associated with the VAR model. To start with the VAR estimation procedure requires the selection of the variables to be included in the system. The variables included in the VAR are selected according to the relevant economic model as discussed in Chapter-II. The next step is to verify the stationarity of the variables. This result, we have already reported in the Table 4.7. As a prerequisite of VAR model, the next important step is to select the appropriate lag length. The lag length of each of the variables in the system is to be fixed. While determining the lag length, econometricians have either fixed the lag length arbitarily or choosen through some statistical procedure. We have considered some statistical lag length criteria such as Likelihood Ratio (LR), Final Prediction Error (FPE), Akaike information criterion (AIC), Schwarz Information Criterion (SC), Hannan-Quinn information criterion (HQ) to choose the optimal lag length. This is reported in Table 4.8. From this table, it can be seen that none of the criteria suggest any lag for the three variable system of the variables. However, we need at least one lag for constructing VAR model. In this context, we prefer to choose 1-period lag for further analysis.

According to VAR methodology, ordering of the variables is made by keeping the policy variables first and the target variables at the bottom. As there are no policy variables, we tried several orderings of the variables. Since varying the order did not systematically alter the results, we have reported the results for only one ordering which is as follows:

Ordering : { ΔLP_1, ΔE_1, ΔRW_1}

The implication of such an ordering is that current innovations in labour productivity (ΔLP_1) can affect the entire system contemporaneously, but innovations in employment (ΔE_1) cannot affect the current period of labour productivity (ΔLP_1). Since largely a shock in real wages (ΔRW_1) cannot affect the current period labour productivity (ΔLP_1) and affect employment (ΔE_1) in the system. Therefore, the variable real wages (ΔRW_1) has seen placed at the end of the ordering with the presumption that current innovations in all the variables affect the current period changes at their respective level, whereas current innovation in real wages (ΔRW_1) cannot affect the current period of any variables in the model, except itself.

Estimation of VAR system:

$$\Delta LP_t = \alpha_1 + \sum_{i=1}^{1} \beta_{1i}\, \Delta LP_{t-i} + \sum_{i=1}^{1} \beta_{2i}\, \Delta E_{t-i} + \sum_{i=1}^{1} \beta_{3i}\, RW_{t-i} + \varepsilon_{1t} \qquad (4.11)$$

$$\Delta E_t = \alpha_2 + \sum_{i=1}^{1} \beta_{4i}\, \Delta LP_{t-i} + \sum_{i=1}^{1} \beta_{5i}\, \Delta E_{t-i} + \sum_{i=1}^{1} \beta_{6i}\, \Delta RW_{t-i} + \varepsilon_{2t} \qquad (4.12)$$

$$\Delta RW_t = \alpha_3 + \sum_{i=1}^{1} \beta_{7i}\, \Delta LP_{t-i} + \sum_{i=1}^{1} \beta_{8i}\, \Delta E_{t-i} + \sum_{i=1}^{1} \beta_{9i}\, RW_{t-i} + \varepsilon_{3t} \qquad (4.13)$$

Table 4.10: VAR Stability Test

Root	Modulus
0.3851	0.3851
0.0138 - 0.160388i	0.1610
0.0138 + 0.160388i	0.1610

No root lies outside the unit circle.
VAR satisfies the stability condition

Where ‘t’ is the time, ΔLP_1, ΔE_1 and ΔRW_1 represents the 1st difference of labour productivity, employment and real wages respectively. The α’s and $\beta_1, \beta_2, \beta_3$, ……..$\beta_9$ are co-efficient that determine how the variables interact and ε_{1t}, ε_{2t} and ε_{3t} are the error terms which capture the annual unexplained or surprise movement in each variable. It is needless to mention over here that the model as specified in the ordering (mentioned before) is estimated with the above specified equations from 4.11 to 4.13.

Impulse Response Function (IRF) shows the possible dynamic response of all the variables in the system to shock or innovation in each variable. In the present study, we have computed 8 periods (Years) ahead impulse response of the VAR system. Impulse responses of each variable are reported in Table 4.11.

Table 4.11: Impulse Response Function

Due to Shock in	Period	Responses to		
		ΔLP_1	ΔE_1	ΔRW_1
ΔLP_1	1	0.055950	0.000000	0.000000
	2	0.002519	0.009043	-0.022097
	3	-0.001407	0.003003	-0.001628
	4	-0.000114	0.000909	0.000135
	5	0.000029	0.000356	-0.000105
	6	0.000002	0.000144	-0.000065
	7	-0.000001	0.000055	-0.000022
	8	0.000000	0.000021	-0.000008
ΔE_1	1	-0.008116	0.036292	0.000000
	2	0.000583	0.013364	-0.002595
	3	0.000169	0.005374	-0.002271
	4	-0.000032	0.002091	-0.000842
	5	-0.000014	0.000800	-0.000290
	6	-0.000003	0.000307	-0.000112
	7	-0.000001	0.000118	-0.000044
	8	0.000000	0.000046	-0.000017
ΔRW_1	1	-0.004609	0.042468	0.049450
	2	0.004834	0.018802	-0.006784
	3	0.000170	0.008059	-0.004665
	4	-0.000153	0.003062	-0.001184
	5	-0.000021	0.001157	-0.000386
	6	-0.000001	0.000446	-0.000162
	7	-0.000001	0.000172	-0.000065
	8	-0.000001	0.000066	-0.000025

Note: Cholesky Ordering: ΔLP1 ΔE1 ΔRW1

In Table 4.11, one standard deviation shock in ΔLP_1 (equal to 0.055950 units) has no contemporaneous effect on $\Delta E_1$and ΔRW_1in 1-year period. In the period 2, a one standard deviation increase in ΔLP_1 (equal to 0.002519 units) gives a contemporaneous increase in $\Delta E_1$by 0.009043 units but a contemporaneous fall in ΔRW_1 by 0.022097units. Similarly a one standard deviation decline in ΔLP_1 (equal to 0.00001 units) induces a contemporaneous increase in ΔE_1 by 0.000055 units, but at the same time it induces a contemporaneous fall in ΔRW_1 by 0.000022 units, in the 7^{th} period. This finding is also clear from the Figure 4.12, which shows that a normalized random shock to each variable in the VAR, system produces a fluctuating response in ΔLP_1, ΔE_1 and ΔRW_1upto around five years. Therefore, the responses decay towards zero.

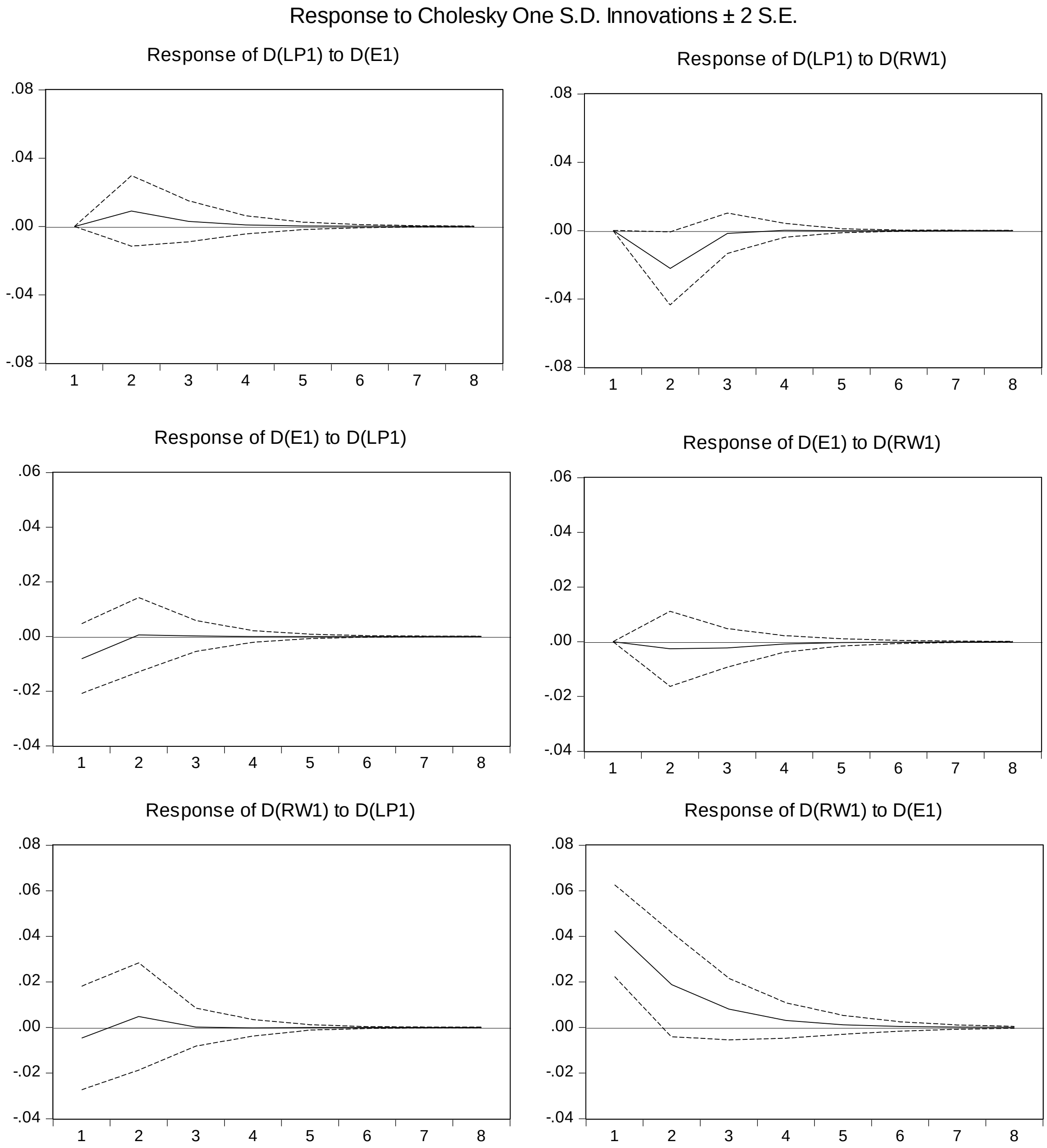
Similarly, one standard deviation shock in ΔE_1 (equal to 0.036292 units) induces a contemporaneous fall in $\Delta LP_1$by 0.008116 units, but at the same time it has no contemporaneous effect on ΔRW_1in 1-year period. Similarly, in the period 5, a one standard deviation increase in ΔE_1 (equal to 0.000800 units) induces a contemporaneous fall in both ΔLP_1 and ΔE_1by0.000014 units and 0.000290 units respectively. In the period 8, a one standard deviation shock in ΔE_1 (0.000046 units) gives a contemporaneous fall in ΔRW_1 by 0.000017 while do not have any contemporaneous effect on ΔLP_1. This finding is also clear from the Figure 4.12.

From Table 4.11, we also infer that a one standard deviation shock in ΔRW_1 (equal to 0.049450 units) induces a contemporaneous fall in ΔLP_1 by 0.004609 units, but at the same time induce a contemporaneous increase in $\Delta E_1$by 0.042468 units. In the 3rd period, a one standard deviation decline in ΔRW_1 (equal to 0.004665 units) gives a contemporaneous increase in $\Delta LP_1$by 0.000170 units and a contemporaneous increase in ΔE_1 by 0.008059 units. Similarly a one standard deviation decline in ΔRW_1 (equal to 0.000065 units) in the 7th period induces a contemporaneous fall inΔLP_1 and $\Delta E_1$by 0.000001 units and 0.000065 units respectively. This finding is also clear from the Figure 4.12, which shows that a normalized random shock to each variable in the VAR, system produces a fluctuating response in ΔLP_1, ΔE_1 and ΔRW_1upto around five years. Therefore, the responses decay towards zero.

From the Figure 4.12, it is also observed that, the impulse response functions indicate that a productivity shock is associated with higher employment and wages, where 1 standard deviation (SE) shock in labour productivity is significantly affecting both employment and wages in the short run. Shocks to employment have a negative effect on productivity in the first year, then have a small positive effect on labour productivity over next 3 to 4 years, while, the real wage is significantly affected by the shock in employment for about 5 to 6 years. Shocks to real wages have short-term impact on employment and labour productivity.

Figure 4.12: Impulse Response Functions:

[Ordering - Ln (Labour Productivity), Ln (Employment), Ln (Real Wages)]



Note: Cholesky Ordering: DLP1 DE1 DRW1

The Variance Decompositions is used to detect the causal relations among variables. It explaines the extent at which a variable is explained by the shocks in all the variables in the system. The forecast error variance decomposition explains the proportion of the movement in a sequence due to its own shocks vurses shocks to the other variables. The forecast error variance decomposition results are reported in Table 4.12.

Table 4.12: Variance Decompositions

Period	S.E.	D(ln(labour productivity))	D(ln(employment))	D(ln(real wages))
Variance decomposition of D(ln(labour productivity))				
1	0.0560	100.00	0.00	0.00
2	0.0609	84.62	2.21	13.17
3	0.0610	84.36	2.44	13.20
4	0.0610	84.35	2.46	13.19
5	0.0610	84.34	2.47	13.19
6	0.0610	84.34	2.47	13.19
7	0.0610	84.34	2.47	13.19
8	0.0610	84.34	2.47	13.19
Period	S.E.	D(ln(labour productivity))	D(ln(employment))	D(ln(real wages))
Variance decomposition of D(ln(employment))				
1	0.0372	4.76	95.24	0.00
2	0.0396	4.22	95.35	0.43
3	0.0400	4.13	95.12	0.74
4	0.0401	4.12	95.10	0.78
5	0.0401	4.12	95.09	0.79
6	0.0401	4.12	95.09	0.79
7	0.0401	4.12	95.09	0.79
8	0.0401	4.12	95.09	0.79
Period	S.E.	D(ln(labour productivity))	D(ln(employment))	D(ln(real wages))
Variance decomposition of D(ln(real wages))				
1	0.0653	0.50	42.24	57.27
2	0.0685	0.95	45.96	53.09
3	0.0691	0.93	46.49	52.58
4	0.0692	0.93	46.58	52.49
5	0.0692	0.93	46.59	52.48
6	0.0692	0.93	46.59	52.47
7	0.0692	0.93	46.59	52.47
8	0.0692	0.93	46.59	52.47

Between ΔLP_1 and ΔE_1

In Table 4.12, at 1 period (Year) ahead horizon, 0 percent forecast error variance in labour productivityis explained by the shock in employment, where as labour productivity explains 4.76 percent forecast error variance in employment in the same period. In the period 4, a shock in employment explains 2.46 percent of forecast error variance on labour productivity. However, in the same period, labour productivity explains 4.12 percent of forecast error variance in employment. Similarly, at the 8 period ahead horizon, the innovation in labour productivity explains 4.12 percent of forecast error variance in employment, whereas, the employment explains only 2.47 percent variance in labour productivity. From these findings, it can be surmised that the causality runs from labour productivity to employment, which in turn implies that the labour productivity affects employment.

Between ΔLP_1 and ΔRW_1

In Table 4.12, at 1 period (Year) ahead horizon, 0 percent forecast error variance in labour productivity is explained by the shock in real wages, whereas labour productivity explain 0.50 percent forecast error variance in real wage in the same period. In the period 4, a shock in real wage explains 13.19 percent of forecast error variance on labour productivity. However, in the same period, labour productivity explains only 0.93 percent of forecast error variance in real wages. Similarly, at the 8 period ahead horizon, the innovation in labour productivity explains 0.93 percent of forecast error variance in real wages, whereas, the real wage explains substantial 13.19 percent variance in labour productivity. From these findings, it can be surmised that the causality runs from real wage to labour productivity, which in turn implies that the real wage affects labour productivity.

Between ΔE_1 and ΔRW_1

Similarly, between employment and real wage in Table 4.12, at the 1 period ahead horizon, 0 percent forecast error variance in employment is explained by the shock in real wages, whereas employment explain 42.24 percent forecast error variance in real wage in the same period. In the period 4, a shock in real wage explains 0.78 percent of forecast error variance on employment. However, in the same period, employment explains a substantial 46.58 percent of forecast error variance in real wages. Similarly, at the 8 period ahead horizon, the innovation in employment explains 46.59 percent of forecast error variance in real wages, whereas, the real wage explains only 0.79 percent variance in employment. From these findings, it can be surmised that the causality runs from employment to real wage, which in turn implies that the employment affects real wages.

In a nutshell, from the above variance decompositions table, we can surmise three major findings:

1) Employment explains labour productivity by 2.5% in 8-year periods ahead, while employment is being explained by labour productivity by 4.1%. Thus, we can infer that employment is driven by labour productivity.
2) Secondly, real wages explains labour productivity by 13.2%, while labour productivity explains real wages by around 1%. Thus, we can conclude that labour productivity is driven by real wages.
3) Lastly, real wages explains employment marginally by 0.8%, whereas real wage is being explained by employment by 47%. Therefore, we can conclude that the real wage is driven by employment.

Table 4.13: VAR Block Exogeneity Test (Wald Test)

Dependent Variable	Excluded	Chi-sq	df	Prob.
DLP_1	DE_1	4.5420	1	0.0331
	DRW_1	4.5859	1	0.0322
	All	5.4029	2	0.0671
DE_1	DLP_1	0.3539	1	0.5519
	DRW_1	0.1431	1	0.7052
	All	0.4447	2	0.8006
DRW_1	DLP_1	0.7371	1	0.3906
	DE_1	2.5723	1	0.1088
	All	2.9195	2	0.2323

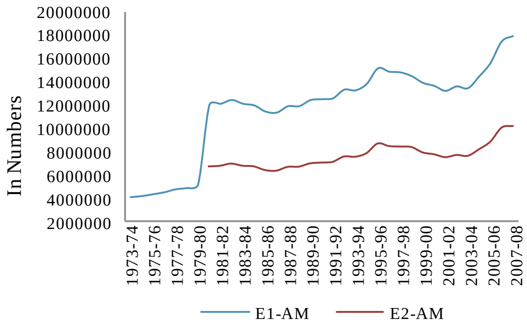
The VAR estimation with lag 1 (Table-4.13) assumes unrestricted intercept and no trend. The estimated result shows that, there exist bi-directional causality from employment (E1) and real wages (RW_1) to labour productivity at 5% statistic significance. Furthermore, thereexists unidirectional causality from employment (E1) to real wages (RW_1) at ten percent statistic significance.

4.7 Conclusion:

The relationship between labour productivity, employment and real wages variables are examined by applying time series techniques such as Cointegration, VAR, Impulse Response Function and Variance Decomposition. The frequency of the data is annual in nature and the period of the study spanning from 1973-74 to 2007-08. We found that the manufacturing sector in the post reform period has recorded a growing employment, compared to the previous two decades. Thus, the reforms during early 90s have encouraged the firms to employ more of the workers to take advantage of increasing returns and economies of scale. This is also because the growth of productivity was much higher than that of labour compensation, so it is always beneficial for the manufacturer to employ more and more workers. The share of workers in the total person engaged remains stable during the entire study period. On the other hand, the growth of labour compensation is easing down during the sample period of study and registered its lowest growth in the post reform period. Moreover, we observed inconsistency in the growth of two labour compensation measures. Labour compensation to persons engaged has grown at a higher rate to that of compensation to workers. This suggests the existence of inequality in term of compensation paid in Indian manufacturing, where the non-worker class, such as managers, supervisors and clerical staff have experienced better growth in their compensation to that of workers.

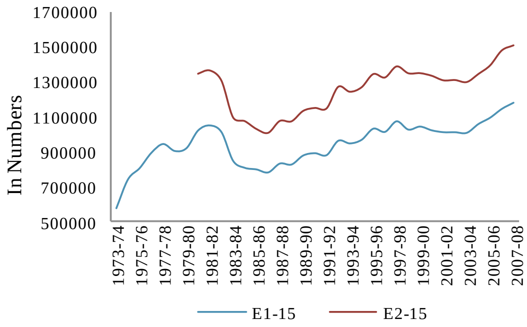
From the time series analysis, the cointegration test can not establish any long-run relationship between labour productivity, employment and real wages. The econometric analysis suggests that labour productivity and employment appears to be exogenous while real wages is driven by its own innovations and a lesser extent by changes in employment. In Indian manufacturing long run dynamic relationship between wage and employment and between labour productivity and real wages does not exist. The results of this study do not provide support to either the Neoclassical or Keynesian theories of a long-run inverse relationship between real wages and employment. Further, the finding of the study discarded the existence of the efficiency wage theory that postulates the relationship between labour productivity and wages. In the present study, we found that employment influenced real wages to a greater extend in Indian manufacturing. One possible explanation is that a higher level of employment may be able to exert more pressure to increase real wages. Contrary to the finding of Alexander (1993), Bender and Theodossiou (1999), Huh and Trehan (1995), and Wakeford (2004), we do not see productivity and real wages are related. This raises questions on the labour policy that wage increases will have to be supported by improvements in productivity and work performance to ensure competitiveness. Given these findings, the focus of policy-makers must therefore be on the upgrading of skills and productivity of workers for them to attain higher earnings and enjoy higher standards of living. This can be done through education and training, and retraining, with proper monitoring and evaluation to ensure that workers are equipped with the knowledge, skills and creativity to match technological advances in production and services.

igure A4.1: Trends of number of workers and persons engaged in Indian manufacturing



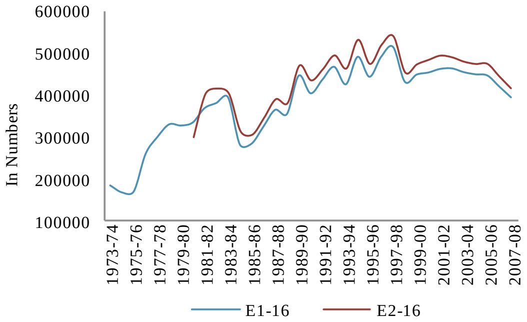
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.2: Trends of number of workers and persons engaged in NIC–15



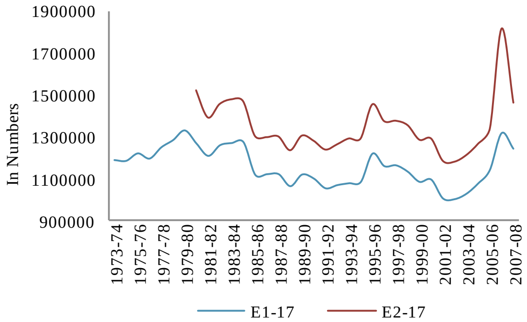
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.3: Trends of number of workers and persons engaged in NIC–16



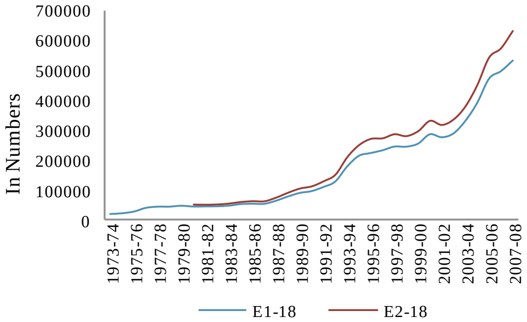
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and *EPW* Research Foundation

Figure A4.4: Trends of number of workers and persons engaged in NIC–17



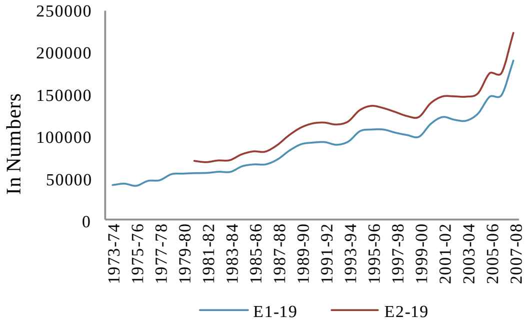
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and *EPW* Research Foundation

Figure A4.5: Trends of number of workers and persons engaged in NIC–18



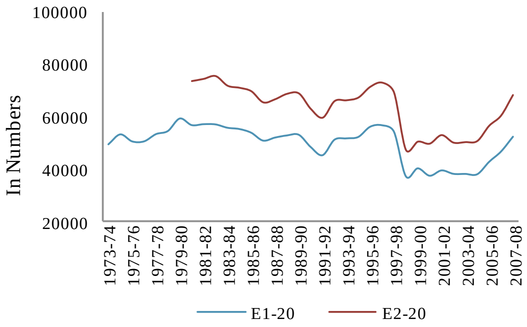
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and *EPW* Research Foundation

Figure A4.6: Trends of number of workers and persons engaged in NIC–19



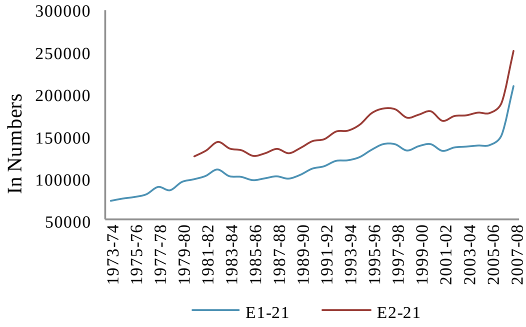
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and *EPW* Research Foundation

Figure A4.7: Trends of number of workers and persons engaged in NIC–20



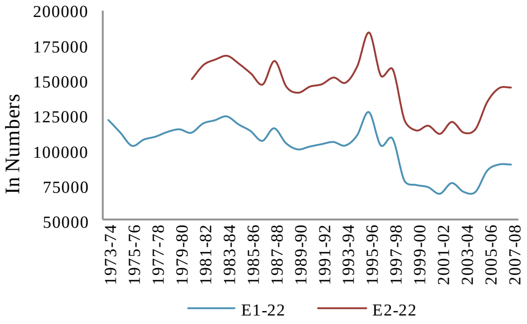
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.8: Trends of number of workers and persons engaged in NIC–21



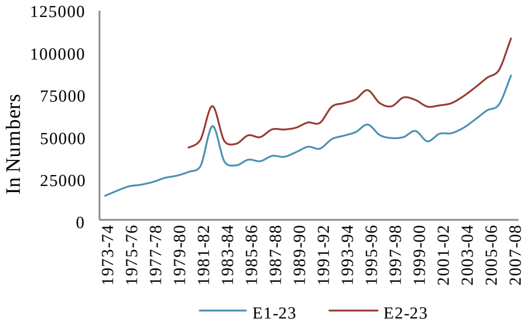
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.9: Trends of number of workers and persons engaged in NIC–22



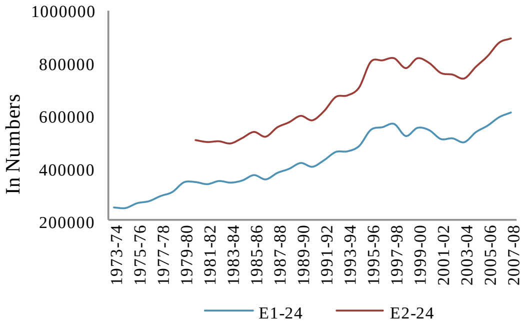
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.10: Trends of number of workers and persons engaged in NIC–23



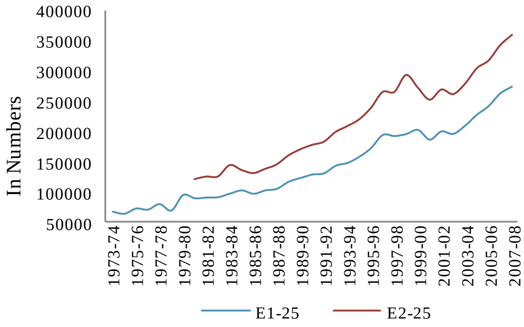
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.11: Trends of number of workers and persons engaged in NIC–24



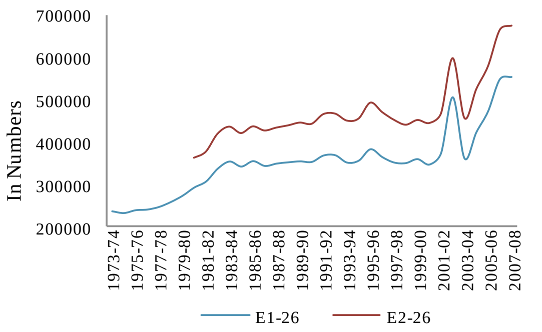
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.12: Trends of number of workers and persons engaged in NIC–25



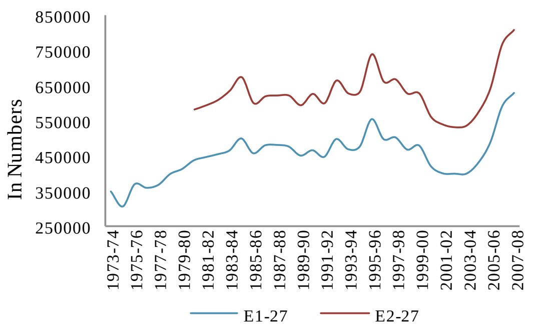
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.13: Trends of number of workers and persons engaged in NIC–26



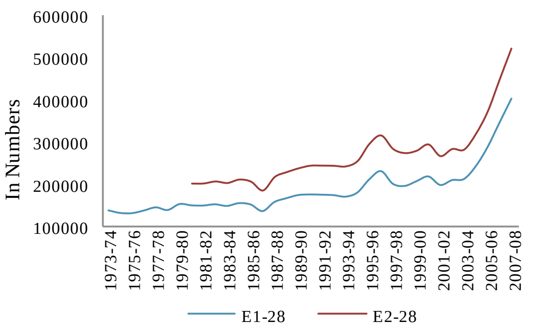
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.14: Trends of number of workers and persons engaged in NIC–27



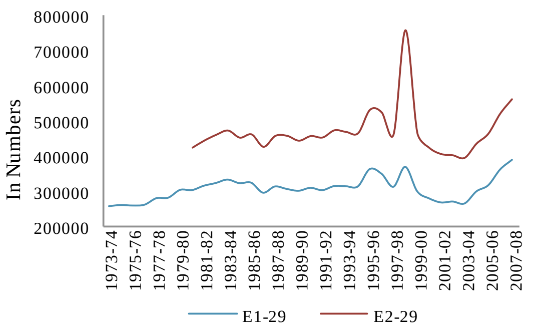
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.15: Trends of number of workers and persons engaged in NIC–28



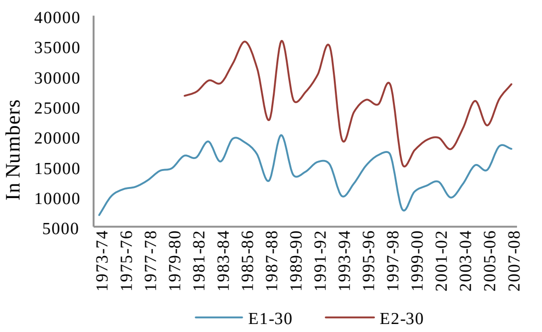
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.16: Trends of number of workers and persons engaged in NIC–29



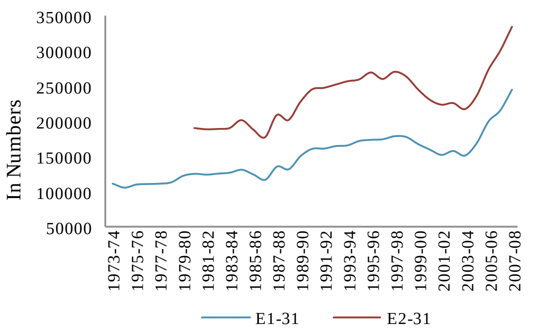
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.17: Trends of number of workers and persons engaged in NIC–30



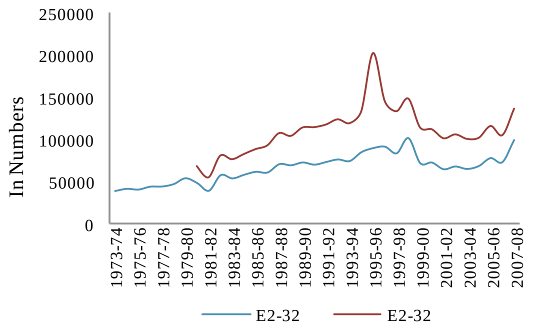
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.18: Trends of number of workers and persons engaged in NIC–31



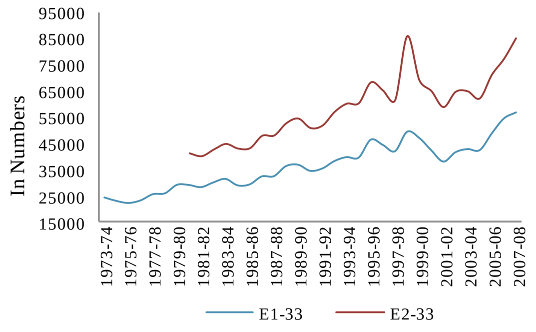
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.19: Trends of number of workers and persons engaged in NIC–32



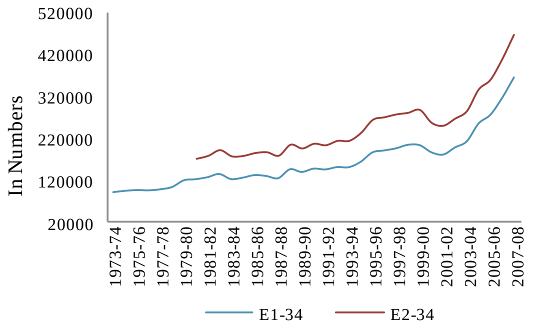
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.20: Trends of number of workers and persons engaged in NIC–33



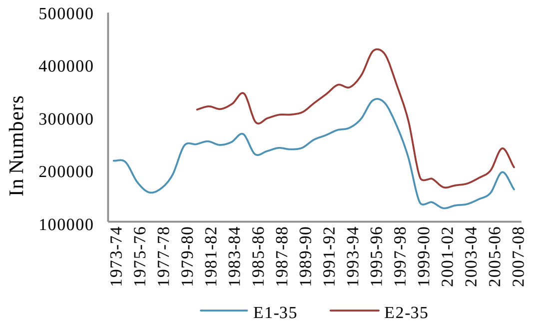
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.21: Trends of number of workers and persons engaged in NIC–34



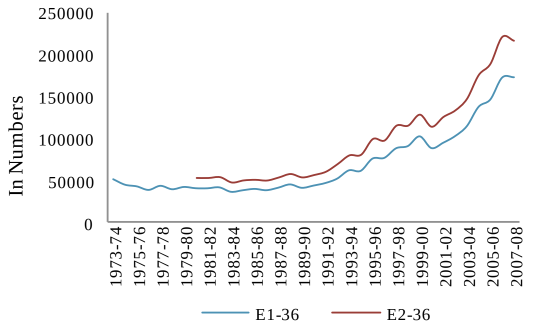
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.22: Trends of number of workers and persons engaged in NIC–35



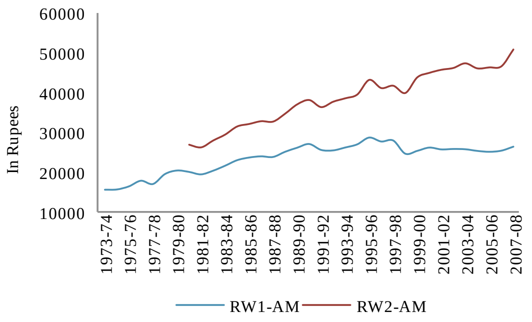
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.23: Trends of number of workers and persons engaged in NIC–36



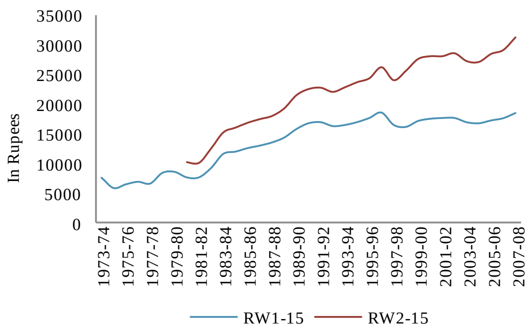
Note: E1 and E2 refers to number of workers and person engaged
Source: ASI, CSO and EPW Research Foundation

Figure A4.24: Trends of labour compensation in Indian manufacturing



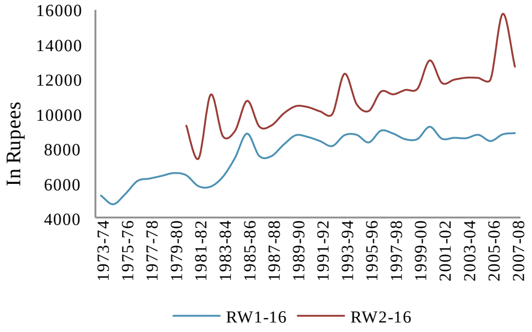
Source: ASI, CSO and EPW Research Foundation

Figure A4.25: Trends of labour compensation in NIC–15



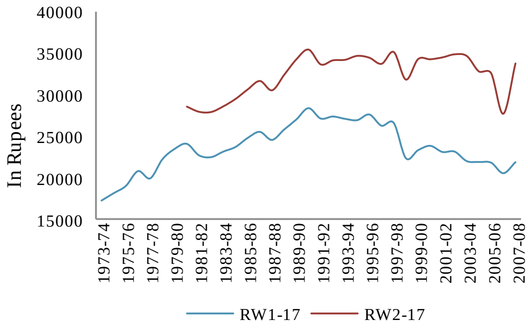
Source: ASI, CSO and EPW Research Foundation

Figure A4.26: Trends of labour compensation in NIC–16



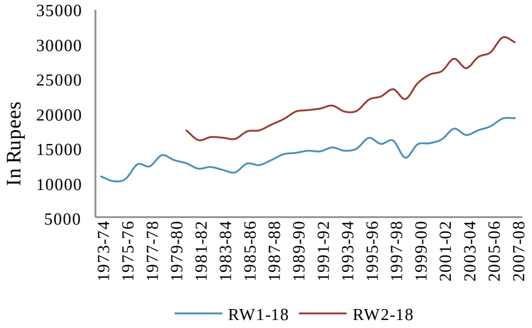
Source: ASI, CSO and EPW Research Foundation

Figure A4.27: Trends of labour compensation in NIC–17



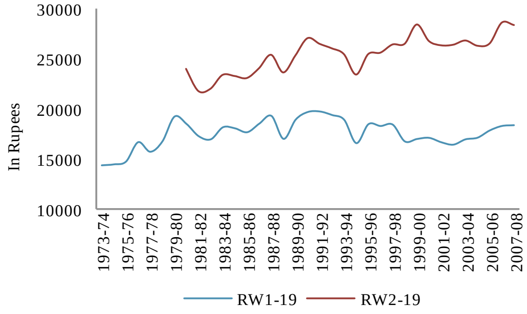
Source: ASI, CSO and EPW Research Foundation

Figure A4.28: Trends of labour compensation in NIC–18



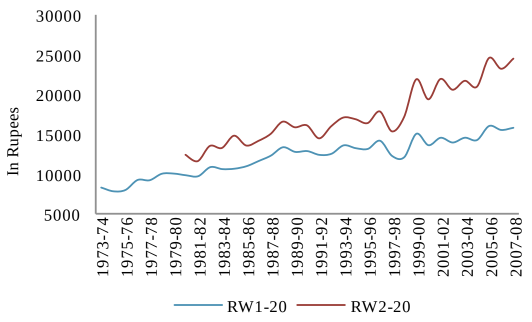
Source: ASI, CSO and EPW Research Foundation

Figure A4.29: Trends of labour compensation in NIC–19



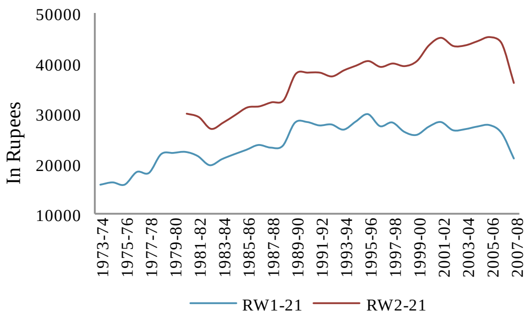
Source: ASI, CSO and EPW Research Foundation

Figure A4.30: Trends of labour compensation in NIC–20



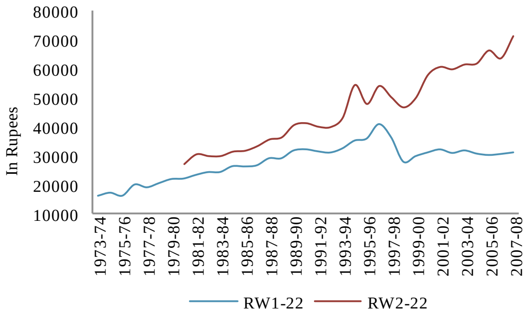
Source: ASI, CSO and EPW Research Foundation

Figure A4.31: Trends of labour compensation in NIC–21



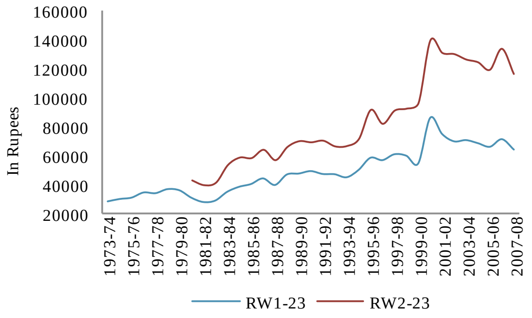
Source: ASI, CSO and EPW Research Foundation

Figure A4.32: Trends of labour compensation in NIC–22



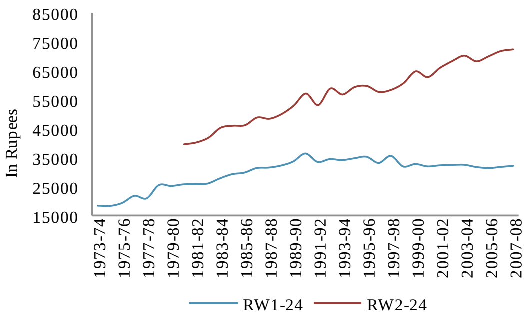
Source: ASI, CSO and EPW Research Foundation

Figure A4.33: Trends of labour compensation in NIC–23



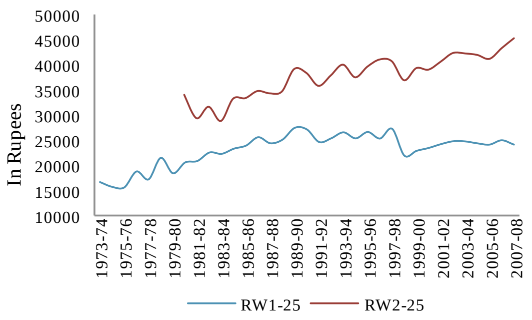
Source: ASI, CSO and EPW Research Foundation

Figure A4.34: Trends of labour compensation in NIC–24



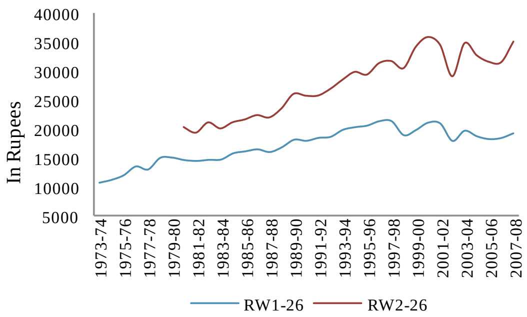
Source: ASI, CSO and EPW Research Foundation

Figure A4.35: Trends of labour compensation in NIC–25



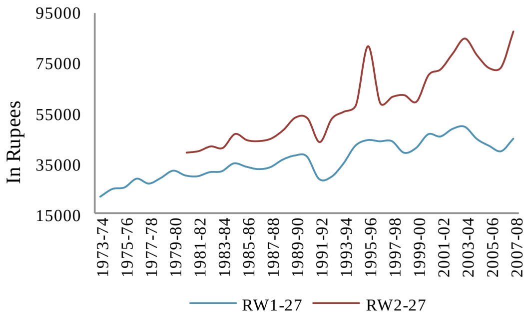
Source: ASI, CSO and EPW Research Foundation

Figure A4.36: Trends of labour compensation in NIC–26



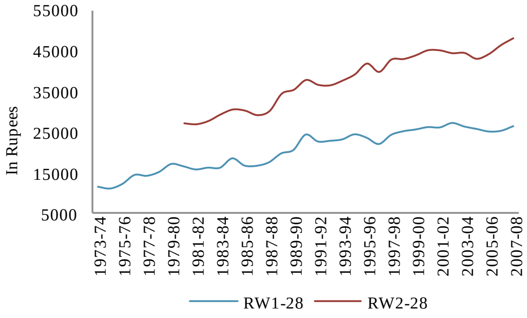
Source: ASI, CSO and EPW Research Foundation

Figure A4.37: Trends of labour compensation in NIC–27



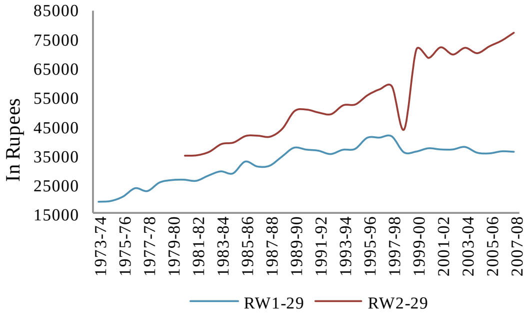
Source: ASI, CSO and EPW Research Foundation

Figure A4.38: Trends of labour compensation in NIC–28



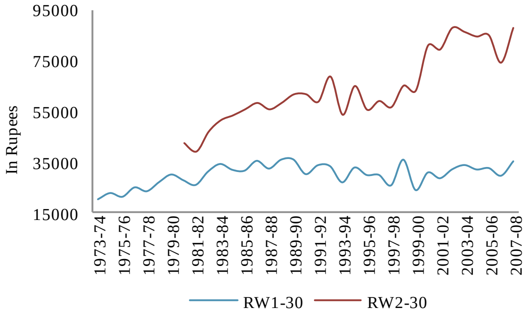
Source: ASI, CSO and EPW Research Foundation

Figure A4.39: Trends of labour compensation in NIC–29



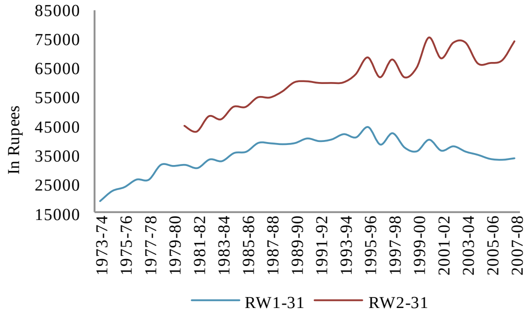
Source: ASI, CSO and EPW Research Foundation

Figure A4.40: Trends of labour compensation in NIC–30



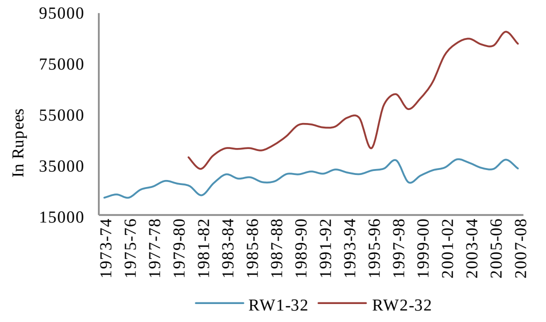
Source: ASI, CSO and EPW Research Foundation

Figure A4.41: Trends of labour compensation in NIC–31



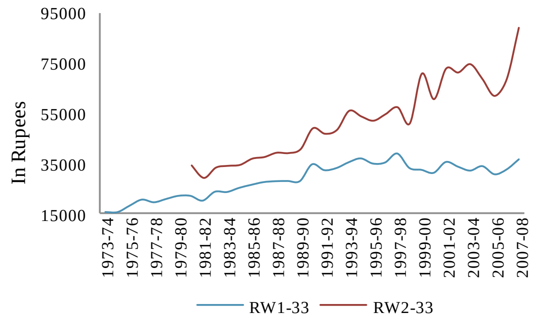
Source: ASI, CSO and EPW Research Foundation

Figure A4.42: Trends of labour compensation in NIC–32



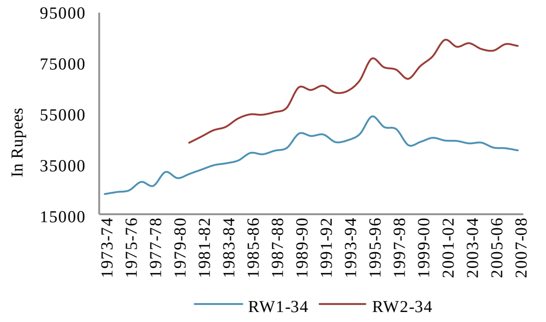
Source: ASI, CSO and EPW Research Foundation

Figure A4.43: Trends of labour compensation in NIC–33



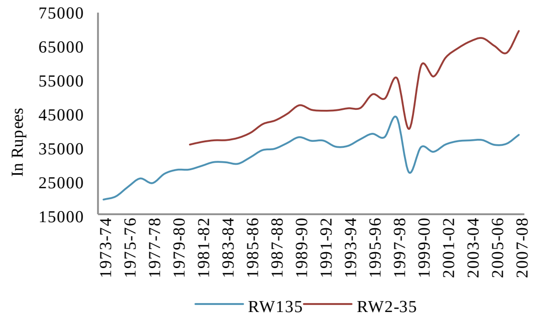
Source: ASI, CSO and EPW Research Foundation

Figure A4.44: Trends of labour compensation in NIC–34



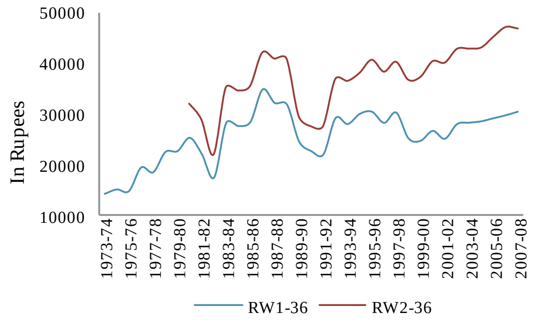
Source: ASI, CSO and EPW Research Foundation

Figure A4.45: Trends of labour compensation in NIC–35



Source: ASI, CSO and EPW Research Foundation

Figure A4.46: Trends of labour compensation in NIC–36



Source: ASI, CSO and EPW Research Foundation

Table A4.1: Share of Workers in Total Person Engaged *(In Percentage)*

Year	AM	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1980-81	78.00	75.81	111.87	83.43	80.39	80.02	77.52	77.64	74.88	66.75	68.38	74.56	81.18	74.85	73.97	70.71	62.55	65.17	69.85	70.90	71.25	78.62	76.38
1981-82	78.08	76.89	91.76	87.00	82.05	82.17	77.12	76.58	74.27	67.61	67.80	72.99	81.88	74.88	73.66	70.39	59.91	65.15	69.91	70.87	71.07	78.86	76.31
1982-83	78.20	77.33	91.89	86.67	81.32	81.76	75.92	76.48	73.97	82.23	69.81	73.31	80.78	74.35	73.37	69.61	65.20	65.77	71.00	70.83	70.07	77.94	76.97
1983-84	77.99	76.97	97.95	86.06	80.64	81.23	78.00	75.11	74.47	73.95	69.72	67.95	81.40	72.92	72.77	69.95	54.65	66.05	69.77	70.43	69.05	77.19	76.07
1984-85	77.38	74.77	90.15	86.88	82.22	82.65	78.17	75.63	73.53	71.87	68.53	75.81	81.55	73.89	73.11	70.76	60.67	64.42	69.97	67.61	70.57	77.32	76.07
1985-86	77.70	77.11	93.09	85.89	81.18	81.70	77.61	76.52	73.75	71.32	69.38	74.63	81.49	75.93	73.37	69.65	53.03	65.30	69.34	68.21	71.26	78.62	78.13
1986-87	77.85	77.10	94.05	86.52	80.77	82.17	77.98	76.29	72.83	71.10	68.66	74.88	80.71	77.16	73.06	68.57	54.53	65.26	65.21	67.82	69.38	78.45	76.30
1987-88	77.52	76.99	93.68	86.32	81.16	81.76	78.34	75.17	70.93	70.79	68.70	72.90	80.71	77.07	72.28	67.90	55.35	64.39	65.73	67.82	69.65	78.84	76.72
1988-89	77.24	76.63	93.36	86.26	82.01	82.68	77.19	76.05	72.52	69.89	69.11	73.46	80.42	76.37	72.68	66.30	56.15	64.73	66.51	69.07	71.16	77.88	78.01
1989-90	77.62	77.21	95.15	85.92	82.61	82.63	77.40	75.77	71.52	73.50	69.99	72.72	79.74	75.58	73.14	67.16	52.24	65.73	63.71	67.78	71.11	77.56	76.37
1990-91	77.11	77.24	93.15	86.05	82.58	80.71	77.13	76.65	70.76	75.06	69.54	72.92	79.95	74.12	71.85	67.13	51.35	65.17	61.16	68.01	71.06	78.14	77.25
1991-92	76.76	76.45	94.78	85.21	82.49	80.43	76.18	77.36	71.14	73.46	69.69	71.97	79.24	74.27	71.54	66.21	51.83	64.70	62.28	68.50	71.40	76.90	77.29
1992-93	76.22	75.57	94.76	84.73	82.41	79.28	77.93	76.96	69.94	71.26	68.75	72.44	79.16	74.66	71.25	65.88	43.95	64.94	61.65	67.16	70.54	75.88	74.61
1993-94	76.05	76.05	92.08	83.59	83.18	80.25	78.35	76.92	69.97	72.02	68.50	71.28	78.26	74.43	70.19	66.43	51.76	64.13	62.43	66.17	70.39	77.99	77.31
1994-95	76.45	76.17	92.62	84.08	84.26	81.42	77.96	75.87	69.33	72.64	68.44	72.34	78.43	75.03	70.57	66.85	50.33	65.93	63.84	65.63	70.18	77.74	75.80
1995-96	75.66	76.69	93.78	83.98	81.27	79.69	79.01	74.89	69.45	73.27	67.76	72.65	77.83	74.76	71.49	68.00	57.85	64.08	44.51	67.95	70.43	77.66	76.16
1996-97	76.67	76.41	94.81	84.54	84.03	81.24	78.05	76.37	67.80	72.43	68.56	73.64	77.63	75.00	73.32	66.37	66.44	66.71	63.22	68.17	70.55	77.84	78.42
1997-98	77.04	77.34	95.55	84.69	84.37	81.25	78.68	76.71	68.91	71.88	69.39	72.92	77.97	75.02	70.79	66.99	59.33	65.79	62.82	68.33	70.66	78.63	76.37
1998-99	74.09	76.03	95.31	83.78	86.14	82.15	78.69	76.83	64.61	67.52	66.84	67.06	79.72	74.30	71.50	48.65	51.21	67.01	68.85	57.49	72.64	76.40	78.60
1999-00	76.84	77.28	95.10	84.50	84.78	81.34	79.91	78.15	65.99	74.00	67.59	74.79	79.80	76.11	74.16	63.67	60.90	67.91	63.01	68.10	70.63	73.59	79.61
2000-01	76.85	76.53	94.01	84.98	85.34	82.81	75.41	77.76	62.77	69.26	68.00	74.31	78.23	74.64	74.25	65.11	60.77	68.79	64.83	65.21	72.42	74.67	77.38
2001-02	76.98	77.22	93.83	85.00	85.95	83.79	74.65	78.27	61.78	75.06	66.97	74.71	80.10	73.91	74.26	65.04	62.89	67.61	63.63	64.74	72.29	74.99	75.27
2002-03	77.72	77.11	94.86	84.96	85.10	81.46	76.27	78.02	63.81	74.12	67.85	75.29	84.46	74.80	73.99	66.28	54.93	69.40	64.02	64.41	74.07	76.47	76.82
2003-04	77.47	77.52	95.02	84.86	86.38	80.95	75.93	78.22	62.52	74.24	67.20	75.55	79.38	74.21	75.35	66.10	56.56	69.12	64.46	66.03	74.55	76.41	77.66
2004-05	78.18	78.64	95.04	85.14	86.10	84.47	75.09	77.53	61.12	75.56	68.29	75.13	80.59	74.70	76.26	68.07	58.58	71.10	67.06	68.33	75.78	77.01	78.24
2005-06	78.52	78.50	94.39	85.37	86.40	84.37	75.85	78.05	63.68	76.77	67.95	76.61	81.47	75.85	77.82	67.81	65.98	72.79	67.29	68.58	76.68	77.58	77.35
2006-07	76.51	77.42	94.77	72.64	86.12	85.33	77.56	79.28	62.42	76.61	67.64	77.07	82.23	76.76	77.79	69.25	69.88	71.53	69.53	70.55	77.42	80.54	77.91
2007-08	78.72	78.30	95.03	85.15	83.78	85.50	77.01	83.03	62.19	79.14	68.43	76.57	81.86	77.59	77.75	69.18	62.34	73.10	73.20	66.67	78.16	78.59	79.68

Source: Author's own calculation from Annual Survey of Industries, CSO, EPW Research Foundation

Table A4.2: Share of Non-workers in Total Person Engaged *(In Percentage)*

Year	AM	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1980-81	22.00	24.19	-11.87	16.57	19.61	19.98	22.48	22.36	25.12	33.25	31.62	25.44	18.82	25.15	26.03	29.29	37.45	34.83	30.15	29.10	28.75	21.38	23.62
1981-82	21.92	23.11	8.24	13.00	17.95	17.83	22.88	23.42	25.73	32.39	32.20	27.01	18.12	25.12	26.34	29.61	40.09	34.85	30.09	29.13	28.93	21.14	23.69
1982-83	21.80	22.67	8.11	13.33	18.68	18.24	24.08	23.52	26.03	17.77	30.19	26.69	19.22	25.65	26.63	30.39	34.80	34.23	29.00	29.17	29.93	22.06	23.03
1983-84	22.01	23.03	2.05	13.94	19.36	18.77	22.00	24.89	25.53	26.05	30.28	32.05	18.60	27.08	27.23	30.05	45.35	33.95	30.23	29.57	30.95	22.81	23.93
1984-85	22.62	25.23	9.85	13.12	17.78	17.35	21.83	24.37	26.47	28.13	31.47	24.19	18.45	26.11	26.89	29.24	39.33	35.58	30.03	32.39	29.43	22.68	23.93
1985-86	22.30	22.89	6.91	14.11	18.82	18.30	22.39	23.48	26.25	28.68	30.62	25.37	18.51	24.07	26.63	30.35	46.97	34.70	30.66	31.79	28.74	21.38	21.87
1986-87	22.15	22.90	5.95	13.48	19.23	17.83	22.02	23.71	27.17	28.90	31.34	25.12	19.29	22.84	26.94	31.43	45.47	34.74	34.79	32.18	30.62	21.55	23.70
1987-88	22.48	23.01	6.32	13.68	18.84	18.24	21.66	24.83	29.07	29.21	31.30	27.10	19.29	22.93	27.72	32.10	44.65	35.61	34.27	32.18	30.35	21.16	23.28
1988-89	22.76	23.37	6.64	13.74	17.99	17.32	22.81	23.95	27.48	30.11	30.89	26.54	19.58	23.63	27.32	33.70	43.85	35.27	33.49	30.93	28.84	22.12	21.99
1989-90	22.38	22.79	4.85	14.08	17.39	17.37	22.60	24.23	28.48	26.50	30.01	27.28	20.26	24.42	26.86	32.84	47.76	34.27	36.29	32.22	28.89	22.44	23.63
1990-91	22.89	22.76	6.85	13.95	17.42	19.29	22.87	23.35	29.24	24.94	30.46	27.08	20.05	25.88	28.15	32.87	48.65	34.83	38.84	31.99	28.94	21.86	22.75
1991-92	23.24	23.55	5.22	14.79	17.51	19.57	23.82	22.64	28.86	26.54	30.31	28.03	20.76	25.73	28.46	33.79	48.17	35.30	37.72	31.50	28.60	23.10	22.71
1992-93	23.78	24.43	5.24	15.27	17.59	20.72	22.07	23.04	30.06	28.74	31.25	27.56	20.84	25.34	28.75	34.12	56.05	35.06	38.35	32.84	29.46	24.12	25.39
1993-94	23.95	23.95	7.92	16.41	16.82	19.75	21.65	23.08	30.03	27.98	31.50	28.72	21.74	25.57	29.81	33.57	48.24	35.87	37.57	33.83	29.61	22.01	22.69
1994-95	23.55	23.83	7.38	15.92	15.74	18.58	22.04	24.13	30.67	27.36	31.56	27.66	21.57	24.97	29.43	33.15	49.67	34.07	36.16	34.37	29.82	22.26	24.20
1995-96	24.34	23.31	6.22	16.02	18.73	20.31	20.99	25.11	30.55	26.73	32.24	27.35	22.17	25.24	28.51	32.00	42.15	35.92	55.49	32.05	29.57	22.34	23.84
1996-97	23.33	23.59	5.19	15.46	15.97	18.76	21.95	23.63	32.20	27.57	31.44	26.36	22.37	25.00	26.68	33.63	33.56	33.29	36.78	31.83	29.45	22.16	21.58
1997-98	22.96	22.66	4.45	15.31	15.63	18.75	21.32	23.29	31.09	28.12	30.61	27.08	22.03	24.98	29.21	33.01	40.67	34.21	37.18	31.67	29.34	21.37	23.63
1998-99	25.91	23.97	4.69	16.22	13.86	17.85	21.31	23.17	35.39	32.48	33.16	32.94	20.28	25.70	28.50	51.35	48.79	32.99	31.15	42.51	27.36	23.60	21.40
1999-00	23.16	22.72	4.90	15.50	15.22	18.66	20.09	21.85	34.01	26.00	32.41	25.21	20.20	23.89	25.84	36.33	39.10	32.09	36.99	31.90	29.37	26.41	20.39
2000-01	23.15	23.47	5.99	15.02	14.66	17.19	24.59	22.24	37.23	30.74	32.00	25.69	21.77	25.36	25.75	34.89	39.23	31.21	35.17	34.79	27.58	25.33	22.62
2001-02	23.02	22.78	6.17	15.00	14.05	16.21	25.35	21.73	38.22	24.94	33.03	25.29	19.90	26.09	25.74	34.96	37.11	32.39	36.37	35.26	27.71	25.01	24.73
2002-03	22.28	22.89	5.14	15.04	14.90	18.54	23.73	21.98	36.19	25.88	32.15	24.71	15.54	25.20	26.01	33.72	45.07	30.60	35.98	35.59	25.93	23.53	23.18
2003-04	22.53	22.48	4.98	15.14	13.62	19.05	24.07	21.78	37.48	25.76	32.80	24.45	20.62	25.79	24.65	33.90	43.44	30.88	35.54	33.97	25.45	23.59	22.34
2004-05	21.82	21.36	4.96	14.86	13.90	15.53	24.91	22.47	38.88	24.44	31.71	24.87	19.41	25.30	23.74	31.93	41.42	28.90	32.94	31.67	24.22	22.99	21.76
2005-06	21.48	21.50	5.61	14.63	13.60	15.63	24.15	21.95	36.32	23.23	32.05	23.39	18.53	24.15	22.18	32.19	34.02	27.21	32.71	31.42	23.32	22.42	22.65
2006-07	23.49	22.58	5.23	27.36	13.88	14.67	22.44	20.72	37.58	23.39	32.36	22.93	17.77	23.24	22.21	30.75	30.12	28.47	30.47	29.45	22.58	19.46	22.09
2007-08	21.28	21.70	4.97	14.85	16.22	14.50	22.99	16.97	37.81	20.86	31.57	23.43	18.14	22.41	22.25	30.82	37.66	26.90	26.80	33.33	21.84	21.41	20.32

Source: Author's own calculation from Annual Survey of Industries, CSO, EPW Research Foundation

Table A4.3: Share of Non-workers in Number of Workers *(In Percentage)*

Year	AM	15	16	17	18	19	20	21	22	23	24	25	26	27	28	29	30	31	32	33	34	35	36
1980-81	28.20	31.91	-10.6	19.86	24.40	24.96	29.00	28.80	33.54	49.82	46.24	34.12	23.18	33.60	35.19	41.42	59.87	53.44	43.16	41.05	40.35	27.19	30.93
1981-82	28.07	30.06	8.97	14.94	21.88	21.70	29.66	30.59	34.64	47.90	47.50	37.00	22.13	33.55	35.76	42.06	66.91	53.50	43.03	41.11	40.71	26.81	31.04
1982-83	27.88	29.32	8.82	15.38	22.97	22.31	31.71	30.75	35.19	21.62	43.25	36.40	23.79	34.51	36.29	43.65	53.37	52.04	40.85	41.19	42.71	28.31	29.91
1983-84	28.21	29.91	2.10	16.20	24.00	23.10	28.21	33.14	34.28	35.22	43.44	47.16	22.85	37.14	37.41	42.95	82.98	51.39	43.34	41.99	44.83	29.55	31.46
1984-85	29.23	33.74	10.92	15.11	21.62	20.99	27.92	32.22	35.99	39.13	45.91	31.90	22.62	35.33	36.79	41.33	64.81	55.22	42.92	47.91	41.69	29.34	31.45
1985-86	28.70	29.69	7.42	16.42	23.18	22.40	28.85	30.69	35.59	40.22	44.13	33.99	22.71	31.69	36.30	43.57	88.58	53.13	44.21	46.61	40.34	27.20	27.99
1986-87	28.46	29.71	6.33	15.58	23.82	21.71	28.24	31.08	37.31	40.64	45.64	33.55	23.90	29.60	36.88	45.84	83.40	53.23	53.35	47.45	44.13	27.46	31.06
1987-88	28.99	29.89	6.75	15.85	23.22	22.31	27.64	33.04	40.98	41.26	45.56	37.17	23.90	29.75	38.35	47.27	80.67	55.30	52.13	47.45	43.58	26.84	30.35
1988-89	29.47	30.49	7.12	15.92	21.93	20.95	29.54	31.50	37.90	43.08	44.70	36.13	24.34	30.95	37.59	50.83	78.10	54.49	50.34	44.78	40.53	28.40	28.19
1989-90	28.83	29.52	5.10	16.39	21.05	21.02	29.20	31.99	39.82	36.06	42.87	37.51	25.41	32.30	36.73	48.89	91.41	52.15	56.97	47.55	40.62	28.93	30.94
1990-91	29.69	29.47	7.36	16.21	21.09	23.90	29.65	30.46	41.32	33.22	43.80	37.14	25.07	34.91	39.17	48.96	94.73	53.45	63.51	47.03	40.73	27.97	29.46
1991-92	30.27	30.81	5.51	17.36	21.22	24.33	31.27	29.26	40.58	36.13	43.50	38.95	26.19	34.64	39.79	51.04	92.93	54.56	60.56	45.98	40.05	30.05	29.39
1992-93	31.21	32.32	5.53	18.03	21.34	26.13	28.32	29.94	42.97	40.33	45.45	38.05	26.33	33.94	40.35	51.80	127.54	53.99	62.21	48.89	41.76	31.78	34.04
1993-94	31.50	31.49	8.60	19.63	20.22	24.62	27.63	30.01	42.91	38.85	45.98	40.28	27.79	34.35	42.47	50.54	93.18	55.94	60.17	51.13	42.07	28.22	29.36
1994-95	30.81	31.29	7.96	18.94	18.68	22.81	28.27	31.81	44.24	37.67	46.10	38.23	27.51	33.27	41.71	49.59	98.70	51.67	56.65	52.36	42.49	28.63	31.92
1995-96	32.17	30.40	6.64	19.07	23.05	25.48	26.57	33.53	43.99	36.48	47.57	37.65	28.49	33.76	39.87	47.06	72.87	56.06	124.65	47.16	41.99	28.77	31.30
1996-97	30.43	30.87	5.48	18.28	19.01	23.10	28.12	30.95	47.48	38.06	45.85	35.80	28.81	33.33	36.40	50.68	50.51	49.91	58.19	46.70	41.75	28.47	27.52
1997-98	29.81	29.29	4.66	18.07	18.53	23.08	27.10	30.37	45.11	39.12	44.10	37.13	28.26	33.30	41.27	49.28	68.54	52.00	59.18	46.34	41.52	27.17	30.95
1998-99	34.98	31.52	4.92	19.36	16.08	21.72	27.09	30.16	54.77	48.10	49.62	49.11	25.44	34.60	39.86	105.53	95.26	49.22	45.25	73.96	37.66	30.90	27.23
1999-00	30.13	29.39	5.15	18.34	17.96	22.93	25.14	27.96	51.55	35.13	47.95	33.71	25.32	31.39	34.85	57.05	64.22	47.26	58.71	46.84	41.57	35.88	25.61
2000-01	30.12	30.67	6.37	17.67	17.18	20.76	32.60	28.60	59.32	44.38	47.07	34.57	27.83	33.98	34.68	53.59	64.57	45.36	54.26	53.35	38.09	33.93	29.23
2001-02	29.91	29.50	6.58	17.64	16.35	19.35	33.95	27.77	61.87	33.23	49.32	33.85	24.84	35.30	34.66	53.76	59.01	47.91	57.15	54.47	38.32	33.35	32.85
2002-03	28.67	29.68	5.42	17.70	17.52	22.76	31.12	28.17	56.71	34.91	47.38	32.81	18.39	33.69	35.14	50.88	82.06	44.09	56.20	55.25	35.00	30.76	30.18
2003-04	29.09	28.99	5.25	17.85	15.76	23.54	31.70	27.84	59.95	34.70	48.81	32.36	25.98	34.76	32.72	51.29	76.80	44.68	55.13	51.45	34.14	30.86	28.76
2004-05	27.90	27.16	5.22	17.46	16.14	18.38	33.17	28.98	63.61	32.34	46.42	33.11	24.09	33.86	31.13	46.91	70.72	40.64	49.13	46.35	31.97	29.85	27.81
2005-06	27.35	27.38	5.94	17.14	15.75	18.53	31.85	28.13	57.05	30.26	47.17	30.54	22.75	31.84	28.50	47.46	51.56	37.37	48.61	45.82	30.41	28.91	29.28
2006-07	30.70	29.17	5.52	37.66	16.12	17.19	28.94	26.14	60.20	30.54	47.84	29.76	21.61	30.28	28.55	44.41	43.11	39.81	43.83	41.74	29.16	24.16	28.35
2007-08	27.04	27.71	5.23	17.44	19.35	16.96	29.85	20.43	60.81	26.35	46.14	30.60	22.15	28.89	28.62	44.55	60.41	36.80	36.62	49.99	27.95	27.25	25.50

Source: Author's own calculation from Annual Survey of Industries, CSO, EPW Research Foundation

Chapter-V

Rate of Profit and Distributive Aspects of Indian Manufacturing Sector

5.1 Introduction:

Distribution[1] is a primordial question. “Who gets what” is a universal and a constant source of antipathy and social conflict. This has its significance both in social and economic theory. Economic theory is however concerned with the positive aspects of the problem of distribution. In this regard, an extensive literature has accumulated in the past century to arrive at a more meaningful distribution theory to contain rising socioeconomic inequality. As per the theories of distribution[2], in a competitive market factors of production are priced according to their marginal[3] or incremental productivity. Sometimes contrasted with the statement that factors involve in the production activity in any sector ought to be rewarded according to their contributions to the production. There are different schools of doctrines on income distribution, however no one concluded it in a convincing way. Though all attempts so far to explain these vast fields are necessary to some extent arbitrary and subjective to the writer, in terms of broad classification and assumptions. Broadly as per the contribution of different school of thoughts and significance to the theory of distribution, made by the economists, sofar we can divide them into four groups. The first of these is the Ricardian or Classical Theory, the second the Marxian, the third the Neoclassical or Marginalist theory and lastly the Keynesian and modern economists.

An important aspect of the classical price system is that the total value added is distributed among the factors so that the entire generated value gets dissolved. As the factors of production in classical doctrine are only labour and capital, the entire value added is distributed as factor payments to those factors as labour compensation and profit. The tendency of the profit rates of industry is to converge towards a common value. As an industry expands its stock of capital, it has to employ more of the labour. So, the labour compensation for its contribution to the production process will rise and as a result, the profit or the payment of capital for its use in the activity will decline. In classical terminology the basic equation for complete distribution of total value added for the equalization is

$$Y = wL + \pi K \qquad (5.1)$$

[1] By "distribution" we mean the relative income received by the owners of factors of production.
[2] Edgeworth F. Y. (1904): “The Theory of Distribution”, *The Quarterly Journal of Economics*, Vol. 18, No.2, pp. 159-219.
[3] Carver T. N. (1905): “The Marginal Theory of Distribution”, *Journal of Political Economy*, Vol. 13, No. 2, pp. 257-266.

Where *Y* stand for total value added, L refers to number of labour, *K* stands for stock of capital and *w* & π represents wage rate and rate of profit respectively. If *L* units of labor are employed in the economy, each unit being paid a wage w, then the *income* of laborers (the owners of labor) is wL. If *K* units of (fixed, endowed) capital are employed and paid a return r, then the *income* of capitalists (the owners of capital) is πK. If we denote by *Y* the economy-wide level of output, then the *income share* of labor can be expressed as $\frac{wL}{Y}$ and the income share of capital is $\frac{\pi K}{Y}$. Consequently, the *relative income shares* of the capital and labor can be expressed as a ratio $\frac{wL}{\pi K}$.

Moreover, as per the theoretical argument, when there is more players involve in various activities, and funds flow to those, where the rate of profit is high. In this way, high rate of profit also intensify the competition. This in turn reduces profitability as more competition lead to gain bigger market share that finally bites the higher rate of profit in that sector or activity. Thus it leads to a convergence to a natural value. As Smith (1776) is rightly quoted,

> "*The rise and fall in the profits of stock depend upon the same causes with the rise and fall in the wages of labour, the increasing or declining state of the wealth of the society; but those causes affect the one and the other very differently. The increase of stock, which raises wages, tends to lower profit. When the stocks of many rich merchants are turned into the same trade, their mutual competition naturally tends to lower its profit; and when there is a like increase of stock in all the different trades carried on in the same society, the same competition must produce the same effect in them all*".

Therefore the competition between the capitalist and the desire to acquire more and more profit compels them to invest in the more profitable sectors. The flow of investment to these profitable sectors leads to a higher rate of capital accumulation. The high profit rate induces investments and capital flow to the sector and this will enhance the competition among the investors. The vague attraction to acquire high profit results in high concentration in those industries and at the same time the automatically generated competition will wash out the profits. The argument can be followed as the convergence of profit rates of the different manufacturing industry sector is the result of the flow of capital and the accumulation of capital in the industry which has a high profitability. The mobility of capital, i.e. its migration from low profit sectors to high profit one is the common tendency that is observed as time passes.

On the backdrop of above theoretical argument, this chapter evaluates the distributive relationship in Indian manufacturing sector. The present chapter examines the trend of compensation to labour and capital in term of real wages and rate of profit. From the previous analysis it is concluded that the labour productivity rises consistently during the sample period of study. Moreover, the study also found that capital-intensity in the Indian manufacturing sector has also observed to be augmented, over the same period. Therefore, it is necessary to investigate the compensation paid to both labour and capital and their respective trends. Since the finding of chapter-III and IV, we observed that there is an increasing divergence between the growth of labour productivity and growth of labour compensation per workers and per person engaged. These empirically established conclusion point towards rapid capital accumulation in this sector. The high growth of capital intensity in the post-liberalisation period indicated the enhanced use more and advanced machines in production activity. This means the profit accrued to capital has been increasing. Thus, we would like to examine the distribution of total output (real gross value added) among factors of production as their respective shares such as wage and profit. Moreover, we have analyzed the trend and growth of the rate of profit in the Indian manufacturing sector.

5.2 Data Sources and Description of Variables:

The principal source of data for the present chapter is the Annual Survey of Industries published by Central Statistical Organization. Besides, the study has also relied on the Economic Political Weekly (EPW) Research Foundation, data base on Indian Manufacturing sector. The data on Wholesale Price Index (WPI) and Consumer Price Index of industrial workers (CPI_{iw}) have been collected from different issues of Handbook of Statistics on Indian Economy, RBI. WPI deflector for respectively 2-digit industry groups with 1993-94 as the base is used to deflate output, while the CPI for industry workers at 1993-94 are used to adjust inflationary effect on the labour payment variable.

In ASI there are different concepts of factor payments such as wages to a worker, total emoluments to employees, provident funds and other expenses, profit, rent paid, interest paid, etc. As the focus is to analyse the share of factor compensation in the gross value added (GVA), we therefore interested in deals with compensation to factors like labour and capital. The compensation to the labour class is the total extended emoluments paid to them while the compensation made to entrepreneur class to investing capital as the factor of production is profit. We have outlined and describes the variables that we use to analyse the distribution aspect and the rate of profit concept in case of Indian manufacturing sector as follows:

Output: ASI provides three concepts of output such as Total Output (TO), Net Value Added (NVA) and Gross Value Added (GVA). In the present analyses we have considered NVA, which is calculated as the gross value added minus the depreciation. Gross value added is the difference between the value of output and value of input.

$$Gross\ Value\ Added = Total\ Output - Total\ Input$$

$$Net\ Value\ Added = Gross\ Value\ Added - Depreciation$$

Labour Compensation: ASI publishes data on various concepts of labour remuneration, such as the total wages paid to workers and total emoluments paid to total employees. For the present study, we have considered the broader measure of labour compensation[4] (LC) corresponding total person engaged by adding the payment that a person engaged in the Indian manufacturing sector received under provident fund and other benefits. Thus, labour compensation in the present study can be arrived as follows:

$$LC = Total\ emolument + PF\ \&\ Other\ Benefits$$

Profit: We have re-estimated both Net Profit (NP) and Gross Profit (GP) by using the variables published by ASI. The ASI concept of profit is arrived by deducting the labour compensation from the net income. Net income is defined as the difference between the net value added and the sum of rent paid and interest paid.

[4] ASI provides Emoluments and Provident Fund & Other Benefits data. To represent the broader concept of labour compensation, we have added the PF &OB with Emoluments to get the total labour compensation.

Rent paid: It represents the amount of royalties paid in the nature of rent for use of the fixed assets in factories.

Interest paid: It includes all interest paid on factory account on loans, whether short term or long term, irrespective of the duration and the nature of agency from which the loan was taken. Interest paid to patterns and proprietors on capital or loan are excluded.

Depreciation[5]: This is also being used to arrive at gross profit in the present study.

Stock of Capital: The stock of capital is calculated by the perpetual inventory method discussed before.

Gross Profit: Profit before rent paid, interest paid and depreciation

Net Profit: Profit before rent paid, interest paid

The profit rate is calculated as the division of profit (GP/NP) to capital

$$Rate\ of\ \ profit = \frac{\mathrm{Pr}\,ofit\ (GP/NP)}{Invested\ Capital}$$

5.3 Distribution in Indian Manufacturing:

After a critical assessment on the employment, real wage and labour productivity relationship in the previous chapter[6], it is time to analyse the distributive relationship in Indian manufacturing sector. By distributive relation we simply mean the sharing of gross value added among the two groups, those are actively participating in the production process via; labourers and entrepreneurs. The past literature[7] reflects that, over a period of time in most of the capitalist and developed countries of the world, the lion share goes to the hands of workers, which ensure the equality in the economy as a whole. This is examined in the light of the present day environment in industries, where strong labour unions are emerging to retain the higher proportion of the total product. This obviously refers that the other parts of the gross value added (GVA) is squeezed automatically i.e. profit. This phenomenon in the capitalist and developed industrial countries reflect the law of diminishing profit, is a hypothesis propound by Marx[8].

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[5] Depreciation can be defined as the reduction in the monetary value of an asset over time, due to its use, wear and tear or obsolescence.

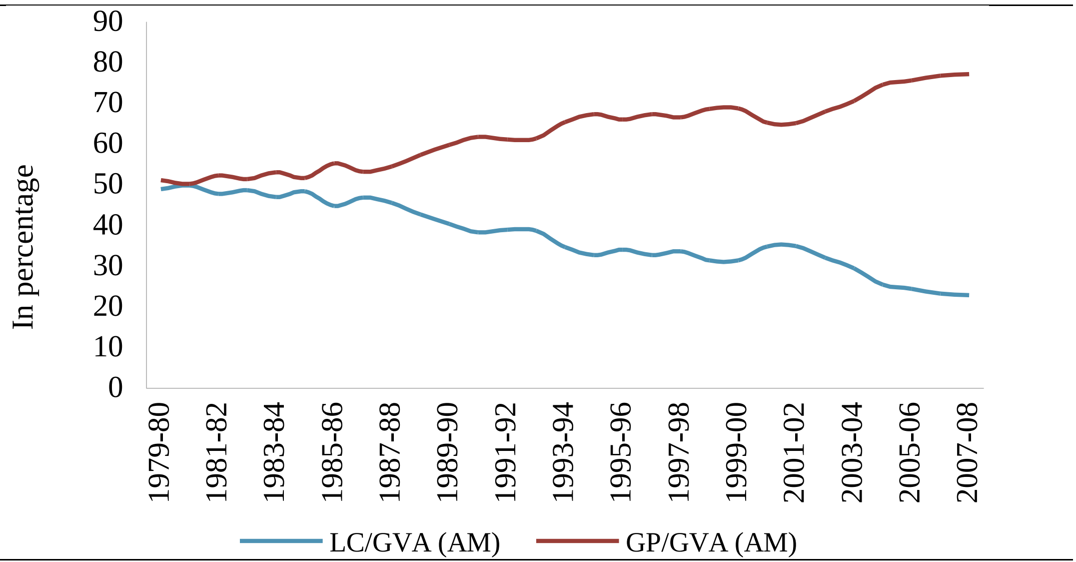
[6] In Chapter-IV, we have discussed the nexus between employment, wages and productivity.

[7]Sosin K. (1967), Spaventa L. (1970), Erdos T. (1977), Hoel M. (1978) and Brown C. (2005).

[8] The ***tendency of the rate of profit to fall (TRPF***) is a hypothesis in the science of economics and political economy most famously expounded by Marx in chapter 13 of his master piece 'Das Capital' Volume 3.

In this section our main emphasis is to test whether this economic hypothesis exist in the case of Indian manufacturing sector. The labour compensation as discussed above should increase over the period with rising labour productivity while profit as we argue should fall with growing competition. However, in the coming section we will validate this argument with Indian manufacturing data. We already observed that[9] labour productivity has consistently rising during the study period, so it would be interesting to enquire, whether labour compensation also follow shoot. As described in the previous section, we have constructed an extended form of emoluments (LC) which we believe represent the real share of labour class. On the other hand the share of the capitalist is represented by the gross profit[10] (GP) which constitutes profit before interest paid and rent paid plus depreciation. As we are interested to analyse the shares of these two classes in the total value added, we have considered the above three variables i.e. GVA, LC and GP at nominal prices. The data on output, i.e. gross value added (GVA) is available over the entire sample period of the study (1973-74 to2007-08). However, to estimate both LC and GP, we have information available from ASI only from 1979-80 onwards. Therefore the present analysis on distribution has been restricted to the period 1979-80 to 2007-08, because of the data constraint.

Figure-5.1: Distribution of GVA in Indian Manufacturing Sector



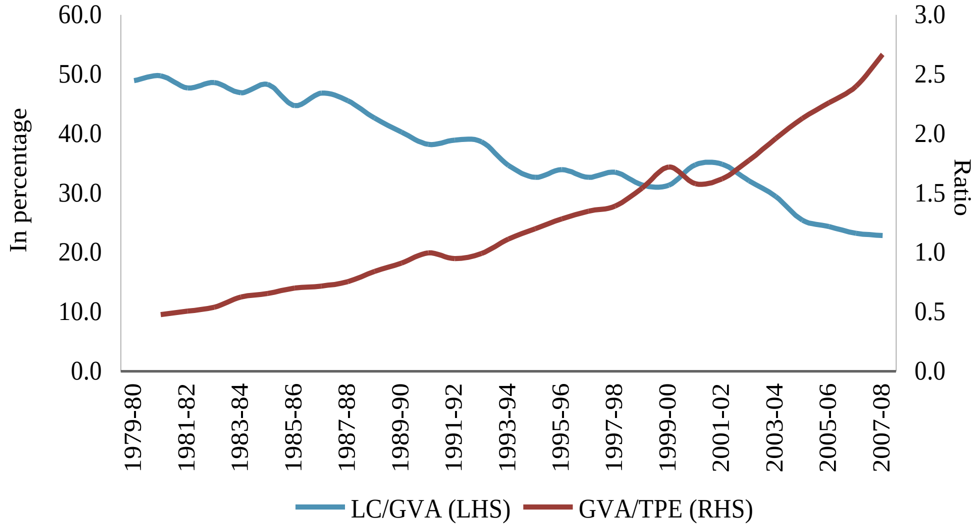
Note: LC stands for labour compensation, GP refers to gross profit and GVA represents gross value added. All variables are at current prices.
Source: Author's own calculation from Annual Survey of Industries, CSO and EPW Research Foundation

[9] From the analysis of Chapter-III, we found that the growth and trend of labour productivity is rising.
[10] We have taken profit before rent paid, interest paid and depreciation to arrive at gross profit.

Figure 5.1, represents the distribution of GVA between labour and capital for the aggregate manufacturing sector during 1979-80 to 2007-08. From Figure 5.1, it is observed that the labour compensation in Indian manufacturing has been consistently falling down over the period of study (1979-80 to 2007-08). When we plot the share of labour compensation and profits we get a mirror image in Figure 5.1, because they added up to unity. As argued by the classical economist, the total compensations to the factor of production should completely exhaust the total output, when factor of productions is paid their relative shares. This holds well in our analysis as we get gross value added is the sum of labour compensation and share of profits. However, we get a contradictory trend of labour compensation against rising labour productivity. This leads to, steady rise in the share of profit in total production during the sample period of the study. The plausible explanation is, more profit has been generated due to higher capital accumulation. The rising capital stock in Indian manufacturing leads to higher investment in industries that in turn fetch higher profit to the entrepreneurs. Which has been retained (then distributed among labourers) for re-investment and to expand the manufacturing activity.

From Figure 5.2, we observed that labour productivity in Indian manufacturing shows a rising trend. However the share of labour compensation in gross value added has been falling despite rising in labour productivity.

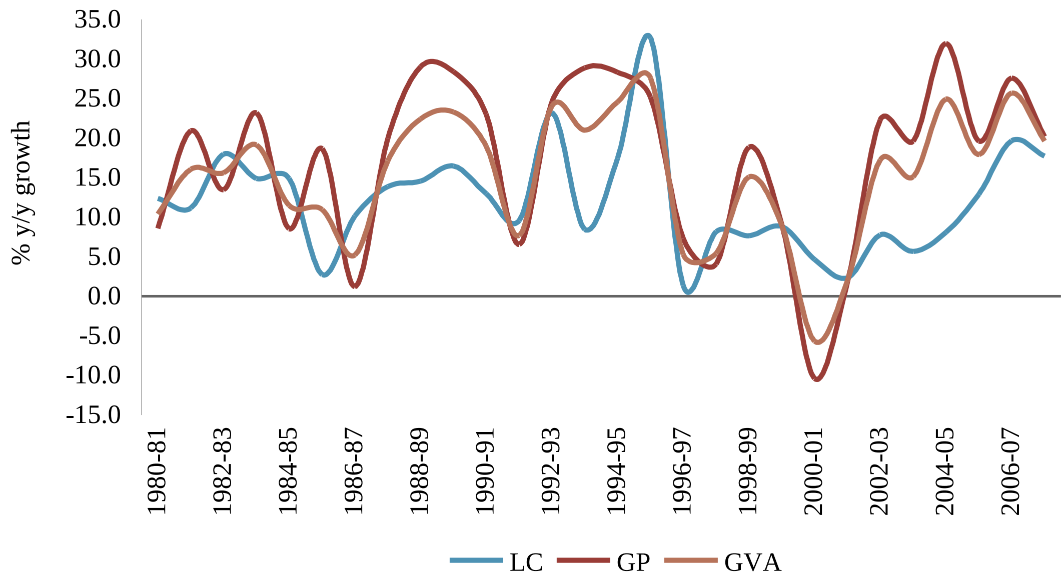
Figure 5.2: Labour Compensation and Labour Productivity in Indian Manufacturing Sector



Source: Author's own calculation, Annual Survey of Industries, CSO, Govt. of India and EPW Research Foundation

It is observed from Figure 5.1, that the share of labour compensation is falling consistently while the share of profit in GVA is rising constantly. To investigate further, we analyze the growth trend of labour compensation, share of profit and gross value added in Figure 5.3. We witnessed that both the growth of gross profit and GVA moves together, while the growth of labour compensation is showing a completely different pattern. This needs further investigation and we intended to see why in case of Indian manufacturing the labour compensation is persistently falling despite rising labour productivity (see Figure 5.2). In a reformist economy like India, its manufacturing sector has a benefit to access the modern technological know-how to have an advantage of substituting capital with labour. Thus, with rising capital accumulation and access to labour saving technology, labour productivity has increased, which in turn raises output growth. With a higher output growth and due to implementation of labour saving technique in place, the share of labour in total gross value added fall down and that in turn lead to higher profitability through falling cost of production.

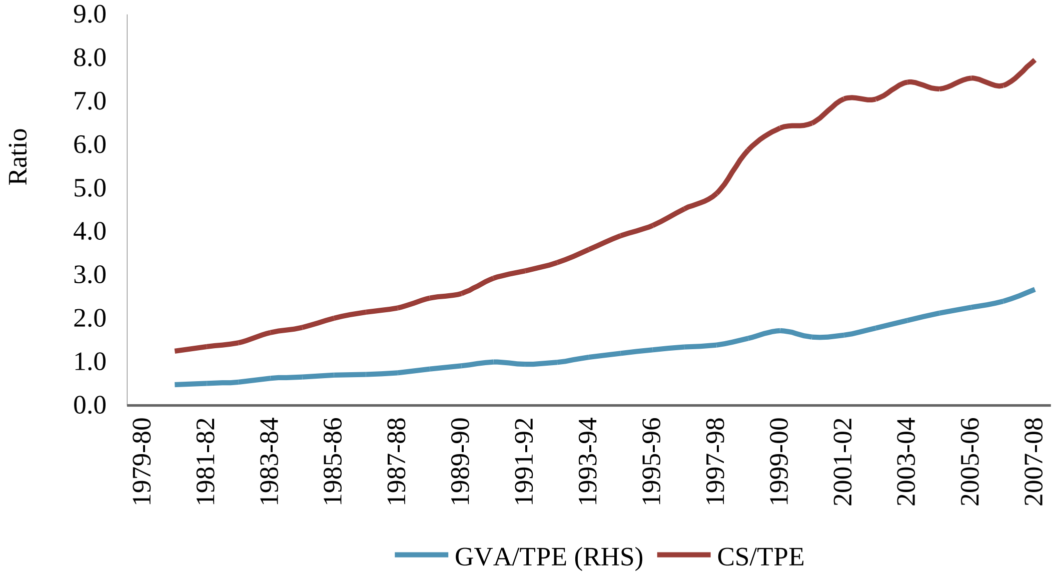
Figure 5.3: Annual Growth Rate of Labour Compensation, Profits and Gross Value Added



Source: Author's own calculation, Annual Survey of Industries, CSO, Govt. of India and EPW Research Foundation

With a higher share of profit, capital accumulation also increases with additional investment. This helps in rising capital intensity as more and more capital stock is engaged in the production activity. With a rise in capital to labour ratio (capital intensity) productivity has also enhanced (Figure 5.4). In Indian manufacturing capital intensity[11] ratio has seen a constant rising trend over the sample period of study (1979-80 to 2007-08). The use of capital and machinery makes labour more effectively, so rising capital intensity (capital deepening) thrusts for higher productivity of labour.

Figure 5.4: Labour Productivity and Capital Intensity



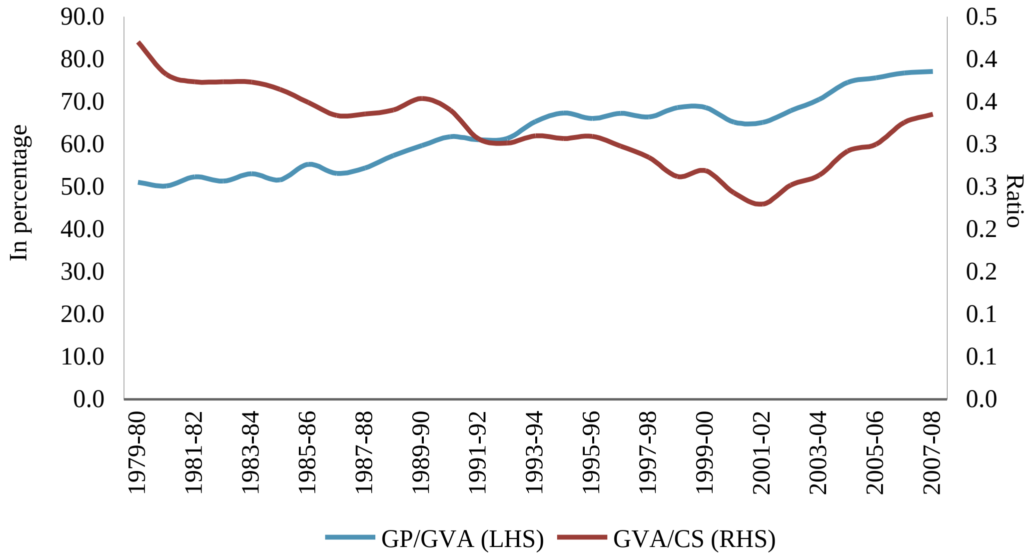
Note: GVA, CS and TPE refer to Gross Value Added, Capital Stock and Total Person Engaged respectively.
Source: Author's own calculation, Annual Survey of Industries, CSO, Govt. of India and EPW Research Foundation

As observed from the Figure 5.4, both labour productivity (GVA/TPE) and capital intensity (CS/TPE) for the aggregate manufacturing sector of Indian is showing a rising trend. From the rising capital intensity trend we can understand that post-liberalisation period has experienced an increasing capital accumulation in the Indian manufacturing sector. This helps to execute production activity more efficiently and in a cost effective way. Past studies[12] suggest that capital intensive societies tend to have a higher standard of living over the long run. The rising productivity, efficiency and labour productivity leads to reduction of cost of production and lead to higher profit (see Figure 5.5). Capital to output ratio also helps profit to increase over a long run. It is also observed from the Figure 5.6 that capital –output ratio and share of profit in output also follows the same pattern over the study period. However the Figure shows that capital-output

[11] Please refer to Chapter-III for discussion on Capital Intensity.
[12] Solow (1957) in his historical research based on importance of savings and capital investment suggested that improvement in the quantity and quality of physical capital were the largest contributor to economic growth in the US. and other developed countries over the previous centuries. Similarly, Kaldor (1966) also emphasizes the importance of higher capital-labour ratio behind the rising growth in the United Kingdom.

ratio (CS/GVA) is constantly falling since 2003-04 till2007-08. This suggests that during this period capital is used in a much efficient manner, as the capital productivity has started increasing from 2002-03 onwards.

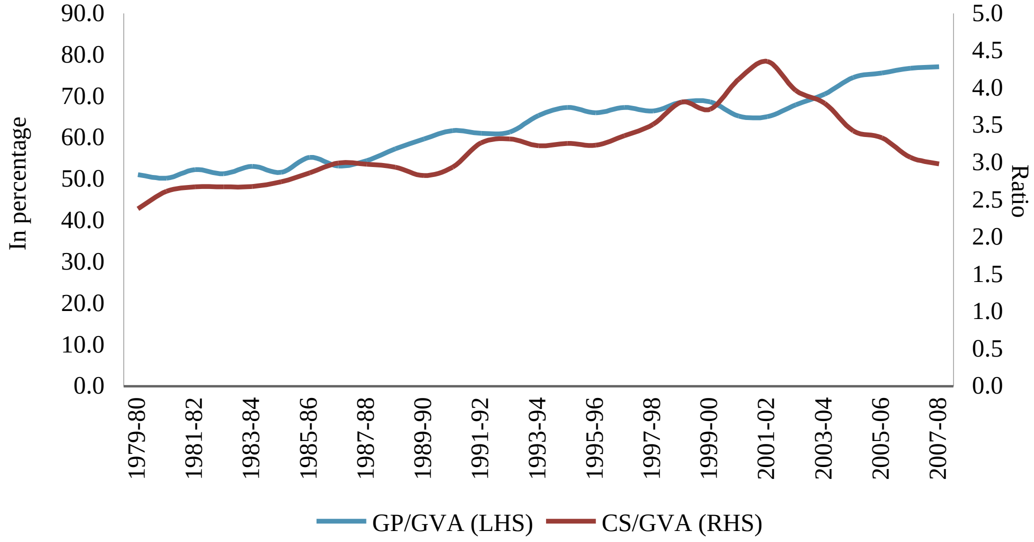
Figure 5.5: Share of Profit and Capital Productivity



Source: Author's own calculation, Annual Survey of Industries, CSO, Govt. of India and EPW Research Foundation

Therefore, there is a clear demarcation of increasing profits in Indian manufacturing, which is steady over the period of the study. Thus, in case of Indian manufacturing Marxian law of diminishing profit is not corroborated and the larger share of GVA is going into the pocket of capitalist, which in turn directly increase the existing inequality in the distribution of production and income in this sector. The major question remains, is even though the labour productivity has increased significantly across NIC 2-digit industry groups over the period 1979-80 to 2007-08, the share of labour compensation in total output is coming down consistently. Which suggest that the new technology, which directly increasing the skill of the laborers turn to increase the productivity of labourers, which in turn contributing increasingly towards the profitability of capitalist. Figure 5.1 has clearly supported our argument.

Figure 5.6: Share of Profit and Capital-Output Ratio



Source: Author's own calculation, Annual Survey of Industries, CSO, Govt. of India and EPW Research Foundation

After the indepth analysis for aggregate Indian manufacturing, now we will shift our focus towards a dis-aggregate analysis. The disaggregate industry level analysis is useful in the sense that we can find out what are the group of industries outperform the trend of aggregate manufacturing and which are not? This also gives scope to make a judgment over the industry specific policy implication. As in the earlier part of this chapter, we have discussed the nature of labour in the economy may not in fact be a variable one and regarding a situation of increased labour productivity being associated with a falling share of wages, which we have tested for the aggregate manufacturing in the above Figures. Now we proceed to take a look in this matter by doing the dis-aggregate analysis for Indian manufacturing. The majority of the two-digit industrial groups follows the same trend of rising share of profit in gross value added. This is quite appalling that labour intensive[13] industrial groups such as Food products ((15), Tobacco products (16), Leather products (19), Wood products (20) etc. are also showing high share of profit in GVA. It's only Wearing apparel, dressing and dyeing (18) group which is having higher labour share in GVA compared to the share of profit in GVA. From the disaggregate analysis, it is observed that industrial groups such as Paper products (21), Petroleum products (23). Chemical products (24), Rubber and plastic products (25), Non-metallic mineral products (26), Basic metals (27), Office accounting

[13] We define the nature of the industry as labour intensive and capital intensive based on the benchmark capital-labour ratio. For further understanding please refer to the Appendix tables at the end of this chapter.

& computing machines (30), Electrical machinery (31) and Other transport equipment (35) are having the highest share of gross profit (more than 70 percent) is significantly high in gross value added. It is the capital intensive industries, where profit share has significantly higher compared to that of labour intensive industrial groups in Indian manufacturing over the study period. So it is observed from the above analysis, industrial groups with high capital investment are experiencing higher share of profit in total production. Labour intensive groups are also experienced more than 50 percent share of profit in total value added, which is due to low bargaining power of the labourers and lack of unity in forming an association. Moreover the rising profit is also associated with an increase in the growth of overall output, as an extension of the market beyond the national boundaries, enhanced demand for manufacturing output over the period. Moreover, both rising output growth due to more capital deepening in the manufacturing sector and extension of the labour market, productivity has experienced significant improvement since the eighties.

From the above discussion, we observed that the share of profit in total production accounts for the largest share, which is increasing during the study period for Indian manufacturing. Therefore the question immediately strikes over here what happens to that huge profit? Whether it is reinvested in the same process or flowing to some other activity? These questions are of relevant policy implications and we are going to address them in the next section by analyzing the dynamic of the rate of profit of Indian manufacturing sector.

5.4 Rate of Profit:

In the whole spectrum of economic literature, Smith was the first economist who enquired into the word ‘rate of profit’ with keen interest. He distinguished the rate of profit into three categories, namely the general rate of profit, the individual rate of profit and market rate of profit. Ricardo has a stand supporting the fall in the profits as temporary one. As the capital stock grows the demand for labor would increase to make use of the accumulated capital. The proposition is just opposite to that of Adam Smith. The distribution of value added between wages and profit is the basic domain in Ricardo’s logic. So the basic difference in the doctrine of Smith and Ricardo in this context is that former establishes relationship between wages and profits. So there is a shift in thought from accumulation to distribution.

The classical growth theory prescribes two models to augment the wealth of an economy: (i) increase the number of productive labour and their additive power. (ii) increasing the productivity of labor by employing additional capital. The improvement of the productivity of labour comes from greater division and specialization of labour and an intensive use of capital. Both of these need more and more capital and greater capital accumulation mean a fall in the profit rate. Thus the fall in the rate of profit is an inevitable process in the growth story of an economy, when rising capital accumulation through greater capital formation.

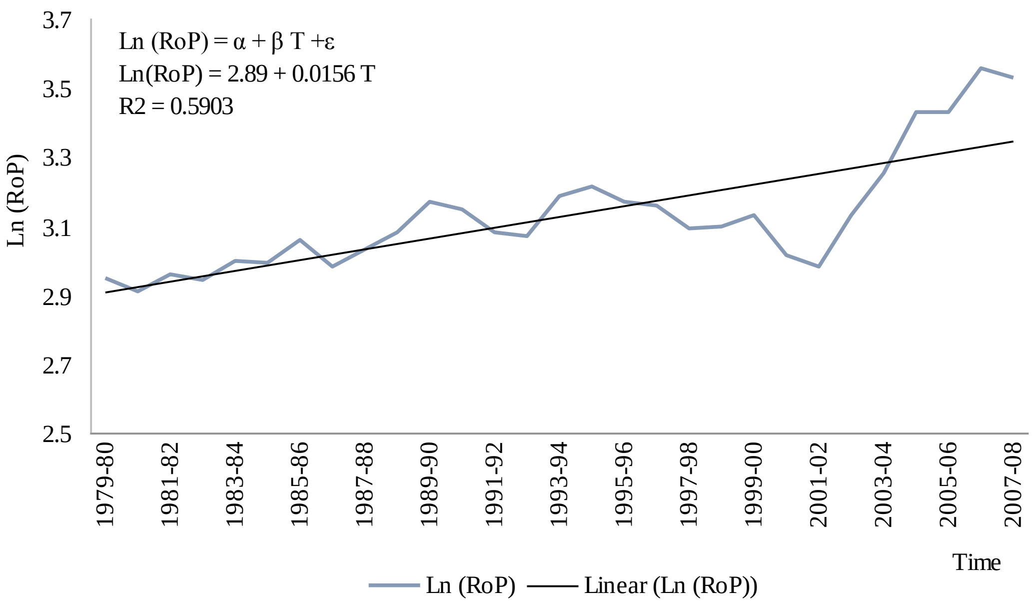
Thus the productivity of labour, capital accumulation and rate of profit is linked in a circular causation that explains the classical growth theory. This section enquired the dynamic of the rate of profit and its relation with the rate of interest and capital formation. The basic motive behind such investigation is to understand the trends, structure and the reason behind its growing share in the total output. We further investigate the validity of this argument for the Indian manufacturing sector, by analyzing the relationship between the rate of profit and capital formation.

5.4.1 Trends of profit in case of Indian Manufacturing:

The profit in the Indian organized manufacturing sector in the post liberalization period has been increasing and has grown tremendously. The profit was 5,49,116rupees in 1979-80 which increased to 4,13,25,135 lakh rupees in the year 2007-08. The profitability of the entire dis-aggregated manufacturing sector also presented an increasing trend. But the rate of profit in the manufacturing calculated as the ratio between profits for capital stock, declined over time in the study period. The rapid accumulation of capital stock and the flow of capital intensive production technique condensed the rate of profit. The profit rate of the manufacturing sector showed an irregular pattern during the sample period of study. Figure 5.7, states that rate of profit was fluctuating and in general has seen a declining tendency up to the year 2001-02from 1993-94. However, a clear rising trend is being noticed in the trend from 2001-02 onwards. The profit rate, though fluctuating, demonstrate a modest rising trend, which is clear from the trend line. The rising rate of profit indicates that the Marxian preposition of falling rate of profit does not hold valid in case of Indian manufacturing sector.

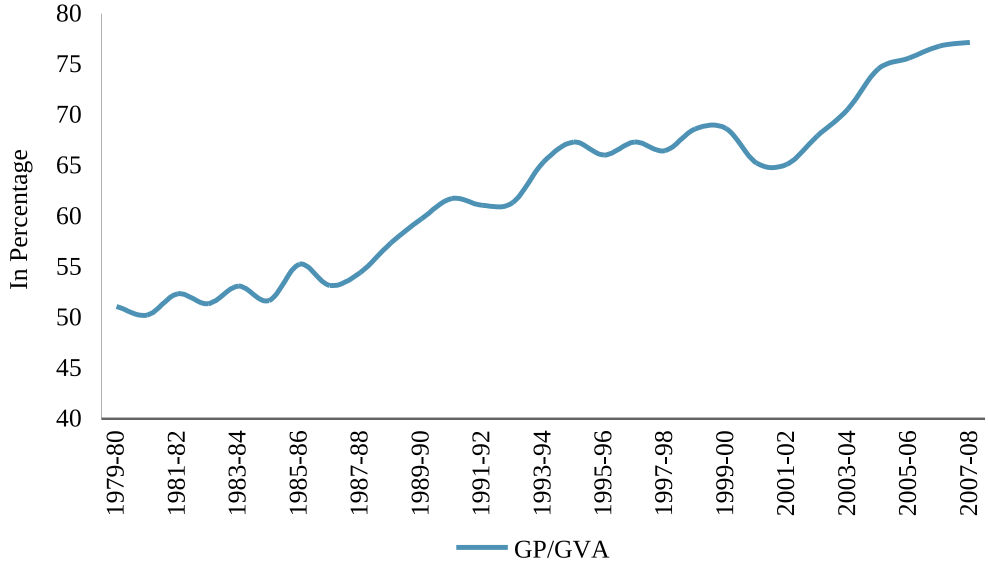
From Figure 5.7, we observed that while the rate of profit has seen an irregular pattern till the implementation of the LPG policies in 1991. However, the rate of profit shows a declining trend during the nineties, because, of cut throat competition from Multinational Companies (MNCs) due to open economic policies. Over 2001-02 onwards, we can observe a rising trend in the rate of profit for aggregate manufacturing sector. Meanwhile the share of profit in total production has revealed a somewhat different pattern over the sample period of study. From Figure 5.8 it is clear that though the share of gross profit in gross value added is showing a modest irregular pattern over the sample period, however it has seen a significant increase in its share from 51 percent in 1979-80 to 77 percent in 2007-08. This shows the rise of the share of profit in gross value added over 51 percent during the 29 years of sample period of study.

Figure 5.7: Trend of Rate of Profit



Note: RoP stand for rate of profit, by deviding e have considered the gross rate of profit divided this with capital.
Source: Author’s own calculation from ASI and EPW Research Foundation.

Figure 5.8: Share of Gross Profit in Gross Value Added



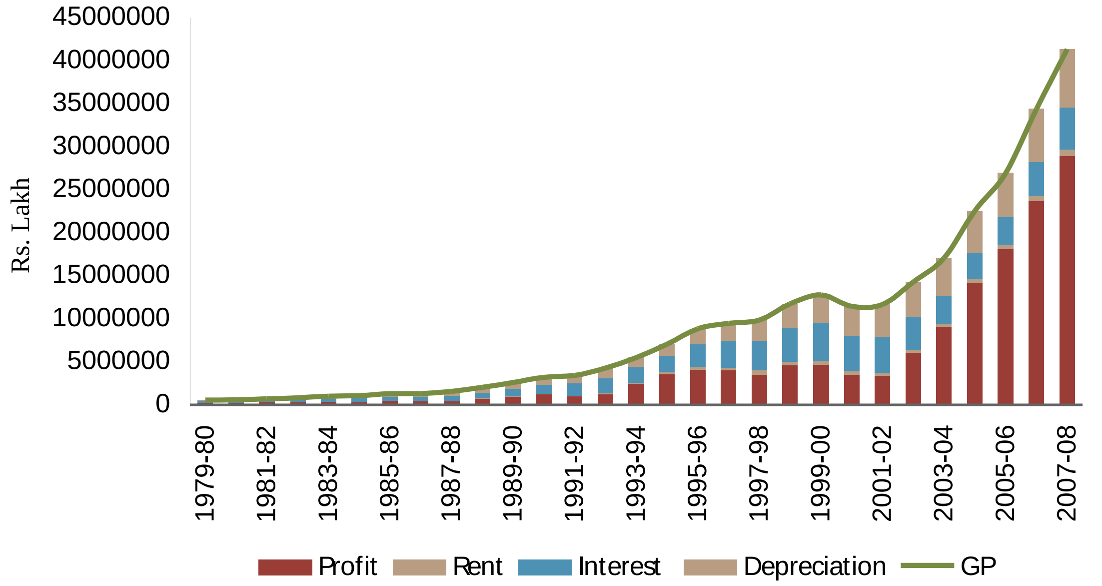
Note: GP stands for gross profit (Profit before rent paid, Interest rate paid and depreciation) and GVA refers to gross value added at current prices.
Source: Author's own calculation from ASI, EPW Research Foundation.

The share of profit before rent paid and interest paid and depreciation in GVA increased over the period of study. The share of profit was 51 percent in 1979-80 but it climbed to 77 percent in the year 2007-08 for aggregate manufacturing. The increasing trend in the share of profit is found in all the industry groups except for the Wearing apparel, dressing and dyeing of FUR (18). At the beginning of the study in 1973-74, industrial groups such as Food products (15), Wood products (20), Paper product (21), Petroleum products (23), Chemical products (24), Rubber products (25), Non-metallic mineral products (26), Fabricated metal products (28) and Electrical machinery (31) are having share of profits in respective GVA were more than the average. Among these, only Petroleum products (23), Chemical products (24), and nonmetallic mineral products (26) maintain the above average share of profit till the end of the study year 2007-08. Nevertheless industrial groups like Textile products (17), Wearing apparels (18), Leather products (19), Printings related (22), Machinery equipment's (29), Communication equipment's (32), Medical &Optical instruments (33), Motor vehicles (34) and Furniture manufacturing (36) where share of profits is less than overall average for the entire sample period of the study. In the year 2007-08 most of the industrial groups experience a higher than the beginning year share of profit in GAV. Moreover, industrial groups like tobacco related products (16), Petroleum products (23), Chemical products (24), nonmetallic products (26) and Basic metals (27) are significantly higher share of profit in GVA in 2007-08. The industries where the share of profit was more than the aggregated average profit were mainly capital-intensive. Moreover, the industrial groups like Tobacco products (16), Publishing, printing (22), Basic metals (27), Radio, television & communication equipment (32), Medical precision & optical instruments (33) and Other transport equipment (35) achieved a higher and significant growth in the share of profit in the GVA during the entire study period of 29 years (1979-80 to 2007-08).

5.4.2 Composition of Gross Profit:

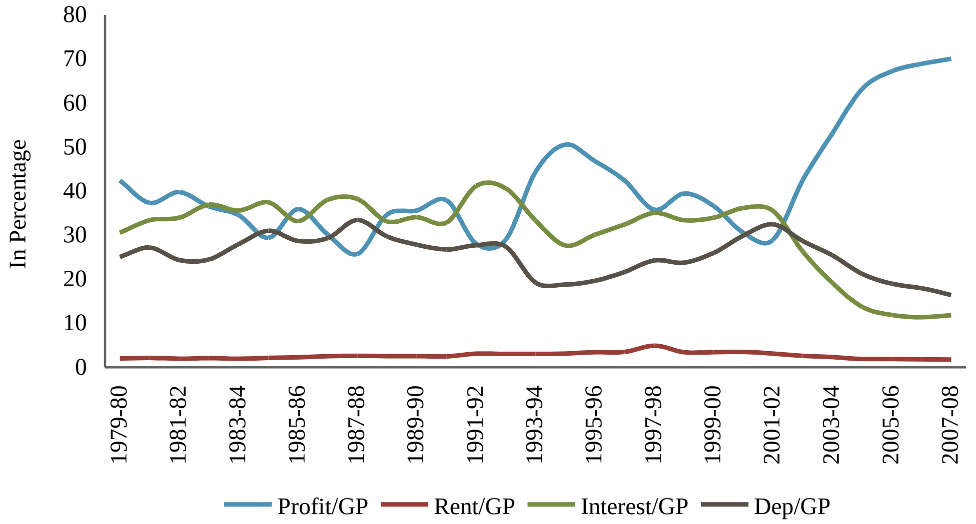
In Indian context the trend of the rate of profit has shown irregular pattern, as observed from the findings of the previous section. This pattern also been observed across twenty two 2-digit industrial groups. Moreover, the share of profit in GVA, on average accounts for a lion share for majority of the 2-digit industrial groups and significantly high for aggregate manufacturing sector. Thus, we make an attempt to analyse the composition of gross profit that offer a fair idea about the constituent and their trends. As described earlier, we have defined profit in a broader perspective over and above the concept of profit explained by ASI. The concept of gross profit is in line with the broader measure of output variables i.e. gross value added and broader concept of labour share i.e. Extended form of emolument by adding provident fund and other benefits paid to industrial labour. We graphically presented the different composition of gross profit in Figure 5.9, which shows that, rent constitute a very irrelevant portion of the gross profit and it is basically other three components that explain the behaviour of gross profit.

Figure 5.9: Composition of Gross Profit in Indian Manufacturing



Note: GP refers to gross profit and others as explained in ASI database
Source: Author's own calculation from Annual Survey of Industries, CSO, EPW Research Foundation

Figure 5.10: Trend of Composition of Gross Profit



Note: GP stand for gross profit and Dep refers to Depreciation. All the variables are at current prices.
Source: Author's own calculation from Annual Survey of Industries, CSO and EPW Research Foundation.

The contribution of interest paid, rent paid and pure profit will give the glimpse of the causes of the increasing profits in the manufacturing sector. From the Figure 5.9 and 5.10 it is apparent that there is a fall in the share of interest paid on gross profit.

Moreover, it is observed that the share of profit for use of the capital is increasing. After the year 2001-02, there is a significant fall in the share of interest paid combined with an increasing share of profit. The increasing share of profit is due to rapid capital accumulation, but cannot be attributed to the other factors.

5.4.3 Rate of Interest and Profit Relationship:

From the discussion on the distribution of gross product between labourers and capitalist, we found that the share of the labourers in gross value added is coming down consistently. On contrary to this, the other part of the total value added i.e. The profit of the entrepreneur accounts for more than a fifty percent share of gross product since the beginning of the study year 1979-80. The increase in the share of profit needed to be examined properly. In the present section we will also make an attempt to find out the rate of interest and profit relationship in Indian manufacturing. Theoretically, the rate of interest as an autonomous determinant of gross profits and normal costs, influence the price level. Because of the relationship between the money and prices and, of the influence of the rate of interest on the price-level are the effects of changes in interest rates on the inducement to purchase commodities.

Here we are interested to analyse the relationship between the rate of interest and the rate of profit. The notion that the rate of profits moves in sympathy with the rate of interest through changes in prices relative to money wage has been pointed out by many contributors starting from the famous '*Oxford Inquiry*' at the end of the thirties. On the other hand Keynes way of postulating the relationship between the rate of profit and the rate of interest is linked with his concept of "*the euthanasia of rentier*". It has recently observed in Sraffa's suggestion that the profit rate is determined by the money rate of interest 'fits in with Keynesian ideas of a long-run character', if interest disappeared then the profit would become merely an entrepreneurial wage. This seems, however, to disregard the fundamental difference we have just pointed out between the two ways of approaching the interest profits connection.

From the above theoretical explanations and different views postulated by different theoreticians, we now move to empirically test the trends and movements of both the rates in the Indian manufacturing sector. The period of analysis is similar to that of the last section i.e. 1979-80 to 2007-08, due to unavailability of data. For the present analysis, we have constructed the nominal rate of interest and two concepts of rate of profits i.e. nominal rate of net and gross profits. In the coming paragraphs we will focus on the trend analysis of nominal rate of interest and nominal rates of net profit and gross profit for aggregate manufacturing. Moreover, we also analyses the relationship between interest rate and rate of profit for disaggregated 2-digit industry groups[14] in the Indian manufacturing sector. In the coming section we will discuss the broad trend that is observed from the dis-aggregate level analysis along with the trends in the aggregate manufacturing.

Table 5.1 represents the broad trends that have been observed in the nominal rate of interest, the net rate of profits and gross rate of profits in the aggregate manufacturing sector in India. Along with the percentage term, all the three rates are presented in index form (by taking the beginning year 1979-80 as the base) for easy comparison of their trends over the sample period of study.

The nominal rate of interest (NIR) can be defined as the ratio between interests paid to loans outstanding and multiply by 100 to get in percentage terms.

$$Nominal\ Rate\ of\ Interest = \frac{Interest\ Paid}{Loans\ Outs\tan ding} \times 100$$

On the other hand, there are two concepts of rate of profit such as the net rate of profit (NRP) and gross rate of gross profits (GRP). We have calculated NRP and GRP[15] as the ratio of net profit and gross profit to Invested Capital (IC) respectively. The question arises here, why we have preferred to take Invested capital (IC) as the capital variable in this particular case[16]? We have preferred IC over capital stock series (that we have generated by using PIM) as capital stock series is derived from fixed capital by using the investment deflator, which is not exactly remain nominal any more.

[14]The corresponding Figures of 2-digit groups of industries are presented in the appendix of this chapter.

[15] The estimation of NRP and GRP has been explained in section 5.2 “Data Sources and Description of Variables”.

[16]ASI provides information on various capital concepts such as fixed capital, working capital, physical working capital, productive capital, and invested capital. In the denominator we have taken invested capital because this concept of capital representing the broader aspect to that of other two available capital variables like, productive and fixed capital.

The above table represents the absolute Figures for a nominal rate of interest, the net rate of profit and gross rate of profit in col. 2, 3 and 4 respectively. The corresponding annual indexes of these rates are presented in col. 5, 6 and 7. Figure 5.11 is the graphical representation of NRI, NRP and GRP.

Table 5.1: Nominal Rate of Interest, Net Rate of Profit and Gross rate of Profit in Aggregate Manufacturing

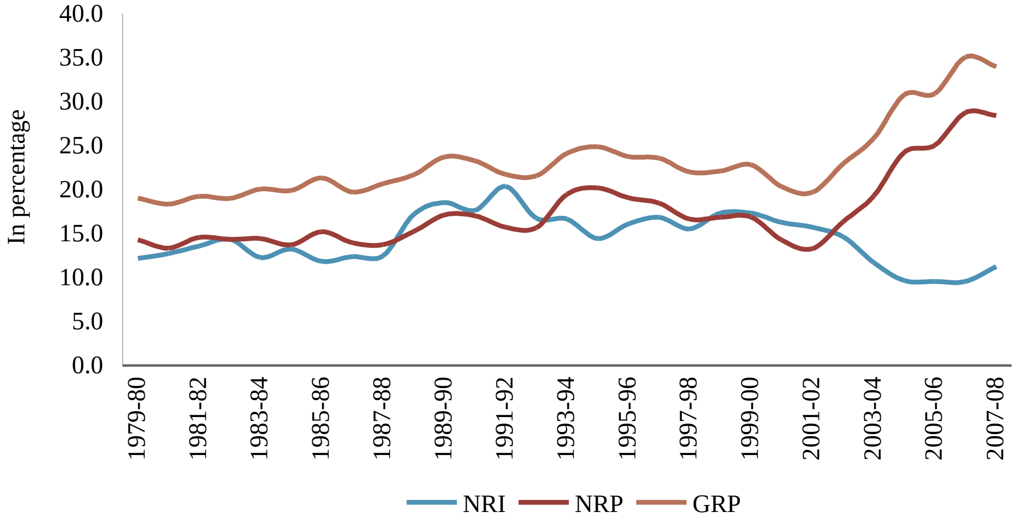
(In Percentage & Index)

Year	NRI	NRP	GRP	INRI	INRP	IGRP
1979-80	12.19	14.28	19.06	100.00	100.00	100.00
1980-81	12.74	13.36	18.35	104.52	93.54	96.27
1981-82	13.57	14.56	19.24	111.27	101.94	100.97
1982-83	14.36	14.35	19.00	117.74	100.47	99.67
1983-84	12.28	14.45	20.05	100.70	101.16	105.20
1984-85	13.25	13.73	19.90	108.64	96.12	104.42
1985-86	11.83	15.21	21.32	97.02	106.46	111.84
1986-87	12.39	13.95	19.74	101.58	97.68	103.59
1987-88	12.51	13.76	20.67	102.57	96.31	108.44
1988-89	17.22	15.27	21.72	141.19	106.88	113.94
1989-90	18.53	17.13	23.73	151.95	119.91	124.52
1990-91	17.65	17.04	23.27	144.79	119.31	122.08
1991-92	20.39	15.72	21.74	167.20	110.07	114.07
1992-93	16.74	15.65	21.56	137.33	109.59	113.10
1993-94	16.65	19.48	24.12	136.55	136.36	126.55
1994-95	14.44	20.21	24.88	118.41	141.46	130.54
1995-96	16.13	19.08	23.74	132.25	133.55	124.58
1996-97	16.87	18.47	23.57	138.38	129.31	123.66
1997-98	15.51	16.66	22.00	127.23	116.64	115.44
1998-99	17.35	16.86	22.11	142.25	118.02	115.98
1999-00	17.35	16.90	22.83	142.26	118.33	119.80
2000-01	16.27	14.26	20.33	133.45	99.84	106.69
2001-02	15.74	13.28	19.68	129.10	92.97	103.24
2002-03	14.65	16.36	22.94	120.15	114.50	120.35
2003-04	11.72	19.28	25.85	96.12	134.94	135.64
2004-05	9.66	24.25	30.78	79.20	169.76	161.47
2005-06	9.54	25.05	30.93	78.27	175.38	162.26
2006-07	9.56	28.77	35.07	78.44	201.42	184.01
2007-08	11.25	28.42	34.00	92.28	198.98	178.40

Note: NRI stands for nominal rate of interest, NRP and GRP refer to net rate of profit and gross rate of profit. INRI, INRP and IGRP are annual index of interest rate, net rate of profit and gross rate of profit respectively.

Source: Author's own calculation from ASI, Central Statistical Organisation and EPW Research Foundation.

Figure 5.11: Trends of Nominal Rate of Interest, Net Rate of Profitand Gross Rate of Profit



Note: NRI refers to Nominal Rate of Interest, NRP and GRP stands for net rate of profit and gross rate of profit.
Source:Author's own calculation from ASI, Central Statistical Organisation, EPW Research Foundation

In Figure 5.11, the trends of nominal rate of interest, net profits and gross profits have been presented graphically. From Figure 5.11 we observed that all the three rates are showing an irregular pattern during the entire sample period. However, both the rate of profit follows similar trend while the nominal rate of interest shows a completely different trend. The prominent rise in the trend of both net and gross rates of profit is observed from 2001-02 till 2006-07. However, for the rest of the sample period of study both the rate of profits is revealing irregular pattern. On the other hand, the nominal rate of interest is showing a rising trend during 1985-86 to 1991-92 and a declining trend during 1999-00 to 2004-05. However, for the rest of the sample period of the study, the rate of interest has revealed a mixed trend. From the above discussion, it is clear that the rate interest and profit do not move with sympathy in case of Indian manufacturing as opposed to the notion of classical economist and Marx.

Table 5.2: Average Rate of Profit and Interest in Indian Manufacturing

(In Percentage & Index)

2-Digit NIC Code	*Rate of Gross Profit*				*Rate of Interest*			
	1979-80 to 2007-08	1979-80 to 1989-90	1990-91 to 1999-00	2000-01 to 2007-08	1979-80 to 2007-08	1979-80 to 1989-90	1990-91 to 1999-00	2000-01 to 2007-08
AM	23.18	20.25	22.98	27.45	14.43	13.71	16.91	12.30
15	21.73	23.51	21.83	19.16	16.87	13.66	21.32	15.73
16	64.34	35.58	68.77	83.67	22.20	18.06	33.26	14.05
17	17.43	17.59	18.28	16.16	14.23	13.93	17.17	10.96
18	40.24	37.03	53.79	27.70	18.10	15.46	24.62	13.57
19	21.42	19.38	25.71	18.85	17.45	13.84	21.54	17.30
20	20.67	23.80	20.86	16.14	15.19	14.23	17.63	13.46
21	16.68	15.38	16.96	18.09	13.98	12.65	15.35	14.10
22	33.76	29.06	37.42	35.62	15.03	14.17	18.21	12.23
23	30.57	25.09	30.75	37.89	11.55	10.19	12.96	11.66
24	26.46	22.60	28.04	29.79	14.37	13.78	16.45	12.57
25	28.19	32.68	25.23	25.73	15.66	14.90	18.60	13.02
26	34.11	22.04	20.92	67.20	13.98	13.34	17.05	11.02
27	16.63	12.51	14.83	24.56	13.06	14.02	13.45	11.25
28	25.31	25.37	23.13	27.96	18.09	14.17	23.01	14.67
29	26.15	23.41	26.51	29.46	17.69	15.51	22.86	14.22
30	34.42	27.04	39.61	38.07	22.35	15.82	41.19	7.77
31	31.42	27.75	32.05	35.69	18.13	15.22	21.62	17.77
32	24.05	21.28	27.38	23.70	15.00	11.25	21.21	12.38
33	29.56	27.05	22.83	41.43	16.67	13.90	22.37	13.36
34	28.96	26.71	28.05	33.19	13.27	13.71	16.10	9.12
35	23.16	9.20	20.79	45.32	12.76	11.47	16.57	9.76
36	31.20	32.76	35.56	23.61	19.58	15.19	25.96	17.64

Note: Rate of profit is nothing but the ratio between gross profit (GP) and invested capital (IC). Both the denominator and numerator are at current prices, whose ratio automatically eliminate out the price effect. The Rate of Interest is at current prices; we derive this nominal rate of interest by multiplying the ratio between Interest Paid (INT) and Loan Outstanding (Loan) to 100.

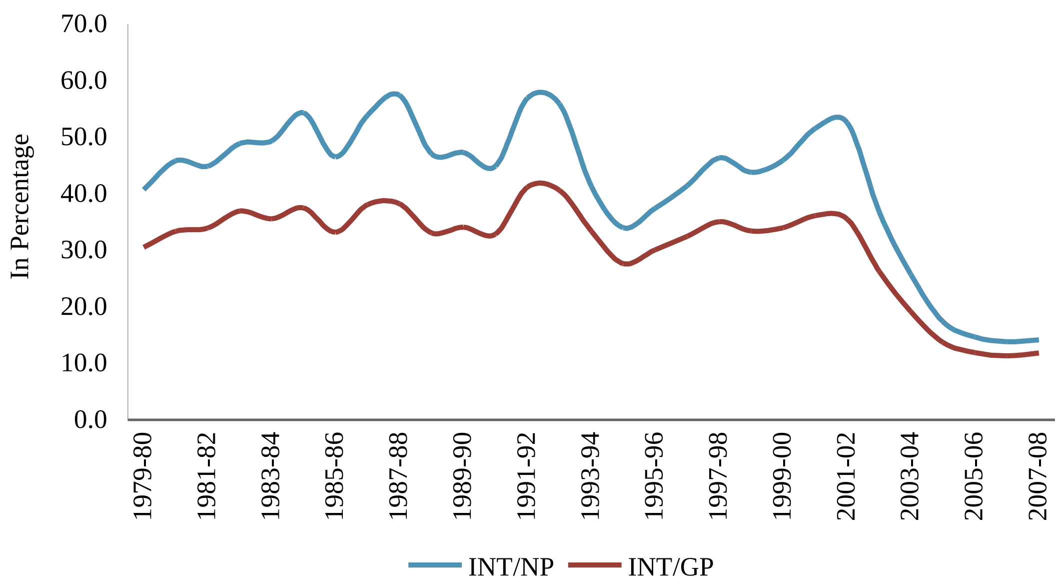
Source: Author's own calculation, Annual Survey of Industries, CSO, EPW Research Foundation

In the above table, we have presented to the average rate of gross profit and average rate of interest for twenty-two 2-digit industry groups for four time periods. The average rate of profits and the rate of interest for the full period (1979-80 to 2007-08) is presented in column 2 and 6, respectively. It is observed that the rate of profit was rising steadily over the period for aggregate manufacturing and industrial groups such as Tobacco products (16), Paper products (21), Petroleum products (23), Chemical products (24), Basic metals (27), Machinery equipments (29), Electrical machinery (31), Motor vehicles (34), and Other transport equipments (35). At dis-aggregated level thirteen out of twenty industrial groups experienced the highest rate of profit during the last sub-period i.e. 2000-01 to 2007-08. It is the Tobacco products industry that has the highest average rate of profit over 80 percent during this period. On the other hand Food products (15), Textile products (17), Leather products (19) and Wood products (20) has the lowest rate of profit at 19.2 percent, 16.2 percent, 18.9 percent, and 16.2 percent respectively. From this we can conclude that capital intensive industries are on an average experienced a higher rate of profit as well they have enjoyed the major share of total value added too.

On the other hand the average rate of interest during the 90s is the highest among three sub-periods. For all the 2-digit industrial groups, the rate of interest in this period is above average (corresponding average rate during the full period). However, it has significantly eased during the last sub-period, i.e. 2000-01 to 2007-08. During the entire sample period of study, the rate of interest is higher for industrial groups like Office accounting & computing machines (30), Furniture & other manufacturing (36), Electrical machinery (31) and Fabricated metal products (28) at 22.4 percent, 19.6 percent, 18.1 percent and 18.1 percent respectively. On the other hand, the lowest rate of interest is seen in petroleum products (23), i.e. 11.5 percent during the entire study period. From the above discussion, we observe that the rate of profit was highest during the third sub period (2000-01 to 2007-08) for aggregate manufacturing and also for the majority (thirteen out of twenty two industrial groups) has observed to have the highest rate of profit during this sub-periods. Moreover, manufacturing sector in general (both aggregate and at dis-aggregated level) experienced the highest rate of interest during the nineties. This finding contradicts the theoretical relationship between interest rate and the rate of profit, as they don't move in sympathy with each other in case of Indian manufacturing sector.

After testing the relationship between rates of interest and profit, now we proceed to find out the share of the rate of interest in both types of rates of profits. From the theoretical discussion we have found that the rate of interest which is the payment made for the use of capital is a part of the total profits, now we will test this for Indian manufacturing. We have estimated the share of interest paid to that of net and gross profit for Indian manufacturing at current prices and it is presented in Figure-5.12. From the Figure it is clear that both the lines are showing irregular pattern, but follows the same trend. Interest (INT) as a percentage of NP and GP is rising during 80s and reached its peak of 57 percent and 41 percent for NP and GP respectively in the year 1991-92. After the implementation of the financial liberalisation in 1991, we observed a sharp fall in the ratio (INT/NP: 34 percent and INT/GP: 28 percent) which continue its declining trend till 1995-96. The second half of the nineties have experienced rising share of interest payment in both net and gross profit, which suggest the possible rise in the cost of borrowing. However, the significant turnaround is observed in the trend of both the ratios from 2001-02, which has fallen consistently till the 2007-08. Thus, interest as part of the profit is showing a falling trend in the case of Indian manufacturing, which suggest the interest payment is not accounted for a major portion of the net and gross profit. This also suggests that Indian manufacturing is spending less on interest payment over the period and they may finance their capital requirement internally through capital formation and reinvestment of the profit that they make. In the next section we will analyse this argument.

Figure 5.12: Trends of Share of Interest in Net and Gross Profit

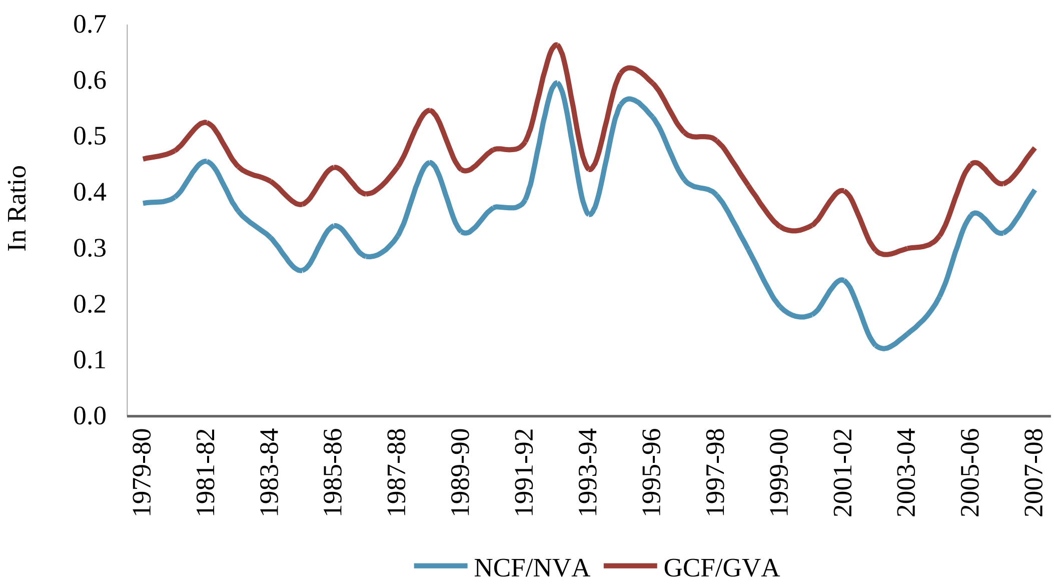


Note: INT refers to interest paid, NP and GP refers to net and gross profit respectively.
Source: Author's own calculation from Annual Survey of Industries, CSO and EPW Research Foundation

5.5 Capital Formation in Indian Manufacturing:

From the analysis so far, it is observed that share of profit and the rate of profit was significantly high and increasing over the sample period of the study. Moreover, the rate of interest has seen to be accounted for a lesser portion of both net and gross profit, which suggests that Indian manufacturing industries are mobilizing their capital requirement from within. Therefore, in this section we examine the capital formation side of the story in Indian manufacturing. The rationale behind the present analysis is to find out what is happening to the high rate of profit and the larger share of profits that the entrepreneur class incurred. The present analysis likes to investigate, whether the manufacturing sector is reinvesting in the future expansion activity or it is being used for some other purpose, like self-consumption. For this we will be analyzing the trends of two ratios in Indian manufacturing. Firstly the ratio at gross level, i.e. Between gross capital formation (GCF) to gross value added (GVA) and secondly, the ratio at a net level, i.e. between the net capital formations (NCF) to net value added (NVA).

Figure 5.13: Capital Formation to Value Added in Indian Manufacturing



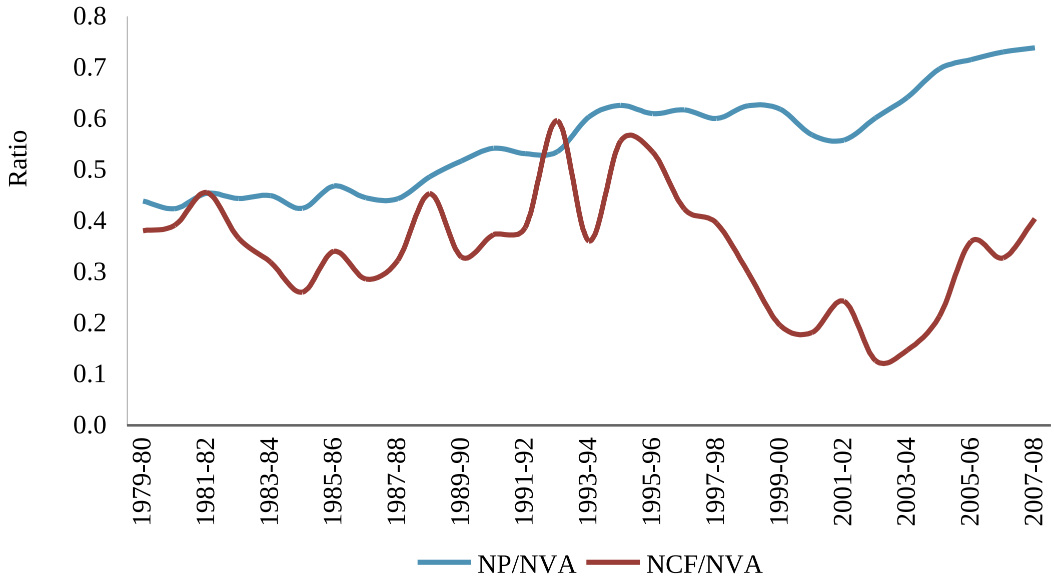
Note: NCF and GCF stands for Net Capital Formation and Gross Capital Formation. NVA and GVA refer to Net Value Added and Gross Value Added. All the variables are at current prices.

Source: Author's own calculation from ASI, Central Statistical Organisation and EPW Research Foundation.

Both the ratios are estimated at current prices, as the units of measurement (of both numerator and denominator are the same) are same, thus, it eliminate out the price effect. From Figure 5.13, it is observed that the ratio of NCF to NVA and GCF to GVA has consistently risen during the first half of the study period (1979-80 to 1992-93). During this period ratio NCF/NVA has increased from 0.38 to 0.60, while GCF/GVA ratio has increased from 0.46 to 0.66. Then the ratio shows sign of retreat in the trend and eases down to 0.13 (NCF/NVA) and 0.30 (GCF/GVA) respectively in 2002-03. This is the period when Indian manufacturing observed a higher share of interest in both net and gross profit (see Figure 5.12). This suggests that, during this period, capital formation is at weakest level, due to a larger share of profit utilized for interest payment. However aggregate manufacturing observed a sharp trend reversal from 2003-04 onwards till the end year of the study period i.e. 2007-08. With a rising share of capital formation in value added, there is rising capital accumulation in Indian manufacturing, which leads to a higher rate of profit. If we compare this with Figure 5.11, we observed that 2002-03 onwards both the NRP and GRP are rising significantly. This supports the view that with the rising capital accumulation, Indian manufacturing has experienced a rising rate of profit too. If we look at the 2-digit industrial group level, the majority of them follows the pattern, reveled by the aggregate manufacturing and shows mixed trend. Broadly speaking, the decline in capital formation of value added is remarkable only in the case of leather products (19), in all other cases the decline is negligible and trends are mixed. However the industrial groups such as paper products (21), Chemical products (24), nonmetallic mineral products (26), Basic metals (27), Radio, television& communication (32), Motor vehicles (34) and Other transport equipments (35) have a considerable high capital formation. Therefore, from this we found that the capital formation is rising during 80s and from 2002-03 onwards, compared to a modest falling trend over 90s. in aggregate manufacturing and majority 2-digit industry groups in the Indian manufacturing sector.

We observed from our earlier analysis that the share of profit in the value added is increasing consistently during the sample period of the study, with more significant rising in the trend since the implementation of financial reform in 1991. Moreover, the rate of profit in aggregate manufacturing and a majority of 2-digit groups are also rising during the same period. To understand the relationship between NP and NCF, we intended to see the trend of net profit to net value added (NP/NVA) and net capital formation of net value added (NCF/NVA). This is to know whether this increasing profit is re-invested in the same process or it is going away to some other activities. To substantiate this argument, we try to analyze the ratio of net profit (NP) and net capital formation (NCF) to net value added (NVA). Our main intention here is to find out whether the capital formation in the Indian manufacturing sectormetits investment requirement from its own profit or it rely on some other source of financing.

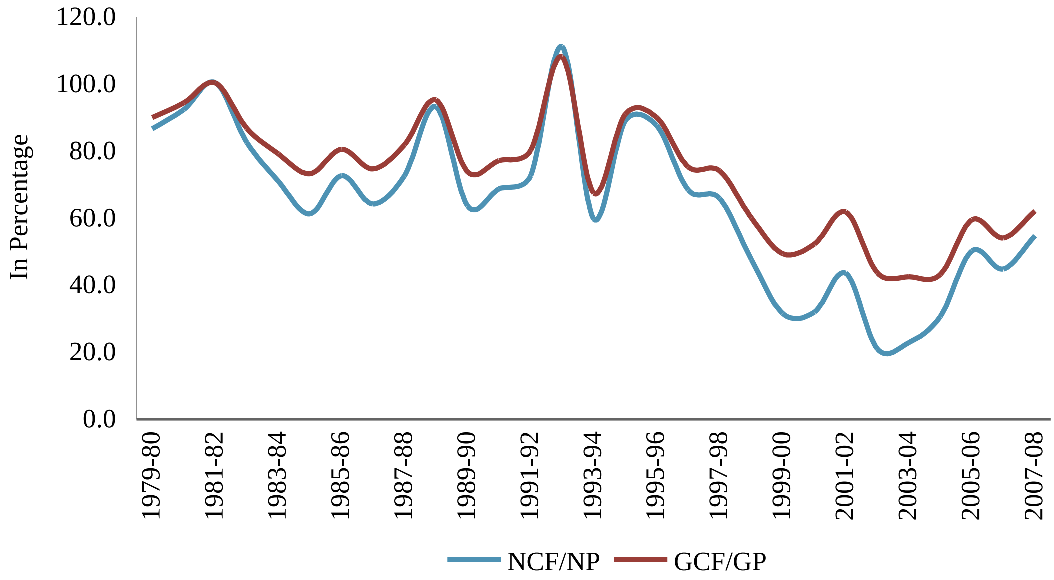
Figure 5.14: Net Profit and Capital Formation in Net Value Added



Note: NP stands for net profit. NVA and NCF stand for net value added and net capital formation. NP, NCF and NVA are at current prices.
Source: Author's own calculation from Annual Survey of Industries, CSO and EPW Research Foundation.

From Figure 5.14, it is observed that NP/NVA is more stable and steadily rising during the entire study period. However, NCF/NVA revealed an irregular pattern, where no specific trend can be observed. Except for the year 1992-93, the share of net profit in net capital formation is larger than that of the share of NCF in NVA. It shows that the total profit accumulated or generated is not automatically re-invested as there is a gap between the ratios, which is considerably high. On the other hand, in the year 1981-82 and 1992-93, the share of net capital formation is higher than that of the share of profit to net value added, which imply the required investment surpass the amount of profits that has been generated by the manufacturing sector in these specific time points.

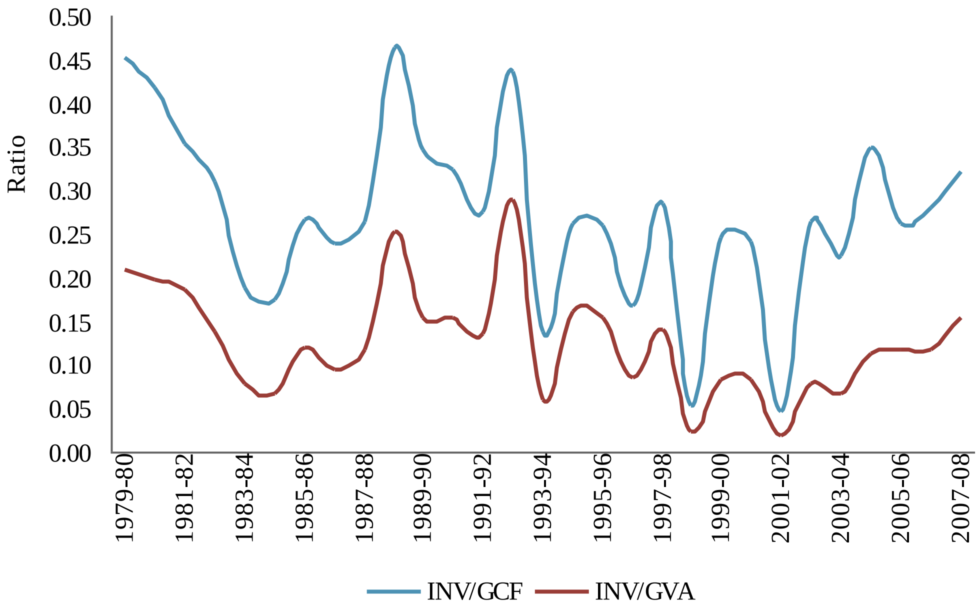
Figure 5.15: Capital Formation to Profit in Indian Manufacturing



Note: NCF and GCF refers to net capital and gross capital formation. While NP and GP represent net and gross profits. All the variables are at current prices.
Source: Author's own calculation from Annual Survey of Industries, CSO and EPW Research Foundation

At the 2-digit industrial group level, most of the groups follow the trend revealed by aggregate manufacturing sector. As we observed rising share of profit (GP) in value added (GVA) before, we observed the same pattern in NP/NVA. However, during the nineties, we observed that the trend of NP/NVA is stable but moderated with easing capital formation. Industry groups such as Manufacturing of Tobacco products (16), Petroleum products (23) and Basic metals (27) experienced a sharp fall in NP in NVA in the first four years (1979-83) of the study, after which they recover significantly. In general the share of NP out of the NVA is increasing during the nineties in comparing to the eighties, which is applied to the majority of the 22 2-digit industrial groups. If we compare the NP to NVA and NCF to NVA at the 2-digit level, we found that, except for 2-digit groups (NIC 21, 25, 27 and 35) all other cases the share of net profit in NVA is substantially higher than that of the NCF to NVA. Industry groups such as Paper products (21), Rubber & plastic products (25), Basic metals (27) and Other transport equipments (35), has seen higher share of capital formation (NCF/NVA) compare to that of share of net profit in net value added. This states that, the investment requirement of these industry groups is fulfilled by the profits, not generated within that group, rather its investment requirement has surpassed its net profit. From the above discussion, we surmised that the increasing rate of profits and the rise in the share of profit in output is more than the capital formation for aggregate manufacturing and also for the majority (18 out of 22 two-digit industrial groups) of two-digit groups in the Indian manufacturing sector. We will be discussing another factor that also affects the investment decision making of any industry and firm. Thus we analyse the share of inventories as percentage of gross capital formation and gross value of output (GVO) next.

Figure 5.16: Trends of Inventories to Gross Capital Formation and Gross Value Added



Note: INV refers to inventories. GFC and GVA stand for the gross capital formation and gross value added
Source: Author's own calculation from Annual Survey of Industries, CSO and EPW Research Foundation

Every industrial unit keeps a certain proportion of its finished and semi-finished goods as stock to face the unforeseen or windfall circumstances as well as a business and management strategy. This stock of the finished[17] and semi-finished[18] goods that's remains as stock or left out in the end of the financial year is known as inventories. The portion of inventories also affects the further investment decision taken at the firm level. Therefore, in Figure 5.16, we present the share of inventories in gross capital formation and gross value of output respectively, in the aggregate manufacturing sector of India. From the above

[17] These are the goods of the factory ultimately ready for sale. It does not required further processing but needs packaging and labeling etc.
[18] Semi-finished goods refer to the imputed value of all materials which have been partially processed by the factory but which are not usually sold without further processing. It includes the work in progress for materials supplied by others, but excludes the value of semi-finished fixed assets produced for factory's own use.

figure, it is observed that the share of inventories, accounts for a smaller proportion of GCF and GVA. From both the lines, it is clear that they revealed an irregular pattern over the entire sample period of study. However, during 1993-4 to 2003-04, both the ratios has seen a below average and declining trend. Inventory level comes down from 45.09 per cent to 28.41 per cent between 1979-80 to 1997-98, during the same period inventories as a percent of GVO has come down from 4.62 per cent to 2.94 per cent.

Thus we can infer from the above analysis that, during the entire sample period of study, the Indian manufacturing sector has substantially condense their inventory level. This may be accounted of two different reasons. Firstly, the gross value of output as well as gross capital formation[19] increased substantially over the period, during which the numerator of the ratio remains stable or falling down. But this is not the case, as the inventories are growing at a rate of 14.55 per cent per annum, which is almost the same rate at which the GCF and GVO variables are growing i.e. 16.55 and 15.08 per cent per annum respectively, over the period of 29 years i.e. 1979-80 to 2007-08. The second possible reason is, over the time period, the technique of production has changed, so the products are more efficiently produced in a short time period, thus can meet the excess demand if any arise in the market in a short span of time. Therefore, the inventory level has reduced to the minimum level which also cut-down the maintenance expenses for stock.

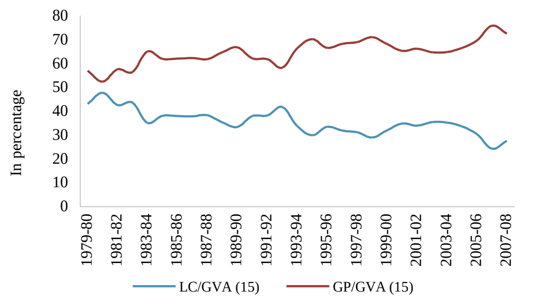
5.6 Conclusion:

In the light of the above discussion, we observe the classical preposition that ‘with rising labour productivity, the labour compensation also rises’ does not hold for the Indian manufacturing sector. The classical postulates that the falling rate of profit is an inevitable process in the growth of labour productivity, does not hold good as we found a persistent rise in the rate of profit along with its share in gross value added figures of Indian manufacturing sector. Thus, in Indian context, we observed that rising competition does not lead to decline in the rate of profit. Further, as the share of profit is increasing in the value added for majority of the 2-digit manufacturing industry groups and also for the aggregate manufacturing, it may be inferred that there is an intensive

[19] Both the gross capital formation and gross value added are the denominator of the ratio. If both of them increased substantially, with the numerator remains as it is, then the ratio itself fall down.

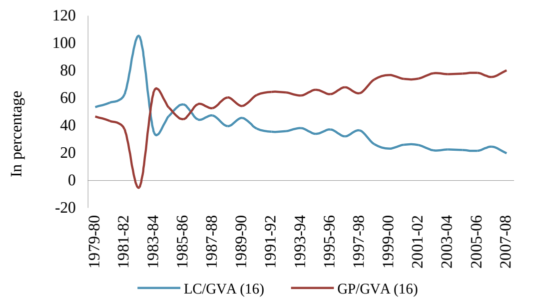
use of capital relative to labour, which is further substantiated with the significant rise in the capital intensity ratio for the Indian manufacturing sector in general. Secondly, we also observed that the rate of profit rises during the period of study for a majority of 2-digit industrial groups and for the manufacturing sector as a whole. To find the reason behind such a substantial rise in the rate of profit, we understand that rising capital investment in Indian manufacturing through capital accumulation is the source. This is more evident in capital intensive industrial groups, those experienced relatively high rate of profit. Moreover, rising capital formations (NCF/NVA) and rising share of profit (NP/NVA) in net value added observed to move in tandem with each other, which confirms that higher capital accumulation and investment leads to generate more wealth in Indian manufacturing through acceleration in the rate of profit. The study also finds that the inventories in Indian manufacturing over the period has declined that suggest products are produced more efficiently that need a short time period to meet the excess demand if any arise in the market in a short span of time. Therefore, the inventory level has reduced to the minimum level which also cut-down the maintenance expenses for stock.

Figure A5.1: Share of Labour compensation and profit in output NIC-15



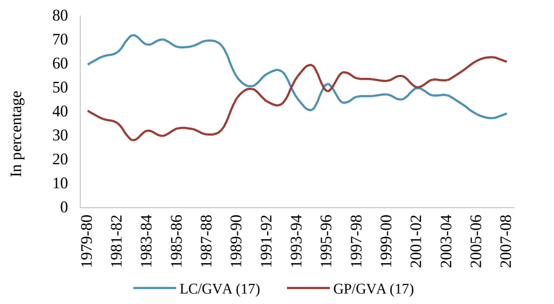
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.2: Share of Labour compensation and profit in output NIC-16



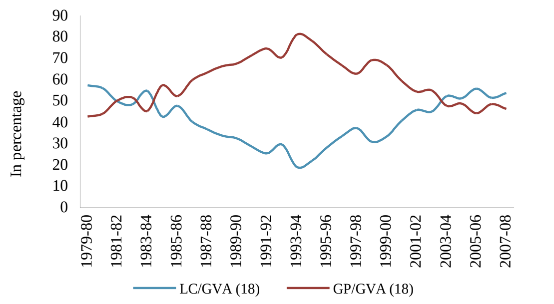
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.3: Share of Labour compensation and profit in output NIC-17



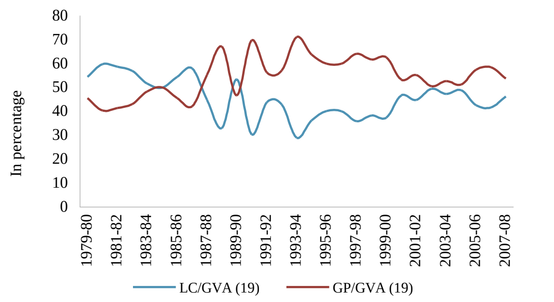
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.4: Share of Labour compensation and profit in output NIC-18



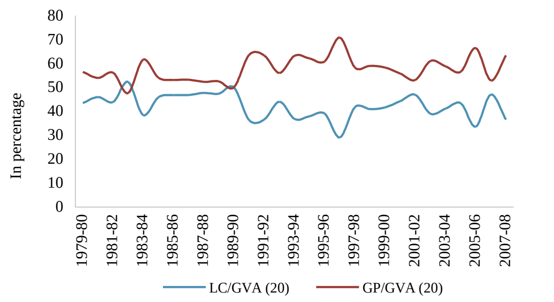
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.5: Share of Labour compensation and profit in output NIC-19



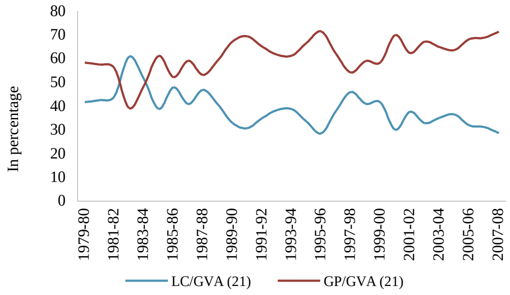
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.6: Share of Labour compensation and profit in output NIC-20



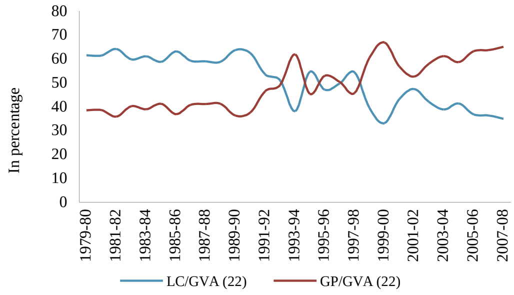
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.7: Share of Labour compensation and profit in output NIC-21



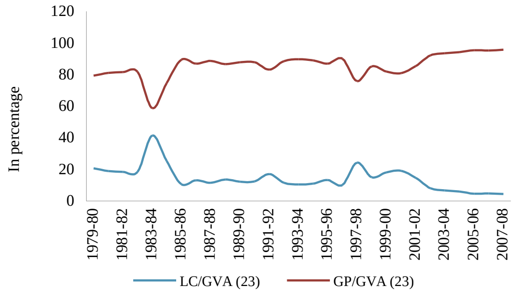
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.8: Share of Labour compensation and profit in output NIC-22



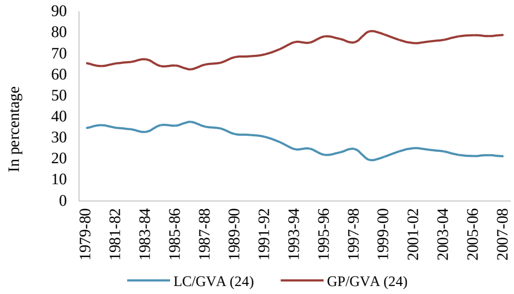
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.9: Share of Labour compensation and profit in output NIC-23



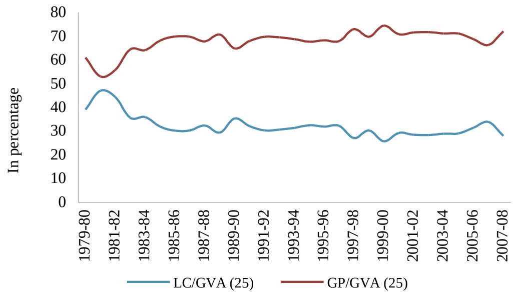
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.10: Share of Labour compensation and profit in output NIC-24



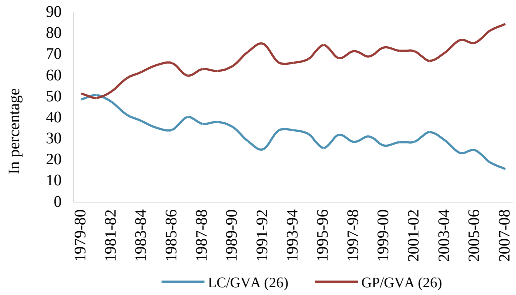
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.11: Share of Labour compensation and profit in output NIC-25



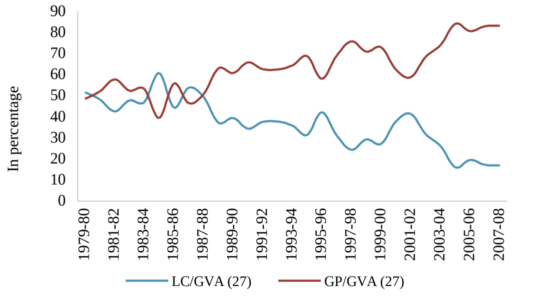
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.12: Share of Labour compensation and profit in output NIC-26



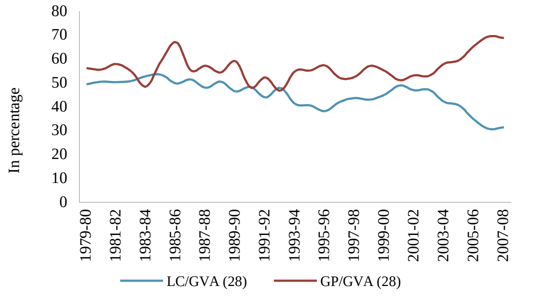
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.13: Share of Labour compensation and profit in output NIC-27



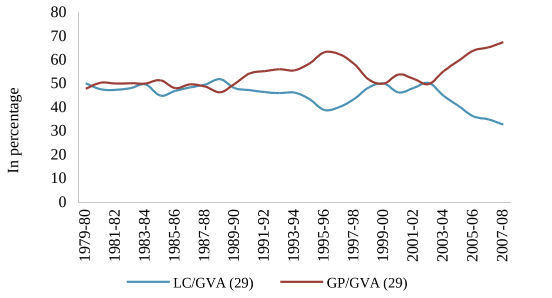
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.14: Share of Labour compensation and profit in output NIC-28



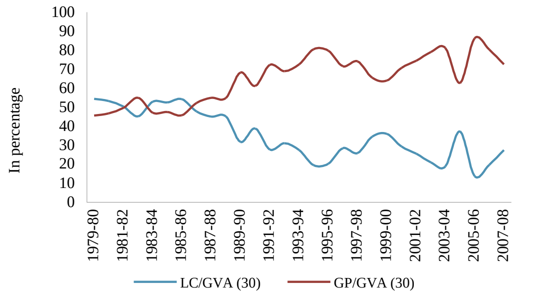
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.15: Share of Labour compensation and profit in output NIC-29



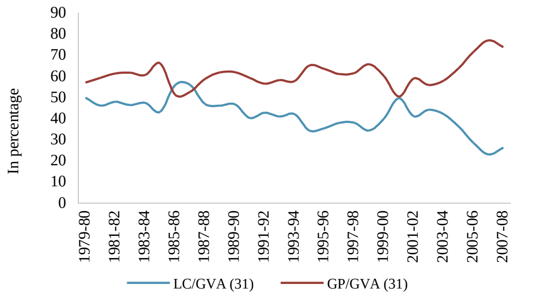
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.16: Share of Labour compensation and profit in output NIC-30



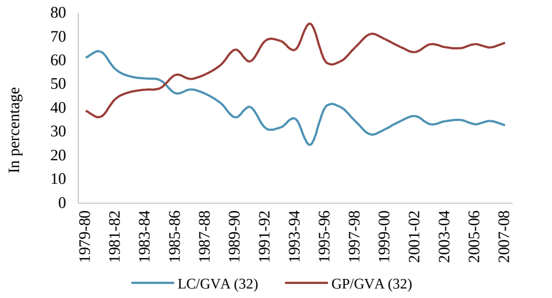
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.17: Share of Labour compensation and profit in output NIC-31



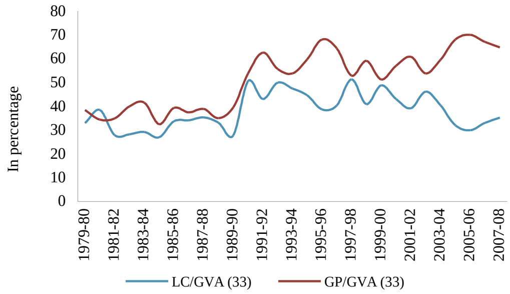
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.18: Share of Labour compensation and profit in output NIC-32



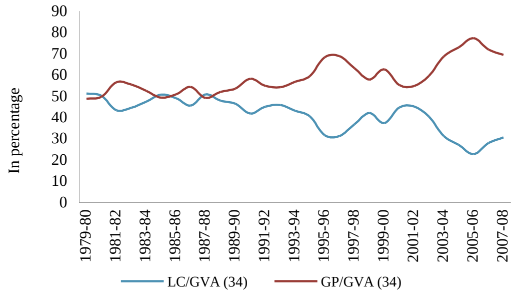
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.19: Share of Labour compensation and profit in output NIC-33



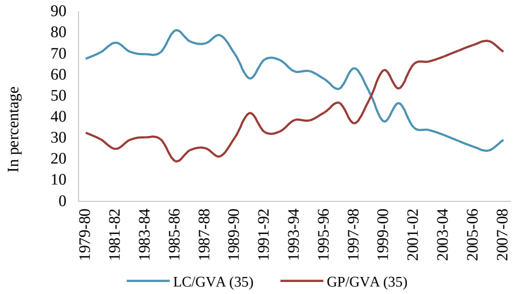
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.20: Share of Labour compensation and profit in output NIC-34



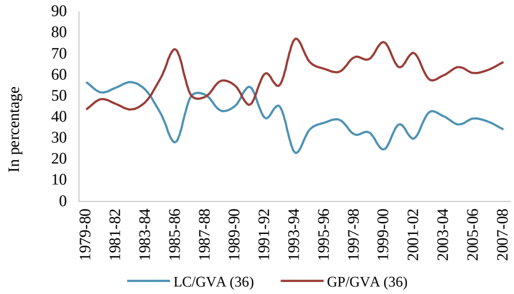
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.21: Share of Labour compensation and profit in output NIC-35



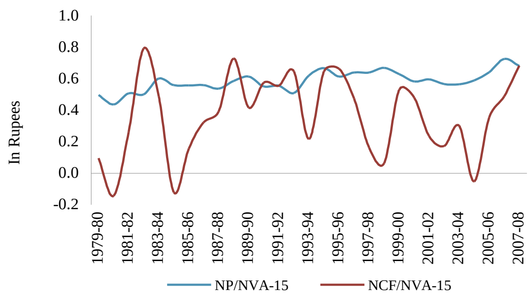
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.22: Share of Labour compensation and profit in output NIC-36



Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.23: Share of net profit and net capital formation in net value added in NIC-15



Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.24: Share of net profit and net capital formation in net value added in NIC-16

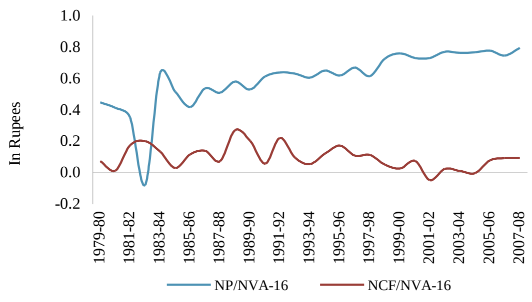


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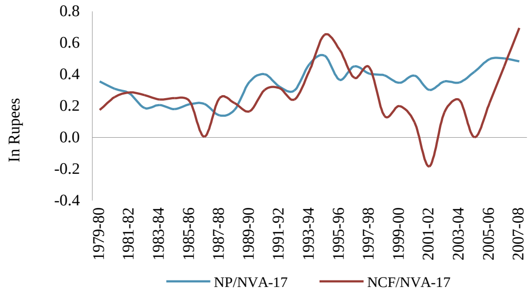
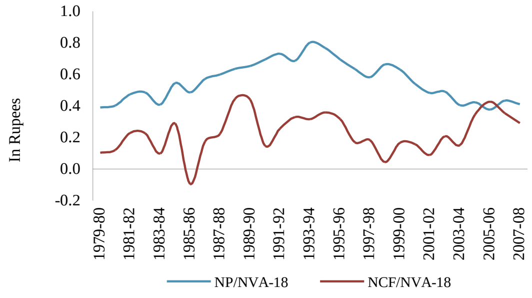
Figure A5.25: Share of net profit and net capital formation in net value added in NIC-17



Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.26: Share of net profit and net capital formation in net value added in NIC-18



Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.27: Share of net profit and net capital formation in net value added in NIC-19

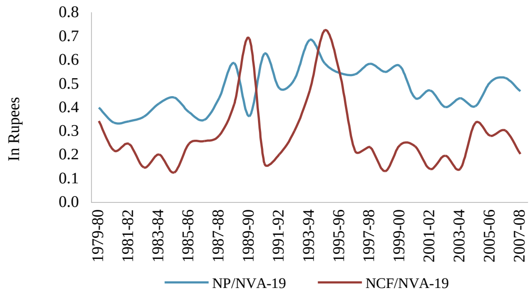


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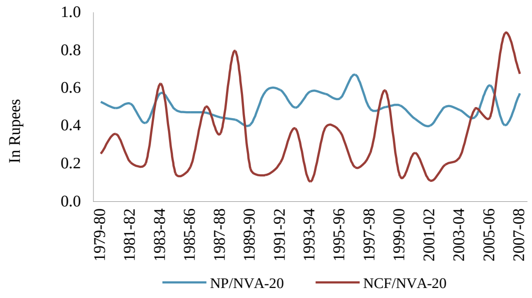
Figure A5.28: Share of net profit and net capital formation in net value added in NIC-20



Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.29: Share of net profit and net capital formation in net value added in NIC-21

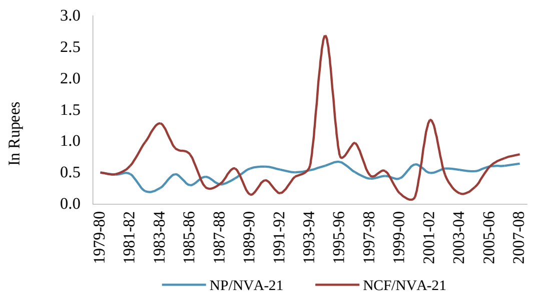


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Figure A5.30: Share of net profit and net capital formation in net value added in NIC-22

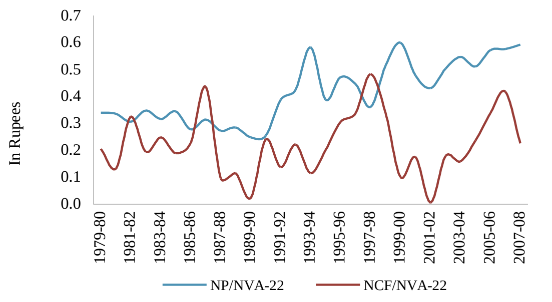

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Figure A5.31: Share of net profit and net capital formation in net value added in NIC-23

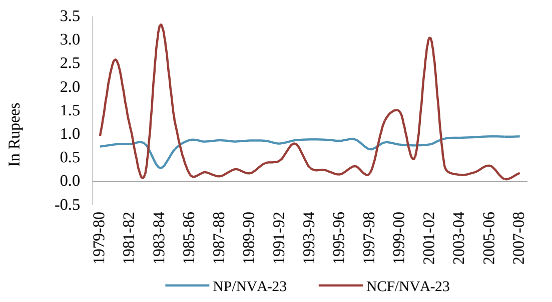

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Figure A5.32: Share of net profit and net capital formation in net value added in NIC-24

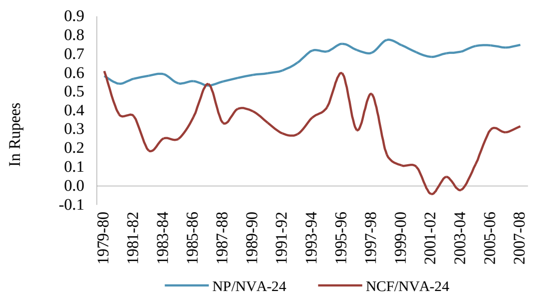

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Figure A5.33: Share of net profit and net capital formation in net value added in NIC-25

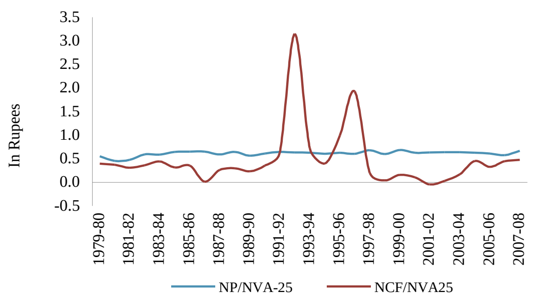

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Figure A5.34: Share of net profit and net capital formation in net value added in NIC-26

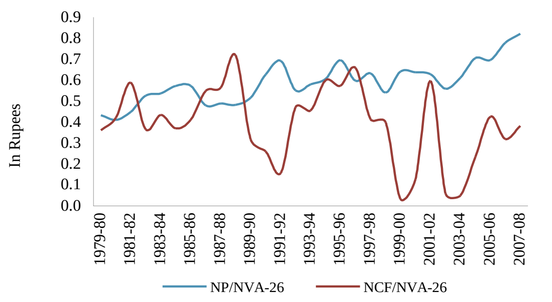

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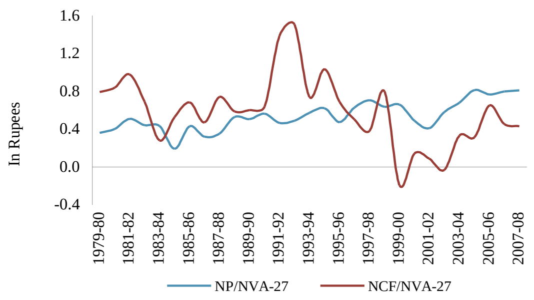
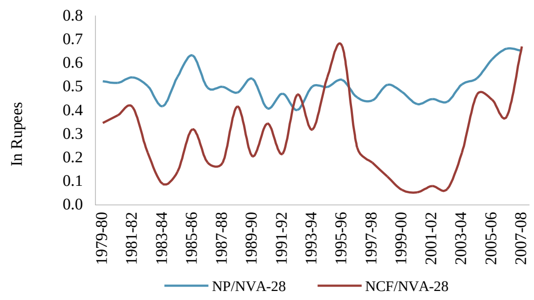
Figure A5.35: Share of net profit and net capital formation in net value added in NIC-27



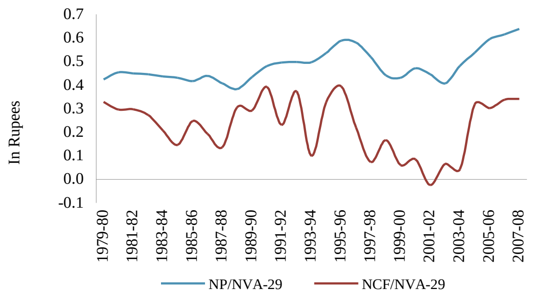
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.36: Share of net profit and net capital formation in net value added in NIC-28



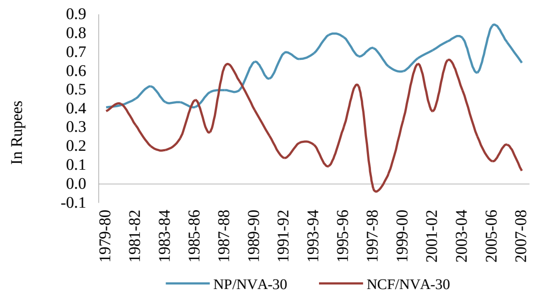
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.37: Share of net profit and net capital formation in net value added in NIC-29



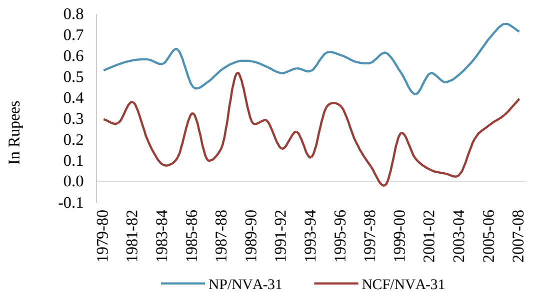
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.38: Share of net profit and net capital formation in net value added in NIC-30



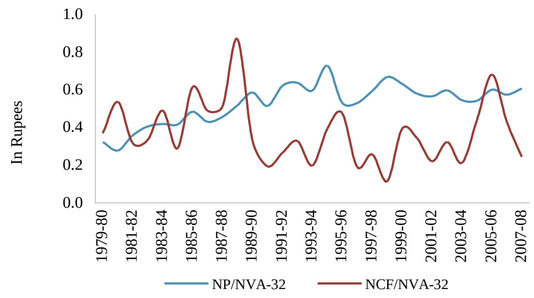
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.39: Share of net profit and net capital formation in net value added in NIC-31



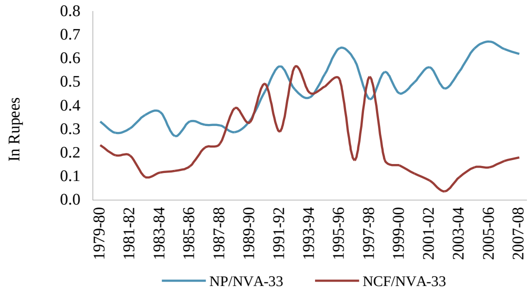
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.40: Share of net profit and net capital formation in net value added in NIC-32



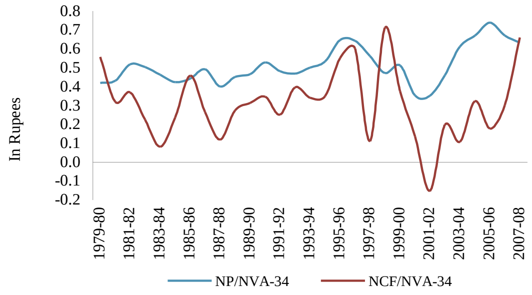
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.41: Share of net profit and net capital formation in net value added in NIC-33



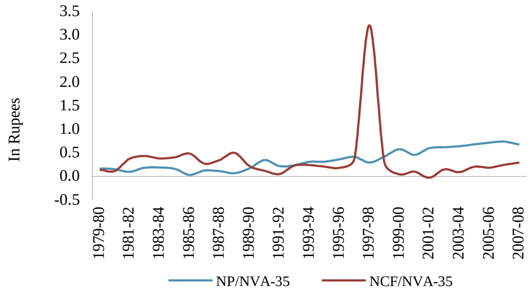
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.42: Share of net profit and net capital formation in net value added in NIC-34



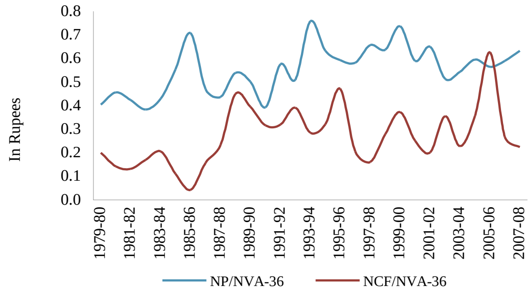
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.43: Share of net profit and net capital formation in net value added in NIC-35



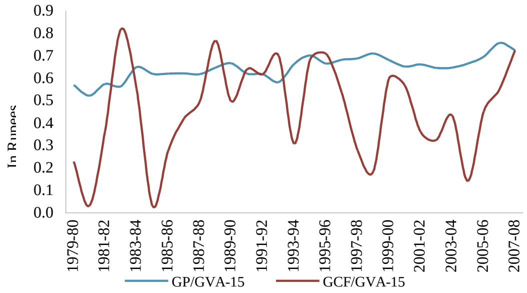
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.44: Share of net profit and net capital formation in net value added in NIC-36



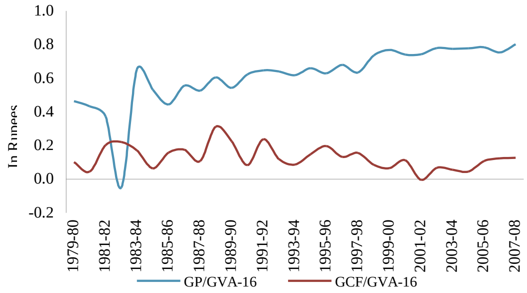
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.45: Share of gross profit and gross capital formation in gross value added in NIC-15



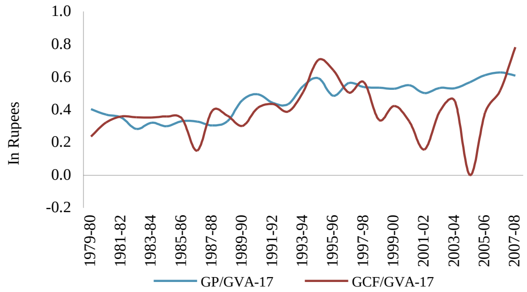
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.46: Share of gross profit and gross capital formation in gross value added in NIC-16



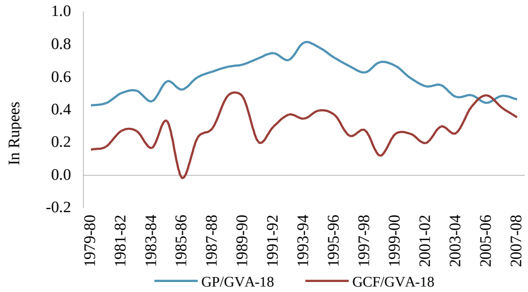
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.47: Share of gross profit and gross capital formation in gross value added in NIC-17



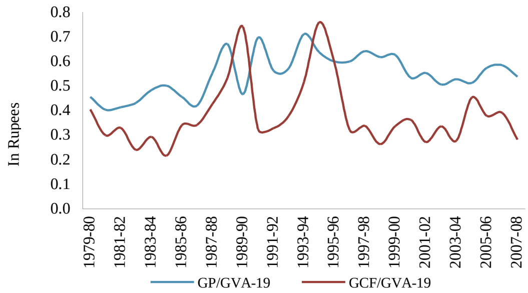
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.48: Share of gross profit and gross capital formation in gross value added in NIC-18



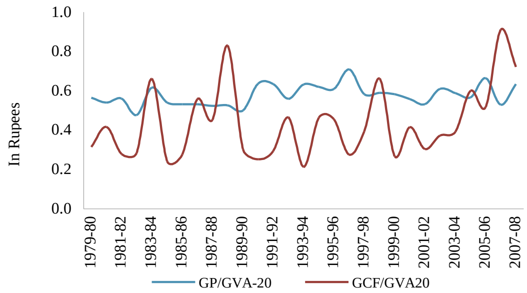
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.49: Share of gross profit and gross capital formation in gross value added in NIC-19



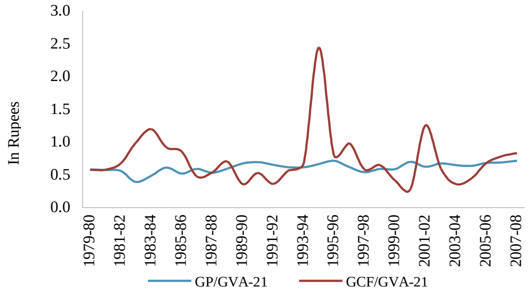
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.50: Share of gross profit and gross capital formation in gross value added in NIC-20



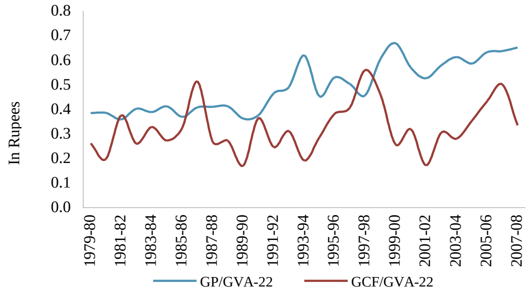
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.51: Share of gross profit and gross capital formation in gross value added in NIC-21



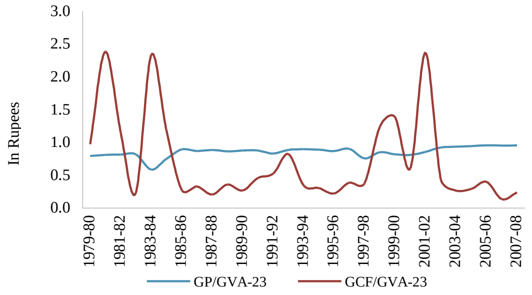
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.52: Share of gross profit and gross capital formation in gross value added in NIC-22



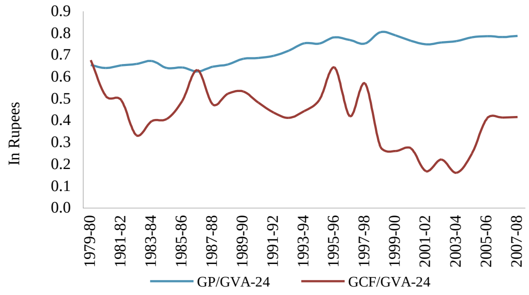
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.53: Share of gross profit and gross capital formation in gross value added in NIC-23



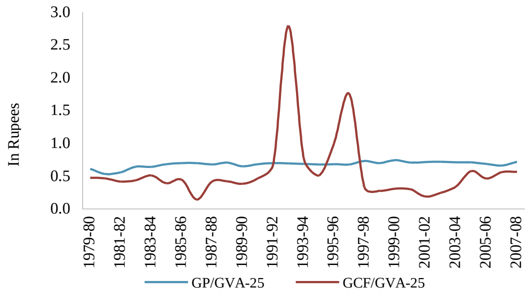
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.54: Share of gross profit and gross capital formation in gross value added in NIC-24



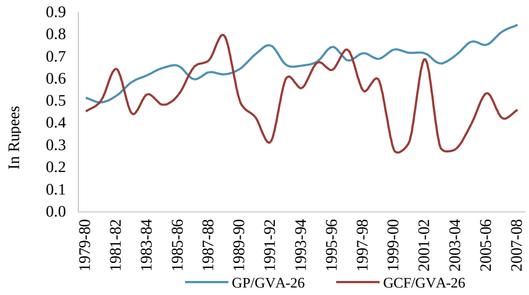
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.55: Share of gross profit and gross capital formation in gross value added in NIC-25



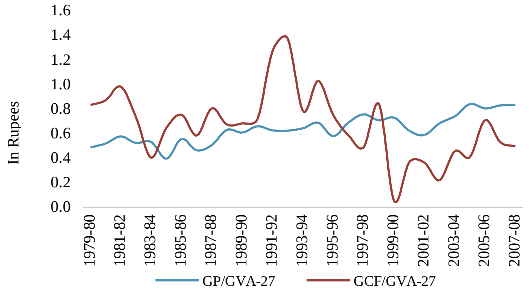
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.56: Share of gross profit and gross capital formation in gross value added in NIC-26



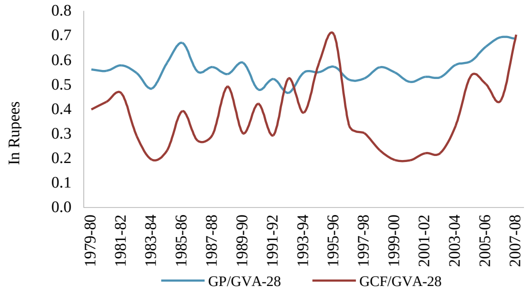
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.57: Share of gross profit and gross capital formation in gross value added in NIC-27



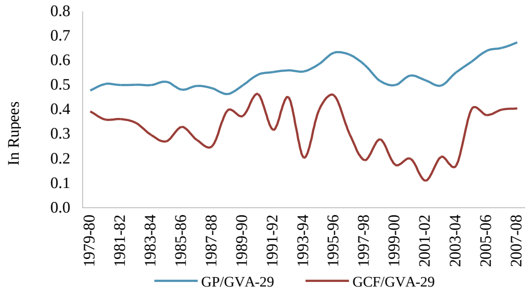
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.58: Share of gross profit and gross capital formation in gross value added in NIC-28



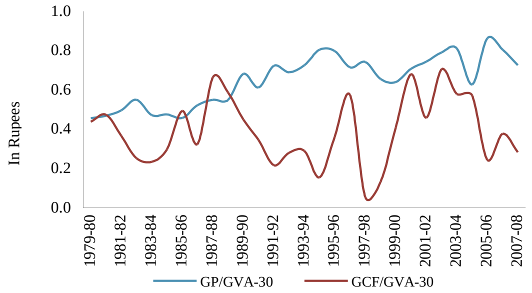
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.59: Share of gross profit and gross capital formation in gross value added in NIC-29



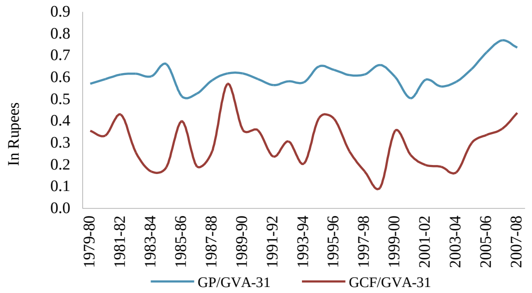
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.60: Share of gross profit and gross capital formation in gross value added in NIC-30



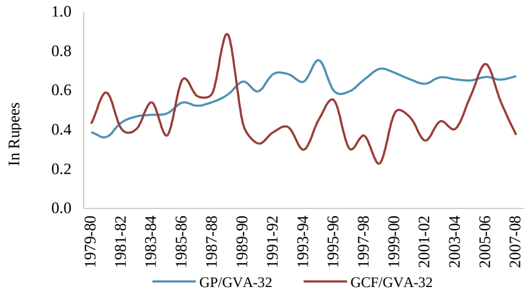
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.61: Share of gross profit and gross capital formation in gross value added in NIC-31



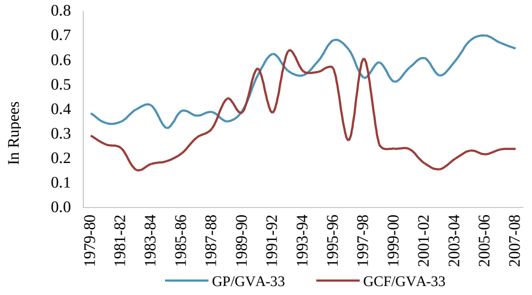
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.62: Share of gross profit and gross capital formation in gross value added in NIC-32



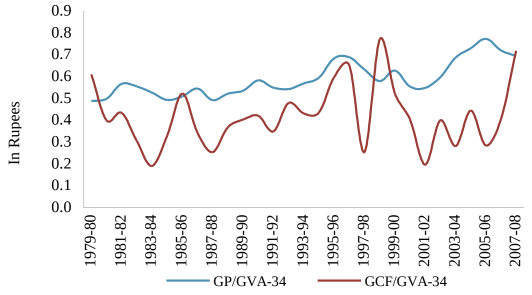
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.63: Share of gross profit and gross capital formation in gross value added in NIC-33



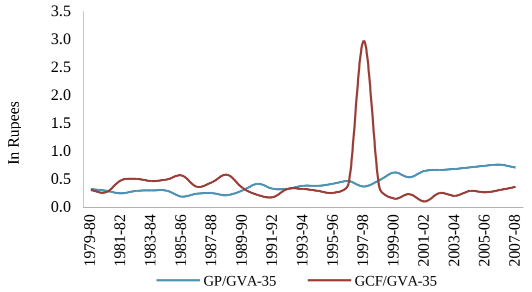
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.64: Share of gross profit and gross capital formation in gross value added in NIC-34



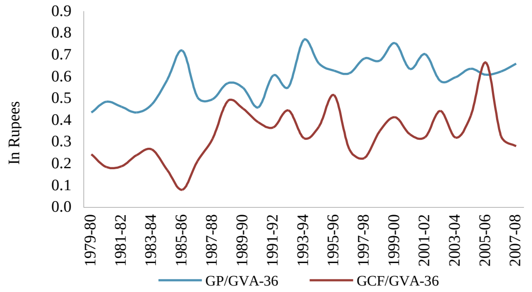
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.65: Share of gross profit and gross capital formation in gross value added in NIC-35



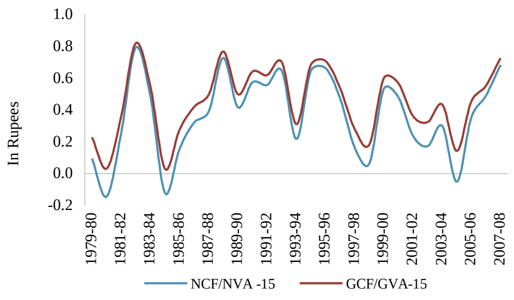
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.66: Share of gross profit and gross capital formation in gross value added in NIC-36



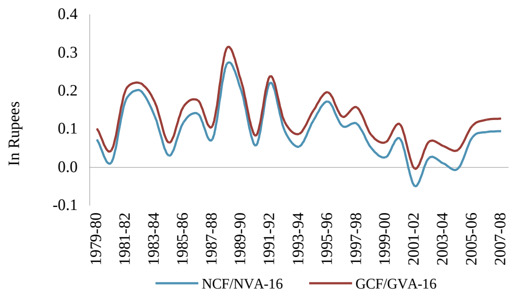
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.67: Share of net capital formation of net value added and gross capital formation of gross value added in NIC-15



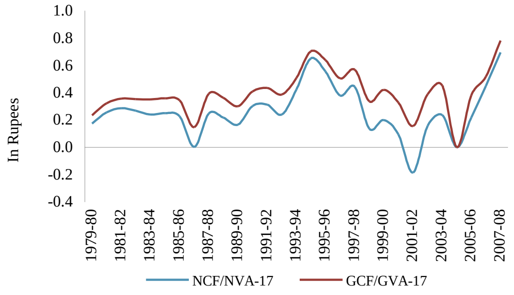
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.68: Share of net capital formation of net value added and gross capital formation of gross value added in NIC-16



Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.69: Share of net capital formation of net value added and gross capital formation of gross value added in NIC-17



Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.70: Share of net capital formation of net value added and gross capital formation of gross value added in NIC-18

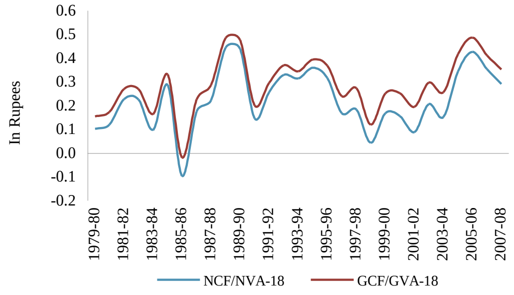


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Figure A5.71: Share of net capital formation of net value added and gross capital formation of gross value added in NIC-19

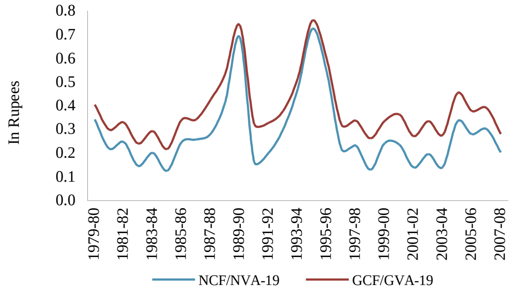

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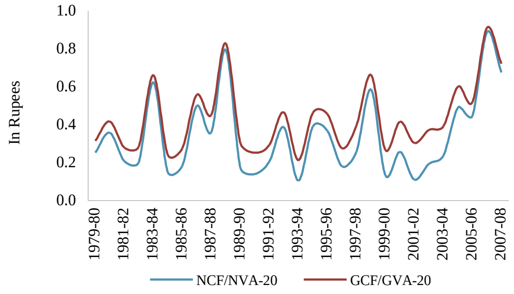
Figure A5.72: Share of net capital formation of net value added and gross capital formation of gross value added in NIC-20



Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.73: Share of net capital formation of net value added and gross capital formation of gross value added in NIC-21

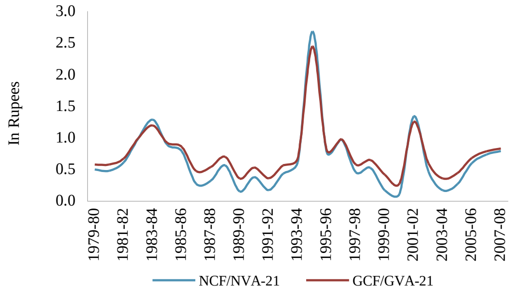


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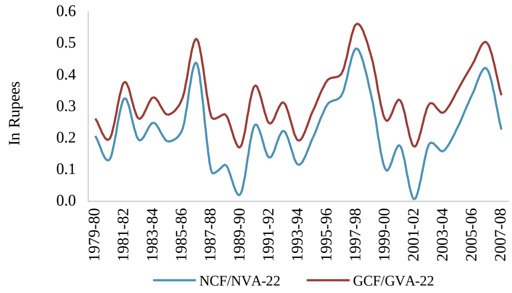
Figure A5.74: Share of net capital formation of net value added and gross capital formation of gross value added in NIC-22



Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.75: Share of net capital formation of net value added and gross capital formation of gross value added in NIC-23

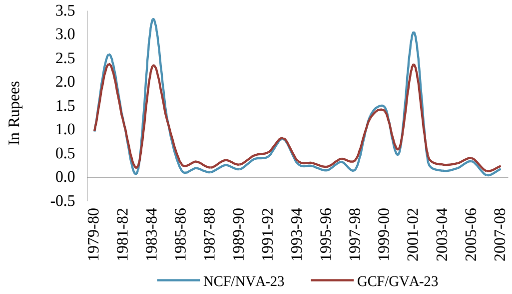


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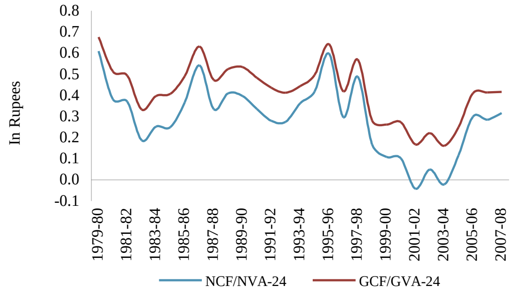
Figure A5.76: Share of net capital formation of net value added and gross capital formation of gross value added in NIC-24



Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.77: Share of net capital formation to net value added and gross capital formation to gross value added in NIC-25

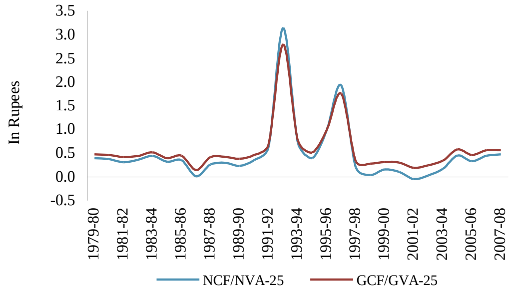


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Figure A5.78: Share of net capital formation to net value added and gross capital formation to gross value added in NIC-26

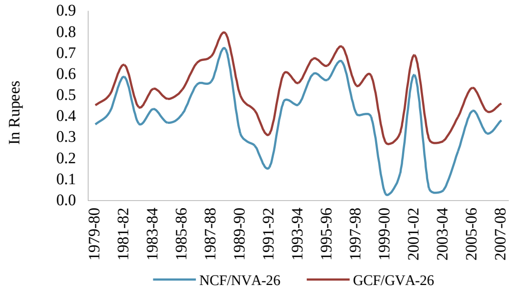

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Figure A5.79: Share of net capital formation to net value added and gross capital formation to gross value added in NIC-27

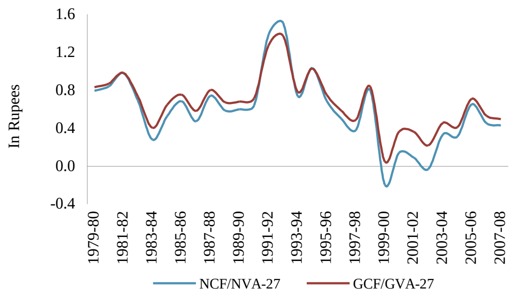

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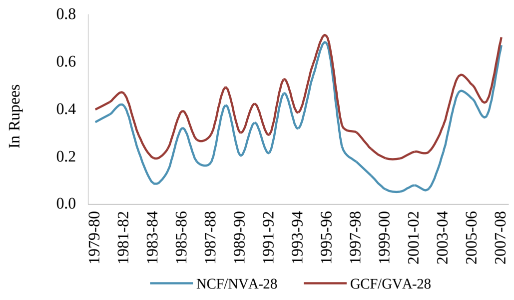
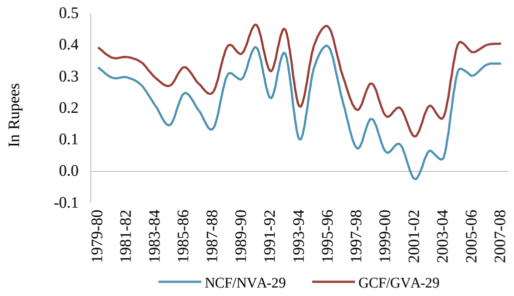
Figure A5.80: Share of net capital formation to net value added and gross capital formation to gross value added in NIC-28



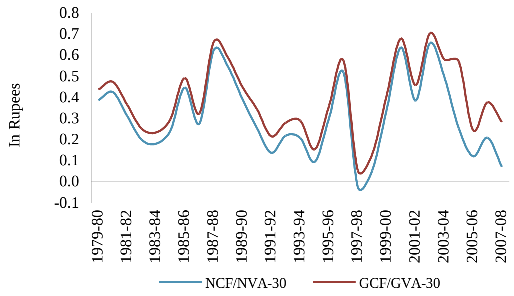
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.81: Share of net capital formation to net value added and gross capital formation to gross value added in NIC-29



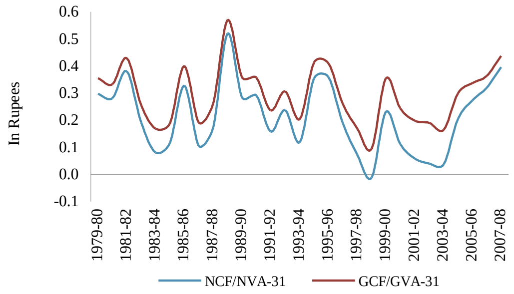
Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.82: Share of net capital formation to net value added and gross capital formation to gross value added in NIC-30



Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.83: Share of net capital formation to net value added and gross capital formation to gross value added in NIC-31



Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.84: Share of net capital formation to net value added and gross capital formation to gross value added in NIC-32

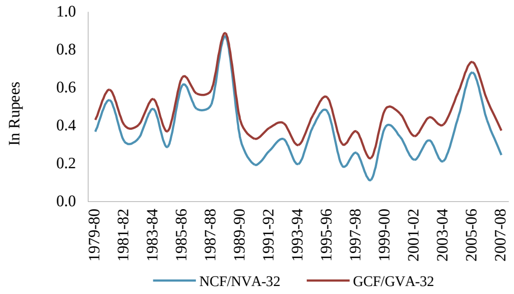


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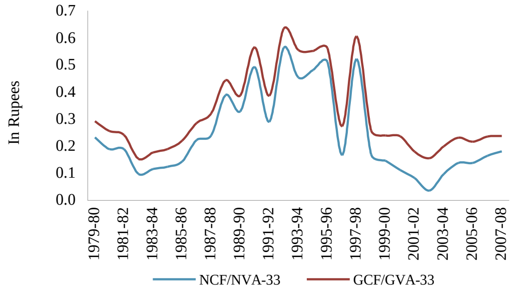
Figure A5.85: Share of net capital formation to net value added and gross capital formation to gross value added in NIC-33



Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.86: Share of net capital formation to net value added and gross capital formation to gross value added in NIC-34

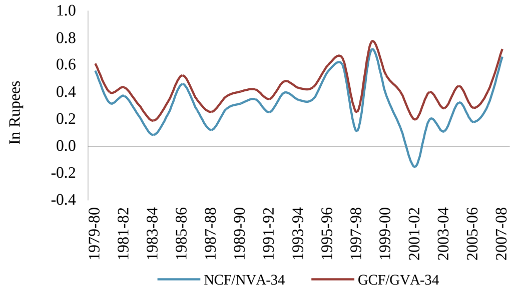


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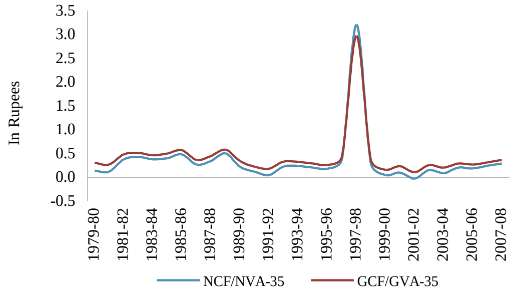
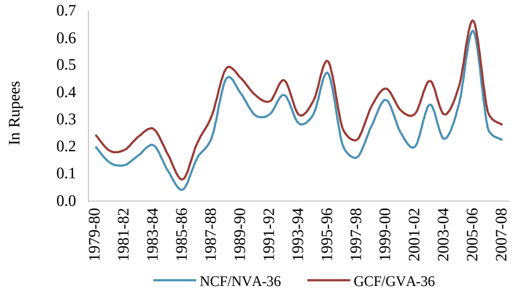
Figure A5.87: Share of net capital formation to net value added and gross capital formation to gross value added in NIC-35



Source: Author's compilation from ASI and EPW Research Foundation.

Figure A5.88: Share of net capital formation to net value added and gross capital formation to gross value added in NIC-36



Source: Author's compilation from ASI and EPW Research Foundation.

Chapter-VI

Summary of Major Findings and Policy Implications

6.1 Approach of the Study:

The study made a pioneer attempt to provide a comprehensive assessment of labour productivity dynamics and distributive relationship in the context of Indian manufacturing both in aggregate and dis-aggregated 2-digit industry level. The increasing importance attached to the manufacturing sector in India is worth to analyse. It's consistent performance is raising hope among the policy makers to expect sustainability in its growth trend in near future. The study embarks on various research issues related to the Indian manufacturing sector, such as trends and growth pattern of labour productivity, dynamic relationship between labour productivity, employment and real wages and the distributive aspects of Indian manufacturing sector. There is no doubt that Indian economy is receiving immense support from this sector by generating huge employment opportunities on one hand and by facilitating higher output growth through rising productivity on the other. However, factors that drive such a high growth in this sector is multifaceted like, the up-gradation of technology, pouring up of investment, public private partnership and government policies, to name a few. As investment levels have increased substantially in the recent past across manufacturing sector, this will constrain the scope for a further increase in capital formation in the future. Therefore, attention has naturally turned to the other aspect of growth i.e. productivity improvement. This aspect is believed to contribute higher growth rate with the use of limited resources for a long period.

Productivity in the Indian manufacturing sector is in debate since the beginning of the second five-year plan. The policy makers and researchers were very keen on debating the importance of productivity to achieve higher growth rates in India. Since the inception of import substitution regime, it has been argued that the productivity is more affected by the approach followed in an open economy like India, where the importshavebeen seen as an impediment to growth. There is a strong belief that open access to the other advanced economies and to their technological know-how will contribute in a larger extend to the productivity enhancement of a country. As a result of which, the knowledge of technological advancement will lead to efficient production process, which in turn significantly conversing towards an average increase in productivity.

The study is framed in such a manner to explain the productivity growth in Indian manufacturing. The recent observation of the high growth rate of Indian economy, which is mainly derived from services and industry sector, coupled with a stagnant agriculture sector is a main source of concern among the economists and policy makers. Hence the question arises that there poses a threat to the sustainable growth of the country in the future time period for an economy where more that 55 percent of its working population depend on a sector (agriculture) and which contributes to only 11.7 percent to Gross Domestic Production (FY 2012-13). Here the main apprehension is how to transform the over populated unskilled labour force from agriculture, to any other sectors where their productivity can be utilized in a positive way. Obviously, the service sector is not a sensible option, as this sector needs some sort of skilled and professional human capital rather than unskilled work force. Therefore, the only possible option left out is the secondary sector. The manufacturing sector can productively absorb the unskilled labourers from agriculture sector as industrial workers with some vocational training. This is why so much of importance and expectation is attached to the Indian manufacturing sector to achieve the 11th plan target of double-digit growth.

With the availability of the private investment across all the sectors of the economy, it is the productivity rather than higher investment, which leads to achieve highest growth rate in a specific sector compared to another, over a long period. Therefore, the framework of the study is to analyse the productivity trend in the Indian manufacturing sector both in aggregate as well as disaggregate (2-digit group) level. The growth of manufacturing sector is considered to be explained by two factors, namely, productivity growth and employment growth, hence we have established that relationship and analysed in what proportion these two factors contributes to the growth of value added. The productivity and its effect on distribution is alsoanalysedin the fifth chapter of the study.

The main intention and objective behind increasing productivity is to achieve a higher standard of living through higher growth rate. The standard of living is directly related to the more equitable distribution of the net output among different classes of the society involved directly and indirectly in the production process. If the distribution does not take care of, then it leads to encourage capitalist oriented activities where the major part of the wealth is concentrated in fewer hands, while the majority of the working populations are left to lead a miserable life. This is going against the whole idea of increasing productivity growth for the enhancement of higher growth rate of the economy, which in turn is projected to provide a better standard of living to the masses. So the wealth or net output generated through the production process in manufacturing sector must be distributed in a manner that realize the main objective behind enhancing the productivity growth.

The relationship between wage rates and employment is also related to productivity growth and we have discussed this aspect in reference to Indian manufacturing in our fourth chapter. This chapter has taken into account both trend and time series analysis to look at the relationship between wage, employment and productivity. The analysis is imperative to know the fact that, whether or not productivity increases in the manufacturing sector appropriately compensates the employees for their contribution. Another aspect where the interest of this research lies, i.e. To analyse the relationship between wage and employment, is of much importance from the policy standpoint to know what the exact relationship exist between them and what should be the approach of the government on the wage front to achieve higher growth rates in employment in Indian manufacturing. This brings our attention to the distribution of output between different factors of production that are determined by their respective contributions. We have discussed the distributive aspects of Indian manufacturing sector in the fifth chapter. In addition, we also discussed the trend and growth of the rate of profit and capital formation in the Indian manufacturing sector.

The study essentially relies on the Annual Survey of industries, published by the Central Statistical Organisation, GoI and Economic and Political Weekly Research Foundation (EPWRF) for its majority of data required. Moreover the sources such as the Reserve Bank of India (RBI) and Labour Bureau, Ministry of Labour is also used as the sources of data for the present study. The period under study spanning from 1973-74 to 2007-08, which is further divided into four sub-periods, such as seventies (1973-74 to 1979-

80), eighties (1980-81 to 1989-90), nineties (1990-91 to 1999-2000) and the last sub-period spanning from 2000-01 to 2007-08. Moreover to understand the repercussions of the reform measures, introduced in April, 1991, the study also analyses the trend and growth of labour productivity over pre-reform (1973-74 to 1989-90) and post-reform (1990-91 to 2007-08) period as well. While we constrained the analysis on distribution to the period 1980-81 to 2007-08, due to unavailability of data on profits and other variables before 1980-81.

6.2 Major Findings of the Study:

There is an attempt to explain the trends and growth of labor productivity in Indian manufacturing both at the aggregate and disaggregated two-digit industry level in chapter-III. We also analyse to validate Verdoorn's law and Kaldor's technological progression function for the Indian manufacturing sector. Chapter four attempts to analyse the nexus between labour productivity, employment and real wages for Indian aggregate manufacturing, to check that we apply the Johansen cointegration test. We also analyses the existence of any dynamic relationship between these three variables through VAR method to understand the possible unidirectional and bi-directional causality among the three variables. The dynamics of the productivity-employment-real wage relationship can further be examined from the impulse response functions. The Variance decomposition is used to detect the causal relation among the variables. It explains the extent to which a variable is explained by the shocks in all the variables in the system. The forecast error variance decomposition explains the proportion of the movements in a sequence due to its own shock versus shocks to the other variable. The distributive aspect of Indian manufacturing is analysed in the fifth chapter, where we also analysed the trend of the rate of profit and capital formation. From the above discussion, we infer the major findings of the present study as below;

- We observed that a labour productivity trend has been increasing consistently during the entire study period of 35 years (1973-74 to 2007-08).

- The sub-periods analysis revealed that during the eighties (1980-81 to 1989-90) labour productivity has been observed to grow sharply compare to the seventies.

- Meanwhile the preposition of rising labour productivity over the post-liberalisation period holds well with a better and stronger growth during the nineties, which was relatively better compared to the eighties. However, the strongest growth in labour productivity has been experienced during the post nineties, i.e. during 2000-01 to 2007-08.

- The present study also found that growth of labour productivity during post-liberalisation period shows an upper hand over the pre-reform period.

- The analysis has revealed that productivity gains are not evenly distributed across 2-digit industries during the entire period of study.

- Two-digit industry groups that experienced high labour productivity are mainly capital intensive in nature.

- From the two-way classification analysis, by size of employment, we observed that manufacturing labour productivity is biased towards the higher size of employment. Similarly, by the size of the capital, industries with a higher capital investment revealed strong labour productivity growth.

- The empirical analysis substantiates the above argument, where we observed, higher gross value added growth is positive and significantly explains growth in labour productivity. Thus, Verdoorn’s law does hold good for the Indian manufacturing sector.

- However, from the empirical analysis, it is clear that Kaldor’s Technological Progress Function for Indian manufacturing, does not hold well.

- The findings of our modified model (by considering both growth of gross value added and growth of capital-labour ratio as independent variables to determine growth of labour productivity) revealed a much better outcome. This suggested that both output growth and capital intensity growth together explain growth in labour productivity in a much better and significant way in the Indian manufacturing sector.

- From the empirical analysis of our modified Ordinary Least Square (OLS) model, we can conclude that both scale economies (as a necessary condition for Verdoorn’s law to hold good) and rising capital accumulation has positive effects on labor productivity growth in the Indian manufacturing sector both at the aggregate and dis-aggregated two-digit industry group levels.

- The manufacturing sector in the post reform periods has recorded better growth in employment compared to the pre reform period. This is because, the growth of productivity was much higher (due to higher capital investment) than that of labour compensation. Therefore, it is always advantageous for the manufacturer to employ more and more workers.

- There is a considerable rise in capital intensity that reflects the rising capital substitution to labour. Thus, it is observed that in case of Indian manufacturing, there is co-existence of both capitals deepening and increasing employment in the post-reform period. Thus, we can say, that the classical postulates of the role of the size of the market or extension of the market do play a decisive role in Indian manufacturing.

- Contrary to the rising labour productivity, the study observed a consistent fall in the labour compensation. We also observed inconsistency in the growth of two labour compensation measures. Labour compensation to persons engaged has grown at a higher rate to that of compensation to workers. This suggests the existence of inequality in the terms of compensation in Indian manufacturing, where the non-worker class, such as managers, supervisors and operational staff have experienced better growth in their compensation to that of workers.

- The Johansen's Maximum Likelihood procedure of cointegration test supports no cointegrating relation between labour productivity, employment and real wages. Hence there is no long-run equilibrium relationship among these variables. Thus, the study found, in Indian context manufacturing long-run equilibrium relationship between wage and employment and between labour productivity and real wages does not exist. The results of this study do not provide support to either the Neoclassical or Keynesian theories of a long-run inverse relationship between real wages and employment.

- The Impulse Response Functions indicate that a productivity shock is associated with higher employment and wages, where one standard deviation (SE) shock in labour productivity is significantly affecting both employment and wages in the short run. Shocks to employment have a negative effect on productivity in the first year, and then have a small positive effect on labour productivity over next 3 to 4 years. The real wage is significantly affected by the shock in employment for about 5 to 6 years. Whereas, shocks to real wages have short-term impact on employment and labour productivity.

- The variance decompositions result suggests that labour productivity and employment appears to be exogenous, while real wages are driven both by its own innovations and by changes in employment.

- Moreover, from Forecasting Variance Decomposition test, it is observed that labour productivity is driven by real wages, real wages are driven by employment and employment in turn is driven by labour productivity. This proves that all the variables are related to each other in a circular causation.

- From the distribution analysis, we found that the classical preposition "with rising labour productivity, the labour compensation also rises", does not hold for the Indian manufacturing sector. The study found that with the steady rise in labour productivity, corresponding labor compensation has declined.

- The trend of falling share of labour has been observed both at the aggregate and disaggregated two-digit level. Even the labour intensive industries too have experienced the same.

- The study found that the classical preposition of falling rate of profit is an inevitable process in the growth of labour productivity does not hold good as we found a persistent rise in the rate of profit along with its share in value added.

- The intensive use of capital relative to labour, as we have seen a significant rise in the capital intensity ratio of Indian manufacturing pave the way for a higher rate of profit.

6.3 Policy Implications:

The present study critically analyses the methodological loopholes and drawbacks associated with the conventional approach of productivity measurement. The present study has also taken care of much neglected part of the distribution aspects in the Indian manufacturing sector, which has significant implication for the equitable growth in the economy. Methodological divergence in the present analysis brings forward some interesting findings that have important policy implications. The increasing labour productivity, which is associated with declining real wage per workers and real emolument per person engaged, need a government policy intervention. It is observed from the analysis that the productivity of the working class is rising substantially, justifying their increasing contribution towards the industrial productivity. However, the remuneration paid against their increasing contribution to realize higher productivity growth is declining. Thus, it is very clear that the working class is not appropriately compensated, which depicts the prevailing inequality in the distribution of income in the Indian manufacturing sector. This argument is backed by the declining trend of share of wages in gross value added since the second-half of the eighties. This uneven distribution of gross value added (which is more biased towards the capitalist group) is a matter of concern as it concentrates wealth and economic power in the hand of few rather than to the masses. Therefore, it is the responsibility of the government to contain this uneven distribution through wage regulation acts. This should smooth the progress of socioeconomic equality by narrowing the gap between the two classes. Moreover the rising share of profits, ask for the prudent measures to channelize for further capital formation that creates more job opportunities.

Though Indian manufacturing has seen rising labour productivity, however, real value added per worker in India is very low as compared to Thailand, Philippines, Malaysia and South Korea (Academic Foundation, 2003). The main reasons for low labour productivity in the Indian manufacturing sector is because of the lack of innovation, product design and bottlenecks in infrastructure facility. Coming to the policy recommendations, the manufacturing sector should improve the labour productivity growth by improving wages and other benefits of the workers alongside skilled-based training, establishing in-house training centers, improve operational efficiency through targeted skill development program and through modernization of the production process and the workplace. Similarly, the productivity can further be enhanced through utilisation of excess capacity that remains ideal in the Indian manufacturing sector. The authorities must take care before giving fresh licenses to establish new production units for those industrial sectors where the excess capacity remains. Thus, due care must be taken to increase the capacity utilisation rate so that higher growth rate can be achieved through higher productivity. In the Indian case where labour is abundant, due policy measures should be taken to encourage to establish more industries which arelabour intensive in nature, so as to absorb more and more unskilled workforce from agricultural sector which leads to employment generation. To establish more labor-intensive manufacturing units, policy must be formulated in such a way where incentives like an investment; tax exemption etc. should be provided to encourage higher employment growth.

It is high time for Indian policy makers to realize that the productivity enhancement not only helps domestic economic growth to accelerate faster but also creates opportunities to become increasingly competitive in the global trade. In the era of globalization, a country like India is not fully insulated from the impact of global economic shocks. The recent growth slowdown (FY 2013 GDP growth gone down below 5%) experience due to the impact of the emergence of second financial crisis, precipitated by the sovereign debt problems of the Eurozone should be a learning lesson. Therefore, it is imperative for policy makers to recognise the significance of productivity and efficiency of the manufacturing sector, as it account for a larger share of total merchandise exports. The government should give priorities to more export-intensive industries like Textiles, Leather, Gems and Jewellery, which have considerable potential to generate employment. Hence, without increasing the productivity, policy makers should not expect more employment generation and better standard of living of the workers in the manufacturing sector. Thus, the government functioning needs to be more efficient to make the Indian manufacturing sector globally more competitive.

6.4 Limitations of the Study:

The present study is carried out in major divergence from the conventional approaches thataredominating the productivity literatures. However, the study suffers from the limitations of its own. The major limitation of the study deals with the unavailability of the data set. Although we are interested to extend the study till the recent years (2010-11, for which ASI reports are available), but due to the unavailability of the comparable data at two-digit levels for different variables constrained us to do so. The limitation of data on capital stock is also one reason, which is responsible for being depended on the conventional measure of capital measurement by the Perpetual Inventory Method. If the information on the working hours is available for Indian manufacturing, then this will become more reflective for the productivity measurement and its accuracy. The incomplete input-output table for Indian case is the main hindrances for the real value added measurement. Even though the double value added is a clear advantage over the single value added, followed in the present study, the material price index necessary for the double deflation procedure cannot be computed with the limited coverage and information pertained in the input-output table for Indian cos.

If the CSO could have collected and maintain data on capital stock and working hours for long time series, then it becomes possible to develop a productivity index, which could be easy for comparable productivity studies and to develop a methodology which could help us make a comparative analysis. On the data front, there is another limitation, that we are facing regarding the information on life span of capital or the year on which new capitals are installed in the manufacturing productivity. If this information is available, then it leads to a more appropriate analysis of capital stock series based on the availability of the information of the life span of the capital stocks and the depreciation rates.

As far as econometric techniques are concerned, there is always a scope for further improvement. Firstly, it needs to be acknowledged that the models and equations estimated in the present study had to be modified and are not fully comparable to the ones produced by the respective authors. This exists because of the endemic difficulties in respect of the availability of long time series data for different variables in Indian manufacturing. Due to frequent changes in NIC classifications, it is difficult to generate compatible long time series data for all the available variables. Therefore, the productivity and distribution analysis can be extended in many directions with the improvement of both the quality and quantity of the data on the Indian manufacturing sector.

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