CHAPTER TWO

REVIEW OF LITERATURE

2.1. Introduction

The review of literature guides us for getting better understanding of methodology used, limitations of various available estimation procedures and database, and logical interpretation and bringing together of the incompatible results. In the light of this, this chapter will be focusing on both theoretical review and empirical review pertaining to wage structure, productivity measurement and linkage between productivity and wages. In industrialized countries there have been a constant research on how to increase the productivity. In a developing country like India there has been an increasing recognition of the need to raise the productivity of labour. The first and second Five Year Plans recommended the introduction of incentive systems to promote more efficient working in industries with due safeguards to protect the interest of the workers, through the guarantee of a minimum wage and protection against fatigue and undue speedup.¹ The third plan emphasized the need for higher productivity and reduction in the unit cost of production in the industries. Thus, wage-productivity relation can play an important role in raising the standard of living and economic growth of the country.

The present chapter is divided into two broad sections. The first section reviews the theories of productivity, wages and their inter-linkages. The second section summarizes the existing empirical studies on wage-productivity analysis. Within the second section, the first sub-section makes an overview of Indian industry in general and performance of Indian manufacturing sector in particular. The second sub-section focuses on the inter-industry, inter-state wage structure and labour productivity analysis and its determinants. The third sub-section presents the measurement of total factor productivity growth. The fourth subsection focuses on the long run impact of the labour productivity on wages and employment. The final sub-section focuses on the productivity convergence analysis.

2.2. Theoretical Review

2.2.1. Theories of Wage Structure

From the textbooks of economics, we find that there is no theory on wage structure as such. But several questions are posed in the thesis like; why does a variety of wage rate exist? How the relationship between wages and productivity shows? How do changes in money wages affect real wages? Answers to such questions may be found in the theory of wage determination. Dunlop (1957) reviews the theory of wage determination in three different periods of time: The classical period ending around 1870, the second period is characterised by marginal productivity distribution theory ending with the Great Depression of 1929 and the third period is the contemporary one.

2.2.1.1. Classical Theory

Classical economic theory postulated a dichotomy between 'real' and 'monetary' theory. In the former, relative prices, including the real wages of various types of labour as a homogenous factor, were determined by the interaction of tastes, technology and factor supplies, on the assumption of individual maximizing behaviour in competitive markets. In the latter, the price level was determined by quantity of money. The quantity of money determined the level of prices, but had no influence on relative prices. The implication for determination of money wage rates was that money wage would be fixed whatever level would yield the real wage rate consistent with full-employment equilibrium, but that this real wage rate would be independent.

The central problem of classical theory was that of distribution and the keystone in the theoretical system was the determination of wages. The use of land according to the theory is not a factor in the pricing process, and the distribution problem becomes the division between labour and capital. The amount of capital used is assumed to be proportional to the amount of labour employed in them. Capital ceases to be regarded as an independent factor of production. Then all types and grades of labour are reduced to 'normal labour' with the result that the analysis dispenses with relative wages and
concerns a single wage rate. So, wage determination by these steps becomes the key question of price determination and distribution.

The Wage Fund Doctrine of Mill is based on short run period. The wage fund is the amount of wage goods, the means of subsistence, or the variable capital, which capitalists have decided to spend on labour. Wages depend upon the demand and supply of labour. Demand of labour (i.e. employment) is created by the amount earmarked as wage fund. Population theory of Malthus says that, in the long run, through the variation in population, wages tend to be fixed at the minimum of subsistence level.

2.2.1.2. Neoclassical Theory

Neoclassical theory suggests that in a sufficiently competitive world the wage rate paid to the labour will be equated with its marginal contribution to the output of the economic activity. In a competitive world, it can be argued that labour is being paid according to its productive contribution. However, if noncompetitive conditions are the rule, the possibility exists that workers may be paid less than their marginal product, with the difference reflecting an element of monopsonistic and/or monopolistic exploitation. Such exploitation is of obvious importance when assessing the equity dimensions of the operation of an economic system. So, the distribution of national product continued to occupy the minds of the neoclassical economists also. Only the difference between the classical school of thought and neoclassical economists is that the former emphasizes on distribution among the 'social classes', whereas, the latter emphasizes on distribution among the factors of production classified on a functional basis.

Marginal productivity theory basically dominated after 1870. Marginal productivity emerges as an extension of marginal utility analysis to the problem of the pricing of the factors. The firm combines and 'co-ordinates' factors so as to maximize profit as the consumer varies the combination of expenditures to maximize his utility. Maximization of profits by the firm requires that as equilibrium condition the price of each factor of production be proportional to marginal physical productivity and the value
of marginal productivity of each factor be equal to its price. But the prices of the factors are not determined by marginal productivity. Marginal productivity establishes the demand schedules, but factor pricing also requires supply schedules. The original formulatores of marginal productivity distribution theory regarded the supply of labour as set by a 'pain-cost explanation'. The amount of labour services offered would be set as the point where the marginal utility of wage equalled the marginal disutility of labour. According to Robertson (1946) wages tend to measure the marginal productivity of labour, but this is not a theory of wage determination. It does not explain particular wages or the general wage level.

2.2.2. Theories of Productivity

2.2.2.1. What is Productivity?

Productivity is interpreted to be the efficiency with which output is produced by the resources utilized. Productivity is generally defined as the ratio relating to output to one or more of the inputs, which are associated with that output. According to Mark (1972), it is an expression of the physical or real quantities of inputs. Changes in productivity, in turn, are measured by relating changes in the real volume of goods and services. The concept of productivity and corresponding measures can be broadly divided into two classes. One expresses productivity as the relationship of output of a producing enterprise, industry, or economy to one type of input such as labour, capital, energy, etc. The other presents productivity as the relationship of output to a combination of inputs extending to a weighted aggregate of all associated inputs.

There are several productivity measures. The most frequently developed and perhaps most useful one is an output per unit of labour input measure, or what is frequently termed as labour productivity. The most important is that labour is almost universally required for carrying through all types of production. There is a labour element of costs in almost all endeavors; the degree varies but it is always present. In

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addition, as a practical matter, it is perhaps the most measurable input. Other factors like capital, materials are much more difficult to quantify.

There are, however, various labour productivity measures, depending on the definition of labour input. One refers to output per person and other is an output per man-hour measure. The definition of productivity as output per man-hour has economic significance because the interest in productivity has centered on its key role in the wage-cost-price relationship. This arises because labour cost per unit of output is affected not only by the compensation paid per man-hour but also the output produced per man-hour. Unit labour cost can, therefore, remain stable if increased wage are offset by increase in output per man-hour. Stable unit labour cost, can, in turn, provide the basis for a stable price level.

There are also various capital productivity measures depending on the definition of capital input. A measure may refer to output per unit of capital stock. But there are different ways of measuring the stock of capital. It may be gross or net. Moreover, for most productivity analysis, the flow of capital services rather than the stock is the preferred measure. A capital stock measure does not account for differences in the concentration of use over time. Equipments may be used for several shifts during a business expansion or may be idle during a contraction. There is also a loss of efficiency of assets, as they grow older. Ideally, a flow measure should indicate the amount of capital employed to produce constant output. But it is very difficult to estimate a capital flow measure. Other single factor measures such as output per energy input or per material input are relevant for plant and industry study where these inputs are of considerable importance in the production process.

The second group productivity measures are relating the ratio of output to the weighted average of inputs. For the most part, these measures have been limited to output per unit of labour and capital combined, which is known as Total Factor Productivity (TFP). Another measure is called multifactor productivity, which is the ratio of output to joint productivity of labour, capital and intermediate inputs. These measures are
important for analyzing sources of economic growth and to obtain an indication of the efficiency in the utilization of more than one factor of production.

2.2.2.2. Classical Theories of Productivity

From the beginning of economic science, leading economists have given importance to productivity and changes therein. The Physiocratic School dichotomized industries under the classification of ‘productive’ and ‘sterile’. According to their theory, productive activities are those which produce those commodities which could be used, if necessary exclusively and self-containedly, in their own reproduction and growth. Adam Smith in his *Wealth of Nations* refers to three sources of productivity improvement. These are, (1) improvements in machinery, facilitating and abridging of labour, (2) alternations in employment in favour of productive employments and (3) increasing returns due to greater division of labour. Smith notes that division of labour improves skill and handiness of the worker, economizes on production-time and helps to originate productive improvements and inventions. He also stated that the division of labour is limited by the size of the market which in its turn is limited by the division of labour. Given capital expansibility there is technically no limit in Smith's world to the extent of labour’s net productivity.

According to David Ricardo, substitution of labour by fixed capitals can cause unredeemed unemployment and only temporarily postpone the advent of the stationary state. The prospect for labour would be one of fixed real wage-rates unless this class controlled its propensity to augment population size. Thus, productivity improvements in wage-goods alone can permanently push the stationary state forward. Marx was pursuing a pattern of analysis different from that of Ricardo. According to him, the co-existence of a constant capital-output ratio with a rising capital-labour ratio and falling rate of profit without a permanent rise in product-wages is the picture of developing capitalism. Bohm-Bawerk, Joan Robinson and others have criticized Marx for neglecting the effect on productivity of the rising drift in the capital-labour ratio. According to them, through reductions in capital-output ratio and improvements in labour productivity will raise the real wage-rates. J.S.Mill establishes the claims of ‘services’ to be equally productive as
agriculture and manufacturing. He accepts the law of diminishing returns and strongly pleads for limitation of a population size; stationariness in population would lead to higher rate of real wage-rates.

To conclude, in classical economics productivity is an important, often independent source of growth. Productivity is viewed as a relation at the macro level between commodity inputs and commodity outputs. Productive improvement can be labour augmenting or capital augmenting. The ratio of surplus to capitals and the rate of profits are useful measures of productive improvement.

2.2.2.3. Neoclassical Approach to Productivity

The neo-classical economists have given importance to the share of various factors of production. According to them, the rents depend upon factors like differences in the expenses production at the final dose of product and the average expenses per product. For wages and profits, it depends upon trade union bargaining, society’s conventions concerning how much of surplus should be ploughed back into accumulation, prospect regarding population growth, impending technical change etc. The classical approach seems to be nearly all right where, both labour and capital are expanding simultaneously, land being perfectly elastic in supply, there is no technical progress affecting the above factors and there are no distribution changes. In the actual world capital normally expands at a higher rate than that of population and land is not in elastic supply. Neoclassical economists like Solow (1957) and Kendrick (1961) given the way by which the quantities of three factors like land, labour and capital could be combined. They estimated an index number of quantity of each of the factors and scope for a method for a combined index of total factor quantity.

The neoclassical economists’ normal impression in regard to a developing economy is that it is well endowed with natural resources. But the country is deficient in capital, knowledge of the most efficient techniques, personal competent, flexibility in preferences and economic security. By making good to the above deficiencies the process
of development is expected to bring a higher rate of growth and also a higher rate of productivity improvement.

2.2.3. Linkage between Wages and Productivity

The purpose of this section is to bring some aspects of the relationship between 'wage-productivity'. Leibenstein's (1957) analysis says that wage is related to productivity through the nutritive value of food intake. A higher wage level enables the worker to increase the caloric content of his diet and this in turn will cause an increase to the amount of effort that he supplies. His postulate says that by paying a higher wage rate, the employer engender an upward shift of average and marginal productivity curve of labour due to increased amount of "units work" forthcoming after improvement in the worker's diet. As a result, employment will reduce to the point where marginal product of labour equals the higher wage rate. In recent years, it has been recognized that productivity is involved in one way or another with most major issues of public and private policy. During the periods of rising prices, interest has been centered on the problem of rising costs and the relationship between productivity, wages and employment.

Branson (1972) points out that as employment increases, the real wage rate decreases, since employer equate the real wage to the negatively sloped demand function, which is related to the aggregate marginal product of labour. In addition, although real wage falls as employment rises, average productivity per man-hour may rise, mainly due to the existence of overhead labour - foreman, office staff, and others - that have more stable employment than production workers.

According to him, utilization of overhead labour is regarded as excess capacity. If there is a large surplus of overhead labour relative to the amount that is normally required for an initial level of production labour, more production workers can be employed with the overhead labour force being 'spread out' over them. Thus, increase in the production man-hour input will reduce the output per production man-hour. It is possible that the average productivity over the whole labour force will continue to
increase because the productivity of *overhead labour* force goes up as output rises. Therefore, in a cyclical upswing, we may see average labour productivity rising as the marginal productivity and real wage of production workers fall, due to the *overhead labour* phenomenon.

Davis and Hitch (1949) make a proposition that money wages should move in relation to changes in labour productivity. This proposition implies that, over the long run as productivity increases, a rising level of money wage with a stable price level is preferable to a stable level of money wage with falling price level. They find a number of compelling reasons why the economy should respond to increase in productivity rather than lower prices in the long run. First, labour organization constitutes a practical device not only for raising money wages for their own members but, in so doing, for raising wages and salary rate generally. In contrast, there is no assurance that seller will make price reductions as productivity increases. Because administered price situations are so widespread, wage and salary increases offer the best hope for increasing real consumer purchasing power as the economy increases its productivity. Second, rising wages and stable price levels are more stimulating to business activity than are stable wages and falling price levels. Third, rising wages with stable prices would reduce the burden of debt, thereby affecting the distribution of income in favour of non-debt owners. Fourth, it must be recognized that unless increased productivity results in higher in money wages, employees will be generally dissatisfied.

According to them, relating wages to productivity does not ensure economic stability unless a "right" wage policy. The "right" wage policy could contribute positively to economic stability through its effect on wage-price-profit relations. In contrast, if wages are increased to such an extent as to raise unit labour costs generally, the result is likely to be either inflation or decrease in employment depending upon the state of the market. If wages generally lag behind productivity so that labour costs are falling, the result is likely to be a falling price level with depressing effects on business.
Kerr (1949) shows that physical productivity and money wages have divergent tendencies in the short-run. Although, over long periods, there seems to have been a high correlation, but year to year relation has not been close. Indirectly, through its effects on prices and profits, productivity indeed influences wages. But special cyclical developments, the relation between wages and the cost of living, and other factors make it difficult to adopt wages to productivity. In fact, Lord Keynes\(^3\) frequently suggested that productivity and wage rates should move in close harmony over some period of time, since, if they did, price stability would be facilitated.

According to Kerr, wages and productivity, in the short-run, may be linked together primarily in three ways: (1) direct linkage of productivity and wages, (2) indirectly through profits, and (3) indirectly through prices. Little direct connection exists between changes in productivity and average hourly earnings in the short-run. Variations in productivity create a few effective pressures focused on the wage setting process. Also, if wage leaders nationally, regionally, or industrially base their wage decisions on a rise or fall in productivity, the influence of these decisions may be fanned out through the pattern of following process. Rises in productivity do help permit wage increases, and aggressive union may take increasing advantage of this in the future. An increase in productivity may have direct effects on profits. This has happened during second half of the 1920's in US. Productivity went up substantially, while prices and wages held relatively stable, and profits rose considerably. Kerr mentioned that the chain of reactions would go something like this: Productivity rises, profits rise, employment rises and wages follow with a lag. He has examined the chain by following link. When there is less than full employment, the supply curve of labour may be substantially horizontal, so that rising employment does not pull wages up very greatly. Under this condition, the effect of changes in productivity on wages is a delayed and dampened one.

Finally, changes in productivity are much more effectively transmitted through the productivity \(\rightarrow\) price \(\rightarrow\) wage chain. Changes in prices and productivity tend to have an inverse relationship to each other, so also will wages and productivity. For the changes

\(^3\) See J.M. Keynes, 1936: 271.
in wage rates, in the short-run, conform much more positively to changes in the cost of living than to changes in productivity or profits.

Mullennix (1955) comments on Backman’s article ‘wage-productivity comparison’. Backman suggests that changes in total labour costs per man-hour provide the proper comparison with changes in productivity rather than wages. But Mullenix did not agree with Backman’s comment. According to him, wages must increase at least as rapidly as productivity if adequate purchasing power is to be provided for the consumption of increasing product. Even if some industries could not profitably increase wage equal to the increase in productivity in the economy, but they can increase the wage equal to gain in productivity. Mullennix also agreed that if prices automatically declined as productivity increased, then there is no compelling reason for comparing productivity with wages. But actually there seems to be no cause and effect relationship between changes in productivity and prices.

Backman (1955) again replies Mullennix’s comments. Backman said that Mullennix misinterpreted his proposition regarding wage-productivity comparison. According to Backman, there is a close relationship between real wages and productivity. It is not generally contended that it is money wages that should keep pace with national productivity. Of course, it must be recognized that when money wages rise more than productivity, there is a rise in unit labour costs, which in turn may exercise for some pressure for price rises. So, the role of price plays an important role to determine productivity, which, Mullennix ignored in his article.

The above discussion provides to see this relationship, particularly in the developing countries like India. The manufacturing sector, which plays an important role for the economy growth, has to be examined in the context of productivity-wage relationship.
2.3. Empirical Review

2.3.1. Review of Studies on the Growth and Reforms of Indian Industry

The record of industrial growth in India since independence appears impressive. In the quarter century from 1950-75, industrial productions were more than quadrupled. During 1951-65, industrial production increased at an average rate of 7.7 per cent per annum. This rate dropped rather sharply to 3.6 per cent per annum during the decade 1965-75 (Nayyar, Deepak, 1978). Several explanations have been advanced to account for sluggishness of industrial growth since the mid-sixties. The emphasis has varied, but short-term analysis draw attention to the following:

(a) The war of 1962, 1965 and 1971, which diverted potential public investment into unproductive uses.
(b) The successive droughts of 1965-66, 1966-67 and later 1971-72, which restricted the supply of raw materials and the demand for industrial goods from the agricultural sector.
(c) The oil crisis of 1973, which led to considerable industrial dislocation and severe balance of payments difficulties.

Government policy changes during the eighties have tended to give wrong signals in some important aspects of industrial growth. They have tended to create a bias in favour of chemical based industries as opposed to metal-based sector. But in reality metal industry is more suited to the country’s development objectives, which is more in line with the economy’s comparative advantage and has better prospect for international competitiveness. Policy signals have also emphasized a modernization of consumption almost at the cost of, or at least in preference to the modernisation of the production structure of the economy. Finally, by relying almost exclusively on non-tariff forms of protection at high rates, in connection with increasing delicensing of entry, the policy has led to excessive entry, high costs of production and lack of competitive quality in domestic industries (Kelkar and Rajiv, 1990).

After 1980, an era of liberalization started. The trend was diluting the strict licensing system and allowed more freedom. The economic reforms Programme got a big boost
when the government announced a new industrial policy in the parliament on July 24, 1991. Since then, it is liberalization, privatization, and globalization all the way and the process is still underway. Major policy changes initiated in the industrial sector since mid-1991 include the following:

- reduction in the number of items subject to licensing
- reduction in areas reserved exclusively for public sector
- rationalization of the approach towards monopolistic and restrictive practices
- liberalization of import policy and foreign investment policy
- tax incentives for industrialization

2.3.1.1. Performance of Indian Manufacturing before Economic Reforms

The slow growth of Indian industry during the earlier period, particularly between mid-1960s and late 1970s, was the focus of a serious academic debate. According to Ahluwalia (1985), India's industrial progress hinders due to the slow expansion of domestic demand—a consequence of unequal income distribution and slow growth of agricultural income in the country.

Nayyar, Deepak (1994) explains the over-dependence on domestic markets for industrial expansion was due to the "export pessimistic" industrial policies. The regime of licensing which imposed a number of controls on industrial expansion. These controls lead to economic inefficiency and resource miss-allocation. From independence, both growth rates of India's GDP and manufacturing have increased from decade to decade. After a good performance in the 1950s, growth of manufacturing and domestic economy dipped low in the next two decades, particularly in the 1960s. Growth of manufacturing and domestic economy revived in the 1980s. According to Nagaraj (1990) better productivity performance and public investment in infrastructure are reasons for the revival of manufacturing growth since late 1970s. But, other economists (Chandrashekhar, 1988; Patnaik and Chandrashekhar, 1995) say that the improved industrial performance in the 1980s and particularly after 1991 was due to the increased current account deficits incurred by government.
Little et al. (1987) observe that industrial policies caused serious misallocation of resources towards capital-intensive industries. Price control, trade restrictions and extensive range of entry barriers prevented the development of an efficient manufacturing sector. In addition certain branches in manufacturing were reserved for small-scale firms, which in some cases caused a slow down in output and productivity growth.

Now we would like to discuss the gross value added per person and employment share of India’s total manufacturing during 1970s and 1980s. In 1970s, the share of value added was higher in case of industries like textiles, chemicals, basic metals and transport equipment and machinery whereas industries like beverages, tobacco products and wood products, value added share was low (ASI, 1975-76). Similarly in 1970s, the employment share was higher in case of textiles, food products, basic metals and machinery industries. Employment generation was lower in beverages, wood products, chemicals and leather, rubber and plastic industries.

In 1980s, industries like chemicals, food and other manufacturing recorded higher growth of gross value added. On the other hand, manufacturing of jute and cotton textiles growth rates were below the average growth. But, several labour-intensive industries like manufacturing of textiles products, leather, beverages and tobacco were relatively high growth performance during this decade (Thomas JJ, 2002).

2.3.1.2. Performance of Indian Manufacturing after Economic Reforms

After a slow growth in the 1970s, the growth of manufacturing GDP accelerated in the 1980s and the pace was nearly the same in the 1990s. In the 1990s, however, there were two distinct phases in manufacturing growth. Between 1994-95 and 1996-97, manufacturing GDP grew in real terms by 11 per cent per year (Kalirajan, 2004). However, in the more recent five-year period 1997-98 to 2002-03, growth was less than half of 11 per cent. Other studies such as Balakrishnan et al (2000) show no evidence of
productivity growth in Indian manufacturing in the post-reform period. The economic reform process initiated in 1985 got a big boost by a new industrial policy. Some of the provisions of the new policy were:

1. It abolished industrial licenses for all projects, except for a short list of 18 specified industries related to (a) securities and strategic areas (b) hazardous chemicals (c) items of elitist consumption.
2. It removed the asset limits for MRTP totally.
3. It raised the limit for foreign equity holding 40 per cent to 51 per cent.
4. Items product reserved for the small-scale sectors would continue to be so reserved.
5. The policy promised social security mechanisms to protect workers interest in affected public sector enterprises.

When the industrial reform process began, it resulted in a severe slowing down of manufacturing sector in the first two years of structural adjustment. Latter the manufacturing, which grew at the rate of 9.3 per cent, was the fastest growing segment in India’s domestic economy in the 1990’s. Compared to 1980’s, manufacturing growth in 1990’s was more employment generating. Goldar (2000) attributes this positive change to one major reason i.e., first slow down in growth of real wages and faster growth of small and medium sized factories, which are more labour-intensive than large size factories. Nagaraj (2000) study observes that faster employment generation in the 1990s was due to the investment boom in that decade. In later study, he points out that faster employment generation in 1990’s was seen only in registered manufacturing, whereas unregistered sector witnessed negative employment growth between the mid 1980’s and mid 1990’s.

Manufacturing of chemicals and food products had consistently high rates of value added growth in the 1990s. On the other hand, growth rate of jute and cotton textiles industries was below the average for factory sector in this decade. Manufacture of basic metals and transport equipment had the highest rate of growth in the 1990’s. In 1990’s, the large number of jobs was generated by the manufacture of chemicals and food products. Manufacture of textiles product, repair of capital goods, and manufacture
of beverages and tobacco were the other labor-intensive industries that were major
generator of employment in the 1990s, but the shares of investment into each of these
industries were very low.

2.3.2. Review on Inter-industry Wage Structure and Productivity Analysis

Dunlop (1948) focuses attention on particular variables as explanation of variation
in the inter-industry wage structure. His statistical evidence is concerned with the
behaviour of average hourly earnings of a group of manufacturing industries plus
bituminous coal and steam railroads over the period 1923 to 1940. The evidence explores
the effect of productivity as measured by output per man-hour as the explanation of a
major portion of the observed variation in wage rates. From this Dunlop concludes,
"these data indicate a significant tendency, not necessarily unique, for wages to increase
by a greater extent in industries with the higher increases in productivity and by a lesser
extent in industries with lesser increases in productivity.\textsuperscript{4}

Ross's (1950) article on "The Influence of Unionism upon Earnings" is made up
of two main parts. The first half of the discussion focuses on the relationship between
unionism and the earnings for the period 1933-45. The second half is a re-examination of
the material and the conclusions on this topic by Paul Douglas in his real wages in the
United States. Ross argued that real hourly earnings have advanced more sharply in
highly organized industries than in less unionized industries, in periods of stable or
decreasing union membership as well as in periods of rapid organization. He did not find any
relationship between labour productivity and real hourly earnings.

Garbarino (1950) attempts to outline a theory capable of accounting for the
observed variation in the industrial wage structure. While wage behaviour is the result of
the operation of a large number of factors, it is argued that the variables of productivity,
concentration and unionization will be capable of explaining the major portion of

\textsuperscript{4} See Dunlop, 1948: 350.
differential movements. Consideration of changes in employment adds to the usefulness of the model in some cases where changes in employment have been substantial.

Meyers and Bowlby (1953) attempts to consolidate the argument by a statistical examination of the relationship between productivity changes and changes in the inter-industry wage structure from 1923 to 1950 for thirty-eight US manufacturing industries in a Bureau of Labour Statistics study. The statistical evidence shows that, at least for the 1933-1950 period, the Dunlop-Garbarino thesis is not so capable. This implies that the correlation coefficient between productivity and inter-industry wages is considerably lower. It also appears that in the earlier period studied by Dunlop and Garbarino, whatever relationship existed was more apparent intracyclically from 1923-1929 and 1929-1933 than over the entire span from 1923-1940. Since 1933, changes in interindustry wage relationships seem largely unrelated to relative changes in labour productivity. According to them, the growth of unionism, the accompanying broadened scope of bargaining units, governmental intervention in wage determination and many other factors are operated to pace the process of wage setting beyond the bounds of unilateral managerial decision. Thus the general conclusion from their study is that in the present institutional setting, one needs to look the factors other than changes in productivity to explain relative wage changes between industries.

Bell, Spurgeon (1940) presents the relationship between physical productivity and wage rates of entire national economy from the period 1919-1938. He finds that productivity gains were distributed to labour and to the rest of the economy in the form of lower prices. Regardless of the sequence of cause and effect, it is interesting to note that Bell’s conclusions were based on a long run divergence between wages and physical productivity. But Kerr (1949) finds a long run relationship between physical productivity and wages in the period 1919-1945. The main reason for the difference lies in the use of different terminal years. Bell’s study compared 1919 with 1938, a year in which prices were lower and productivity greater than 1919. While, Kerr’s study compared 1919 with 1945, a year when both prices and productivity were greater than in 1919.
Perlman (1956) examines the value of productivity and the inter-industry wage structure in the case of US manufacturing industries from the period 1939 to 1953. According to his approach, value productivity should compare with inter-industry wage structure rather than the physical productivity. Productivity improvement in some industries may lead to price reductions rather than wage increases. Thus, some industries with large productivity gains may experience a relatively smaller wage increase than other industries with an inferior productivity record. The more important weakness in the physical productivity-wage comparison, however, is that demand factors working through price changes may raise wages without any definite effect on physical productivity.

On the other hand, by correlating value productivity, instead of physical productivity, with wages, these two disturbing factors are eliminated. The two factors whether productivity improvement takes form of price decline rather than wage increases, or whether demand-induced price rises in particular industries lead to wage increases in the absence of productivity increases, in no way affects the relationship between value productivity and wages. However, the close relationship between these two variables in recent years is consistent with a strong union influence on the wage structure.

A number of studies have been conducted in the manufacturing sector in India. But a very few number of studies have been done on wage structure and productivity analysis. Sinha and Sawhney (1970) examine wage-productivity relationships in selected Indian industries for the period 1950-63. The study brings out a key finding, i.e., the inverse relationship between the share of labour in productivity gains and the rates of productivity advance, with only one or two minor exceptions, which may be explained in terms of stickiness of wages. Labour enjoys positive gains even during the period of productivity decrements.

Sastry (1992) presents a study on wage structure in organized industrial sector. Her study analyses wage structure at national level, inter-state wage structure, inter-industry wage structure at the individual state level and inter-regional wage disparities.
within the same industry. The major findings of her study are per capita nominal wage levels of the industrial workers are far higher in the industrial forward states as compared to the backward states in India. Inter-industry wage differentials increased over a period of time. Johri and Agarwal (1966) examine a time-series analysis of national wage structure covering the period 1950-61. NCAER (1969) covers the period 1956-63 in its very brief account of inter-industry wage structure. Rabindranath (1976) limits his analysis to the industrial area of Pune. Recently, Goldar and Banga (2004) have examined the wage-productivity relationship of organized manufacturing sector in a state-wise perspective. The analysis of time-series data for states reveals a positive relationship between labour productivity and wage rate, but the marginal effect of labour productivity on wage rate as well as the elasticity was found to be low.

2.3.3. Review on Productivity Growth and Efficiency of Indian Manufacturing

There has been large number of studies on productivity growth in Indian manufacturing sector. Most of them have discussed the measurement of Total Factor Productivity (TFP) growth rate both at the aggregate and disaggregate level. This section reviews only the selective study from post independence period. We consider only the studies undertaken at the registered aggregate manufacturing sector. Again, not all the studies at the aggregate level are covered; the important one and those, which raise significant methodological issues, are covered. These can be classified into two broad groups: (a) studies undertaken during pre-reform period and (b) studies undertaken after 1991 economic reforms. The first group includes Diwan and Gujarati (1968), Dadi and Hashim (1973), Brahmananda (1982), Ahluwalia (1985, 1991), Goldar (1986) and Krishna (1987). The second group of studies includes Balakrishnan and Pushpangadan (1994, 1995, 1996), Dholakia and Dholakia (1994), Mohan Rao (1996), Pradhan and Barik (1998, 1999), Gangopadhyaya and Wadhwa (1998), Unel (2003), Trivedi et.al. (2000), TSL (2003), and Goldar (2000, 2002, 2004).

Diwan and Gujarati (1968) estimate Constant Elasticity of Substitution (CES) production function in 28 Indian industries using time series data for the period 1946-58.
It is observed that elasticity of capital-labour substitution is quite low. As regards the magnitude of the elasticity between labour and capital, only two industries, namely, starch and cement have an elasticity of substitution equal to or greater than one. All the remaining 26 industries have elasticity of substitution less than one.

Banerji (1971) analyses the productivity growth in Indian manufacturing industry using Census of Indian Manufactures (CMI) and Annual Survey of Industries (ASI) data for the period 1946-64. He computes TFP indices to capture the trend of technical progress and to estimate the coefficient of elasticity of substitution. It is observed that the performance of the manufacturing sector had been rather sluggish over the study period. There was no sign of technical progress in the Indian manufacturing sector.

Dadi and Hashim (1973) estimate the Cobb-Douglas production function for the large-scale census sector of Indian manufacturing sector over two periods: 1946 to 1964 and 1953 to 1964. They find that coefficient of labour is not statistically significant in the first period, while both labour and capital were not significant in the second period. But the coefficient of time trend variable is positive and significant in both the periods.

Goldar (1986) analyzes the productivity trends in Indian industry for period 1951-1979 covering roughly the first three decades of the post-independence era of industrialization. He presents two sets of estimates pertaining respectively to the periods 1951-1965 and 1959-1979. The estimates of TFP for the aggregate manufacturing sector for the period 1951-65 give an average annual growth rate of about 1.3 per cent. A significant rising trend has been observed in labour productivity and capital intensity, while a significant falling trend has been noticed in capital productivity. Corresponding estimates for 1959-79 give an average annual growth rate of TFP of about 1.3 per cent. He observes a significant falling trend in labour productivity, capital intensity and capital productivity. He found capital deepening seems to have slowed down appreciably after 1970. Estimates of the rate of technological progress, obtained from the production function estimation, were broadly consistent with results based on TFP indices, especially in terms of direction.
Bhatia (1990) examines changes in productivity during 1965-85 in the manufacturing sector of India in comparison with UK and US through Kendrick and Solow indices of total factor productivity. The results indicate that productivity in Indian manufacturing sector was observed to have declined during 1965-75, but rise subsequently during 1980-85 and was even faster than that of UK and US. However, in absolute terms, the level of productivity in India was much lower than that in the two countries. According to the author, a very low level of productivity in India could be due to: (i) a lower capital-labour ratio, (ii) low level of technology, and (iii) a relatively higher share of housing in the fixed capital stock.

Ahluwalia (1991) finds a marked increase in the growth rate of total factor productivity in Indian manufacturing in period 1980-85 (3.4% per annum) as compared to the period 1965-79 (0.3% per annum). Her estimates of the translog production function using pooled cross-section and time-series data also showed a marked improvement in the rate of total factor productivity growth from 1982-83. The study points out that the real wages of workers in manufacturing sector increased. Such sharp increase in wages possibly raises the productivity and decline of manufacturing employment that took place during the same period.

Aggarwal and Kumar (1991) examine Verdoorn’s law in case of Indian manufacturing industry. According to Verdoorn the strong positive relationship between the productivity and output growth have been attributed mainly due to two factors (i) technological progress and (ii) economies of scale. Here the authors compare the relation between growth in output and productivity for two sub-periods chosen i.e. pre 1980’s and post 1980’s. For this they used Granger Causality Test to inquire into the causal relationship between the productivity growth and the output growth, and employment growth and output growth. The empirical results suggest that the Verdoorn’s law holds for large manufacturing sector in India for the period 1973-86. However, the relationship for the two sub-periods separately (1974-78 and 1982-86) does not provide conclusive evidence in favor of the law.
Ghosh and Neogi (1993) examine the performance of 29 ‘sunrise’ Indian industries in terms of labour productivity to capital intensity. They try to study the effect of technological advancement as reflected in strictly rising capital intensity on the productivity of labour. The study used ASI data for the period from 1974-75 to 1986-87. The following observation are by authors on the basis of empirical analysis: (i) increasing use of overhead capital has not produced any significant improvement in productivities, (ii) whether one considers skill personnel or just production workers in the definition of labour, in both cases, the downward shift of productivity locus suggests that inefficient use of resources has become the order in Indian ‘sunrise’ industries in recent years.

Balakrishan and Pushpangadan (1994) point out that the price index of materials input used in manufacturing as a ratio of the price index of manufactured articles increased sharply in the 1970’s, and there was a marked decline in the relative price of materials in the 1980’s. For constructing a price index for materials used in manufacturing industry, they have used input-output transactions table prepared by the CSO for 1973-74. They consider 19 input groups and take the weights from the input-output table. The price indices for the 19 groups, which include agricultural products, minerals, manufactured products and electricity, are combined to form the price index for material input (including energy).

Dholakia and Dholakia (1994) address the two issues: (1) the qualitative conclusion about the behaviour of TFP growth in the Indian manufacturing sector over time, particularly during 1980s as compared to 1970s, does not change if sufficient care is taken about applying the double deflation method in order to measure real gross output. (2) The double deflation method per se not necessarily superior to single deflation method. They compute the right weights to be used for registered manufacturing sector and show that, TFP growth rate based double-deflated value added method turns out to be higher for the period 1980-81 to 1988-89 than for the period 1970-71 to 1980-81. Their results are in line with Ahluwalia’s (1991) findings and in disagreement with the findings of Balakrishan and Pushpangadan (1994).
Balakrishan and Pushpangadan (1995, 1996) replied to this criticism of Dholakia and Dholakia (1994), and shown that even if weights for registered manufacturing are used the estimated growth rate of TFP in Indian manufacturing is much lower for the 1980s than that for 1970s.

Mohan Rao (1996) estimates TFP growth in Indian manufacturing for the period 1973-74 to 1992-93. In his paper, he focuses on a particular method of empirically measuring industrial performance that has acquired some prominence in recent years. His approach relies on an accounting decomposition or an econometrically estimated decomposition of the sources of growth. He uses gross output in order to measure TFP growth, rather than gross value added. According to him the concept of value added is ill defined and one will get a biased estimate of TFPG if a two-input framework is used as done by Balakrishan and Pushpangadan, Ahluwalia, Goldar and many others. From his estimates, he has noted that the single deflation method resulted in a significantly larger magnitude of error than double deflation method. Mohan Rao has also presented productivity estimates based on gross output function. These estimates of TFPG show a pattern similar to the estimates obtained from double deflation value added.


Pradhan and Barik (1998) estimate the TFP growth of eight selected polluted industries from the period 1963-64 to 1992-93. They argue that for estimating TFP growth for Indian manufacturing a three input framework based on gross output function should be used. The empirical results find that value added function does not exist for either the aggregate manufacturing or the individual industries. It, therefore, casts doubts on the appropriateness of value added as the variable in estimation of TFP in Indian industries.
Pradhan and Barik (1999) capture the total factor productivity growth (TFPG) during the period 1963-93 for aggregate manufacturing sector and eight selected industries by estimating the Translog cost function. The scale factor for aggregate Indian manufacturing sector was found to be less than unity. Except paper industry, a deceleration in scale factor is found in all industries in 1980s. For aggregate manufacturing sector and most of individual industries, a declining trend in technical change has been noticed in recent years. On the whole, a declining trend of TFPG in Indian manufacturing sector-both at aggregate and disaggregate levels has been noticed.

Gangopadhyay and Wadhwa (1998) analyze the changing pattern of labour productivity, labour costs and total factor productivity in Indian industry over the period 1973-74 to 1993-94 at the disaggregated level of two-digit industries. In this study, they examine whether the sweeping economic reforms of 1991 have any significant changes in industrial productivity in early 1990’s or not? According to them globalization will successful in India only when higher incomes for existing labour prevails and job opportunities for new entrants into the labour force. They divide the entire period into two sub-periods and made a comparison between the two sub-periods. The result shows that except four industries, all other industries’ employment growth has slowed down between 1973-83 and 1984-93. Slowing down of both employment and wage growth rates are reflected in falling share of wages in net value added.

Mitra (1999) uses the methodology suggested by Cornwell et al. (1990) to study the technical efficiency and TFP growth in Indian industries. He uses panel data for the analysis, which covers 15 states and 17 two-digit industries for the period 1976-77 to 1992-93. A frontier production function is estimated for each of the industries using state-wise, year-wise panel data. Apart from the disaggregate study, he also estimated TFP at the all-India level. He applies a two-input framework (labour and capital) by using double-deflated value added. For this purpose, value of output and intermediate inputs has been deflated separately. His estimates show that in four industries (food products, beverages and tobacco products, basic metals and metal products) there has been a decline in TFPG in the later period (i.e. 1985-86 to 1992-93) as compared with
the former (i.e., 1976-77 to 1984-85) in most or majority of the states. In other 13
industries, there has been an increase in TFPG in 1985-86 to 1992-93 in most or
majority of the states.

Unel (2003) examines the impact of the economic reforms on productivity of
Indian manufacturing using aggregate and sectoral level data from 1979-80 to 1997-98.
By applying standard growth accounting framework, he constructs Total Factor
Productivity (TFP) series for each sector. He finds that the growth rate of labour
productivity in total manufacturing during 1979-80 to 1997-98 is 6 per cent; Total Factor
Productivity is 1.5 per cent under observed labour share and 3 per cent under the
assumption of constant labour elasticity. A comparison of the performance of sectors
before and after the 1991 reforms indicates that the labour productivity and TFP growth
rates increased by 24 per cent and 46 per cent, respectively.

Tata Service Limited (TSL) (2003) study estimates the TFP for the organized
manufacturing sector for the period 1981-82 to 1999-2000. Using the gross output
function framework, estimation of TFP growth has done. The estimated average annual
growth rate of TFP in manufacturing is 0.68 per cent for the pre-reform period (1981-82
to 1992-93) and 0.97 per cent for the post-reform period (1993-94 to 1999-2000), lending
support to the findings of Unel (2003).

But Goldar (2004) finds a deceleration growth in Indian manufacturing during
post-reform periods as compared to pre-reform period. He compares 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 Indian organized
manufacturing sector after 1997-98.

Kalirajan (2004) analyzes the source of output growth in manufacturing in the
post-reform periods and identified the crucial factors influencing manufacturing
productivity. His study is based on the corporate database of the Centre for Monitoring of
Indian Economy (CMIE). He finds after the 1991 economic reform, it appears that the
speed of the engine has slowed down. His analysis indicates that on an average about 15 per cent output growth can be achieved by improving firm’s efficiency without having to increase any input.

The present objectives differ from the previous literature in particular on the ground of specific focus on explaining a method to decompose the TFP growth into technological progress (TP) and changes in TE within the framework of the time varying coefficients frontier production function.

2.3.4. Review on the Nexus between Productivity, Wages and Employment

In the Indian Context, several studies like Nagaraj (1994), Goldar (2000), Tendulkar (2003), Bidhe and Kalirajan (2004), and Banga (2005) have been focused on the employment growth of organized manufacturing sector. Nagaraj (1994) shows the trends and evidence between employment and wages in manufacturing industries. According to him, the decline in registered manufacturing employment that took place in the 1980s is widely believed to reflect substitution of capital for labour because of increased wage rate.

Goldar (2000) and Tendulkar (2003) study point out an accelerated growth of employment in the organized sector of manufacturing in the 1990s as compared to the previous decade. These studies also point out that after allowing for some other factors such as real wage growth and the number of days worked per worker (rather than total number of workers), the employment elasticity of output does not show any decline in the 1980s. These studies suggest that the economic reforms of the 1990s may indeed have had a positive impact on employment in manufacturing.

Bidhe and Kalirajan (2004) find that organized manufacturing sector provide more employment in the 1990s after the stagnation in the 1980s. This outcome provides some support for economic reforms. While the stagnation in employment in the organized sector of manufacturing has been at least partly attributed to rising real wage
rates in the period, in recent times, there has also been concern on the need for reforms in the labour policies to promote employment in manufacturing.

Banga (2005) estimates the impact of liberalization on wages and employment in the Indian manufacturing industries in the post reform period. She finds that higher FDI in an industry does not lead to a higher employment level but has a significant positive impact on the wage rate of the industry. On the other hand, higher exports in an industry improve its employment level.

However, none of these studies has given attention to labour productivity, which is the key player in the labour market. Unless the employer ensures about the higher productivity, he would not bring more employees even though there is lower wage rate. The other factor is the price. Price plays an important role for wage determination. Higher the price, lower is the wages and hence lower is the productivity. The present objective has a different dimension. It differs from the previous literature on the ground of specific focus on explaining the long run causal relationship between productivity, wages and employment in the manufacturing sector. It is well documented that the mutually reinforcing phenomenon of low productivity in manufacturing sector is the cause for low income. Low income in turn leads to low standards of living, which constitute the root cause for poverty and unemployment in the country. So, the issue of labour productivity growth, the only route to enhance labour welfare in the long run has been under examined.

In light of this, we have reviewed some of the international literature pertaining to our study. Policy-makers and financial analysts cite wage pressures and productivity gains as leading factors in explaining inflation. Mehar (2000) shows that prices explain wages, but that wages are not a causal factor in determining inflation. Studies by Huh and Trehan (1995) and Gordon (1988) report evidence indicating that wage growth has no predictive content for inflation, rejecting the cost-push view. Ghali (1999), using Granger-causality tests, finds that wage growth does help to predict inflation, supporting the cost-push view. Lindbeck (1983), Giersch and Wolter (1983) and others examine 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 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 cointegration test results strongly reject the null of no cointegration in the panel between both price and wage-adjusted productivity and between labour productivity and real wages.

Wakeford (2004) analyzes empirically the relationship between real wages, employment and labour productivity in the context of South African manufacturing sector from the period 1970 to 2002. He uses the multivariate cointegration technique in order to see the long-run relationship between among these variables. The modelling suggests that a cointegrating relationship may exist between real wages and productivity for the period 1970–2002. According to the model, a 1 per cent rise in productivity is associated with an increase of approximately 0.38 per cent in real wages in the long run. This coefficient may be implausibly small, although the fact that it is less than one is congruent with the preliminary data analysis in that real wage growth has not kept pace with productivity gains in the long run. The error correction model suggests that the long-run causality runs from productivity to real wages, which is consistent with wage-bargaining theory.

2.3.5. Review on Inter-state Productivity Analysis and its Determinants

From the previous section, we find that vast number of studies analyzes the productivity growth of Indian manufacturing sector both aggregate and inter-industry disaggregate level. These studies focus on the measurement of Total Factor Productivity (TFP) and the methodological aspects associated with it. Similarly, the recent literature
on productivity in India, such as, Aghion et al (2003), Das (2003), Topalova (2003), attempts to examine the relationship between the economic reforms and productivity growth in India. However, the studies dealing with productivity at regional (state) level have been rather few.

India’s performance in the industrial sector is certainly impressive since independence. Still, there are evidences of inter-regional disparities in various dimension of development, which call for serious attention. The fluctuations in size and composition of manufacturing sector are understandable in a country, which is highly dependent on the industrial climate and income. But sharp fluctuations in inter-state manufacturing industrial disparities have raised the question whether there is something endemic in economic system, which has been responsible for this. Studies by Nair (1983) and Krishna (1980) have pointed out the increase in per capita income disparities among the states and thus have refuted. Another group of studies by Sekhar (1983), Gupta (1985), Anuradha and Rao (1995), and Kelkar and Sastry (1987) have concluded that the regional disparities in the industrial development have been declining among the state in 1970s and 1980s.


Mitra et al (2002) examine the effects of infrastructure on manufacturing industries’ total factor productivity (TFP) and technical efficiency (TE) in the case of 17 industries in 15 major Indian states from the period 1976 to 1992. They have shown that differences in infrastructures endowments across Indian states explain in a significant way their differences in industrial performances, in total productivity and for technical efficiency. Their findings also identify the industries where total factor productivity and
technical efficiency, the competitiveness and export capacity, depend particularly on infrastructure.

Trivedi (2004) attempts to provide a comparison of productivity growth process both at inter-state level and at disaggregated industry level in each state during 1980-81 to 2000-01. Her study encompasses ten major states of India and five industries from each state, based on their share of exports to total India exports. The major findings of her study are that the policy reforms do not seem to have impacted positively most of the industries, except for metal industry. TFP growth in most of the industries decelerated during the post-reform period. Bihar and West Bengal have witnessed low growth rates, severe joblessness and also states with low levels of TFP.

The issue of what determines labour productivity received significant attention in the developed countries while it received less attention in the developing countries. There are plethora of approaches adopted both at aggregate and disaggregate level. Lindbeck (1983) identifies the major determinants of labour productivity in seventies are inflation rate, lower profits, and higher relative prices of various inputs of major macroeconomics importance. His econometrics results show a negative impact of expected inflation rate on 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 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, would 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.

Finally, Madden and Savage (1998) employ a multivariate cointegration 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.

In the Indian literature, the determinants of labour productivity in the regional context have so far been addressed mainly in Kumar's (2002) paper. He 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) makes 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) examine 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.

2.3.6. Review on Productivity Convergence

The theoretical and empirical literature on convergence and catch-up has focused almost exclusively on aggregate income, output and productivity. A primary concern has been whether the empirical evidence supports neo-classical growth model or a model from 'new growth' literature. There has been vast number of studies relative to income convergence both among industrial countries as well as in developing countries. However, studies on productivity convergence are few. In the light of this objective, we reviewed some of the papers, which analyzed the productivity convergence both at aggregate and sectoral level.

Dollar and Wolff (1988) investigate convergence of labour productivity levels in individual manufacturing industries over the 1963-1982 period for 13 industrialized countries. Their main empirical finding is that among 13 industrial countries there has in fact been convergence of labour productivity levels in every manufacturing industry during 1963 to 1982. Furthermore, during the same period they found more intercountry variation in productivity at the industry level than at the level of manufacturing, which confirms the earlier work by (Dollar, Wolff and Baumol, 1987). The second major
findings is that variation in the employment mix among countries does not play an important role in explaining cross-country differences in aggregate productivity in all manufacturing, nor have changes in employment mixes been an important source of convergence.

Barro and Sala-i-Martin (1991) disaggregate the nonagricultural part of gross state product into value added per worker for eight sectors. The main finding is that convergence shows up significantly within these sectors of production, especially for manufacturing. The main inference from these results is that poorer states grow faster not only in terms of overall gross state product per person, but also in terms of labour productivity within various sectors of production.

Barro and Sala-i-Martin (1992) analyze the per capita income and productivity convergence by using neo-classical growth model across the 48 contiguous U.S. states. Their empirical results document the existence of convergence in the sense that economies tend to grow faster in per capita terms when they are further below the steady-state position. This phenomenon is valid over various periods from 1840 to 1988. But, over long samples, poor states tend to grow faster in per capita terms than rich states even if we do not hold constant any variable other than initial per capita income or product.

Baumol (1986) regresses the average rate of annual labor productivity growth over 1870-1979 on a constant and on the log of labour productivity in 1870 for sixteen countries. He also regresses the log difference in per capita income between 1870 and 1979 on a constant and the log of per capita income in 1870 provides a slightly stronger case for convergence than productivity convergence. Baumol’s finding of convergence supports two further conclusions. First, slow relative growth in the U.S. since world war II was inevitable: convergence implies that in the long run divergent national cultures, institutions, or policies cannot sustain significant productivity edges over the rest of the developed world. Second, one can be optimistic about future development.
De Long (1988) comments upon Baumol’s (1986) paper “Productivity Growth, Convergence, and Welfare.” According to him, Baumol’s regression line tells us little about the strength of forces making for convergence since 1870 among industrial nations. The sample suffers from selection bias, and the independent variable is unavoidably measured with error. Both of these create the appearance of convergence whether or not it exists in reality. A fair test of convergence requires not an ex post sample of countries that have converged but an ex ante sample of countries that in 1870 looked likely to converge. Moreover, least squares is not a satisfactory estimation technique because of errors in measuring 1870 incomes. Such errors induce opposite errors in 1870-1979 growth and bias the regression slope toward -1.

Bernard and Durlauf (1995) propose and test a new definition of convergence for per capita output, using century-long time series data for 15 OECD economies. According to them, the use of cross-section results, however, suffers from several problems. First, it is possible for a set of countries which are diverging to exhibit the sort of negative correlation, so long as the marginal product of capital diminishing. Second, the cross-section procedures work with the null hypothesis that no countries are converging, which leaves out a host of intermediate cases. Their analysis of the relationship among long-term output movements across countries reveals little evidence of convergence. They find evidence that there is a substantial cointegration across OECD economies. The results therefore imply that there is a set of common long-run factors, which jointly determine international output growth among these OECD economies.

Bernard and Jones (1996a) examine the role of sectors in aggregate convergence for 14 OECD countries during the same time period by using different measure of productivity. First, they estimate the convergence in labour productivity measures and Total Factor productivity measures. According to them the use of labour productivity necessarily entails restrictions on the depth of analysis because convergence in neoclassical growth framework places heavy emphasis on the accumulation of capital as the driving force behind convergence, but analysis of labour productivity does not allow the identification of separate influences of technology and capital. To determine the
robustness of the convergence results, they construct a new measure called Total Technological Productivity (TTP). The major finding is that manufacturing shows little evidence for convergence in all the measures. While other sectors, especially services are driving the aggregate convergence result.

Bernard and Jones (1996b) again examine whether the Total Factor Productivity (TFP) convergence in aggregate economy is also occurring at the industry level in 14 OECD countries from 1970 to 1987. Using both cross-sections, they found strong evidence for aggregate convergence in TFP with both decreasing cross-country variance and catch-up by lower initial productivity countries. In contrast, there is heterogeneity of productivity movements across the sectors. Most striking was the lack of evidence for convergence in manufacturing sector. They also extend the existing results on asymptotic normality in panel unit root estimators in panel data and found additional evidence for differences across sectors. Manufacturing again shows the least evidence for convergence.

Cornwell and Wachter (1998) propose a methodology for analyzing productivity convergence based on frontier production functions to a sample of 26 OECD countries observed over the period 1965-1990. They find convergence and catch-up was fairly strong among European countries but not between the G-7. The changes in country efficiency explain a large percentage of the variation in output growth, indicating the importance of country’s ability to absorb new technology.

Carree et al (1999) investigate convergence of average labour productivity across manufacturing industries in 18 OECD-countries over the period 1972-1992. For each industry they determine the extent of β convergence and σ convergence and their statistical significance. The results show large inter-industry differences in the extent of convergence, part of which can be explained from differences in the level of average labour productivity.
Togo, Ken (2002) studies the convergence of labour productivity in 12 manufacturing industries in Japan during 1985 to 1997, using the transition matrix for analysis. The results indicate that industries have variety of ergodic distributions of labour productivity. He also finds that industries with relatively high labour productivity would have a bipolar distribution of labour productivity.

Mulder and Groot (2003) analyze the convergence patterns between comparison of energy- and labour-productivity convergence at a detailed sectoral level for 14 OECD countries, covering the period 1970-1997. They come across cross-country differences in energy-productivity level are to be substantially larger than cross-country differences in labour-productivity level at all the sectoral aggregation. At the macroeconomic level they find evidence of energy-productivity divergence, driven by aggregate Manufacturing, as well as labour-productivity convergence, mainly driven by Services. It is the Iron and Steel and Non-Ferrous Metals sectors that drive energy-productivity divergence in aggregate Manufacturing. Moreover, despite a lack of evidence of labour productivity convergence at the aggregate Manufacturing level, there is evidence of labour productivity convergence in several Manufacturing sub-sectors, with Machinery as the most important exception in that it shows a clear pattern of divergence (in particular after 1985).

Using a panel-data approach, they found energy productivity in most sectors to grow relatively fast in countries with relatively low initial productivity level. This evidence of β-convergence supports the hypothesis that being relatively backward in productivity carries a potential for rapid advance, in particular in terms of energy productivity. Moreover, they also find economies of scale to contribute to energy- and labour productivity growth in several sectors, while investment share, openness and specialization play only a very limited role in explaining (cross-country) differences in energy- and labour productivity growth.

Similarly, as far as convergence of Indian studies is concerned, a number of studies by Cashin and Sahay (1996), Rao et al (1999) and Adabar (2004) measure the
income convergence across the states and suggest several policy implications. There is a smaller literature, which considers productivity convergence of Indian manufacturing sector. 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 indexes of productivity growth for the sample years. According to him, the annual rate of productivity growth has been higher in the reform period than in the pre-reform period and there is a tendency towards convergence in the productivity growth rates across states.

Mukherjee and Ray (2004) analyzes 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 and post reform years. Using the non-parametric method of Data Envelopment Analysis, they utilize super-efficiency models to rank the states in terms of their performance and investigate the dynamics of the efficiency rankings over time. They find no major change in the efficiency ranking of states after the reforms and there is evidence of no convergence in the distribution of efficiency in the reform period.

But none of the above two studies has discussed the productivity convergence in detail. Even they found that there is no convergence in the reform period, but they did not explore the reasons for no convergence. In this context, the major research issue is to see the productivity convergence in manufacturing sector across the major Indian states and to see what are the factors that causing for productivity convergence or divergence. The key issue is to understanding long-run productivity performance as the process of economic growth, which tends to involve reductions in productivity differences among states, for example, due to capital accumulation or technology transfers. The above review of both the theoretical and empirical literature has helped to conceptualize the relationship between wage and productivity. This has also been advantageous in identifying the research issues and research gaps on which the objectives of the present study are based on. In the subsequent chapters, the study analyzes the objectives empirically, which has mentioned in chapter one.