LABOUR PRODUCTIVITY IN INDUSTRY

- A REGIONAL ANALYSIS

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I certify that the dissertation entitled "Labour Productivity in Industry - A Regional Analysis", submitted by Ms Gursharan Kaur Bhalla, in fulfilment of six credits out of the total twenty four credits for the Degree of master of Philosophy (M. Phil) of the University, is to the best of my knowledge, her original work, and may be placed before the examiner for evaluation.

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CHAPTER ONE

INTRODUCTION

This dissertation seeks to assess the efficiency of the labour force in Indian industry. The measure of efficiency adopted is labour productivity defined as real value added per mandays employed.

A number of studies have been made done which deal with the wage rate in industry. However, wages and labour productivity are two different things. Wages refer to the income per worker received, while productivity refers to the income per worker generated.

The focus of the work is on an inter-regional analysis of industrial labour productivity but the productivities of various industries at the national level also have been described in the first analytical chapter.

At a regional level, the labour productivities of the industrial sectors of various states over a period of time have been looked into. The growth rates of labour productivity in various states over the same time period, and the changes over time of the coefficients of variation, have been studied. An analysis has then been attempted of the reasons that have caused the productivity of individual states to vary from the productivity of the nation. A more detailed account of what is dealt with in each chapter follows.

Chapter Wise Scheme:

Following this introduction, chapter two presents a review of the literature together with an overview of the industrial sector. Chapter three shows how the 15 major states covered

performed in terms of the labour productivity of the total industrial sector from 1969-70 to 1987-88. The performance of individual industries from 1976-77 to 87-88 in India as a whole is also dealt with in this chapter.

The fourth chapter analyses the interface of inter regional and inter industrial labour productivity growth rates. In this chapter the difference between national industrial labour productivity and an individual state's labour productivity is explained in terms of the "structure", "region" and "interaction" effects. If a state enjoys greater labour productivity than the country as a whole then a measure of how much of this difference is due to the state having a mix of industries such that, on the average, more workforce is engaged in the highly productive industries is called the structure effect. The measure of how much of the difference is due to the individual industries in the state being more productive on the average than the same industries in the country, is termed the 'region effect'.

The fifth chapter looks at the factors affecting labour productivity, and how these factors have moulded the regional variations in productivity depicted in the previous chapter.

The final chapter is a brief resume of the conclusions of the previous chapters.

In the remainder of the present introductory chapter, the relevance of studying labour productivity is first considered. The fact that labour productivity is often associated with wages, the questions of why there is this association of terms, and what is the difference between the two, are then looked at. The limitations of studying productivity in the sense of what information the concept conveys and what it fails to convey, is

also put forward. The method used to calculate productivity, and the limitations of this method are also mentioned.

Link between labour productivity and wages:

Labour productivity (or value added per worker/employee) is a concept that has often been used in the literature, because it gives one at a glance, how much of the value added each worker would get if this were distributed equally amongst them. It shows how rich the given industries are. Of course this is not a measure of the contribution of each worker in the production process. This is so because the capital/labour ratio, technology, infrastructure, relative number of skilled labourers and the degree of their skill, and so on, are also important factors influencing labour productivity.

Wages on the other hand are what the workers actually get. This is not equal in value to the contribution of each worker; rather it depends on a number of factors. Wages also differ a lot from labour productivity. It has often been said that productivity should be linked to wages. How far this is the case, and what determines wages in the first place, has been discussed briefly in the first part of chapter two.

Although in this dissertation, the link between wages and productivity is not studied, the logic of linking the two is that labourers also have a right to a share of the gains from technological progress. The increase in capital is attributable partly to their efforts, hence it is sometimes argued that the gains should also go to them. This view is accepted in varying degrees by most people. However, extreme views have been expressed, for example, (a) that all the value added should be divided amongst the workers as 'they are the producers of all

income'. Alternatively, (b) the minimum possible should be given to the workers and the owners of capital should get the rest. This is because the owners are the ones who spend the money on capital, so they are entitled to get the maximum return from it.

Relevance of studying productivity and its limitations:

One can take labour productivity as value added per worker or value added per employee. (Employee includes workers and skilled labourers). In both cases usually some contributors to value added are left out. When one calculates labour productivity as value added per worker one is not including the skilled labour force in the denominators. Even when one defines labour productivity as Value Added per employee, often labour engaged in producing technological innovations, as for example such labour employed in governmental research organisations is not taken into account. In other words, what is being argued is that if the Value Added were distributed equally amongst all those who had contributed to it, the productivity figures would have been different. As it is, some of these contributors are left out in the calculation of productivity. However, as the numbers of such people are a small proportion of the total contributors to Value Added, the major proportion being the workers, the others can be ignored without affecting the results significantly.

Per capita income denotes how rich a region is, but labour productivity does not show how industrially rich a region is. That is because there may be a small number of highly productive industries in a region, but their total industrial Net Value Added may be modest. By contrast if the same region has many industries which are not highly productive but their total Value

Added is large; it will be rich industrially. Between regions, the industrial Value Added per unit total workforce has to be compared to see which is more rich industrially. In a region even if two industries generate equal value added it does not mean that they contribute equally to industrial development. This is because, due to lack of perfect competition in product and factor markets, one does not get a proper idea of what the Value Added of an industry is. For example production of electricity is a government monopoly and in India it is under priced. Moreover, some industries may themselves have less Value Added, but they may contribute tremendously to the growth of other industries. For example a steel plant could contribute a lot to the growth of other industries whereas a consumer goods industry might not contribute so much to growth. Finally, the whole picture of industrial well being of a country is determined not only by industrial Value Added per unit total workforce, but also by how fast this grows. However, labour productivity determines how rich, or efficient the given industries in a region are at a given time and although this is just part of the picture, it is this part the dissertation deals with.

Methodology used to calculate productivity and its limitations:

Deflation by the Wholesale Price Index of the Value Added of an industry describes correctly that Value Added in constant prices, i.e., it makes comparable over time the purchasing power of goods produced by a particular industry. However the price index of Value Added of an individual product may rise more slowly than the Wholesale Price Index, so that deflating the same by the Wholesale Price Index, will give an incorrect picture of the relative quantities of Value Added of a product produced in

different years. Suppose for example, that there is a technological change in the computer making industry such that production of computers doubles, while the price index of Value Added remains constant. Suppose also, that in the same period the Wholesale Price Index for all industries doubles. If the Value Added of computers is deflated by the Wholesale Price Index, the same Value Added at constant prices of both years, is obtained.

Thus, Value Added at constant prices does not show us the change in quantity of computers produced. To capture this change one should multiply the quantity of output of a product with base year prices of that output to get total revenue at base year prices; multiply the quantities of various raw materials required for making the product with their respective base year prices and add the result to get total cost at base year prices; and subtract the cost at base year prices from revenue at base year prices. Also, one should subtract depreciation, thereby getting net Value Added at base year prices.

Various states have different prices of raw materials and products. To make one unit of Value Added of a particular industry of a state have the same value as that of other states, it is necessary to take the base year prices of raw materials and output of all states to be the same, that is, to take national prices for all states.

An exercise involving various quantities of raw materials and products and their base year prices is beyond the scope of this thesis. Instead the assumption is made, that the prices of various raw materials and their produce are the same in all states as the national prices given, and the Value Added of

different industries is deflated by their corresponding Wholesale Price Index. As mentioned above, this method of deflation is inaccurate for several reasons. In the first place raw materials price rise is the major factor determining the Wholesale Price Index of an industry, because in manufacturing, generally seven eighth of the value of output is the raw materials cost. Therefore the price rise of raw materials has much greater weightage than the Value Added price rise for determining the overall Wholesale Price Index. Thus, instead of getting an idea of the quantities produced as Value Added, one gets an idea of how much of the output of an industry can be bought by the Value Added of the same industry. This constitutes one limitation of the methodology. Secondly, wholesale price indices are constructed using Laspeyer's method whereas the index referred to earlier is a Paasche Index. Finally, the Wholesale Price Index is inclusive of excise and other indirect taxes, and this factor should not have been taken into account, because it distorts the estimates of Value Added of different industries covered.

Certain other clarifications are also in order. Perfect competition does not occur in any industry. Different industries have various degrees of competition in factor and product markets which is also reflected in the industries' productivity levels. Ideally deviations in productivity caused by differing degrees of competition in factor and product markets, should not be considered. However these are considered, since it is difficult to calculate these deviations. It should also be noted that had a different year been taken as the base year, the figures for comparison between industries, would have been different. For

example, an industry 'A', in 1970 might show greater productivity than industry B with 1965 as the base year. However if 1950 had been taken as the base year, productivity of industry A in 1970 might have been less than industry B. However the trends of productivity, within an industry and between industries over the years would be the same. It must also be mentioned that differences in quality of the produce have been ignored, which gives an inaccurate picture. For example, if a factory produced inferior quality cotton cloth earlier but now produces the same amount of superior quality cotton cloth, the resulting price rise is considered to be due to inflation only, whereas actually part of the price rise is due to quality change. Similarly difference in the quality of produce of different industries have been ignored. All these constitute limitations in the present study.

CHAPTER TWO

REVIEW OF LITERATURE

This chapter falls into two main parts, corresponding to the two broad themes examined in literature on the subject. The first is wages and productivity, which includes (a) the manner in which wages and productivity have been linked, and (b) studies on trends in real labour productivity, real wages and similar studies. A second stream of studies examines growth rates of labour and total factor productivities. This group includes (a) studies of growth rates of labour and total factor productivities, (b) investigations into factors affecting productivity, how they do so, and some examples where productivity is affected by particular factors, and (c) specific empirical studies showing the relationship between certain causes of productivity and productivity itself. These two classes of works are dealt with, in greater detail, below.

Wages And Productivity:

In general, wages are related to prices or the cost of living on the one hand, and productivity of the workers on the other. Wages are also influenced by customs of the country, external influences and demonstration effects.

Shivamaggi et al (1968), note that under stable prices, an increase in wages leads to growth especially when (as in India) the existing level of wages is below minimum needs. The reason for this is that workers 'efficiency is raised through improved living conditions. At the same time however, the profits ploughed back into investment must contract due to wage increases, and this may adversely affect productivity. If the

gain due to increased efficiency, outweighs the loss due to decreased investment there may be an overall net gain in productivity. On the other hand an excessive rise in wages in relation to the increase in productivity tends to push up costs and through it, prices.

After the second world war, in Western Europe and the United States, national production or industrial product rose substantially by roughly four percent per annum. Since the rate of growth of the population and the labour force was small, say one per cent per year in West European countries, productivity per worker kept on rising substantially at the rate of about 3% per year. Simultaneously the cost of living rose by about 1% per year, and labour demanded higher wage increases. Thus in Western Europe and the United States, wages got linked up more closely to productivity than to the cost of living. The picture in India has been different. The national product has risen by less than 3.5 % per year. Industrial production has risen by about 5% per annum and population has grown at approximately 2.5% per year.

Pramod Verma (1972), in his article on wage determination in Indian manufacturing, found that in multiple regressions with money wages, productivity is a significant variable in the operation of the wage system in the industrial sector. The consumer price index and trade union membership were also significant explanatory variables in this regression. Capital intensity had a positive influence on money wages, but the relationship was not statistically significant. In a bivariate regression capital intensity as well as labour productivity were highly significant. He also found that real wages and real productivity are positively correlated.

Tulpule and Dutta, in a point to point comparison of real wages in manufacturing in 1960 and 1983 derived an average rate of increase of 1.8% whereas value added in manufacturing per worker year grew at the rate of 3.9%. In the same period a three year average shows that wages increased at 1.5% and the value of production per worker at 3.6% i.e. productivity per worker rose faster than real earnings. According to them, labour productivity and fixed assets per employee are both positively correlated with the real wages of workers. (Correlation coefficients were .81 and .89 respectively).

In a later article, they took 8 industries: - sugar, cotton, textile, paper and paper products, petroleum refining, cement, leather, iron and steel, and coal mining. They found that the relation between value added in manufacturing (VAM) per worker at constant prices and real wages again failed to show any consistent pattern. By and large real wages in these industries seem to have risen more than VAM per worker except in sugar where the rise in both is more or less the same, and in leather and tanneries in which the increase in real wages has lagged far behind the increase in VAM per worker. The reasons given for the erratic behaviour is the same for both articles. The reasons are: the proportion of capacity being utilized, the relative movements of prices of inputs and outputs, the rate of wage increase, the effects of administered prices, and the volume of employment. These and other factors play an important part in determining labour productivity in value and physical terms and its relation to real wages.

From 1967-84 they found that VAM per worker at constant prices fell for paper and petroleum refining, although for the

former physical production per worker had risen slightly. For the other five industries in the factory sector VAM per worker at 1970 prices rose although in cotton textiles and iron and steel physical production per worker fell, only marginally so in the latter.

Shivamaggi et al in 1968 took data from CMI and ASI on quantities of gross output and materials and fuels consumed with their values. From this they worked out for 1961 values of one unit of various products manufactured by an industry and materials and fuels consumed by it. The difference between the gross value of output and value of inputs as calculated above is VA in real terms but gross of depreciation. To calculate depreciation, they divided estimated value of gross fixed assets at constant prices, by the average life of fixed assets as revealed by the data on company finances (published by RBI) for each of the seven selected industries. However they are doubtful of the reliability of these estimates, so they analysed data on indices of productivity gross of depreciation.

The seven industries they covered were cotton textiles, jute textiles, iron and steel, cement, paper and paper boards, chemicals and chemical products and sugar. Some of their conclusions were: first, that the rise in real wages, overall and industry wise, lagged behind improvements in labour productivity. This is in contrast to Tulpule and Dutta's findings which showed exactly the opposite, although the years analysed were different. Secondly, the relatively greater rise in labour productivity may be partly associated with the increase in fixed capital per unit of labour and improvements in management techniques.

While Shivamaggi et al (1968), found that the rise in real wages, overall and industry-wise, generally lagged behind the improvement in labour productivity, A.M. Kadak (1986) found that there was no positive association between net wage rate and labour productivity. He also noted that the increase in the wage rate was less than the increase in labour productivity. Thus the tendency for increases in labour productivity to outpace wage increases seems to be a phenomenon characteristic of widely separated periods in India's industrial development.

A recent study of growth rates of labour and total factor productivity is that of Isher Ahluwalia (1991) who has calculated partial and total factor productivity growth rates (TFPG) for the period 1960-61 to 1986-87. While conceding that the quality, classification and coverage in various countries varies, so that it is difficult to make comparisons between them, she thinks that comparisons have some validity. They showed that the growth of TFP in India was poor as compared to other countries. In fact, of the fifteen developing economies for which growth estimates were available, India's performance was one of the lowest, although China and Yugoslavia performed only slightly better. She quotes Chenery, Robinson and Syrquin (1986), who had found that TFPG caused 50% of the total growth of developed countries whereas it caused only 31% of the total growth of developing countries. Pack has pointed out that this was due in a large extent to the faster growth of factor inputs in developing than developed economies. Absolute growth of TFP was 2.7% for the developed countries as compared to 2% for the developing countries. From 1959-60 to 1985-86 India had a negligible growth in TFP of -0.4% per annum. In this period

value added grew by 5.3%, capital by 8% and employment by 3% per annum. Value added grew because of growth in factor inputs, but their efficiency declined slightly over this period.

Some of the industries with the greatest TFPGs were high technology industries like equipment for electricity generation and telecommunications. Industries like boilers, furniture and fixtures, motorcycles and bicycles, matches, etc., also had a good TFPG of 2-3% per annum during this period.(1959-60 to 1985-86). Industries with the highest share in value added, generally had low TFPG. Among these cotton textiles and iron and steel were prominent. The industries with low shares in value added had either the highest or lowest growth of TFP. The highest TFPGs were positive figures ranging between 3.4 and 4.4%. The lowest TFPGs were negative figures ranging from -3.7 to -7.3%. The former, as has already been mentioned included equipment for electricity generation and telecommunications. The later included non-ferrous metals, petroleum and coal products.

Isher Ahluwalia also studied trends in labour productivity. She notes that when the capital-labour ratio is increasing over time, partial productivity analysis exaggerates the increase in labour productivity and understates the increase in capital productivity. In this period she found a sharp increase in capital intensity, falling capital productivity and moderately rising labour productivity. However in the earlier years of the eighties she found a strong growth of labour productivity. The rate of growth of labour productivity in manufacturing was 2.2 per cent per annum, while capital per unit of labour increased at the rate of 4.9 per cent per annum and capital productivity decreased at the rate of 2.5 per cent per annum.

For almost all of the 63 industries she took, capital intensity showed a strong and significant upward growth. While capital intensity increased for almost all industries, labour productivity showed significant positive growth for fewer industries accounting for 64 per cent of the value added in manufacturing. There were a few industries in which labour productivity declined, for example sugar, non-ferrous basic metals, and tyres and tubes. Iron and steel, food manufacturing and jute textile industry had almost the same labour productivity throughout. Watches and clocks with 7.1%, photographic and opticals goods with 7%,fertilisers and insecticides with 6.3% showed the highest growth rates of labour productivity, followed by equipment for electricity generation at 6.1%, telecommunications at 5.9% general items of machinery at 5.3%, and boilers and internal combustion engines at 5.1%. Their share in value added is respectively 0.14%, 0.09%, 2.48%, 2.21%, 1%, 1.62% and 1.42%. Non-ferrous metals at -3% and petroleum and coal products at -2.7% showed the lowest labour productivity growth rates. Their share in value added was 2.19% and 2.02% respectively. No definite pattern can be seen between share in value added and labour productivity growth of industries.

Isher Ahluwalia had divided the industries into use-based sectors namely, capital-goods, consumer durables, consumer non-durables, and intermediate goods sectors. She has not taken the basic goods sector, but has included the non-mining, non-electricity part of the basic goods, for example iron and steel, non-ferrous metals etc. with the intermediate goods. Intermediate goods recorded the largest share in value added in manufacturing of 36-38%. Some of the industries this group

includes are, iron and steel, cotton spinning, fertilizers, and non-ferrous metals. Consumer non-durables had a share of 35% in value added. This group includes cotton weaving, food manufacturing, sugar, and pharmaceutical industries. The capital goods sector had a share of 17-20%. This group comprises machinery and equipment. Consumer durables had a share of 3-5%. Motor cycles and bicycles, motor cars, commercial and household equipment etc, are some of the industries included in this group. Intermediate goods and consumer non-durables which have claimed the highest share in value added also have shown the lowest growth of labour productivities of 1.8 and 1.7% respectively. The capital goods sector has had the highest growth in labour productivity of 4.3%, whereas consumer durables with the lowest share in value added had almost the same growth rate (4%).

Ahluwalia divided the period 1960-61 to 1985-86 into three periods on the basis of growth in value added. The first period is the first half of the sixties which was a period of rapid growth due to a lot of investment in heavy industries and policies of import substitution. The manufacturing sector grew at a rate of 9% per annum. This was the peak of the Mahalanobis phase. The second period identified was from 1965-66 to 1979-80. It may be noted that this includes the decade from the mid sixties to the mid seventies which is well known as the period of industrial stagnation. Various authors have different views of when the 'turnaround' took place in the period 1975-76 to 1980-81. This 'turnaround' is the line separating the period of stagnation from a later period of improved total factor productivity growth. Isher Ahluwalia thinks that 1980-81 is the point at which TFP as well as value added show a high growth.

Thus she includes this period of 1975-76 to 1980-81 in the industrial stagnation period, which she defines as the period 1965-66 to 1979-80. The reasons for the stagnation were given as a higher than expected import-intensity of industrialisation, gaps in the planning for public sector and other factors such as two consecutive agricultural droughts, decrease in foreign aid, and the war with Pakistan.

The third period covers the year 1980-81 to 1985-86. This period shows a higher growth, but it is interesting to note that while the growth in the first half of the sixties was due to high rates of growth of factor inputs and poor total factor productivity growth, the growth in the recent period was due to good TFP growth. In this period, there was a moderate growth of investment, a decrease in employment and strong total factor productivity growth. In the stagnation period, while the growth of capital stock declined along with a decline in growth of value added, the growth rate of employment did not show a corresponding decline. The productivity of the manufacturing sector showed a poor performance in the first two sub-periods, and a substantial improvement in the third period not only for TFP but also for capital and labour productivities.

Several factors have been identified as contributing to the turnaround. One of the most important is infrastructure. The critical importance of public investment in India has been that it has the sole responsibility for the development of the infrastructure sectors, which are crucial for the development of the economy at its present stage. It has also been the a major means for generating demand for capital goods. Isher Ahluwalia points out that the evidence shows that there was a slowdown of

investment in the public sector and the brunt of it was borne by the infrastructure sectors. The mid sixties to the mid seventies was the worst decade in this respect. In the second half of the seventies there was some improvement in the growth of infrastructure investment although public investment showed little pick-up. During the third period there was a more rapid growth rate of infrastructure investment. With the revival of investment in infrastructure there was a corresponding improvement in the efficiency.

Ahluwalia(1985) demonstrated that during the industrial stagnation period there was not much basis for the argument that the growth of wage goods was a retarding factor on the growth of the industrial sector. Moreover the slowdown of growth rates for commercial crops held back the growth of agro-based industries only to a limited extent. What happened was that the slow growth of agricultural incomes per capita led to a slow expansion of demand for consumer goods and this slowed down the growth of consumer goods production. In the eighties also she concludes that, as in the past, the agricultural drag on industrial growth was not due to a wage constraint. However she argues that the slow growth of agricultural incomes per capita caused an agricultural push to be absent in this period. The Indian government policy was also a factor determining the timing of the turnaround. With time vested interests became more and more entrenched and the policy instruments became increasingly regulatory and discretionary, and decreasingly effective. Due to this, policy reorientation was started in the late seventies and it gained momentum in the eighties. The most important changes have been to reduce domestic barriers to entry and

expansion, to make domestic industry more competitive, to simplify the procedures, to make technology and intermediate material imports more readily available, and to provide more flexibility in the use of installed capacity so that supply can change more easily in response to changes in demand. Large business houses have been allowed to have a greater role in industrial development. Policies have also been made with the aim of increasing modernization of capital stock in Indian industry.

Isher Ahluwalia has examined whether specified factors explain inter-industry differences in TFPG. However, she first explains the reasons why she expects these factors to explain the differences. One of the explanatory factors she takes is value added. Verdoorn(1949) had pointed out a positive relationship between the growth in labour productivity and the growth in output. Kaldor(1967) said that this relationship was most prominent in manufacturing and was largely due to scale economies. Kaldor also argued that the scale economies arise not only due to the expansion of a single industry, but also from a general industrial expansion. One can expect the growth of productivity (TFP or labour productivity) to be positively linked to growth in output or value added of that industry. This is because the faster an industry grows, the more opportunities it has to exploit economies of scale. Also, where there is excess capacity, the expansion in level of operations allows such capacity to be used.

Another variable Ahluwalia took was the degree of import substitution. Import substitution, through both physical control of imports and tariff protection causes domestic demand to increase. This enables industry to expand, to exploit economies

of scale, and thus improve productivity. However the protection of domestic industry due to import substitution has a negative impact because it prevents the introduction of new products and methods, and lowers the incentive to reduce costs and improve productivity. Also since imported inputs embody new technologies not available to the domestic producers, so restricting these imports will decrease the speed of productivity growth.

Other factors she has taken into account are, capital intensity, growth in the number of factories, and a scale variable measured as size of capital stock per factory. She has used these factors to explain inter-industry variations in TFPG. Ordinary Least Squares Regressions were calculated using cross-section data from 1959-60 to 1979-80 for 62 industry groups covering most of the manufacturing sector. She obtained the following results in an equation that included all of these factors together. First, growth in value added had a positive and statistically significant impact on productivity growth. The elasticity of TFP with respect to value added was 0.42. Import substitution had a small negative influence of -0.027, and capital intensity that of -2.14. Both coefficients were significantly different from zero. The growth of factories of an industry was negatively related to TFPG. Ahluwalia thinks that this may be due to fragmentation resulting from the policies of protection of the small scale sector. The scale coefficient showed a positive sign, but was not significantly different from zero. When she divided the whole period into two periods from 1959-60 to 1979-80 and 1980-81 to 1985-86, she found that the coefficient in the second period of growth in value added was statistically different from that in the first period. The

elasticity of TFP with respect to value added in the eighties was more than twice as high as that in the first period. Thus in the early eighties the effect of a growth in value added on TFPG was much higher than in the earlier period.

She studied the four use-based industries in each of these three periods.

The first period (1960-61 to 1965-66) showed the following trends. As pointed out earlier, TFP growth during this period was negligible, while the capital-labour ratio showed a substantial increase. While the investments were highest in both the capital and intermediate goods, growth in value added in the intermediate good sector was slower. Consumer goods grew at a much slower rate, which was in tune with the strategy of sacrificing a little in the short run to gain more in the long run. Within this group however, consumer durables had a high growth in value added, capital and employment, while consumer non-durables which form a larger portion of consumer goods was the slowest growing sector. The growth of employment in the consumer non-durable sector was also extremely poor. She thinks that this may be due to some data problems in the early years of the period. The TFP growth in the intermediate goods sector (the largest sub-sector of manufacturing in the use based classification) was the worst of -1% per annum, although its value added grew at 11% per annum. The growth of capital intensity in this sector was the maximum of 9.9% per annum, while labour productivity grew only at the rate of 4.4% per annum. The consumer non-durables sector was the only slow growing sector during this period, and it showed negligible growth in TFP, but a good growth rate of labour productivity of 4.2%. Capital goods

showed a decent growth rate of TFP 2.7%, and a high growth of labour productivity of 6.2%. Consumer durables had a growth of TFP of 2.6%, and a growth of labour productivity of 4.8%.

The study of the second period (1965-66 to 1979-80) revealed the following trends. First of all, growth in value added and capital was slower than that in the first period. Heavy industries, that is capital and intermediate goods industries showed the least growth as compared to the first period. The growth in consumer durables in value added and capital stock also slowed down a little, but still maintained a high growth rate. Consumer non-durables, which had a slow growth rate in the first period, experienced slow growth in the second period also. However its growth in the second period was not much different from that in the first period. The slowdown in employment growth in this period was not very great because of the employment growth in the consumer non-durables sector which generated the maximum employment in manufacturing. TFP remained at almost the same low level in the second period as in the first. TFP growth in manufacturing and in heavy industries remained negligible in the second period, while capital and consumer goods sectors continued to perform comparatively better than the other industries during this period. The capital goods sector had the highest growth rate of TFP of 1.7-2.8% during this period. Manufacturing and all its use-based sectors other than consumer durables showed a significant slowdown in capital intensity , and labour productivity slowed down in all the use-based sectors. Isher Ahluwalia found that value added grew at a lesser rate in this period as compared to the other periods because capital

accumulation had slowed down, and inefficiency in factor use in the first period showed its influence in this period.

The third period (1980-81 to 1985-86) was characterised by the following trends. As mentioned earlier, this period recorded high growth in value added due to a good TFP growth. Consumer non-durables grew in value added at a rate of 7.6% per annum. Consumer durables however experienced an even faster pick up in the growth rate of value added. Amongst all the use-based sectors the two consumer goods sectors showed the maximum increase in the growth rates in this period when compared to the growth rates in the first period. TFP grew at a better rate in this period in all the use-based sectors, although the improvement is not statistically significant for capital goods. The manufacturing sector as a whole, had a TFP growth of 3.4%, while the labour productivity grew at a rate of 8.3% per annum during this period.

The most striking difference in this period was that capital productivity was no longer decreasing. Due to the strong acceleration in capital intensity, in this period, labour productivity also accelerated strongly. Both the intermediate goods and the consumer non-durable goods sectors showed a good acceleration in TFPGs. The consumer non-durables sector had a TFPG of 5.2%, which was the second fastest growth rate. The fastest TFPG of 6.6% took place in the consumer durables sector. Their labour productivities also grew at the most rapid rates of 10.9 and 11.5% respectively. The TFPG of the capital goods sector accelerated from 1.7 to 3.4% per annum, but this acceleration was not statistically significant. The labour productivity of the capital goods sector was 7.4%, and that of the intermediate goods

was 5.6% per annum. Ahluwalia pointed out that given the increase in capital intensity, consumer non-durables showed a much slower increase in labour productivity than consumer durables. She noted that along with the acceleration in the growth rate of TFP, labour, and capital productivity, there was no corresponding acceleration in growth of factor inputs, and whatever pick-up in growth took place, it was in the capital stock, and was concentrated in the consumer goods sectors, especially consumer non-durables. Employment declined in this period for the manufacturing sector as a whole at 0.7% per annum. Consumer non-durables showed a decrease in employment at 3% per annum. The intermediate goods sector showed a considerable slow-down in the employment growth in this period.

Tulpule and Dutta's study for the period from 1967-84 overlaps the years covered by the Ahluwalia study. They found that VAM per worker at constant prices fell for paper and petroleum refining, although for the former physical production per worker rose slightly. For the other five industries in the factory sector VAM per worker at 1970 prices rose although in cotton textiles and iron and steal physical production per worker fell, only marginally so in the latter".

Shivamaggi et al studied labour productivity for seven industries for a much earlier period, between 1951 and 1961. They found that the increase in labour productivity between 1951 and 1961 (66%) was considerably greater than the increase in real wages (28%). They feel that the labour productivity increase could not have been so great, had there not been a substantial increase in the capital labour ratio during this period as reflected in the rise in the index of fixed capital per man-hour

worked (85%). Between 1951 and 1956, labour productivity showed an increase of 17%. Between 1956 & 1961 the increase in productivity was of the order of 42%. The bulk of the increase in fixed capital employed per man-hour worked took place in the period after 1956, reflecting the major new investments made during the second plan period. Most of the investment was in capital intensive industries including iron & steel. These industries were characterized by long gestation periods. If the gestation periods had been shorter, the rise in productivity during 1956-61 would have been much higher. There was also an improvement in the quality of products.

The comparison of the performance of the seven industries in the period 1951-61, is shown in table 2.1. It is seen that three industries enjoyed growth rates of productivity exceeding 100%, whereas the other four had growth rates of less than 50%. The former industries were cement, chemicals and chemical products and paper and paper boards. Cement had the maximum rate of growth of 199%, followed by chemicals and chemical products at 120% and then by paper and paper boards at more than 100%. The latter category consisted of cotton textiles, jute textiles, iron and steel and sugar. The sugar industry had the lowest growth rate of 29%. When the period 1951-61 is divided into the two plan periods, that is from 1951-56 (first plan), and 1956-61 (second plan), it can be seen that in general, the second period exhibited greater growth rates than the first period. The sugar industry is one exception which had a growth rate of only 2% in the second period as compared to a growth rate of 26% in the first period. Another exception was the cement industry which showed a growth rate of 71% in second period as compared to 75%

in the first period. It is interesting to note that the paper and paper boards industry, showed a higher growth rate in the second period with 75% than the cement industry in the same period with 71%. This is despite the fact that productivity in the cement industry grew at almost twice the rate as the paper and paper boards industry, in the entire period of 1951-61.

Shivamaggi et al also looked into the industry wise trends of productivity gross of depreciation. He found that between 1951 and 1961 the rise in productivity was 45%. During the first plan period the increase in productivity was 7%. The increase in productivity was as high as 36% during the latter half of this period (1956-61).

In jute textiles there was an increase in labour productivity of 42% between 1951-61. Real wages rose by 10% and productivity by 37% during the period 1951-56. During the period 1956-60, there was a fall in real wages, as well as in productivity. This was due to shortages of raw jute and power supply.

The trend in the paper and paper board industry, for which the gain in productivity was even more than 100% between 1951 and 1961, accelerated in the second half of this decade. There was an increase in productivity of 34% during the period 1951-56; between 1956 and 1961 labour productivity increased by 75%.

In the sugar industry the increase in productivity was comparatively low i.e. about 29% and there was increase in productivity of 26% during the period of 1951 to 1956. During 1956-61 the increase in productivity was only 2% and there was a steady increase in productivity between 1959-61 of 61%. This was partly due to various incentive measures introduced by the

government and the establishment of sugar factories in areas where quality sugarcane giving high recovery was grown.

In the cement industry labour productivity was found to have risen by 199% between 1951 and 1961. There was a 75% increase in productivity during the period 1951-56 and between 1956 and 1961 it was nearly 71%.

In chemicals and chemical products, there was a steep rise of 128% in productivity between 1951-61, while in iron and steel labour productivity rose by 32% between the 1951 and 1961. However, the productivity fell over the period of 1956-60.

Considering seven industries together, Shivamaggi et al found that the productivity net of depreciation was broadly the same as productivity gross of depreciation with only a slight difference. During the period 1951-61 the productivity net of depreciation recorded a rise of 62% as compared to an increase of 66% in productivity gross of depreciation.

There was also not much difference between the trends of productivity gross of depreciation and that net of depreciation. On the contrary, there is a considerable depreciation deduction in the base year on the basis of replacement cost in 1961 prices. This leads to lower productivity in the base year and as a corollary, a higher productivity index for 1961. Thus between 1951 and 1961, labour productivity net of depreciation had a larger rise as compared to productivity gross of depreciation in the case of paper and paper products and cement industries. There is not any significant difference in productivity in the case of the cotton and jute textiles, sugar and chemicals. In the case of the iron and steel industry, labour productivity net

of depreciation showed a fall since 1959, indicating higher replacement in recent years.

Factors affecting productivity:

A number of scholars have studied the factors affecting productivity, how they do so, and some examples of productivity being affected by various factors have been described. These factors include those affecting the quality of labour and the adoption of better technology and the substitution of capital for labour.

An important factor influencing productivity is the quantity and quality of labour, both skilled and unskilled, actually used in the production process. Tiwari and Trivedi (1975), wrote that the labour force coming from the villages works in industry generally on a seasonal basis. This is no longer true today. This caused a large labour turnover in the cotton textiles at that time. Due to this, continued replacement of workers became necessary, and as a result efficiency and productivity were low. Procuring sufficient and stable labour force for the factory was a difficult task mainly because textile workers were forced to go to their villages in order to supplement the meagre income from factories through other sources like agriculture. As said earlier, this is no longer true today, because the majority of the urban industrial work force resides permanently in the cities.

Productivity is also affected by illiteracy and low educational standards in two ways : by decreasing the supply of educated labour force and by decreasing the ability of workers to follow instructions and learn new ways of doing things. Moreover, certain social values are unfavorable to productivity.

Rigid caste systems, for example reduce economic incentives because some workers have pre-determined notions that they cannot rise out of the caste they originally belonged to.

Recruitment through traditional agencies like relations and friends still dominate and employment exchanges perform a minor role. This also reduces the quality of labour. It is generally accepted that job training is costly, insufficient and of haphazard character. This is because almost all the workers learn their jobs within the mills and are not given training through training courses.

According to Kendrick (1956) in industries in which capital has been substituted for labour at a relatively high rate productivity has also advanced more rapidly. In most underdeveloped countries the low real income is due to low productivity which in turn is largely due to the lack of capital resulting from a small capacity to save. Underdeveloped countries are more efficient in producing consumer goods rather than capital goods; secondly its scarcity is also felt because of greater wastage of capital resulting from the fact that capital goods are not handled carefully.

Shivamaggi et al (1968) think that the larger rise in labour productivity over the period between 1951 and 1961 may be associated partly with the increase in fixed capital per unit of labour and improvement in management techniques. This was particularly true of cement, paper manufacturing and chemical industries. They note that in the iron and steel industry, although capital/labour ratio was fairly high, the increase in productivity was relatively small owing to the high levels of

productivity already achieved in the base year and the long gestation period in the new units of this industry.

Another factor determining the level of productivity is the use of technology which lends to greater improvements in output per worker. S.B. Sarkar (1961) quotes Dutta who says that in underdeveloped countries the scarcity of skill and technical knowledge is more widespread than the scarcity of capital. This is also one of the reasons for low productivity, although Galenson thinks this is a transitory problem and resolves itself once economic development gets under way. Shivamaggi et al have found that the cotton textile industry also showed an improvement in labour productivity, particularly after the end of the First Plan period which is partly due to the steps taken towards modernisation of machinery. They pointed out that, the major portion of improvement in productivity in the jute industry took place in the First Plan period itself. Apart from shortage of raw jute supplies, the trend during the later period may also have been an indication that the process of modernisation was not yet completed in that industry. However, one should note that capital and technology are very closely related; in fact improved technology is incorporated in new equipment.

Inefficiency, including losses arising out of under utilised labour and equipment, also reduces productivity. A.K. Bose (1961), writes that industrial processes in less developed countries tend to be labour intensive when compared to other countries, especially West Germany, U.S.A., and U.K. According to him it is more expensive to keep one machine hour idle as compared to one man hour in India. It is the opposite in West Germeny and U.S.A. He believes that considerable loss takes

place due to absenteeism of operatives, machine breakdown, power failure, avoidable idle time because of bad coordination between machines, uses of improper tools, tool breakages etc. He also argues that the amount of actual hours of work done is less than the number of hours spent, that is, workers may perform about three hours of work in an eight hour workday. The work force hired is also often too large due to incorrect estimates of the number of men required. Shivamaggi et al found that part of the improvement in productivity in the cotton textile industry, particularly after the end of the First Plan period was also due to the steps taken towards a fuller utilization of capacity. The implementation of the Factories Act which deals with working conditions, wages, labour welfare, social security and industrial relations also influences productivity.

There is yet another strand in the literature which deals with the impact of incentives on labour productivity. One can have economic and non-economic incentives for higher production; and economic incentives may be direct or indirect. Direct economic incentives such as piece wages give quicker results than indirect forms such as promotion to efficient workers, attendance bonus, profit sharing bonus etc. Non-economic incentives include working conditions, interest in the work itself, a sense of order and responsibility and perhaps the desire for status and respect amongst the group with whom one lives and works and labour emulation. Improvement in working conditions may increase productivity. For example Tewari and Trivedi (1975) write that temperature and humidity in the loomsheds affect not only the comfort of workers but also the quantity produced. The higher the temperature, the higher would be the breakages of yarn

leading to low production and low productivity. It is believed that if incentive payments cause a large increase in the index of industrial production the cost of doing this will be more than covered. According to an ILO publication, "the chief advantage of payment by results is that, when well designed and properly applied, it can generally be relied upon to yield increased output, lower cost of production and higher earnings for the workers". However the ILO itself mentions that good relations should already exist between the employers and the workers for this to work. This payment must however immediately be given on achievement of results so that their living standards increase due to their contribution. V.V. Reddy (1961) writes that labour emulation is one method of increasing labour productivity by combining modern science and technology with the conscious and voluntary association of the workers at all levels of production. This method was tried and successfully developed in the U.S.S.R. during the 1920s with good results. However, this method was not successful in later years, perhaps because the excitement of it subsided. At that time, factory managements were directed to cooperate with the trade unions in organizing 'production conferences' regularly in every industry where current issues of industrial life were discussed and suggestions made for improving the daily work. A scale of bonuses was introduced for the proposals and innovations according to degree of economies they brought about. In 1926, in the metal industry of Leningrad alone, the application of one-quarter of the suggestions is reported to have led to economies of more than 450,000 roubles a year.

During the First Five Year Plan 1928-32, shock brigades were formed to set an example of good production. Shock brigading usually was due to friendly competition within the brigade, or between different brigades. Another form was the throwing of friendly challenges at each other. One form of emulation was 'social tug' where a successful business would help a less successful one. Coordination of several shock brigades, from the designing office to the assembly office, was called 'chain brigading'. This increased the efficiency in the manufacture of advanced machinery. Groups were formed, which analyzed possibilities of cost-efficient technical programmes. They tried to raise both the quantity and quality of product by using the method of "rouble-control" on the work of each worker. As Adam Smith pointed out around 200 years ago, specialization in different jobs by different people increases production greatly. This concept was put into practice in the U.S.S.R. by organizing groups of 'Stakhanovites' in various factories. 'Stakhanovites' were workers who had established new records for production. This movement was named after a miner, who had cut 102 tonnes of coal, while the prescribed quota was 7 tonnes. This record was due to re-arrangement of the jobs of an entire group of miners so that each was employed at his own specialty, and thus the coal-cutting machinery was utilized to its full capacity. Due to the war 1300 factories had to be shifted from the west to the east in the Soviet Union, and re-located on new sites, as soon as possible. In spite of a very difficult situation factories shifted to the east began production at their new sites 3-4 weeks after their arrival, and within 2-3 months were working at their full capacity. This speed would not have

been possible without high labour emulation. The drive for technical progress was one way labour emulation yielded very good results.

In India, it was realized in the Second Five Year Plan, that workers should be closely associated with production, and it was recommended that councils of management consisting of representatives of employers and employees should be set up. Some such councils were set up at the Hindustan Machine Tools and Hindustan Insecticides, and a few businesses in the private sector around 1960. These councils were however, restricted to joint consultations at the top, and the workers by and large were passive. It has been suggested that broad-based participation both from above and below should be there. However such a situation is far from being realized even today.

In brief it can be said that labour can contribute by: (i) integrity and honesty of their leaders, (ii) a positive trade Union's wage policy which is linked to productivity, (iii) a reasonable attitude of workers towards rationalization and mechanization, (iv) their outlook towards strike and their willingness to discuss issues with employers, (v) having an understanding with the government and employers on their share of the rise in productivity, and (vi) development of democratic unions with no immediate political aims or guidance from political parties.

Other studies focus on the role of management - the force that guides, organizes and gives direction to cooperative human effort. Methods of management which influence productivity include 'rationalization'. One method of rationalisation is automation that involves reduction in work force. This method

is not welcomed by many labour leaders, and may cause unrest and consequent decrease in productivity. Work study is another method. By studying the most effective use of existing or proposed plants, the most effective use of human effort and a reasonable work load for those employed one can increase labour productivity. Other management efforts may be aimed at convincing people of their genuine interest in them. These include the supply of good quality products at reasonable prices, being considerate of legitimate consumer interests, having welfare measures for employees and their dependents, and participation in social and cultural life of the community.

Finally, the government has a duty towards the people to increase productivity. It also has the means to do this. Among other things the government can: (i) make laws relating to industries commerce and labour, and organisations to deal with the same, (ii) formulate a policy towards management and labour, (iii) introduce fiscal and monetary measures to provide incentives for higher productivity, (iv) collect data relating to productivity, (v) take care of education and research and, (vi) create a body for labour, management, and other interested parties, to come together and discuss issues.

Specific Empirical Studies Showing The Relationship Between Certain Causes Of Productivity And Productivity Itself:

Several scholars have undertaken studies to determine what factors influence productivity and in what way. Moneer Alam (1977) analyses the role of non-production workers in productivity (value added per worker) in Indian manufacturing industries. He took sixteen manufacturing industries for this study. He believes that occupational composition of workforce is

a better indicator of the quality of labour as compared to the educational level. He suggests that the nature of the job and capital employed gives us the role of technology. He considers the ratio of non-production workers to total workers as a proxy for the occupational mix. He justifies the adoption of this measure on the grounds that: firstly, the use of new technology is dependent on the availability of skilled labour, and secondly, if one assumes a relationship between fixed capital and highly skilled manpower, it means that given any change in quality or quantity of capital there would be a corresponding change in the proportion of non-production workers. Thirdly, since improvement in technology also depends on spending on research and development, which in turn may be determined by the employment of say scientists, the given ratio is important for understanding changes in productivity. The Alam model merits elaboration.

MONEER ALAM MODEL:

O/L= F(L'/L, K/L) EQN-1

O/L= F(L1/L, K/L) EQN-2

O/L= F(L2/L, K/L) EQN-3

O/L= F(L1/L, L2/L, K/L) EQN-4 where:

O/L = Value added per worker in industries in question;

L'/L= Ratio of 0 to 3 categories of non-production workers to total workers;

K/L = Capital per unit of worker;

L1/L= Ratio of 0 and 1 category of non-production workers to total workers; and

L2/L= Ratio of 2 and 3 category of non-production workers to total workers;

Categories of Non-Production Workers:

0= Professional, Technical and Related Workers;

1= Administrative, Executive and Managerial Workers;

2= Clerical and Related Workers; and

3= Sales Workers.

The main results of the exercise are outlined below. First, his linear functional form gave better results than the log-linear form. The results of the linear form are given below:

Equation 1: This combines all the four non production worker categories. The coefficient of non-production workers is positive, and the results are significant. Thus, productivity increases with the increase in the proportion of these workers.

Equation 2: In this equation, he uses L1, which includes category 0 and 1 of workers. The coefficient is positive and significant at 5% level. The level of significance shows that this is a better specification of the relationship than that in equation 1.

Equation 3: This equation groups together category 2 and 3 of workers. The coefficient is positive but is significant only at the 10% level. He suggests that the low level of significance may be due to excessive employment of these categories of workers.

Equation 4: In this equation he uses L1 which includes category 0-1, and L2 which covers category 2-3 of workers. The result of this equation confirms that the clerical and sales workers do not make any significant contribution to output. However,tests revealed a high correlation between the two categories (0-1 and 2-3) of non-production workers. Thus the significance of the results and its sign are likely to have been spoiled due to multi-collinearity.

Muthukrishnan et-al have analysed the effect of financial and other incentives on productivity. For this purpose, the indices they used were:

$$\text{Financial Incentives Index} = \frac{\text{Total money earnings of the workers covered under incentive scheme}}{\text{Total money earning- incentive earnings}}$$

$$\text{Industrial Disputes Index} = \frac{\text{Total mandays - Mandays lost due to industrial disputes}}{\text{Total mandays available}}$$

$$\text{Supervisory Control} = \frac{\text{No. of first line supervisors in a plant}}{\text{No. of workmen}}$$

$$\text{Accident Rate} = \frac{\text{Total mandays available}}{\text{Total mandays available- Mandays lost due to accidents}}$$

$$\text{Labour Turnover Rate} = \frac{\text{Total separation per month + Total accession per month}}{\text{Average No. on payroll per month}}$$

$$\text{Training Index} = \frac{\text{No. of personnel attended training during the previous quarter of the year}}{\text{Total No. of people in the work force}}$$

$$\text{Job Security} = \frac{\text{Permanent workers + Permanent work}}{\text{Temporary workers}}$$

$$\text{Semi-Financial Incentives} = \frac{\text{Total money spent on welfare measures and fringe benefits for the workers}}{\text{Total wages paid to the work force}}$$

The results of this study indicate that incentives can be classified into three categories. Firstly, there are those incentives where it can be can asserted that a certain relationship between them and productivity exists always. In other words, the 't' values were found significant in all the estimated equations. Secondly, there are incentives where it can be asserted only sometimes that a certain relationship exists. In other words the 't' values were found significant only in some of the cases. Thirdly, for some incentives one cannot be sure of the relationship ever. In other words the 't' values were never found to be significant here.

His results show that the first category included financial incentives, industrial disputes, supervisory control and training. The coefficients of financial incentives were positive and the 't' values significant at the 0.01 level. Industrial disputes had a negative impact on productivity. Its 't' values were also significant. Supervisory control had a positive influence on productivity and its coefficients were significant at 0.05. Training has a positive influence on productivity.

Muthukrishnan et al found that the second category included job security and labour turnover. The coefficient of job security was found positive in all cases, but significant only in a few. The coefficient of labour turn over was found to be negative, but not significant in all cases at 0.01 level. Thus, it can be said that these were not important factors in raising labour productivity. They found that the third category included mandays lost due to accidents, and semi-financial incentives. The coefficient of mandays lost due to accidents had a negative sign and the 't' values were not significant. Coefficients of semi-financial incentives do not have consistent signs, and are insignificant.

A.M.KADAK (1986), found that capital-labour ratio and labour productivity were significantly and positively associated in 27 industries. He found this relationship mostly in textile and chemical industries. However, the increase in productivity was found to be small as compared to the increase in capital intensity. He quotes Mehta (1980) who said that if labour and capital productivity increase, despite a decrease in the K/L ratio, it means that there is better utilization of capital and capacity. Kadak found such a trend in dairy products, in large scale industries. He found that the employment of skilled workers increased with increases

in capital stock. This association was also confirmed by Goldar and Seth. Labour productivity was found by them to be positively associated with output. Goldar and Seth also found that when the size of the organization increases, the proportion of non-production to production workers decreases.

These studies together form the background to the present investigations.

TABLE-2.1: SHIVAMAGGI'S INDUSTRY-WISE GROWTH RATES OF PRODUCTIVITY

INDUSTRY	1951-56	1956-61	1951-61
Cement	75%	71%	199%
Chemicals and Chemical Products			128%
Paper and Paper Boards	34%	75%	>100%
Cotton Textiles			
Jute Textiles	37%		42%
Iron and Steel			32%
Sugar	26%	2%	29%

CHAPTER THREE

AN OVERALL PERSPECTIVE ON LABOUR PRODUCTIVITY LEVELS AND GROWTH IN INDIA: AN INTER-TEMPORAL, INTER-REGIONAL AND INTER-INDUSTRIAL ANALYSIS

This chapter consists of two major portions, namely: an overall view of labour productivity in various states for the total factory sector and their movements over time, and an inter industrial analysis for India as a whole over time.

A State-wise Analysis:

In this section, an overview of labour productivity and trends in labour productivity in various states for the total factory sector is given. This part of the chapter is divided into the following subsections: an introduction, an analysis of ranks of states based on their productivities, and the changes in ranks over time, an analysis of the ranking of various states based on their growth rates of productivity over time, and a view of how the actual productivities and their growth rates in various states have changed over time. This is followed by the analysis of the ranks of relative productivities of states compared to that of India, and the rank of changes in these productivities over time, by a rank - wise analysis of the change in relative productivities of various states over time, and finally, a description of the behaviour of the coefficient of variation between states over time. The state-wise analysis ends with a statement of conclusion.

Introduction:

This subsection examines the industrial sector as a whole for 15 states relative to India, over the period 1969-70 to 1987-88. The figures for India, in this part include all the states of India,

and not only the sum of the 15 states covered for the state level analysis. The data are taken from the Annual Survey Of Industries (factory sector). Figures for various industries relate to the two digit level of classification. The factory sector includes both the census, as well as the sample sectors. The industries taken include manufacturing industries, repair services, electricity, gas and steam, water works and supply, and storage and ware-housing. A.S.I. covers all factories registered under sections 2m(i) and 2m(ii) of the Factories Act of 1948, which refer respectively to the factories employing 10 or more workers and using power or those employing 20 or more workers but not using power on any day of the preceding 12 months.

If a mental picture is drawn of a graph of any variable, say the production of rice over time, the graph will not be a smooth curve, but will show fluctuations from year to year. In spite of this the broad trend can usually be visualised that, is, whether the production is increasing, decreasing or remaining constant. This is done by ignoring the short term fluctuations, and drawing a line that passes between these variable points. When dealing with numbers, one does the same thing by: (1) taking triennium averages as the figures for the mid-years of the respective triennia at various points of time, and (2) taking care that these points of time are not too close to each other. The triennium averages are taken as the values for the mid-years at three points of time in the period 1969-70 to 1987-88, thus taking care of both the above mentioned points. The triennia 1969-70 to 1971-72, 1977-78 to 1979-80, and 1985-86 to 1987-88 are used for our analysis. The weighted average of productivities for those years was adopted

as the productivity figure for the mid year i.e.1970-71, 1978-79 and 1986-87 respectively.

As noted earlier, value added at constant prices (in rupees) divided by the number of mandays-employees is calculated to obtain the measure for labour productivity used in this analysis. Thus the unit taken for measuring labour productivity is rupees per mandays-employees. In future references, the unit will not be mentioned to avoid repetition.

Productivity Ranks:

In this subsection, the ranks of states based on their productivities, and the changes in ranks over time, are analysed.

The weighted triennium productivities of 1970-71, 1978-79 and 1986-87 of the combined industrial sector of various states in descending order in each year are given in table 3.1. The different years are partitioned with a line in the table. Between the partitions are two columns, the right hand column showing the productivities in descending order and the left hand column showing the states corresponding to the productivities. It can be seen that All India productivity declined marginally from 24.68 rupees per manday-employees in 1970-71 to 24.15 rupees per manday-employees in 1978-79. It then increased substantially to 30.17 rupees per manday-employees in 1986-87. The change in the All India figures can be said to represent the movement of all the states we have taken put together. This is because although the All India figures taken are the total of the figures of all the states of the country; all the major states have been included in the analysis, hence it can safely be assumed that the remaining states make a negligible difference to the total.

If a state called 'a' had a higher ranking than a state called 'b' in one year and it had a lower ranking than state 'b' in a later year two things could have happened. Either (1) the decrease in productivity of 'a' and increase in productivity of 'b' was so much as to reverse the relative ranking or (2) the growth in productivity of 'b' was such that 'b' not only bridged the gap between the two but overtook it.

From the same table one can see that whereas in 1970-71 and 1978-79 six states exceeded the All India productivity level, in 1986-87 there were five states above the All India level. Maharashtra was the only state which remained at an above all India level throughout the entire period from 1970-71 to 1986-87. It had the maximum productivity amongst all the states in all three years 1970-71, 1978-79 and 1986-87. In 1970-71 and 1978-79 there were four states in common whose productivity remained above the All India level. They were Maharashtra, Haryana, Karnataka and Rajasthan. However, their relative ranking changed with respect to one another. In 1978-79 and 1986-87 there were two states, namely Maharashtra and Gujarat whose productivity remained above all India level. Kerala and Bihar dipped downwards from an above the all India level in 1970-71 to below the all India level in 1978-79. But they surfaced back to above the all India level in 1986-87.

In 1970-71 and 1978-79 there were eight states having a productivity level below that of all India, while in 1986-87 there were nine such states. There were five states which remained below the All India productivity figures in all three years. They were Punjab, Tamil Nadu, West Bengal, Uttar Pradesh and Andhra Pradesh. Amongst these, whereas Andhra Pradesh retained the lowest

productivity throughout, the relative position of the remaining states changed. Andhra Pradesh, Uttar Pradesh and West Bengal were the three lowest productivity states in 1970-71 and 1978-79. Gujarat lay below the all India productivity level in 1970-71, went above the all India level in 1978-79 and returned to below the all India level in 1986-87. Madhya Pradesh lay below the all India level in 1970-71 and 1978-79 and then rose above the All India level in 1986-87. Orissa lay below the All India level in 1970-71, went above it in 1978-79 and returned to below the All India level in 1986-87. In fact Orissa's position changed from number five (from top) in 1978-79 to number fourteen in 1986-87.

Productivity Growth:

In this part an analysis of the ranking of various states based on their growth rates of labour productivity over time, is presented.

As noted earlier the triennium averages were taken as the values of the mid year of the relevant triennia. By the same line of reasoning the period of growth between two triennia is labelled as the period between the mid-years. Thus when the mid-years of the two triennia were 1970-71 and 1986-87 respectively, the period of growth was labelled as 1970-71 to 1986-87.

From table 3.1 itself, it can be seen that all India productivity grew at a compound growth rate of 1.26% per annum for the entire period from 1970-71 to 1986-87. The states having a higher growth of productivity in this period were, in descending order, Gujarat, Madhya Pradesh, Kerala, Maharashtra, Bihar and Uttar Pradesh. Gujarat had as high a rate as 2.48% per annum. Those having a lower growth than All India were, in descending order, Tamil Nadu, West Bengal, Karnataka, Rajasthan, Haryana,

Andhra Pradesh, Orissa and Punjab. Punjab had the lowest growth rate of -0.49% per annum. Andhra Pradesh and Orissa also recorded negative growth rates i.e. their productivities declined over the years.

The break up of growth rates into two periods is shown in the same table. The most obvious fact is that growth rates in the second period were distinctly higher than those in the first period. In fact whereas All India showed a negative growth of -0.27 % in the first period, that in the second period was 2.82%. This indicates that the nation as a whole suffered a decline in productivity in the first period but in the second period, labour productivity grew considerably. When the ranking of various states according to their growth rates is examined in the two periods, it is found that there was a virtual reversal in the growth trends. For example, Orissa with the highest growth rate of 2.2% (compound), in the first period had the lowest growth rate of -2.45% in the second period. Haryana with the third highest growth rate in the first period, had the second lowest growth in the second period. Rajasthan, with the fourth highest growth rate in the first period had the third lowest growth rate in the second period. Uttar Pradesh with the lowest growth rate of -2.66% during the first period, had the highest growth rate of 5.73% during the second period. Bihar with the second lowest growth rate in the first period had the second highest growth rate in the second period. Kerala with the fourth lowest growth rate during the first period had the third highest growth rate during the second period.

It can be seen also that the ranking of states according to growth rates of the two periods combined is quite similar to the ranking in the second period alone. The reversal in trends could

be due to higher infrastructure investment or higher growth of capital - labour ratio in the first period in those states which had lower growth rates, in comparison to those states which had high growth rates during the same period. This could have been due to introduction of such technology that was capital intensive, while not affecting the absorption of labour into industry. In other words, employment in industry could have grown at a reasonable rate, but Value Added could have grown at an even greater rate. The high capital -labour ratio could also have been due to the technology remaining roughly the same while the absorption of labour force was less than the growth in Value Added. However, an analysis of such factors is beyond the scope of this thesis, and therefore nothing definite can be stated about the above mentioned possibilities. It must be noted, that the factors mentioned above, would have to be stronger in the states with low growth rates in the first period as compared to the states with high growth rates in the same period, to cause the reversal in trends of growth between the two periods.

From table 3.3, it can be seen that at the three points of time i.e. 1970-71, 1978-79 and 1986-87, the states that showed a continuous increase in the productivity were Gujarat, Karnataka, Madhya Pradesh and Rajasthan. Haryana and Orissa showed an initial increase and then a decrease. Whereas in Haryana the figure for 1986-87 was slightly higher than in 1979-80; in Orissa the figure for 1986-87 was slightly lower than in 1979-80. India as a whole and the rest of the states, that is Andhra Pradesh, Bihar, Kerala, Maharashtra, Punjab, Tamil Nadu, Uttar Pradesh, West Bengal showed an initial decline and then an increase in the labour productivity figures. Of these Andhra Pradesh and Punjab in the latter period

were unable to make up for loss in the previous period i.e. their productivity figures for 1986-87 were lower than their figures for 1970-71. The remaining states in this category showed a higher figure for 1986-87 than for 1970-71 i.e. in the latter period they were able to more than compensate for the loss in productivities in the initial one; in fact in these states the final years productivity figures were considerably higher than initial year figures except for West Bengal, which had only slightly higher final year figures. All this is evident also from the growth rates of the respective states, which have been shown in the same table, beneath the figures for the productivities of various states.

Relative Productivity Ranks:

In this subsection an analysis of the ranks of relative productivities of states compared to that of India, and the ranks of the changes in these productivities over time, has been done.

In tables 3.2 and 3.3, all India figure for productivity in the three years has been taken as 100 in each and a state-wise index prepared. These numbers can be said to denote the 'relative' productivities of the various states, for with these figures one can see, in terms of percentages by how much the productivity level of a particular state is more or less than the All India Level. One can also see whether the productivity level of a state relative to India has declined or increased over the years. It may be noted that the productivity of a particular state can increase, while its relative productivity decreases. This happens when India's productivity grows at a faster rate than the state's productivity.

It is obvious that the ranking according to relative productivities is the same as the ranking according to absolute productivities. It is however, interesting to see how the change

in relative productivities of various states is ranked in the two periods taken separately and combined. From tables 3.1 and 3.2, we can see that there is almost a one to one correspondence between the ranks of states according to their growth rates of actual productivities and the rank of states according to the change in relative productivities. The reason why there is not an exact one to one correspondence has been given above. Since the ranking of the two is roughly the same, it follows that there has been a reversal in the trends of change in relative productivities also, between the two periods. The ranking of states according to the change in relative productivities for the two periods taken together is similar to that of the second period alone.

It is also of interest to determine how the relative productivities of various states with respect to India, has changed over the years. As mentioned earlier, these figures do not exhibit the same trends as those for actual productivity figures for various states. As can be seen from table 3.4, Punjab shows a decline in actual productivity from 1970-71 to 1978-79, and an increase from 1978-79 to 1986-87. However, relative labour productivity in Punjab declined continuously from 1970-71 to 1986-87. Many similar examples can be identified from the table. The results in the table, reveal that at the three points of time Andhra Pradesh, Punjab and West Bengal showed a continuous decline in their relative productivities. Gujarat and Madhya Pradesh recorded a continuous increase. Bihar, Kerala, Maharashtra and Uttar Pradesh experienced an initial decline and a later increase in relative productivity figures. In all of them the final year figures were higher than those for the initial year. This means that their position relative to India improved in the intervening years. The rest of the states

i.e. Haryana, Karnataka, Orissa, Rajasthan and Tamil Nadu showed an initial increase, followed by a decrease in relative productivity. All of them showed lower final year figures than those in the initial year. In other words their position relative to India was worse in the end than the position from which they started. All this becomes even more obvious when the figures for the change in relative productivities in various periods is examined. These figures have been given in table 3.4 just beneath the figures for relative productivity levels.

Coefficients Of Variation:

In this subsection, the behaviour of the coefficient of variation between states over time, has been described.

It is interesting to see whether the disparity between states has increased or decreased over time. For this purpose, the triennium averages of productivity whose mid-years are 1970-71, 1978-79 and 1986-87, have been taken and their weighted coefficients of variation calculated. The weighted coefficient of variation between states for each year has also been computed and a regression between it and time has been run. A glance at the coefficients of variation for the triennia whose mid-years are 1970-71, 1978-79, and 1986-87 in table 3.3, reveals that disparities increased steadily from 14.91 in 1970-71 to 18.77 in 1978-79 to 21.19 in 1986-87. This shows that the gap in labour productivity levels between states has tended to widen over time. This is a matter for concern. A log linear regression line was fitted between coefficient of variation as dependent and time as independent variable. It was found that the compound rate of growth of the coefficient of variation was 1.91% per annum. The result is shown in table 3.5. The result was significant at the 95% level of confidence.

Inter Industrial Analysis For India As A Whole Over Time:

This section of the chapter can be divided into the following parts: (a) an introduction; (b) an analysis of ranks of industries based on their productivities, and the changes in ranks over time; (c) an analysis of the ranking of various industries based on their growth rates of productivity over time; (d) Analysis of the ranks of relative productivities of industries compared to that of all industries combined, and the ranks of the changes in these productivities over time; (e) a rank-wise analysis of the change in relative productivities of various industries over time, and finally a (f) description of the behaviour of the coefficient of variation between industries over time.

Introduction:

The data base is provided by the industrial classification according to A.S.I., at the two digit level. The industries covered include manufacturing industries, repair services, electricity, gas and steam, water works and supply, and storage and ware-housing. The numbers identifying the industries have been altered so as to simplify matters. The industries in the tables also are renumbered in the same way. Industry (0) is the sum of all the industries listed below. The industries along with their numbers are as follows :

(0) All Industries Combined;

(1) Manufacture of Food Products;

(2) Manufacture of Beverages, Tobacco and Tobacco Products;

(3) Manufacture of Cotton Textiles;

(4) Manufacture of Wool, Silk and Synthetic Fibre Textiles;

(5) Manufacture of Jute, Hemp and Mesta Textiles;

(6) Manufacture of Textile Products (including wearing apparel other than footwear);

(7) Manufacture of Wood and Wood Products, Furniture and Fixtures;

(8) Manufacture of Paper and Paper Products, Printing and Publishing and Allied Industries;

(9) Manufacture of Leather, Leather and Fur Products (except repair);

(10) Manufacture of Rubber, Plastic, Petroleum and Coal Products;

(11) Manufacture of Chemicals and Chemical Products (except products of petroleum and coal);

(12) Manufacture of Non-metallic Mineral Products;

(13) Basic Metal and Alloys Industries;

(14) Manufacture of Metal Products and Parts except Machinery and Transport Equipment;

(15) Manufacture of Machinery, Machine Tools and Parts except Electrical Machinery;

(16) Manufacture of Electrical Machinery, Apparatus, Appliances and Supplies and Parts;

(17) Manufacture of Transport Equipment and Parts;

(18) Other Manufacturing Industries;

(19) Electricity;

(20) Gas and Steam;

(21) Water Works and Supply;

(22) Storage and Ware-housing; and

(23) Repair Services

To simplify the analysis the industries have been divided into two categories, here described as 'basic' and 'non basic' industries. 'Basic industries' include capital goods industries and those intermediate industries where a large portion of Value

Added out of the total Value Added of that industry is contributed by those manufacturing units that employ large amounts of capital. For example the industry numbered (10), that is manufacture of rubber, plastic, petroleum and coal products, is put under the category - 'Basic'. All the other industries are included under the category - 'Non Basic'. The list of 'basic' and 'non basic' industries is given below. Basic industries include: Manufacture of Rubber, Plastic, Petroleum and Coal Products (10), Manufacture of Chemicals and Chemical Products (except products of petroleum and coal) (11), Basic Metal and Alloys Industries (13), Machinery (15), Manufacture of Electrical Machinery, Apparatus, Appliances and Supplies and Parts (16), Manufacture of Transport Equipment and Parts (17), Electricity (19).

Non basic industries include Manufacture of Food Products (1), Manufacture of Beverages, Tobacco and Tobacco Products (2), Manufacture of Cotton Textiles (3), Manufacture of Wool, Silk and Synthetic Fibre Textiles (4), Manufacture of Jute, Hemp and Mesta Textiles (5), Manufacture of Textile Products (including wearing apparel other than footwear) (6), Manufacture of Wood and Wood Products, Furniture and Fixtures (7), Manufacture of Paper and Paper Products, Printing and Publishing and Allied Industries (8), Manufacture of Leather, Leather and Fur Products (except repair) (9), Manufacture of Non-metallic Mineral Products (12), Manufacture of Metal Products and Parts except Machinery and Transport Equipment (14), Other Manufacturing Industries (18), Storage and Ware-housing (22), and Repair Services (23).

For the inter industrial analysis the weighted triennium averages of the years 1976-77 to 1978-79, and 1985-86 to 1987-88, have been taken as the figures for the mid-years, that is 1977-78.

and 1986-87 respectively. In the table the mid-years have been labelled 78 and 87, and the period between them as 78-87. The latter labelling will be used for the analysis.

In what follows, first the behaviour of Basic and Non Basic industries is described in terms of comparisons with all industries put together. Then the individual industries at two digit level of classification are dealt with in each subsection.

Productivity Ranks:

In this subsection the ranks of industries based on their labour productivities, constitute the focus of analytical attention. The changes in ranks over time are also analysed. It is found that basic industries have the highest labour productivity levels in both the years 1978 and 1987 of 29.11 and 37.35 respectively. Non Basic industries record productivities of 16.84 and 21.20 in the same years. All industries combined have productivities of 22.44 and 29.04 in 1978 and 1987 respectively.

In table 3.6, as in the case for the interstate analysis, the figures for the various years have been separated by vertical lines. Between two lines, there are two columns. On the right are the productivity figures for various industries in descending order are given with the industry number corresponding to the figure on the left side. From this table, it is evident that the productivity of all industries combined has increased from 22.44 in 1977-78 to 29.04 in 1986-87.

From table 3.6 it can be seen that there has not been any drastic change in the ranks of various industries in the two years 1978 and 1987. For example, Manufacture of Rubber, Plastic, Petroleum and Coal Products (10), and Manufacture of Electrical Machinery, Apparatus, Appliances and Supplies and Parts (16), occupy

the first, and third ranks in the two years. It is established that the industries having above all industry productivities in 1978 also have above all industry productivities in 1987. An industrial category which has shown a substantial change in ranks is, Storage and Ware-housing (22), which has risen twelve ranks from a lowest productivity figure of 7.7 in 1978 to a figure of 26.7 in 1987. Manufacture of Textile Products (including wearing apparel other than footwear) (6), has declined five ranks; Manufacture of Transport Equipment and Parts (17), has declined three ranks; Other Manufacturing Industries (18), has risen four ranks, and Repair Services (23), has risen three ranks.

The industries in which labour productivity stands above the all industry level in both years include Manufacture of Rubber, Plastic, Petroleum and Coal Products (10), Manufacture of Chemicals and Chemical Products (except products of petroleum and coal) (11), Manufacture of Electrical Machinery, Apparatus, Appliances and Supplies and Parts (16), Manufacture of Transport Equipment and Parts (17), Manufacture of Machinery, Machine Tools and Parts except Electrical Machinery (15), Other Manufacturing Industries (18), Manufacture of Wool, Silk and Synthetic Fibre Textiles (4). Towards the other end of the scale, the industries below the all industry level in both years include Electricity (19), Manufacture of Metal Products and Parts except Machinery and Transport Equipment (14), Manufacture of Paper and Paper Products, Printing and Publishing and Allied Industries (8), Basic Metal and Alloys Industries (13), Manufacture of Cotton Textiles (3), Manufacture of Non-metallic Mineral Products (12), Manufacture of Textile Products (including wearing apparel other than footwear)(6), Manufacture of Food Product (1), Manufacture of Jute, Hemp and Mesta Textiles (5), Manufacture

of Beverages, Tobacco and Tobacco Products (2), Manufacture of Leather, Leather and Fur Products (except repair) (9), Repair Services (23), Manufacture of Wood and Wood Products, Furniture and Fixtures (7), and Storage and Ware-housing (22).

Productivity Growth Ranks:

In this section the ranking of various industries based on their growth rates of productivity over time is examined. This is shown in table 3.6.

The growth rate in labour productivity in Basic industries was slightly higher than in non-basic industries at 2.81% per annum, which grew at the somewhat lower rate of 2.59% per annum. It may be recalled that Basic industries also started with higher productivity figures. The all industry productivity growth rate stood at 2.91% per annum. From the table, it can be seen that there is no relationship between the ranks of the industries in 1978 and 1987, and the ranks of the industries based on the growth rates between these two years. All industries combined grew at a rate of 2.91% per annum.

Among individual categories, Storage and Ware-housing (22), Other Manufacturing Industries (18), and Manufacture of Electrical Machinery, Apparatus, Appliances and Supplies and Parts (16), recorded the first, second and the third highest growth rates of 14.81%, 10.54%, and 4.81% respectively. Manufacture of Textile Products (including wearing apparel other than footwear) (6), and Manufacture of Leather, Leather and Fur Products (except repair) (9), had the lowest growth rates, which were negative, at -0.76% and -0.34% respectively.

The industries enjoying an above all industry growth rate were Storage and Ware-housing (22), Other Manufacturing Industries

(18), Manufacture of Electrical Machinery, Apparatus, Appliances and Supplies and Parts(16), Manufacture of Machinery, Machine Tools and Parts except Electrical Machinery (15), Manufacture of Rubber, Plastic, Petroleum and Coal Products (10), Repair Services (23), Manufacture of Food Product (1), and Manufacture of Metal Products and Parts except Machinery and Transport Equipment (14).

The industries having below all industry growth rates were: Manufacture of Non-metallic Mineral Products (12), Manufacture of Cotton Textiles (3), Manufacture of Wool, Silk and Synthetic Fibre Textiles (4), Basic Metal and Alloys Industries (13), Manufacture of Wood and Wood Products, Furniture and Fixtures (7), Manufacture of Jute, Hemp and Mesta Textiles (5), Manufacture of Chemicals and Chemical Products (except products of petroleum and coal) (11), Manufacture of Transport Equipment and Parts (17), Electricity (19), Manufacture of Beverages, Tobacco and Tobacco Products (2), Manufacture of Paper and Paper Products, Printing and Publishing and Allied Industries (8), Manufacture of Leather, Leather and Fur Products (except repair) (9), and Manufacture of Textile Products (including wearing apparel other than footwear)(6).

Relative Productivity Ranks:

In this part the ranks of relative productivities of industries compared to that of all industries combined are determined, together with the ranks of the changes in these productivities over time. The results pertaining to this have also been shown in table 3.6.

The relative productivities are in effect an index with the productivity of all industries combined taken as equal to 100. As is the case with all indices, the ranks of industries based on their relative productivities in the two years are the same as the ranks of industries based on their actual productivities

in the same years. However, it is worth knowing how much the productivity level of a particular industry is more or less than labour productivity in all industries taken together. This can be seen from the relative productivity figures in table 3.6. It is also worth knowing whether the productivity level of an industry relative to the productivity level of all industries taken together has declined or increased over the years. This can be seen from the change in relative productivity, which is shown in the same table.

It may be noted that the productivity of a particular industry can increase, while its relative productivity decreases. This happens when the productivity of all industries taken together grows at a faster rate than does that particular industry's productivity. For example in table 3.7, we can see that both Basic and Non Basic industries had positive growth rates but the change in relative productivity of both Basic and Non Basic industries was negative. In other words, although the productivity of both Basic and Non Basic industries grew, its position in comparison to all industries put together declined. The reason why the relative productivities of both of them could decline, is that the productivity averages taken are weighted by the number of mandays employed.

It is also evident that all the industries having positive growth rates of actual productivities, but negative changes in their relative productivities, would have actual productivities rising, with relative productivities falling. These industries include Manufacture of Non-metallic Mineral Products (12), Manufacture of Cotton Textiles (3), Manufacture of Wood and Wood Products, Furniture and Fixtures (7), Basic Metal and Alloys Industries (13), Manufacture of Jute, Hemp and Mesta Textiles (5),

Manufacture of Wool, Silk and Synthetic Fibre Textiles (4), Manufacture of Beverages, Tobacco and Tobacco Products (2), Electricity (19), Manufacture of Paper and Paper Products, Printing and Publishing and Allied Industries (8), Manufacture of Transport Equipment and Parts (17), and Manufacture of Chemicals and Chemical Products (except products of petroleum and coal) (11).

Ranks Of Change In Relative Productivities:

In this subsection the rank-wise account of the change in relative productivities of various industries over time is presented. This is shown in table 3.6.

At the aggregated level, the change in relative labour productivity of Basic industries was -1.11 points, whereas the change in relative productivity of Non Basic industries was -2.04 points. Several industries having a relative productivity level of more than a hundred in 1978, showed an increase in their relative productivities. These include Manufacture of Rubber, Plastic, Petroleum and Coal Products (10), Manufacture of Electrical Machinery, Apparatus, Appliances and Supplies and Parts (16), Manufacture of Machinery, Machine Tools and Parts except Electrical Machinery (15), and Other Manufacturing Industries (18). Industries that showed a decrease in their relative productivities, were, Electricity (19), Manufacture of Paper and Paper Products, Printing and Publishing and Allied Industries (8), Basic Metal and Alloys Industries (13), Manufacture of Cotton Textiles (3), Manufacture of Non-metallic Mineral Products (12), Manufacture of Textile Products (including wearing apparel other than footwear) (6), Manufacture of Jute, Hemp and Mesta Textiles (5), Manufacture of Beverages, Tobacco and Tobacco Products (2), Manufacture of Leather, Leather and Fur Products (except repair) (9), and Manufacture of

Wood and Wood Products, Furniture and Fixtures (7). The Manufacture of Chemicals and Chemical Products (except products of petroleum and coal) (11), Manufacture of Transport Equipment and Parts (17), and Manufacture of Wool, Silk and Synthetic Fibre Textiles (4), also showed a decline in their relative productivities. Manufacture of Metal Products and Parts except Machinery and Transport Equipment (14), Manufacture of Food Product (1), Repair Services (23), and Storage and Ware-housing (22), showed an increase in their relative productivities. However, all industries which had a relative productivity of more than a hundred in 1978, also had a relative productivity of more than a hundred in 1987.

Other Manufacturing Industries (18), showed the highest change in relative productivity of 104.22 points. Storage and Ware-housing (22), with a change of 57.62 points, and Manufacture of Rubber, Plastic, Petroleum and Coal Products (10), with a change of 33.3 points were the next highest. The maximum decrease in relative productivity was recorded by Manufacture of Chemicals and Chemical Products (except products of petroleum and coal) (11), with -29.23 points, followed by Manufacture of Transport Equipment and Parts (17), with -19.52 points, and then Manufacture of Textile Products (including wearing apparel other than footwear)(6), by -19.25 points.

Coefficients Of Variation:

In this section the behaviour of the coefficient of variation between industries over time is considered.

As is evident from Table 3.7, the coefficient of variation between Basic and Non Basic industries rose slightly from 27.23 in 1978 to 27.79 in 1987. From the same table it is seen that the coefficient of variation increased from 45.60 in 1978 to 52.58 in 1987. In table 3.8, the results of the log-linear regression

and of the coefficient of variation against time are shown. What emerges is a growth rate of the coefficient of variation equal to 1.51% per annum, but this is insignificant even at the 90% level of confidence.

Conclusions:

Inter-regional differences in labour productivity have increased from 1970 to 1988. The inter state coefficient of variation of productivity has grown at the rate of 1.9% per annum. This result was significant at the 98% level of confidence. In other words, divergence between productivities of states took place at a constant rate during this period.

The inter industrial differences in labour productivity also increased from 1977 to 1988. The coefficient of variation between industries, grew at 1.51% per annum. However, this result was not significant. In other words, although there was a divergence between productivity of industries during this period, it was not at a constant rate.

The ranks of states according to their labour productivity growth rates, were very similar to the ranks of states according to the relative productivity change during the period 1971-1987. The ranks of industries according to productivity growth rate from 1978-1987, were quite similar to the ranks of industries according to relative productivity change during the same period.

Haryana, Rajasthan, Karnataka, West Bengal and Tamil Nadu, showed an increase in actual labour productivities but a decrease in relative productivities in the period 1971-1987. Manufacture of Beverages, Tobacco and Tobacco Products, Manufacture of Cotton Textiles, Manufacture of Wool, Silk and Synthetic Fibre Textiles, Manufacture of Jute, Hemp and Mesta Textiles, Manufacture of Wood

and Wood Products, Furniture and Fixtures, Manufacture of Paper and Paper Products, Printing and Publishing and Allied Industries, Manufacture of Chemicals and Chemical Products (except products of petroleum and coal), Manufacture of Non-metallic Mineral Products, Basic Metal and Alloys Industries, Manufacture of Transport Equipment and Parts, and Electricity, that is, industry numbers 2,3,4,5,7,8,11,12,13,17 and 19; showed an increase in actual productivity, but a decrease in relative productivity during the period 1978 to 1987.

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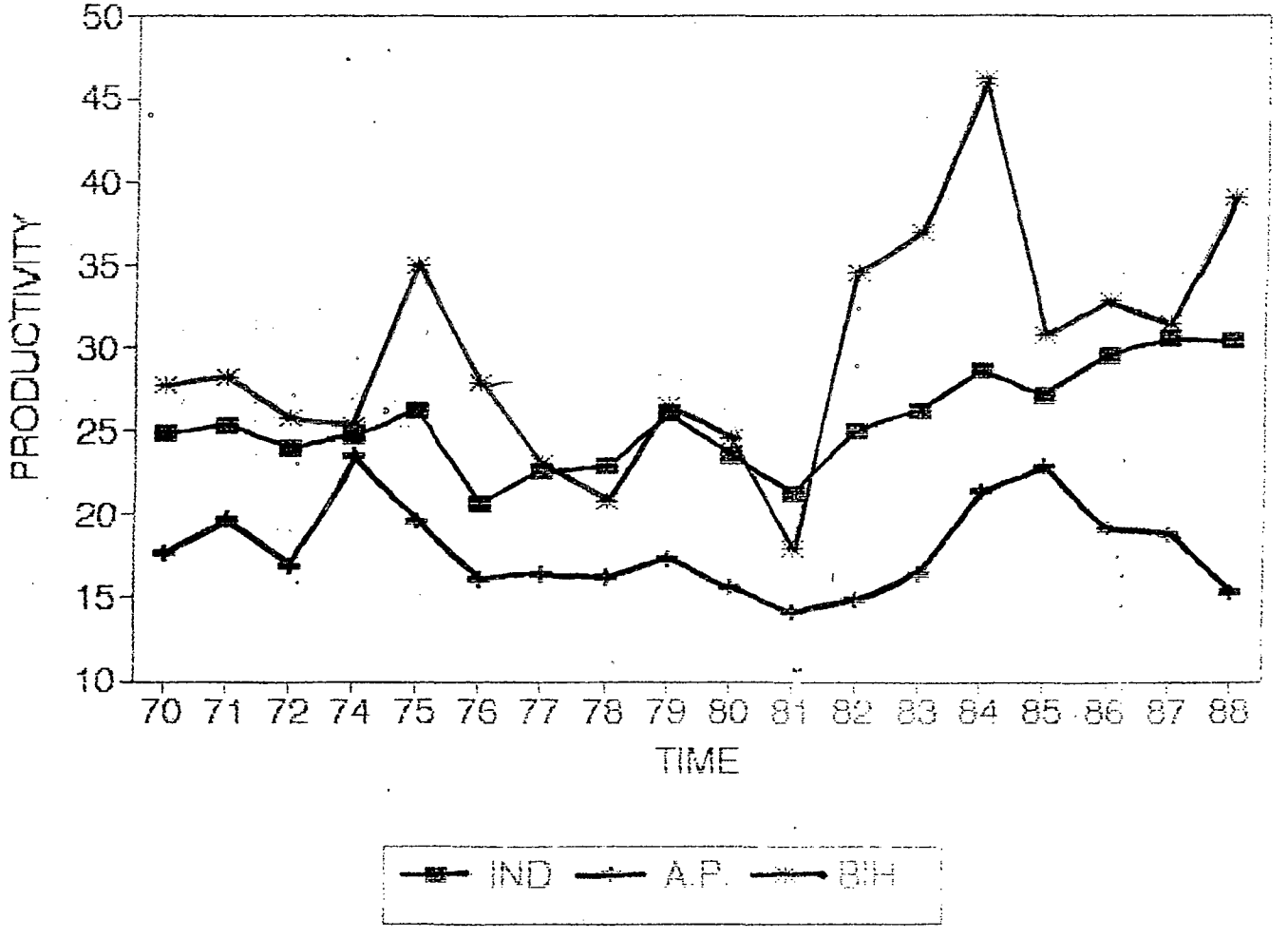

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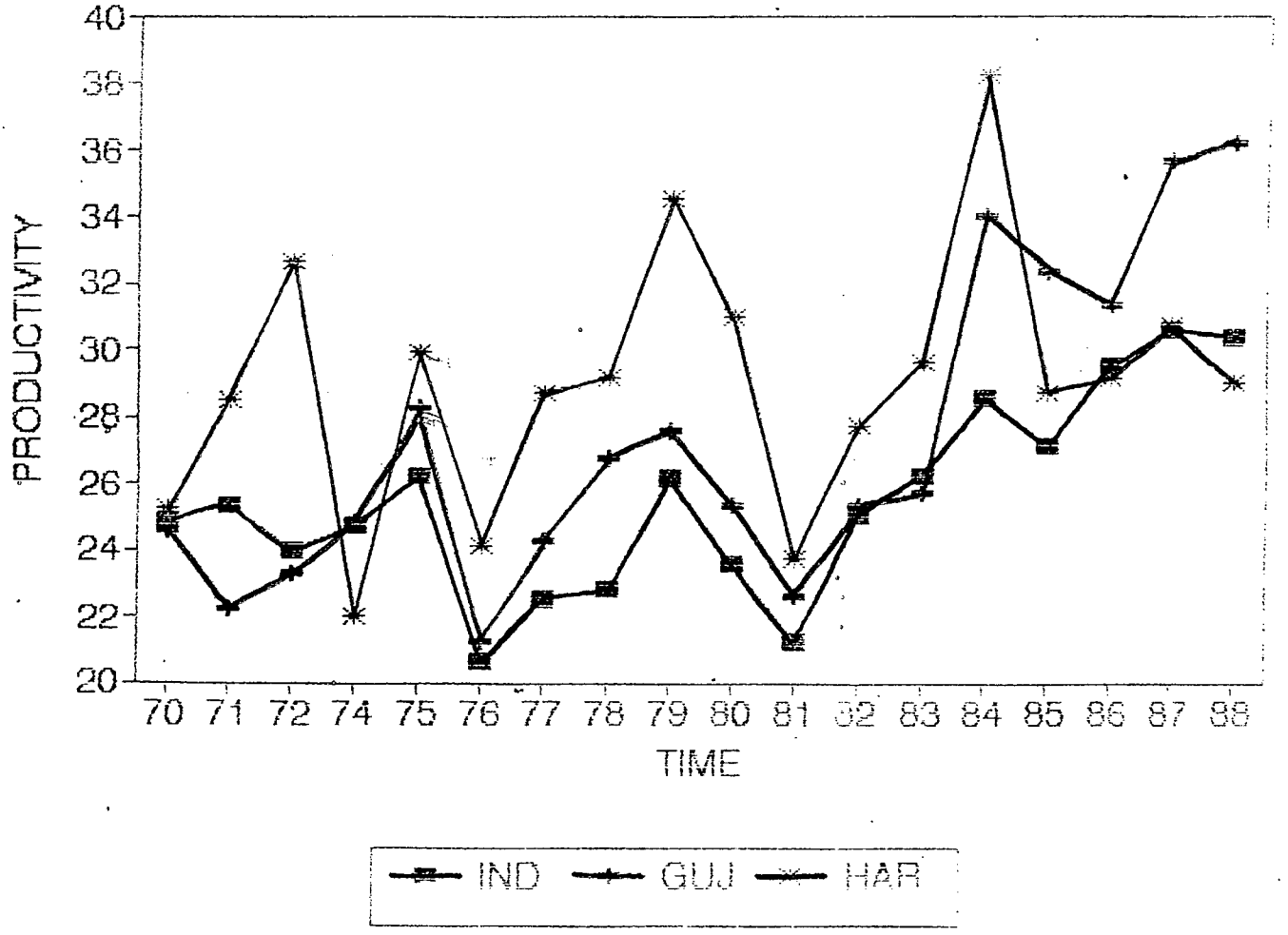

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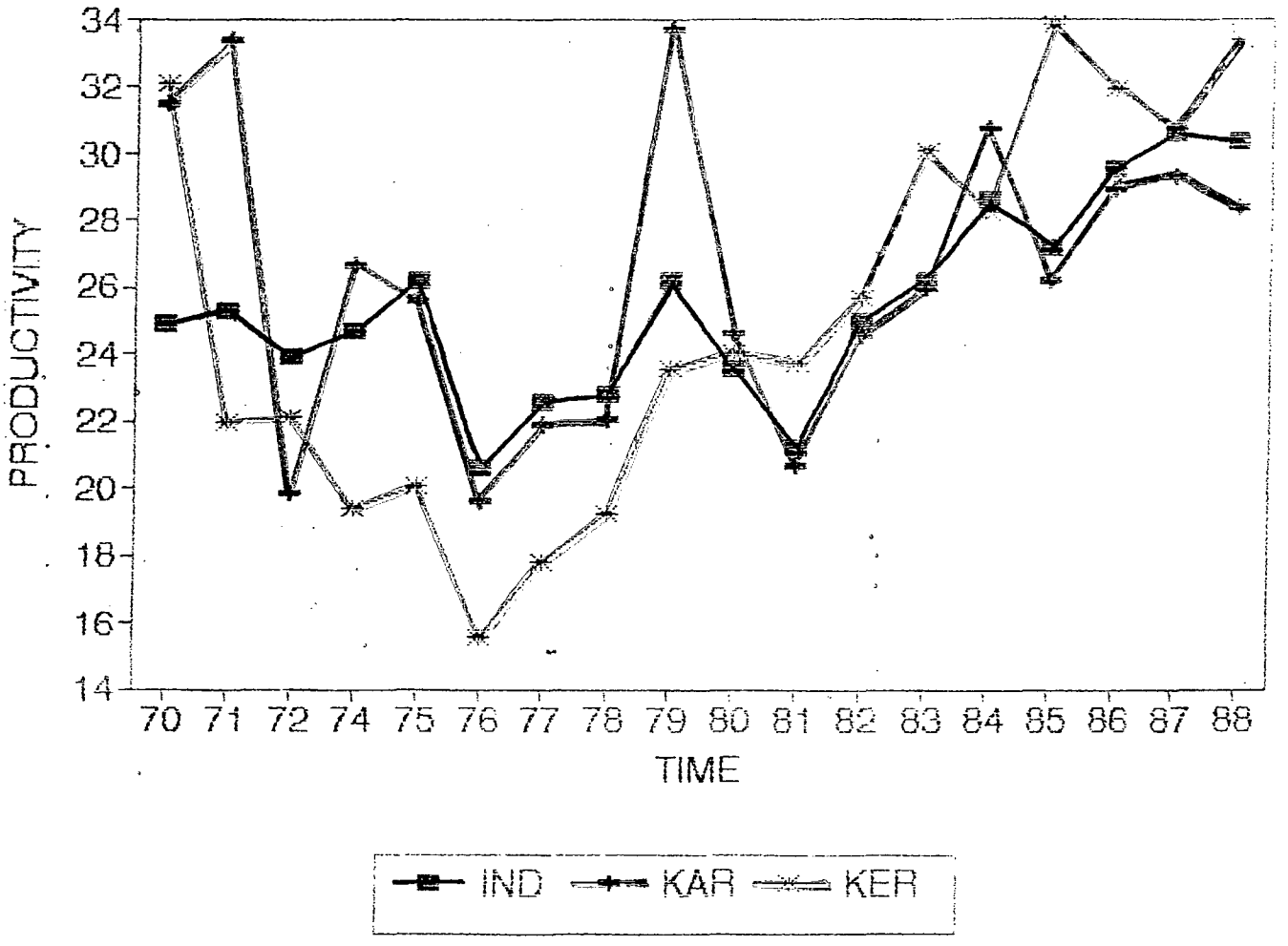

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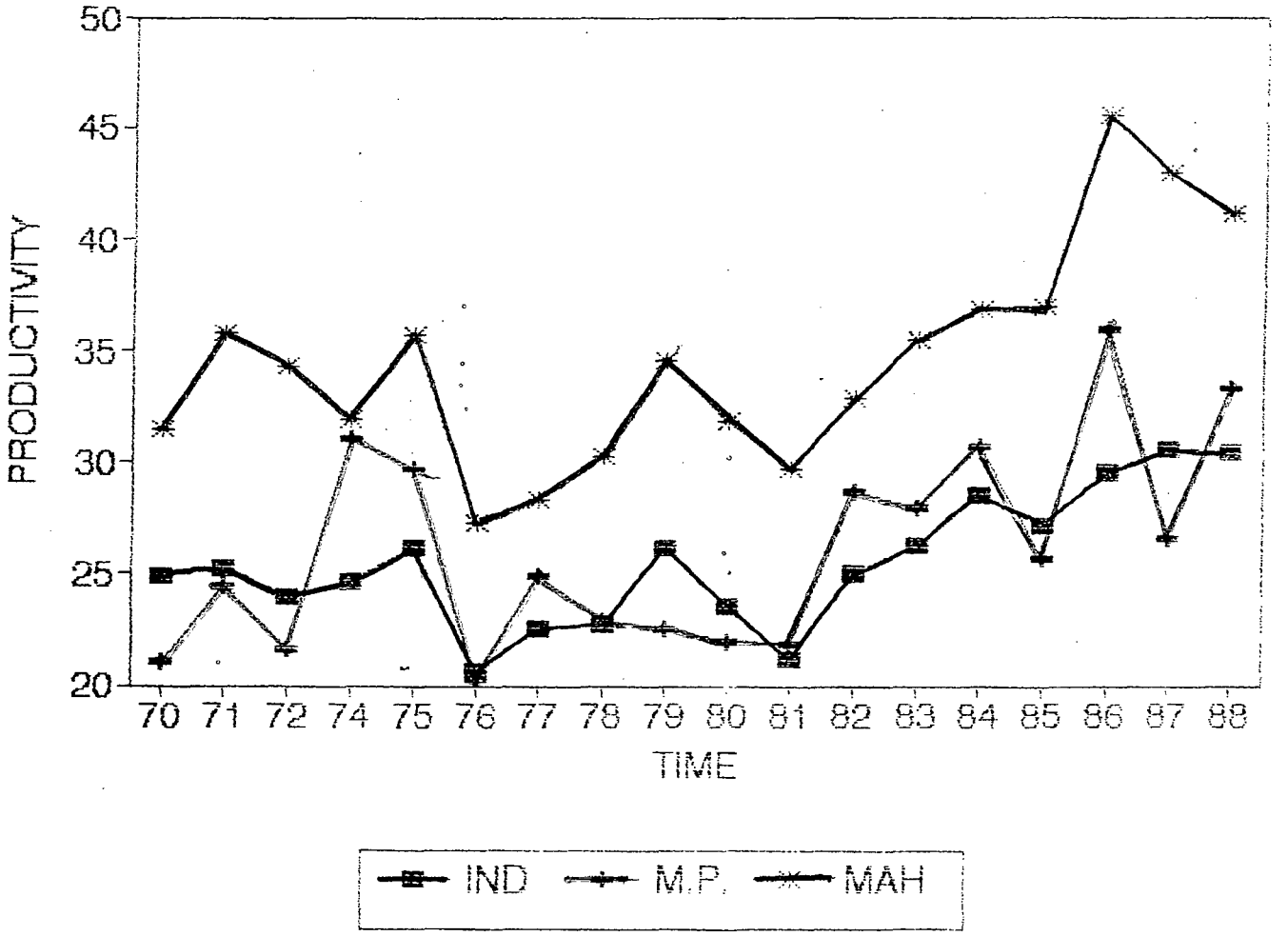

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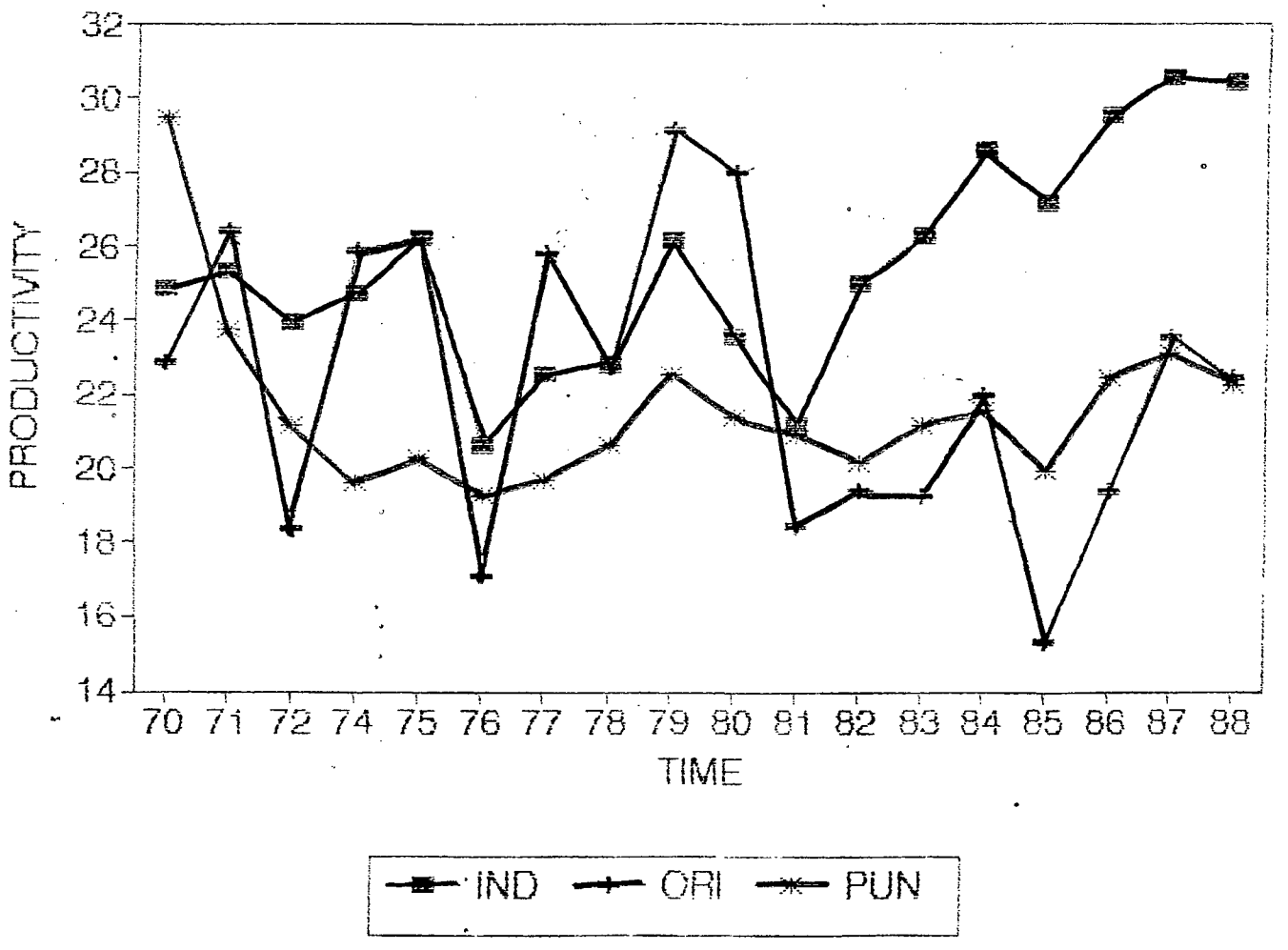
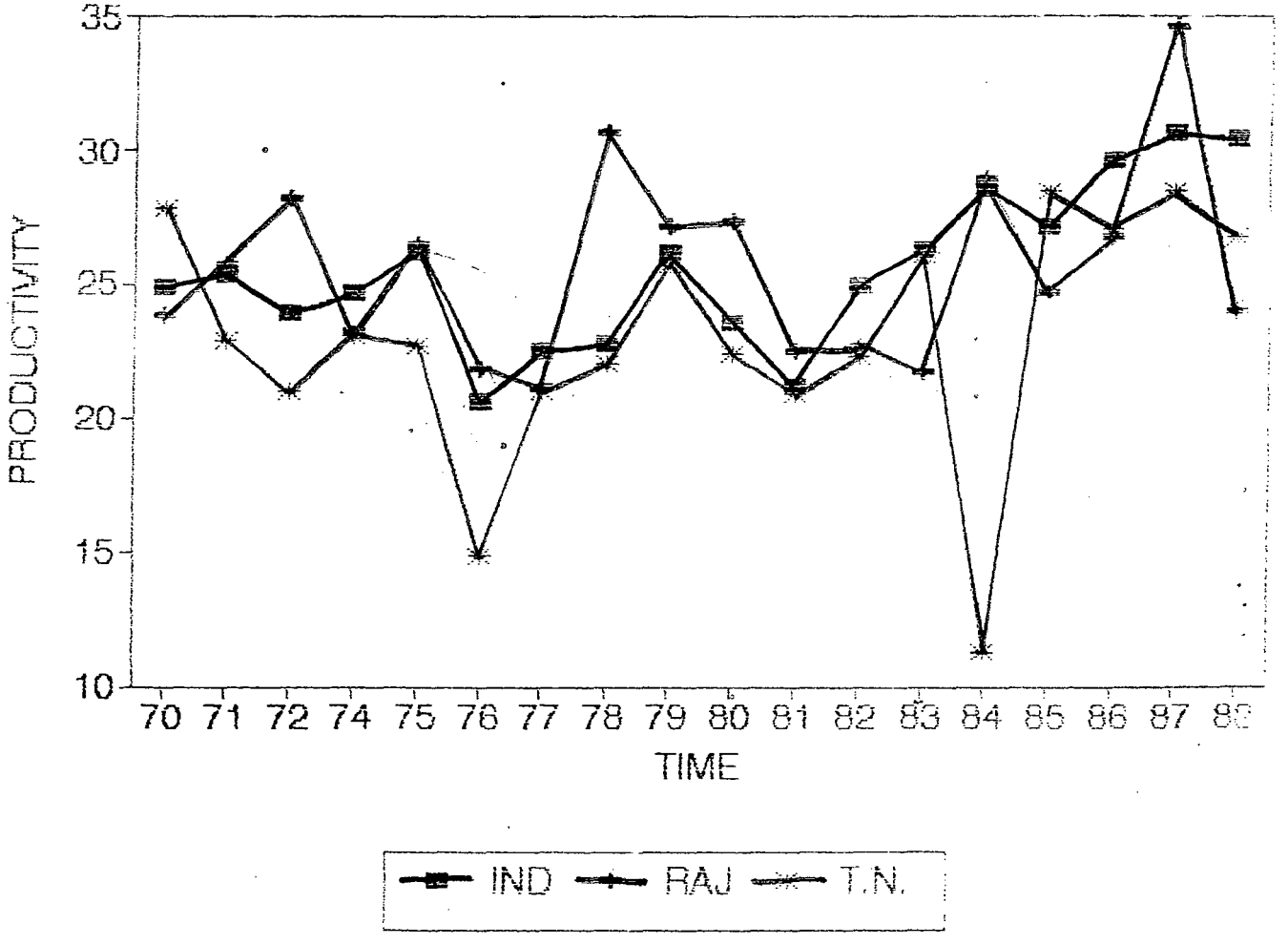
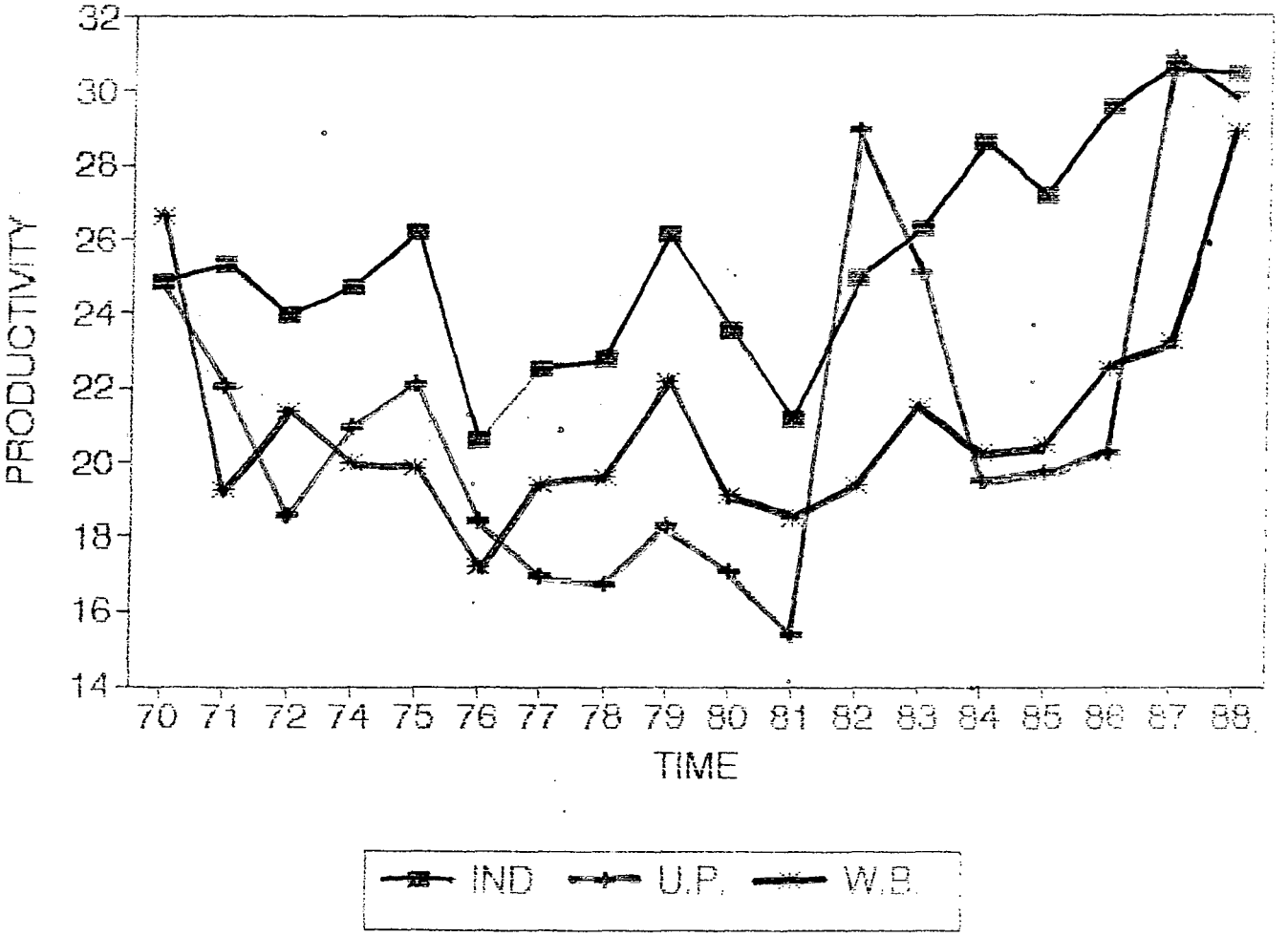


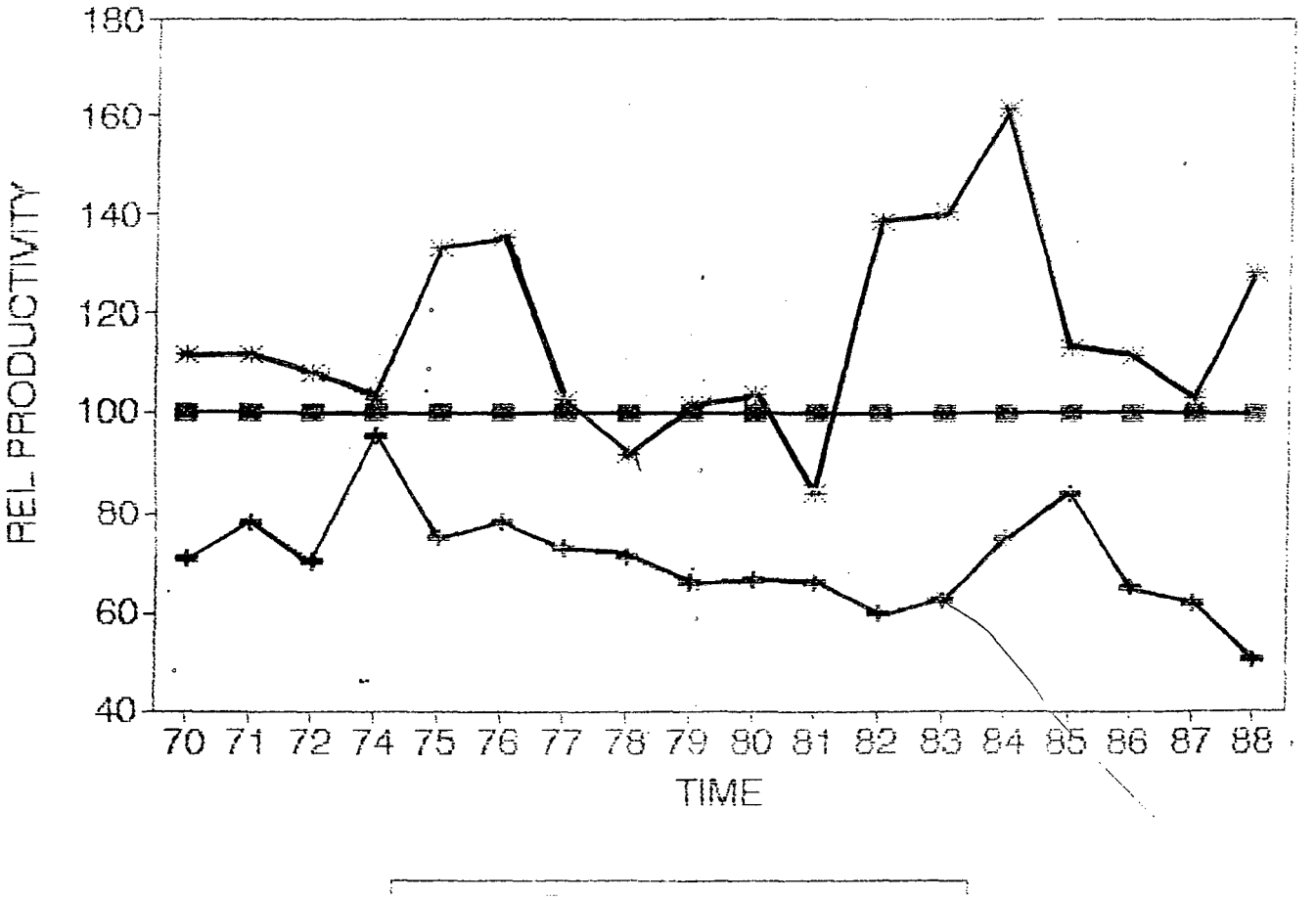
(6) STATE PRODUCTIVITIES



(7) STATE PRODUCTIVITIES



(8) REL STATE PRODUCTIVITIES



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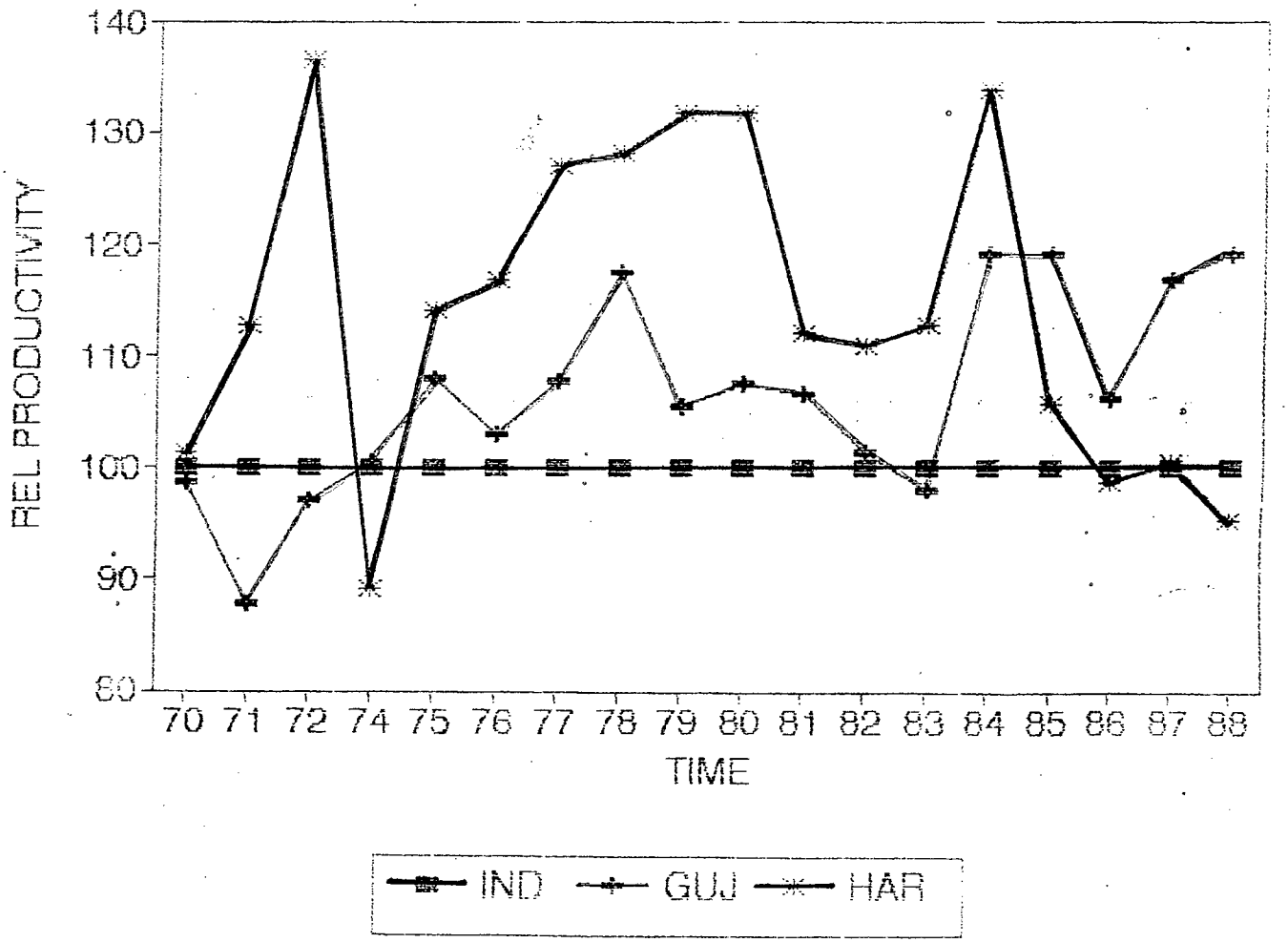
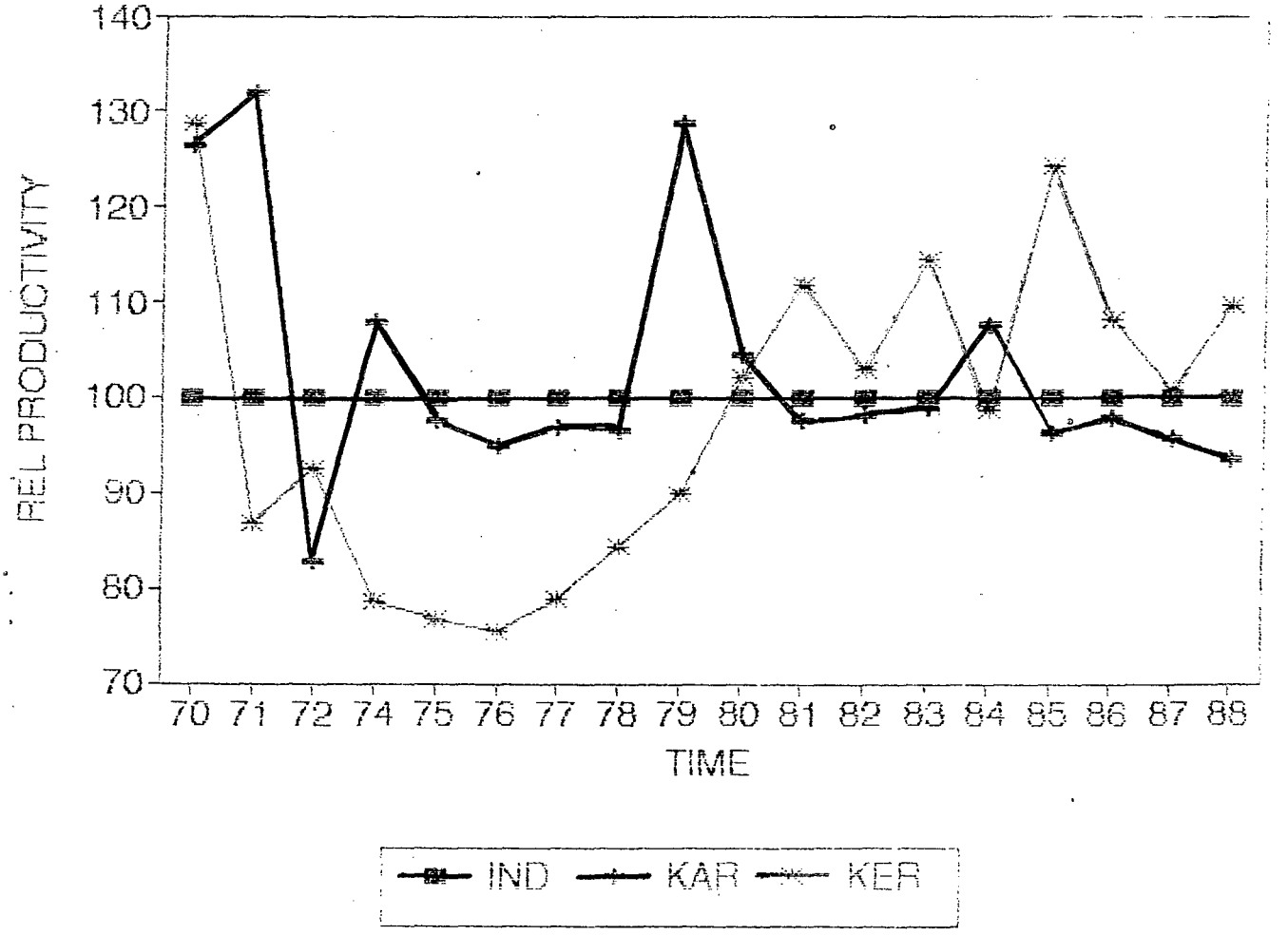
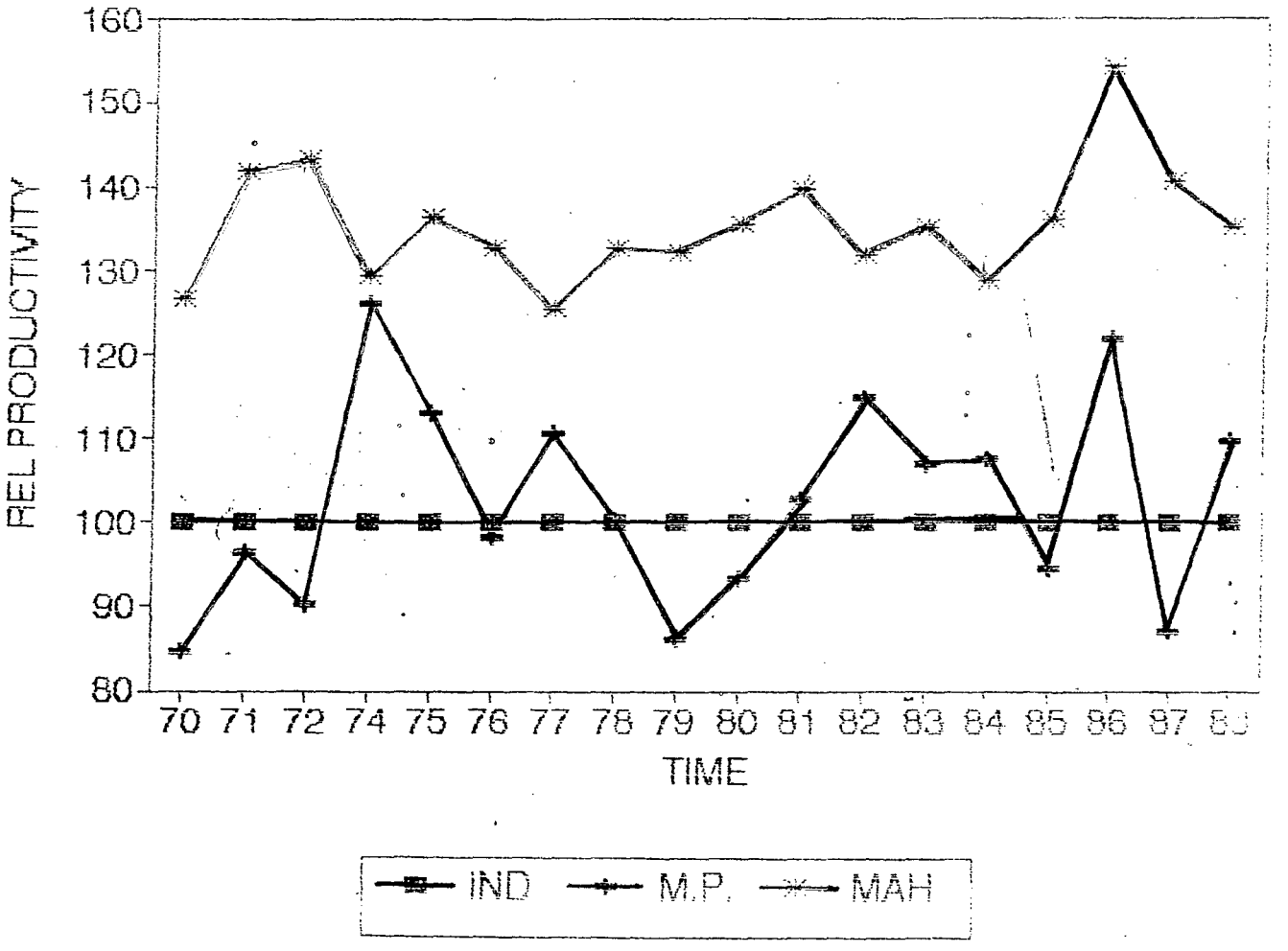


(10) REL STATE PRODUCTIVITIES



(11) REL STATE PRODUCTIVITIES



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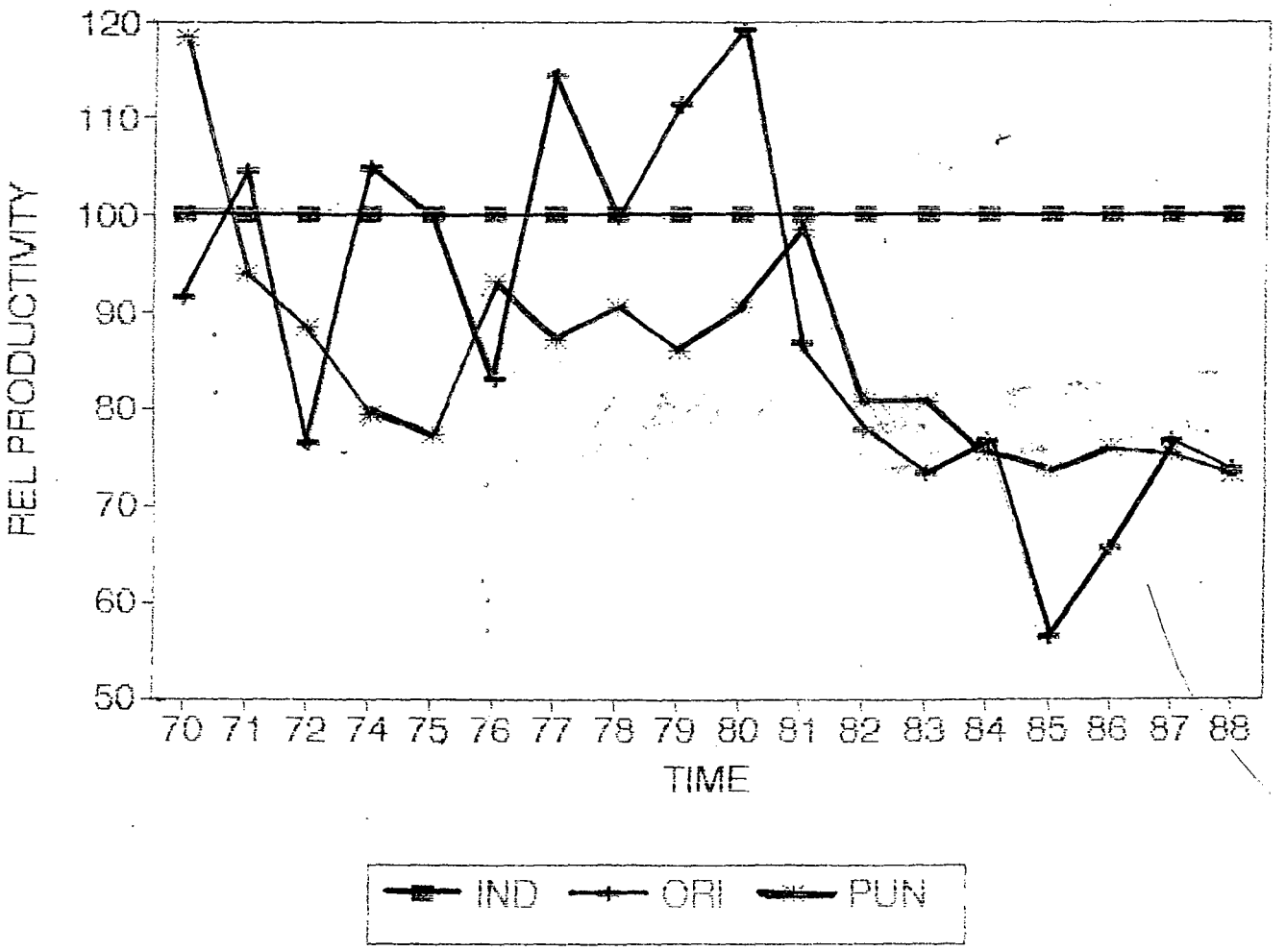
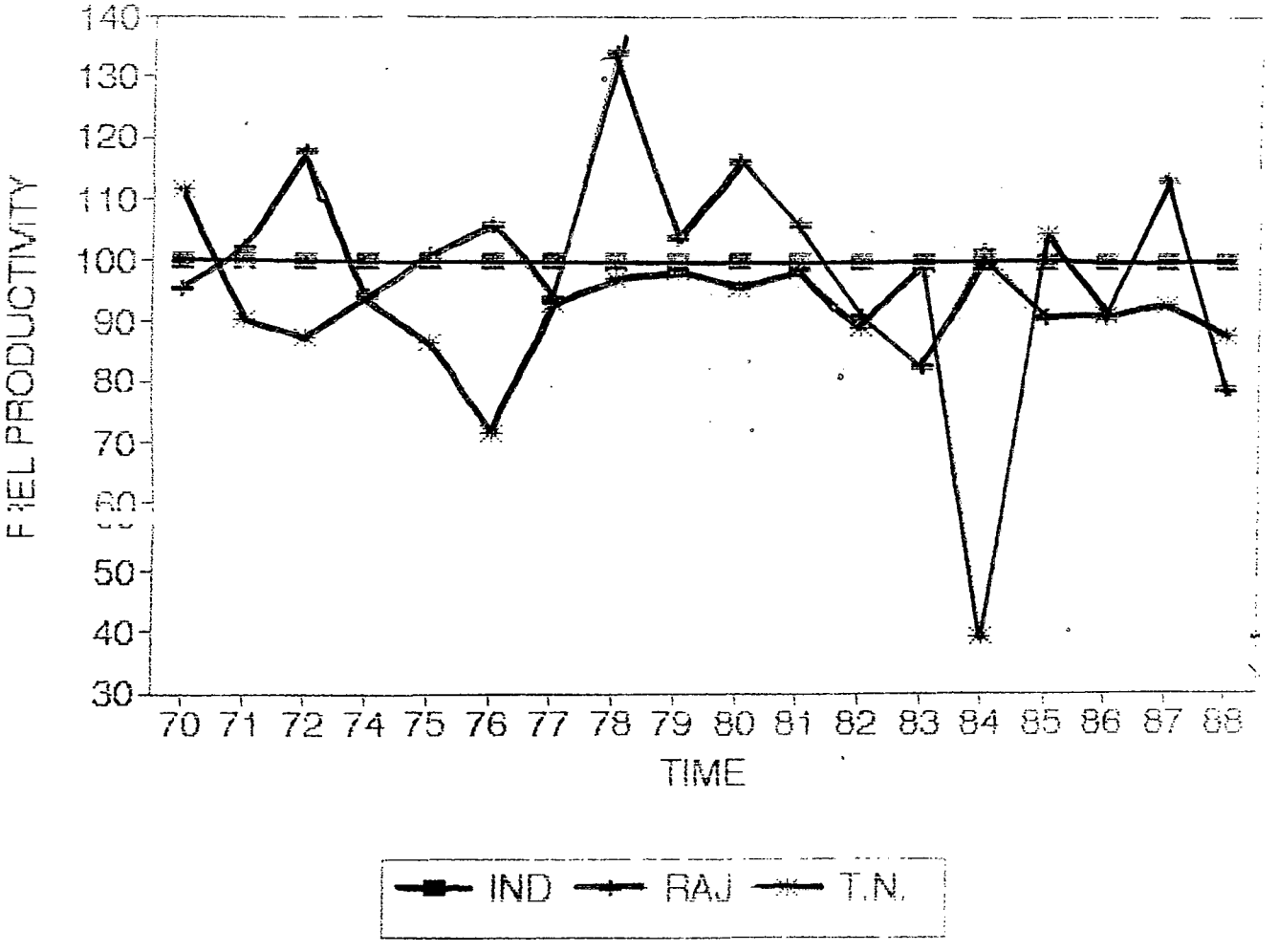
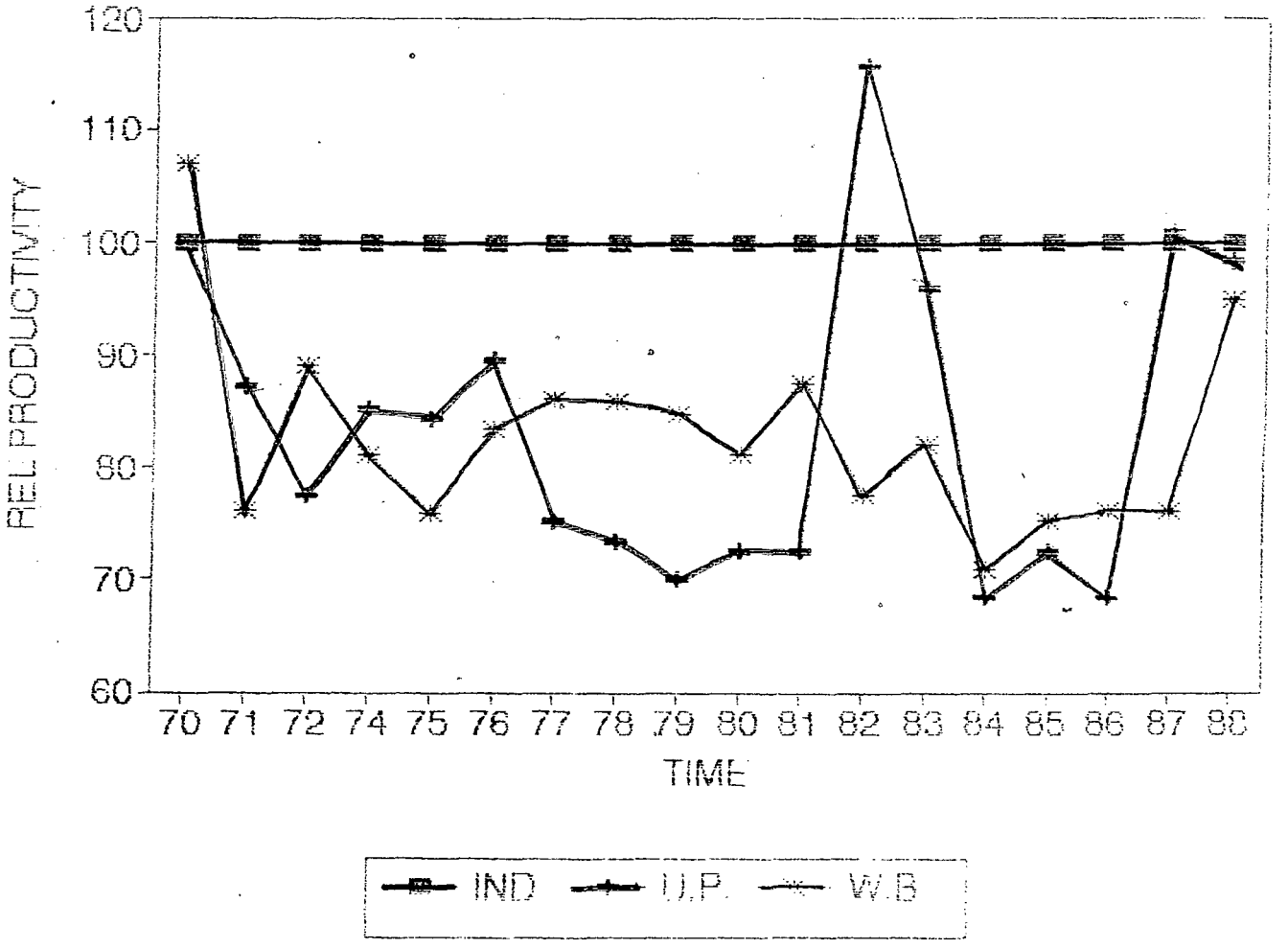


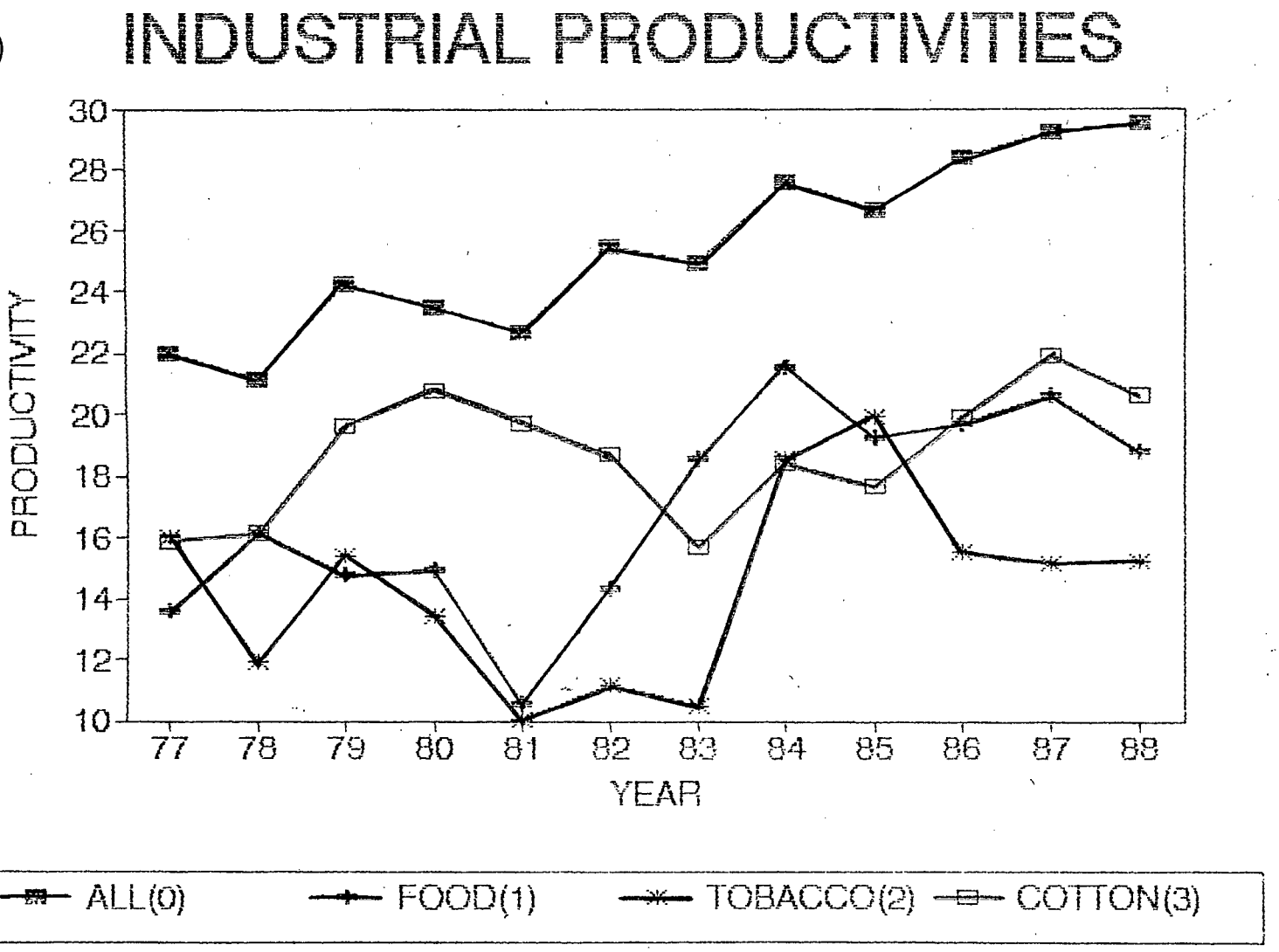
(13) REL STATE PRODUCTIVITIES



(14) REL STATE PRODUCTIVITIES



(1)


INDUSTRIAL PRODUCTIVITIES
PRODUCTIVITY
30
28
26
24
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16
14
12
10
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81
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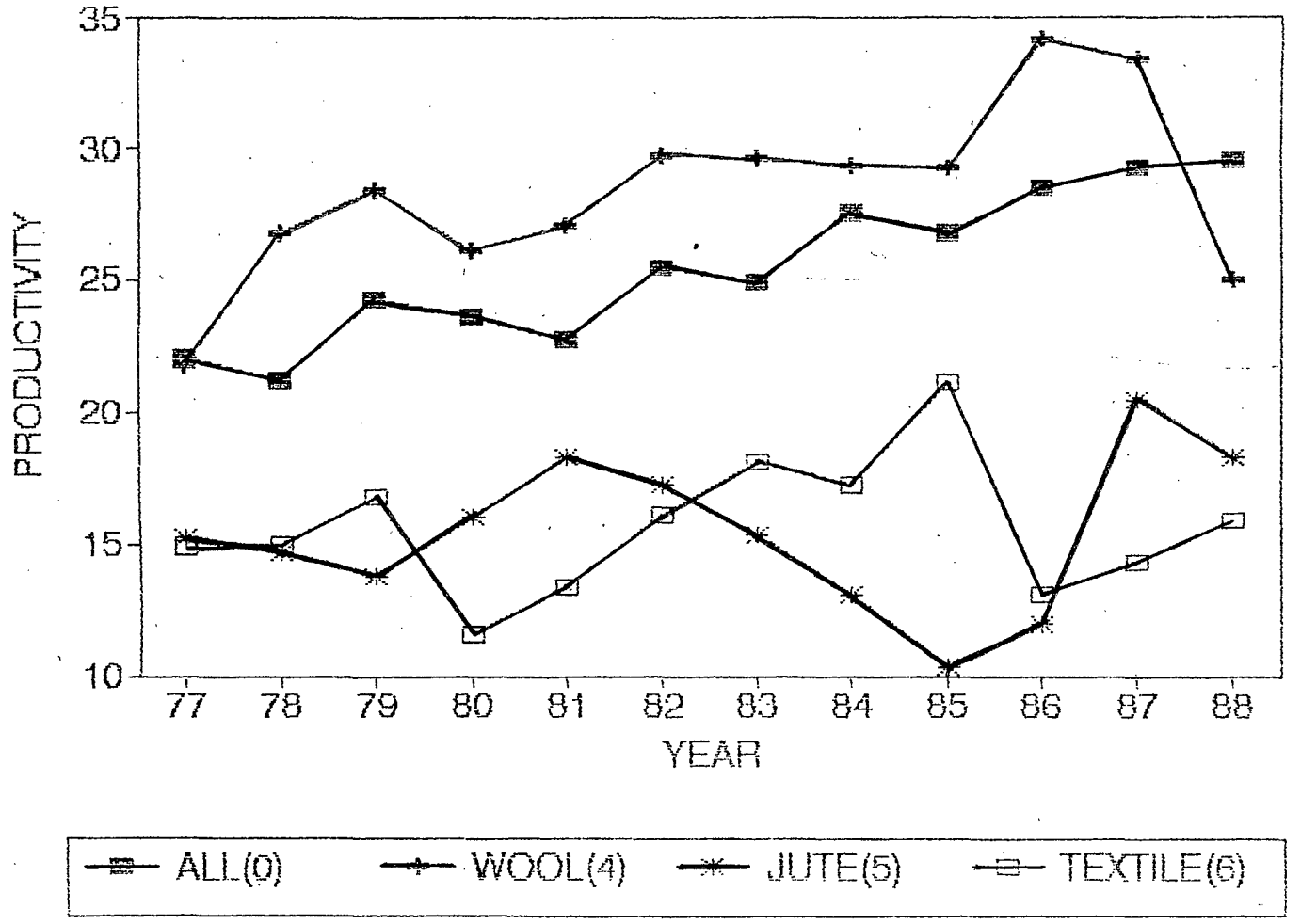
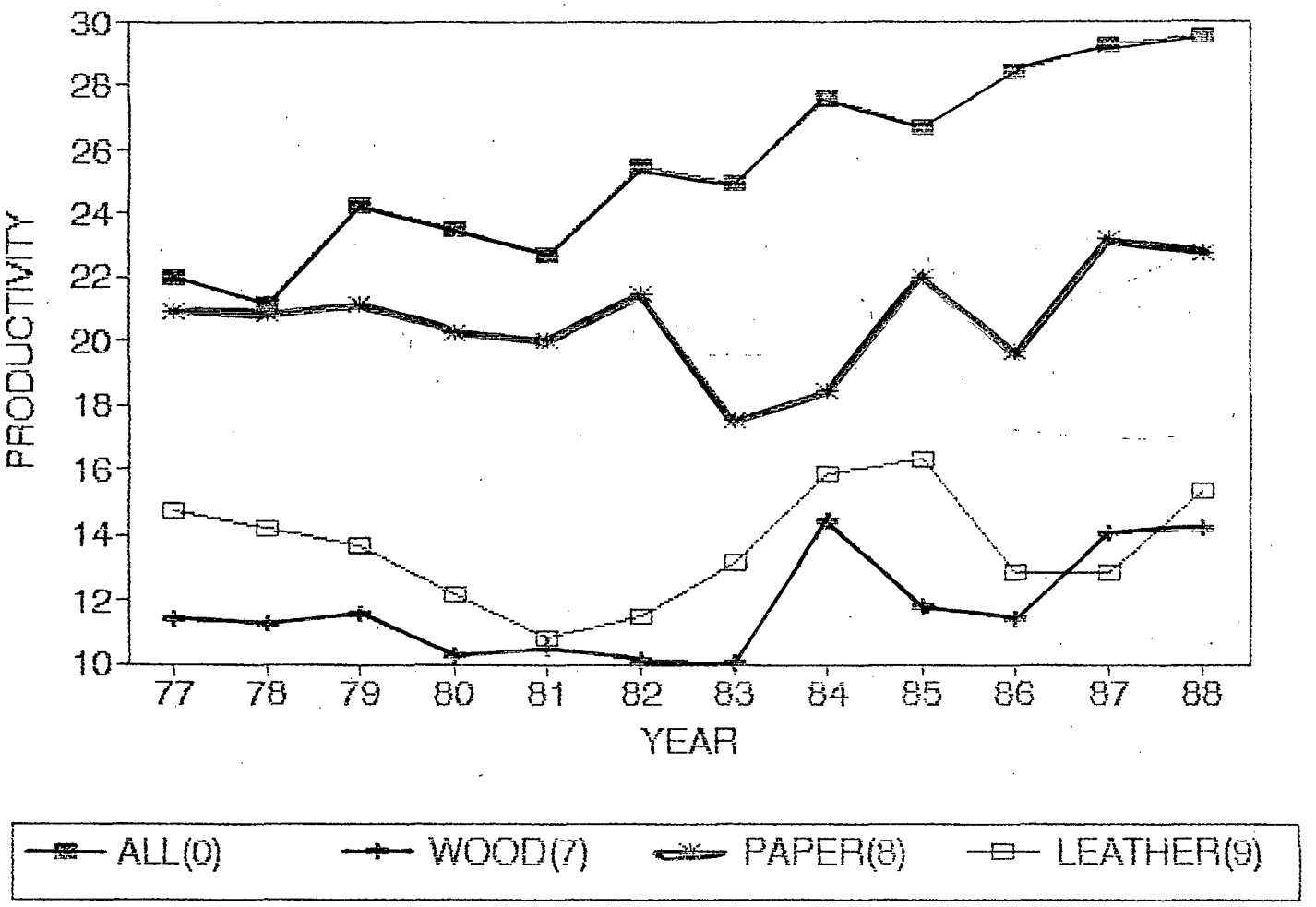
83
84
85
86
87
88
YEAR
ALL(0)
FOOD(1)
TOBACCO(2)
COTTON(3)

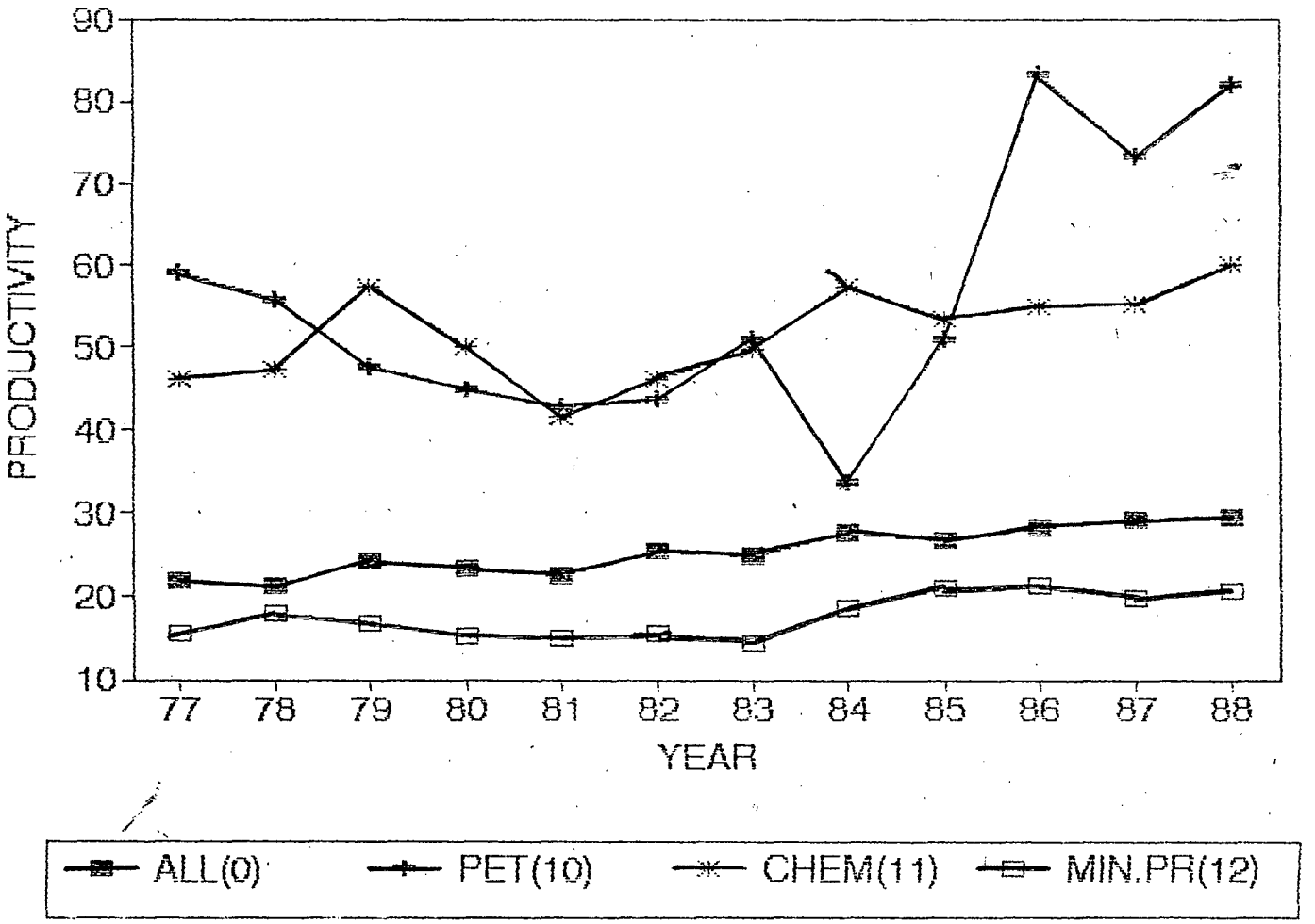
(2) INDUSTRIAL PRODUCTIVITIES



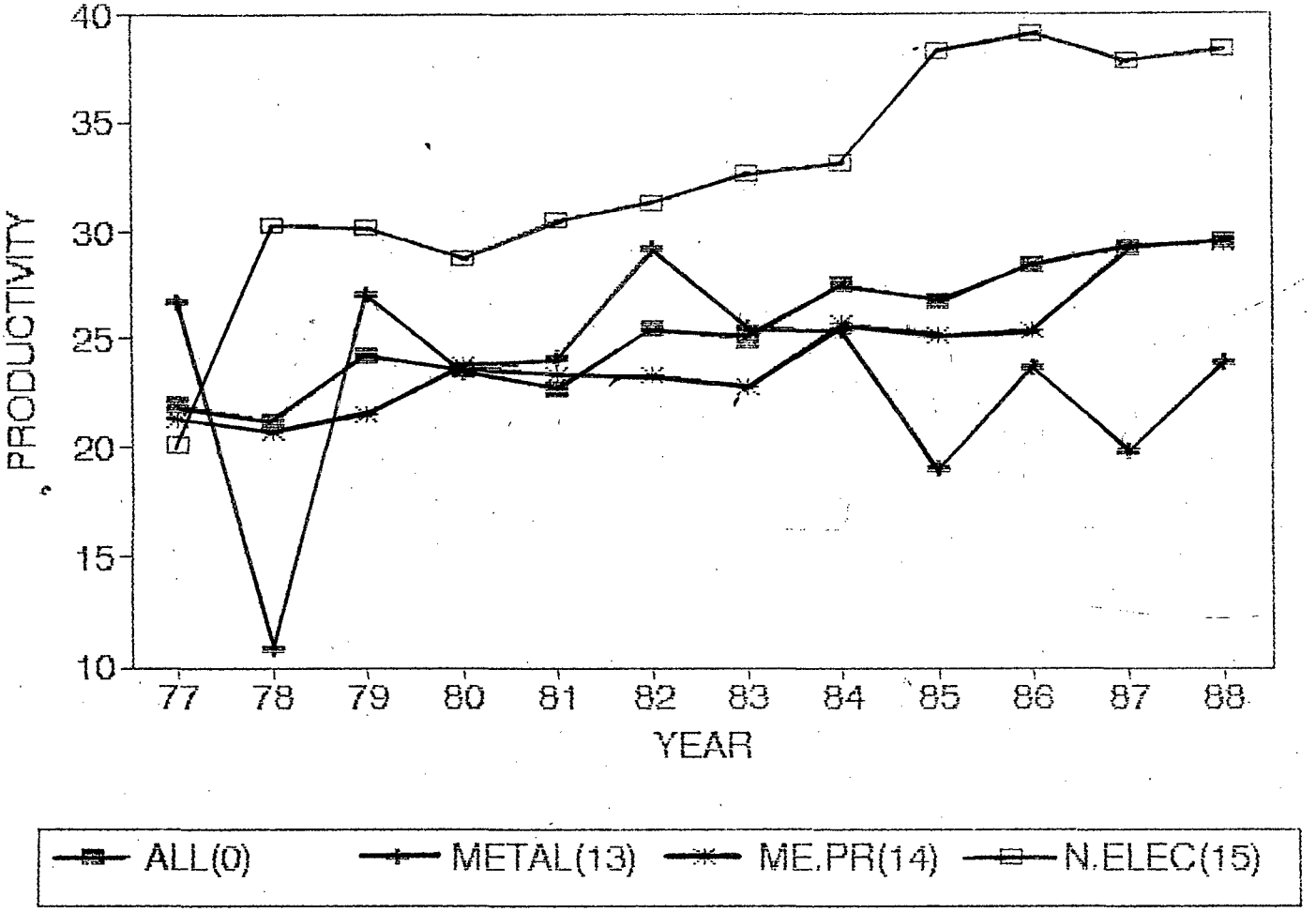
(3) INDUSTRIAL PRODUCTIVITIES



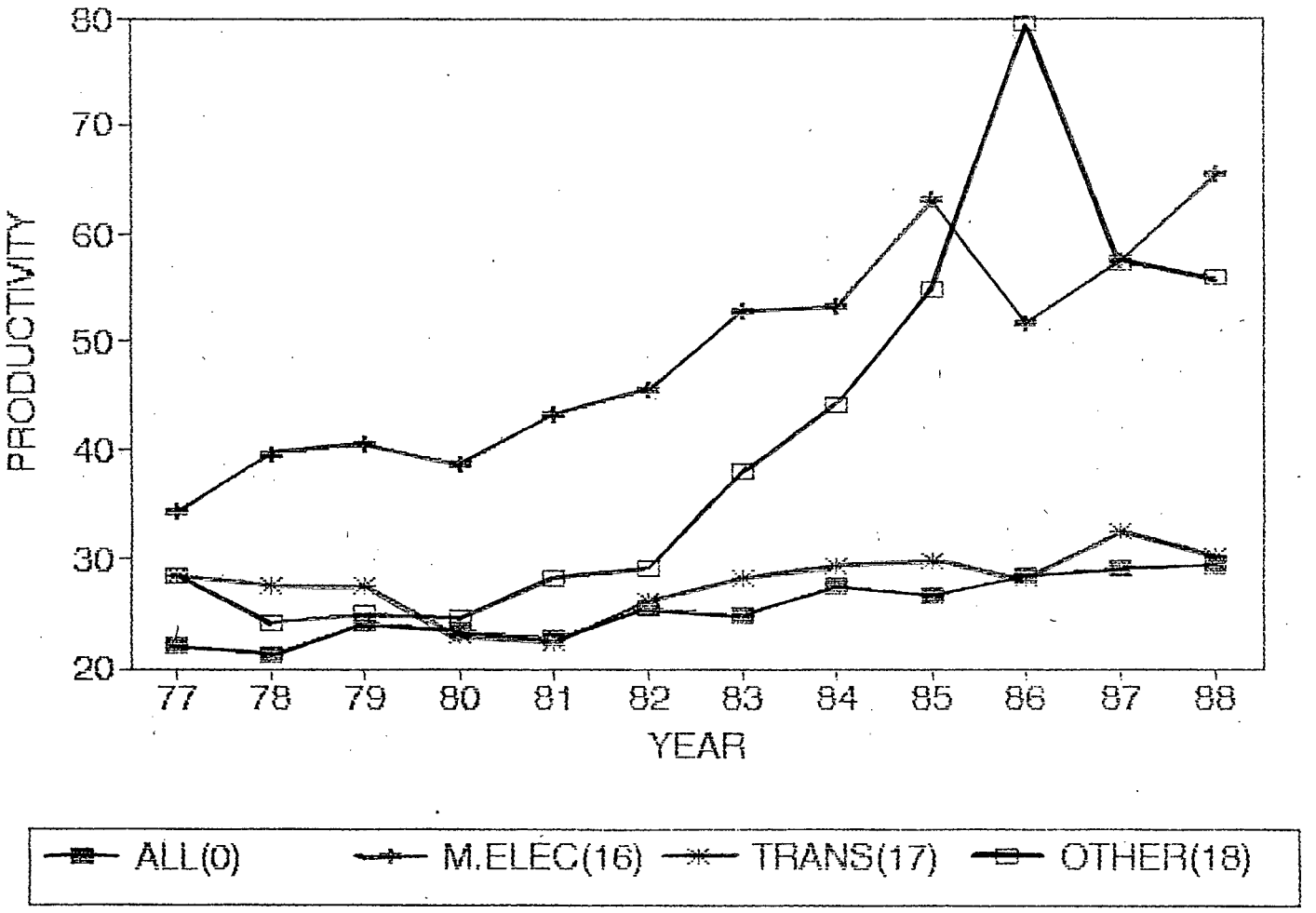
(4) INDUSTRIAL PRODUCTIVITIES



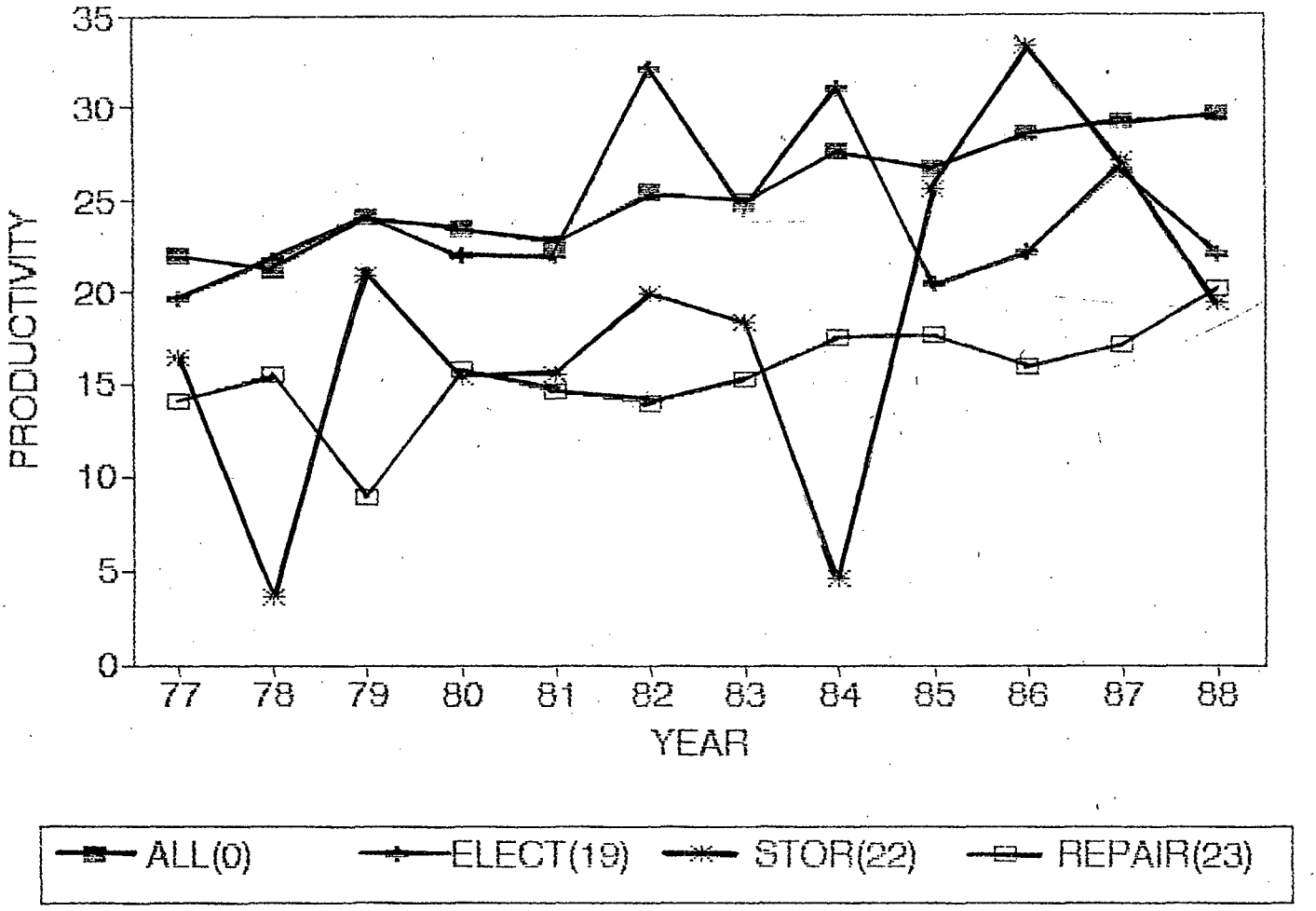
(5) INDUSTRIAL PRODUCTIVITIES



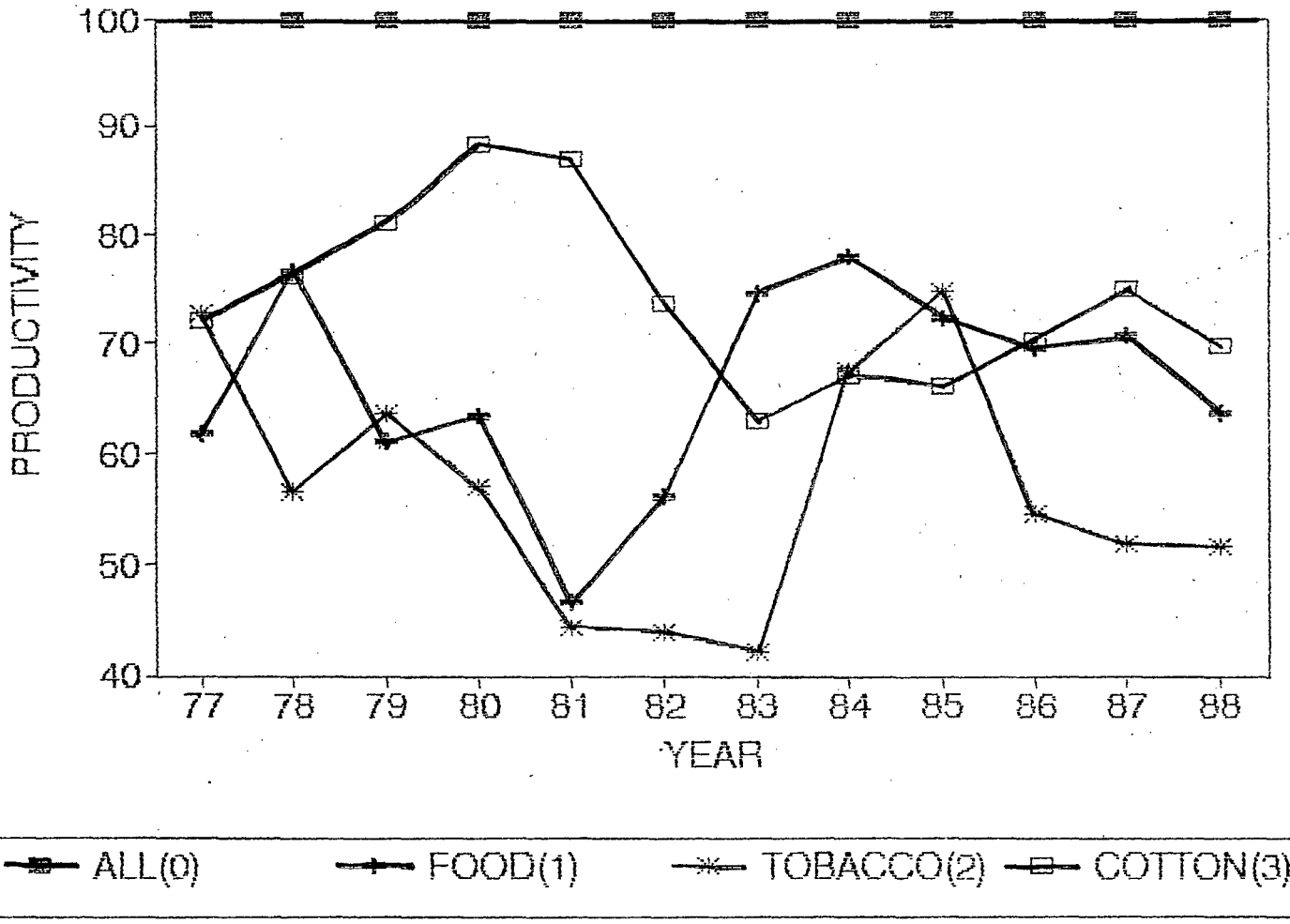
(6) INDUSTRIAL PRODUCTIVITIES



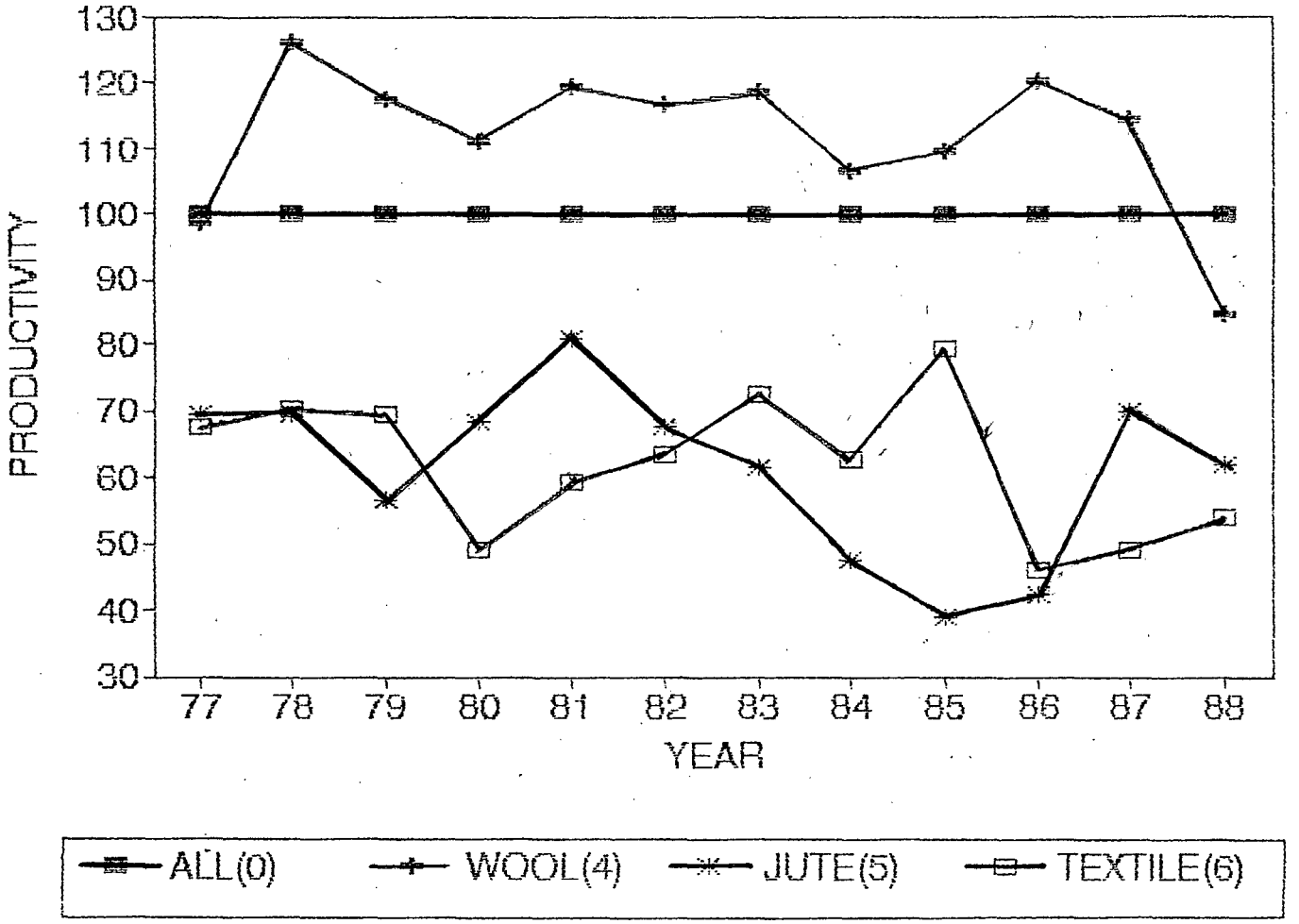
(7) INDUSTRIAL PRODUCTIVITIES



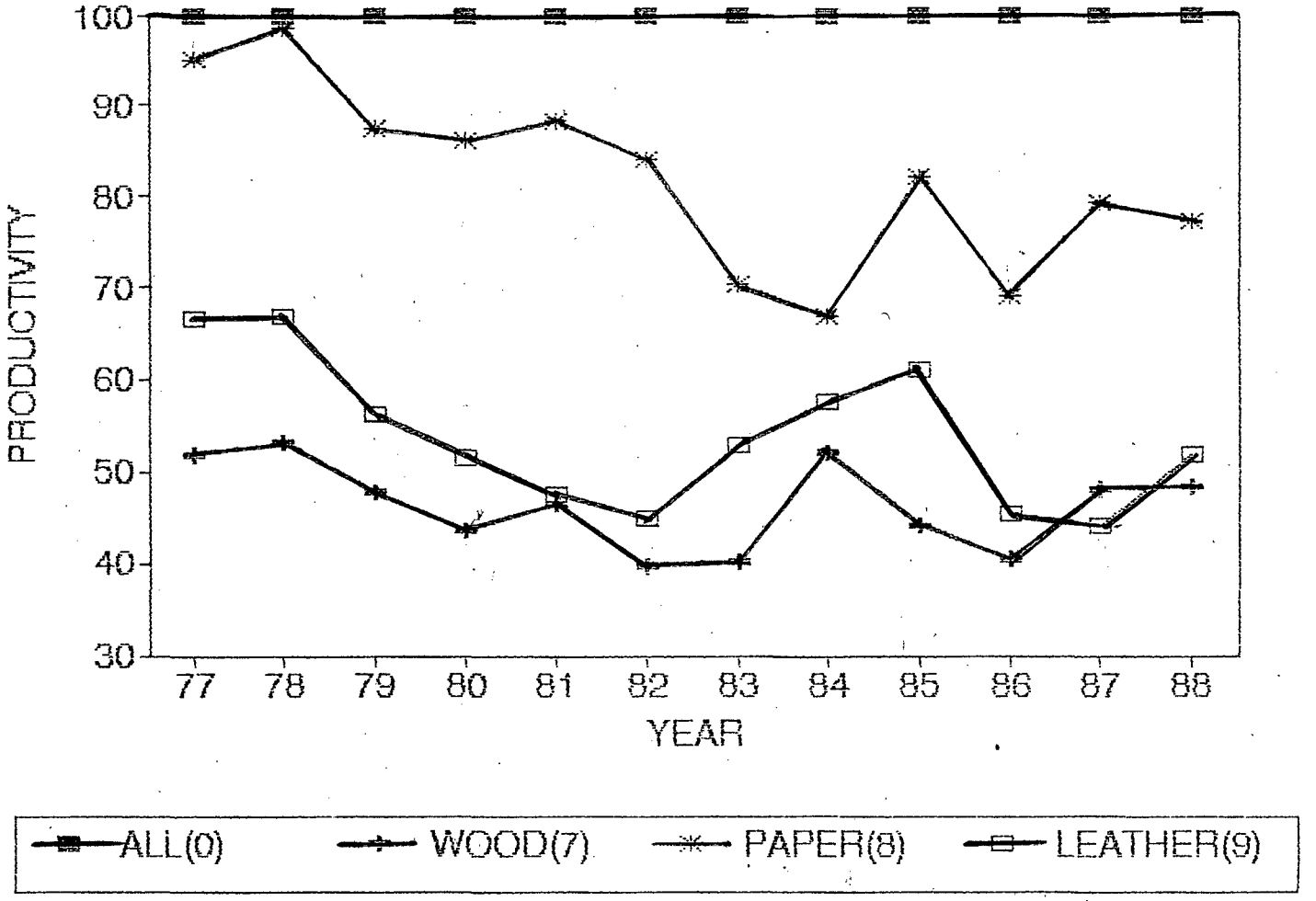
(8) INDUSTRIAL PRODUCTIVITIES



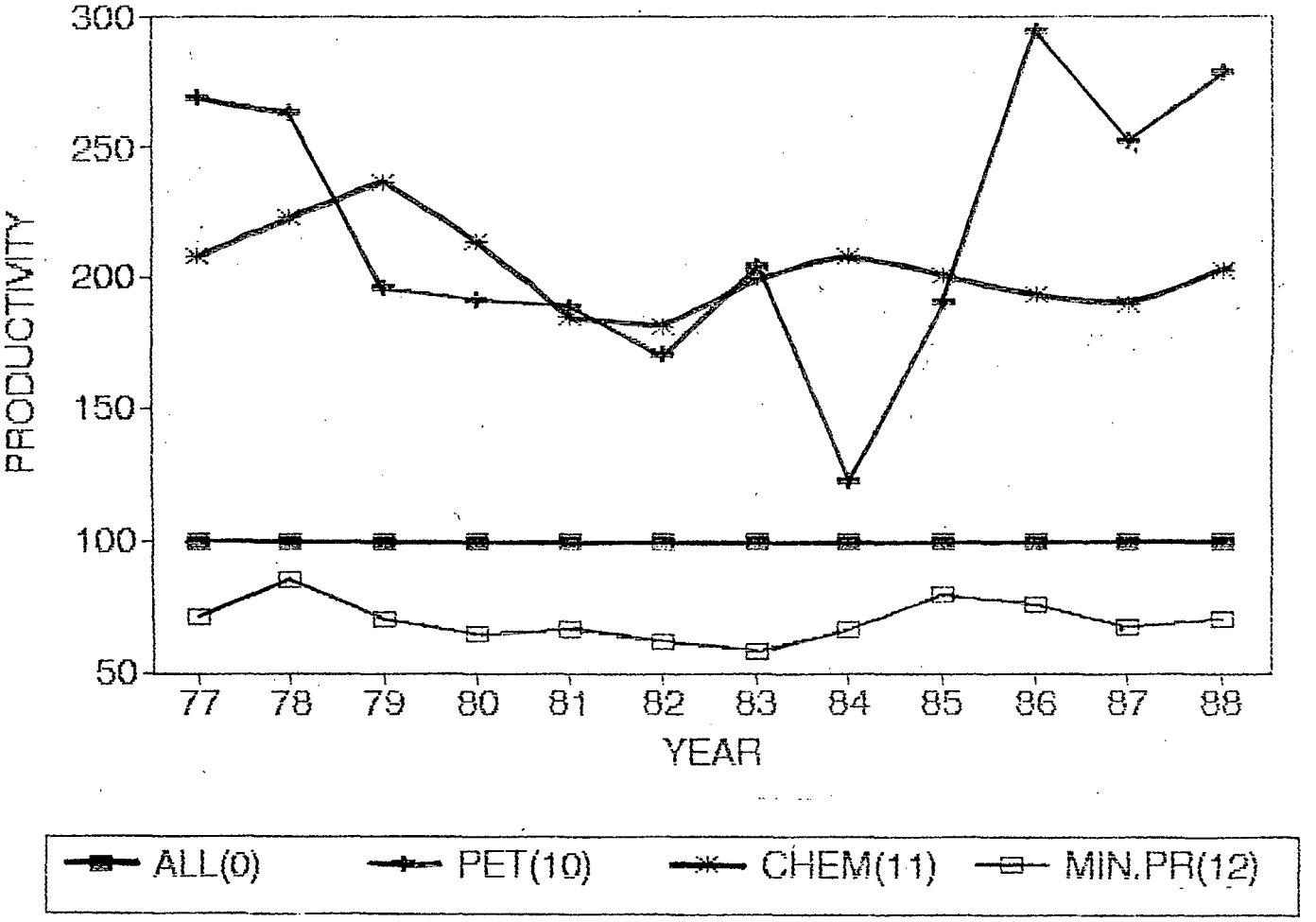
(9) INDUSTRIAL PRODUCTIVITIES



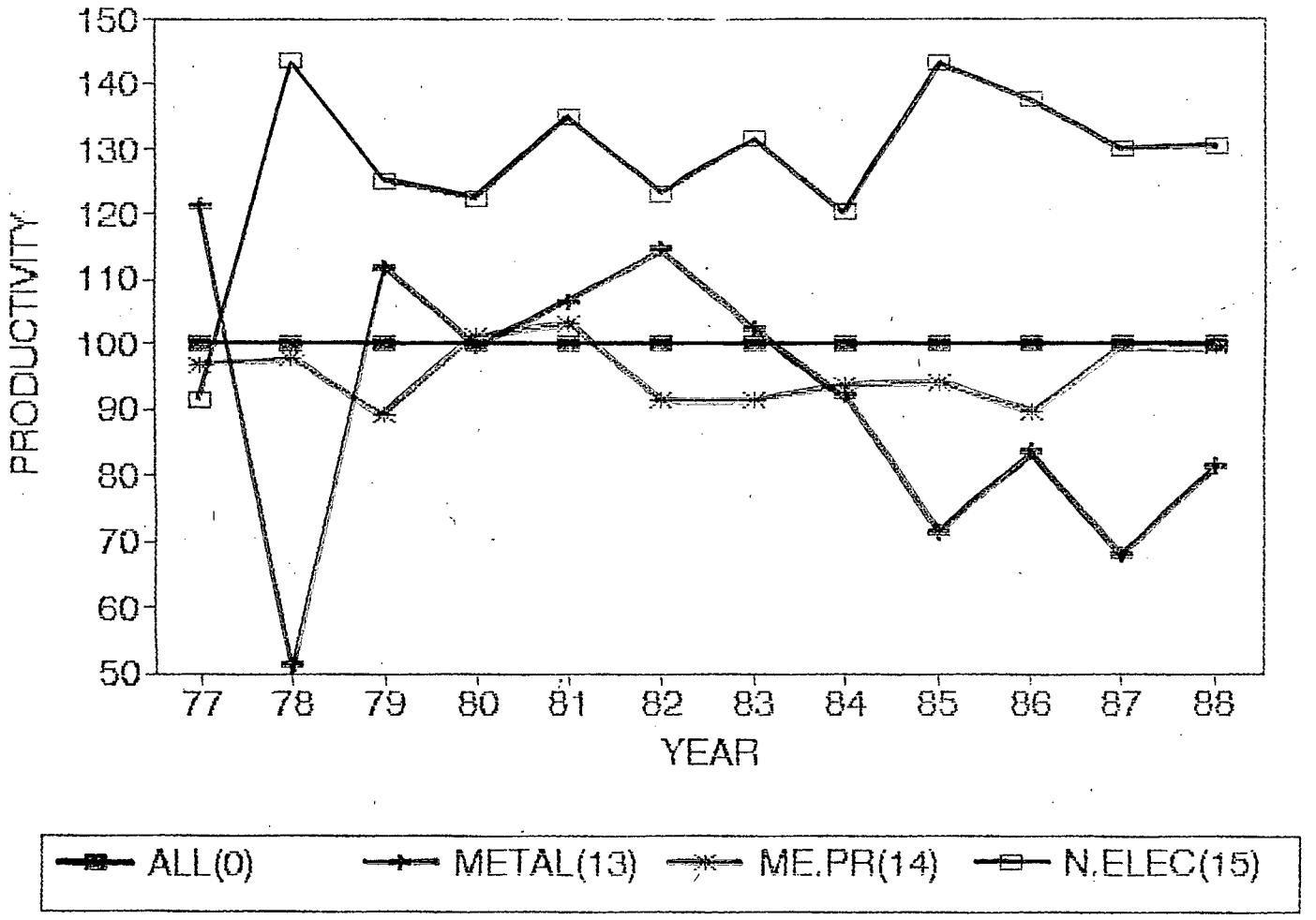
(10) INDUSTRIAL PRODUCTIVITIES



(11) INDUSTRIAL PRODUCTIVITIES



(12) INDUSTRIAL PRODUCTIVITIES



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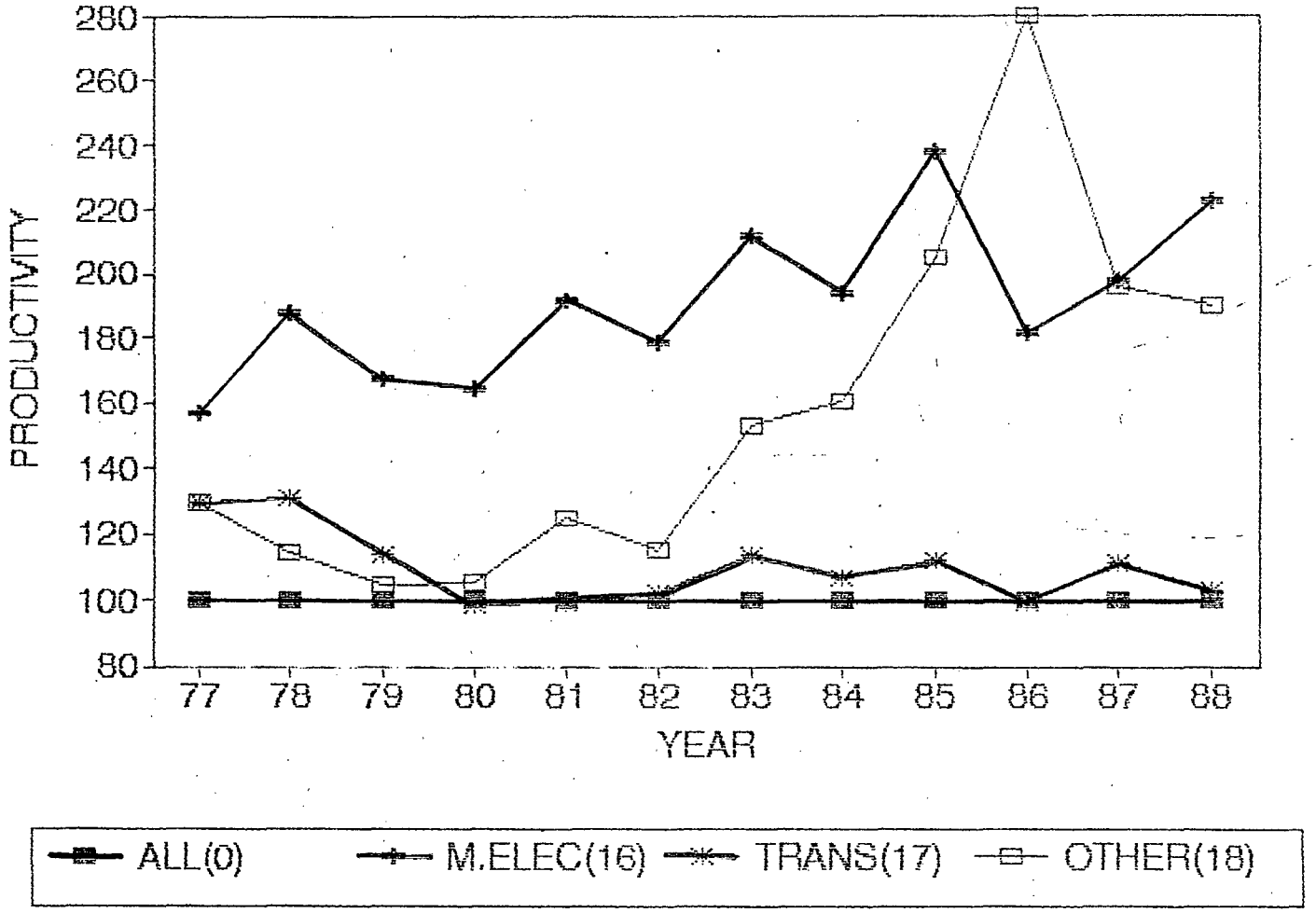


(14) INDUSTRIAL PRODUCTIVITIES

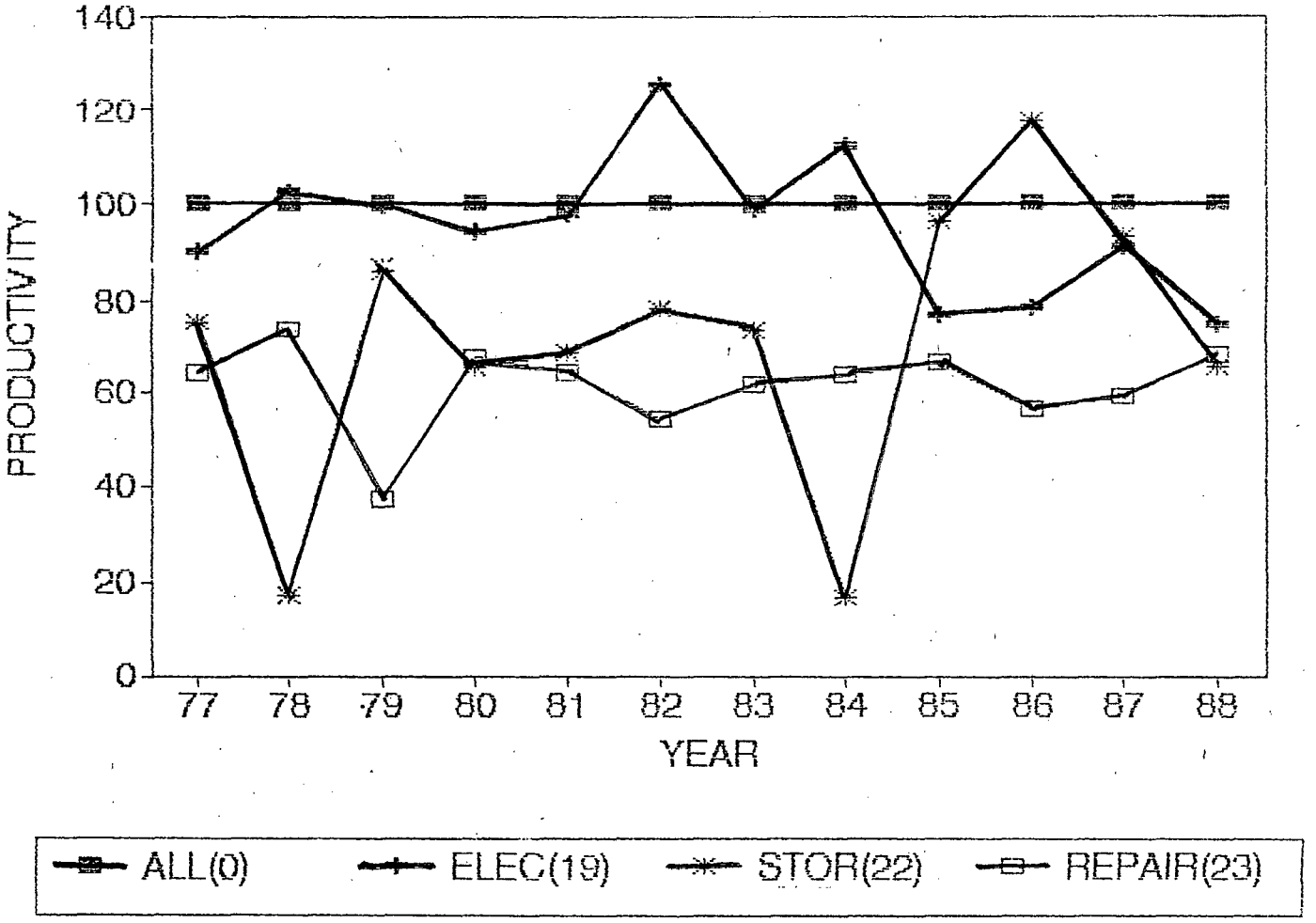


TABLE-3.1: ACTUAL STATE PRODUCTIVITIES

Productivity Levels (Descending)			Compound Rates Of Growth (Descending)		
1970-71	1978-79	1986-87	1971-79	1979-87	1971-87
			ORI 2.20		
MAH 33.83	MAH 32.21		GUJ 1.67	UP 5.73	GUJ 2.48
HAR 28.95	HAR 31.54	MAH 43.15	HAR 1.08	BIH 4.71	MP 2.26
BIH 27.15	RAJ 28.26	BIH 34.55	RAJ 1.07	KER 4.69	KER 1.55
KAR 26.45	KAR 26.71	GUJ 34.40	KAR 0.13	MP 4.51	MAH 1.53
RAJ 25.95	ORI 26.59	KER 32.05	MP 0.05	MAH 3.72	BIH 1.52
KER 25.06	GUJ 26.52	MP 31.95	TN -0.05	GUJ 3.30	UP 1.44
IND 24.68	IND 24.15	IND 30.17	IND -0.27	IND 2.82	IND 1.26
PUN 24.42	BIH 23.92	HAR 29.60	MAH -0.61	WB 2.55	TN 0.97
TN 23.47	TN 23.38	KAR 28.87	WB -1.05	TN 1.99	WB 0.73
GUJ 23.24	MP 22.45	RAJ 28.32	AP -1.16	KAR 0.98	KAR 0.55
MP 22.35	KER 22.21	TN 27.38	KER -1.50	AP 0.94	RAJ 0.55
ORI 22.33	PUN 21.52	UP 27.15	PUN -1.57	PUN 0.61	HAR 0.14
WB 22.03	WB 20.26	WB 24.77	BIH -1.57	RAJ 0.03	AP -0.12
UP 21.58	UP 17.39	PUN 22.58	UP -2.66	HAR -2.79	ORI -0.15
AP 18.00	AP 16.39	ORI 21.80		ORI -2.45	PUN -0.49
		AP 17.67			

TABLE-3.2: RELATIVE STATE PRODUCTIVITIES

Relative Productivity (Descending)			Change In Relative Productivity (Descending)		
1970-71	1978-79	1986-87	1971-79	1979-87	1971-87
			ORI 19.6		
MAH 137.1	MAH 133.4		GUJ 15.7	UP 18.0	GUJ 19.9
HAR 117.3	HAR 130.6	MAH 143.0	HAR 13.3	BIH 15.5	MP 15.3
BIH 110.0	RAJ 117.0	BIH 114.5	RAJ 11.9	KER 14.3	MAH 5.9
KAR 107.1	KAR 110.6	GUJ 114.0	KAR 3.5	MP 13.0	KER 4.7
RAJ 105.2	ORI 110.1	KER 106.2	MP 2.4	MAH 9.6	BIH 4.5
KER 101.5	GUJ 109.8	MP 105.9	TN 1.7	GUJ 4.2	UP 2.5
IND 100.0	IND 100.0	IND 100.0	IND 0.0	IND 0.0	IND 0.0
PUN 98.9	BIH 99.0	HAR 98.1	MAH -3.7	WB -1.8	TN -4.3
TN 95.1	TN 96.8	KAR 95.7	AP -5.0	TN -6.1	WB -7.2
GUJ 94.2	MP 92.9	RAJ 93.9	WB -5.4	AP -9.3	RAJ -11.3
MP 90.5	KER 92.0	TN 90.8	KER -9.6	PUN -14.2	KAR -11.5
ORI 90.5	PUN 89.1	UP 90.0	PUN -9.8	KAR -14.9	AP -14.4
WB 89.3	WB 83.9	WB 82.1	BIH -11.0	RAJ -23.1	ORI -18.2
UP 87.4	UP 72.0	PUN 74.8	UP -15.4	HAR -32.5	HAR -19.2
AP 72.9	AP 67.9	ORI 72.3		ORI -37.8	PUN -24.1
		AP 58.6			

TABLE -3.4: RELATIVE STATE PRODUCTIVITIES

	Relative Productivity (Alphabetical)			Change In Relative Productivity (Alphabetical		
	1971	1979	1987	1971-79	1979-87	1971-87
IND	100.00	100.00	100.00	0.00	0.00	0.00
AP	72.92	67.87	58.56	-5.05	-9.31	-14.36
BIH	109.99	99.02	114.51	-10.97	15.49	4.52
GUJ	94.16	109.82	114.02	15.66	4.21	19.87
HAR	117.27	130.60	98.12	13.33	-32.48	-19.15
KAR	107.15	110.60	95.69	3.45	-14.91	-11.46
KER	101.54	91.97	106.24	-9.57	14.27	4.70
MP	90.55	92.93	105.90	2.38	12.97	15.35
MAH	137.08	133.37	143.01	-3.71	9.64	5.93
ORI	90.48	110.07	72.26	19.59	-37.81	-18.22
PUN	98.92	89.08	74.84	-9.84	-14.24	-24.08
RAJ	105.15	117.01	93.87	11.85	-23.14	-11.29
TN	95.08	96.81	90.75	1.73	-6.05	-4.32
UP	87.43	71.99	89.98	-15.45	17.99	2.55
WB	89.27	83.86	82.09	-5.41	-1.77	-7.18

TABLE -3.4: RELATIVE STATE PRODUCTIVITIES

	Relative Productivity (Alphabetical)			Change In Relative Productivity (Alphabetical)		
	1971	1979	1987	1971-79	1979-87	1971-87
IND	100.00	100.00	100.00	0.00	0.00	0.00
AP	72.92	67.87	58.56	-5.05	-9.31	-14.36
BIH	109.99	99.02	114.51	-10.97	15.49	4.52
GUJ	94.16	109.82	114.02	15.66	4.21	19.87
HAR	117.27	130.60	98.12	13.33	-32.48	-19.15
KAR	107.15	110.60	95.69	3.45	-14.91	-11.46
KER	101.54	91.97	106.24	-9.57	14.27	4.70
MP	90.55	92.93	105.90	2.38	12.97	15.35
MAH	137.08	133.37	143.01	-3.71	9.64	5.93
ORI	90.48	110.07	72.26	19.59	-37.81	-18.22
PUN	98.92	89.08	74.84	-9.84	-14.24	-24.08
RAJ	105.15	117.01	93.87	11.85	-23.14	-11.29
TN	95.08	96.81	90.75	1.73	-6.05	-4.32
UP	87.43	71.99	89.98	-15.45	17.99	2.55
WB	89.27	83.86	82.09	-5.41	-1.77	-7.18

TABLE-3.5: CROSS SECTION COEFFICIENTS OF VARIATION
FOR FOURTEEN STATES: 1969-70 TO 1987-88

YEAR	C.V.
1969-70	14.53
1970-71	23.85
1971-72	24.12
1973-74	18.13
1974-75	23.43
1975-76	22.28
1976-77	18.20
1977-78	21.16
1978-79	22.32
1979-80	22.24
1980-81	22.38
1981-82	22.95
1982-83	22.84
1983-84	34.61
1984-85	23.01
1985-86	29.77
1986-87	23.87
1987-88	24.80

LOG-LINEAR REGRESSION RESULTS	
Independent Variable:	Time
Dependent Variable:	C.V.
Constant	1.27
Std Err of Y Est	0.07
R Squared	0.33
No. of Observations	18
Degrees Of Freedom	16
X Coefficient	0.01
Std Err of Coeff	0.00
`r´	1.91
`t´	2.82***
*** Significant at 99%	

TABLE-3.6:INDUSTRY-WISE PRODUCTIVITIES: ACTUAL AND RELATIVE

Actual Productivity (Descending)				Compound Growth Rate (Descending)		Relative Productivity (Descending)				Relative Productivity Change (Descending)	
Code	1978	Code	1987	Code	1978-87	Code	1978	Code	1987	Code	1978-87
				22	14.8					18	104
10	54.0	10	79.6	18	10.5	10	241	10	274	22	58
11	50.3	18	63.7	16	4.9	11	224	18	219	10	33
16	38.1	16	58.4	15	4.4	16	170	16	201	16	31
17	27.9	11	56.6	10	4.4	17	124	11	195	15	16
15	26.0	15	38.4	23	4.3	15	116	15	132	23	7
18	25.9	4	30.5	1	3.2	18	115	4	105	14	2
4	25.5	17	30.4	14	3.2	4	114	17	105	1	2
0	22.4	0	29.0	0	2.9	0	100	0	100	0	0
19	21.9	14	28.0	12	2.2	19	98	14	96	12	-4
14	21.1	22	26.7	3	2.1	14	94	22	92	3	-5
8	21.0	19	23.5	4	2.0	8	93	19	81	7	-5
13	18.8	13	22.4	13	1.9	13	84	13	77	13	-7
3	17.2	8	21.9	7	1.6	3	77	8	75	5	-7
12	16.9	3	20.8	5	1.6	12	75	3	72	4	-9
6	15.5	12	20.6	11	1.3	6	69	12	71	2	-11
1	14.9	1	19.7	17	1.0	1	66	1	68	9	-16
5	14.5	23	17.7	19	0.8	5	65	23	61	19	-17
2	14.4	5	16.7	2	0.7	2	64	5	58	8	-18
9	14.1	2	15.3	8	0.5	9	63	2	53	6	-19
23	12.1	6	14.5	9	-0.3	23	54	6	50	17	-20
7	11.4	9	13.7	6	-0.3	7	51	9	47	11	-29
22	7.7	7	13.2			22	34	7	45		

TABLE-3.71: INDUSTRY-WISE PRODUCTIVITIES, ACTUAL AND RELATIVE
(ALL, BASIC AND NON-BASIC INDUSTRIES)

Actual Productivity			Compound Growth Rate	Relative Productivity		Relative Productivity Change
Industry	1978	1987	1978-87	1978	1987	1978-87
Basic	29.11	37.35	2.81	129.70	128.59	-1.11
Non.Basic	16.84	21.20	2.59	75.03	72.99	-2.04
All	22.44	29.04	2.91	100.00	100.00	0.00
CV	27.23	27.79				

TABLE-3.72: INDUSTRY-WISE PRODUCTIVITIES, ACTUAL AND RELATIVE
(BY INDUSTRY CODE)

Actual Productivity			Compound Growth Rate	Relative Productivity		Relative Productivity Change
Industry Code	1978	1987	1978-87	1978	1987	1978-87
1	14.87	19.68	3.16	66.24	67.75	1.51
2	14.36	15.27	0.69	63.97	52.58	-11.38
3	17.25	20.81	2.11	76.85	71.67	-5.18
4	25.54	30.46	1.98	113.79	104.90	-8.89
5	14.52	16.75	1.60	64.72	57.67	-7.05
6	15.51	14.48	-0.76	69.11	49.86	-19.25
7	11.40	13.20	1.64	50.80	45.44	-5.36
8	20.98	21.86	0.45	93.48	75.25	-18.23
9	14.13	13.70	-0.34	62.95	47.18	-15.77
10	54.02	79.58	4.40	240.71	274.01	33.30
11	50.34	56.65	1.32	224.28	195.06	-29.23
12	16.86	20.56	2.23	75.12	70.80	-4.32
13	18.83	22.40	1.95	83.89	77.13	-6.76
14	21.14	27.98	3.16	94.19	96.33	2.13
15	26.03	38.42	4.42	115.96	132.29	16.33
16	38.10	58.36	4.85	169.76	200.94	31.18
17	27.86	30.38	0.97	124.13	104.61	-19.52
18	25.87	63.74	10.54	115.25	219.47	104.22
19	21.94	23.53	0.78	97.76	81.02	-16.74
22	7.70	26.70	14.81	34.32	91.94	57.62
23	12.12	17.65	4.27	53.99	60.78	6.79
0	22.44	29.04	2.91	100.00	100.00	0.00
CV	45.60	52.58				

TABLE-3.8: CROSS SECTION COEFFICIENTS OF VARIATION FOR TWENTY ONE INDUSTRIES

YEAR	C.V.
1976-77	44.5Ø
1977-78	51.51
1978-79	47.46
1979-8Ø	41.22
198Ø-81	41.33
1981-82	4Ø.47
1982-83	47.88
1983-84	42.28
1984-85	5Ø.93
1985-86	54.67
1986-87	48.46
1987-88	56.19

LOG-LINEAR REGRESSION RESULTS	
Independent Variable:	Time
Dependent Variable:	C.V.
Constant	1.63
Std Err of Y Est	Ø.Ø5
R Squared	Ø.23
No. of Observations	12
Degrees Of Freedom	1Ø
X Coefficient	Ø.Ø1
Std Err of Coeff	Ø.ØØ
`r´	1.51
`t´	1.72

CHAPTER FOUR

ANALYSIS OF DIFFERENCES BETWEEN VARIOUS STATES' LABOUR PRODUCTIVITIES AND THE PRODUCTIVITY OF THE NATION AS A WHOLE

This chapter falls into four main parts. Following the introduction, the results are reported of an analysis of ranks of states according to their total effects, structure effects, and region effects, and the change in these ranks over time. This leads to a consideration of the ranks of states according to the change in total effect, structure effect, and region effect. The final subsection presents the results of an analysis of the behaviour of the standard deviations of Total effect, Structure effect and Region effect between states over time. A concluding section sums up the main findings.

Introduction:

This part of the chapter begins with a broad overview of what is to be discussed in the chapter. The methodologies previously adopted, and the methodology used to calculate structure, region, and interaction effects in the present work are then described.

Overview:

As mentioned earlier, the data is taken from the Annual Survey of Industries for Value Added and Mandays-employees for fourteen major states and all the industries at the two digit level of classification. To arrive at the all India figures, the state figures have been added. Value Added has been deflated by the Wholesale Price Index of manufacturing of the respective industries. Triennium averages of 1976-77 to 1978-79, and 1985-86 to 1987-88 for Value Added and Mandays Employed have been taken as the figures for 1977-78 and 1986-87 respectively. For short, these years are

identified as 1978 and 1987. The triennium average figures were used to calculate the Total Effect, Structure Effect and Region Effect for 1978 and 1987.

It may be pointed out that, as the total effect denotes the position of various states with respect to India, it is a sort of index of relative productivities of various states to that of India, with India's figure with respect to itself equal to 0. Further it needs to be noted that as structure and region effects are the components of total effect, these numbers are also indices, with the number of both structure and region effects of India with respect to itself equal to 0. Therefore the question of examining both actual and relative figures, (as in the previous chapter), does not arise.

Methodologies:

There are two methodologies for calculating the various effects that are to be estimated in the analysis of this chapter. The first is one of the methodologies mentioned by A.J. Brown (1969), and also used by T.S. Papola (1971) in his article on inter-regional variations in manufacturing wages in India, which describes industrial structure and region effects. This is called METHOD 1 below. The second approach is another methodology mentioned by A.J. Brown (1969). This is called METHOD 2 below.

The following abbreviations have been used in setting out the details of both methods.

T.E. = Total Effect

S.E. = Structure Effect

R.E. = Region Effect

I.E. = Interaction Effect

P = Productivity of nation

p_j = Productivity of state

$p_j(s)$ = Structure Constant productivity of state

$p_j(r)$ = Region Constant productivity of state

H = No. of mandays employed of nation

h_{ij} = No. of mandays employed of i'th industry, j'th state

p_{ij} = Productivity of i'th industry, j'th state

The Structure Constant productivity is defined as the sum by industries of (productivity of individual industries in the state multiplied by the number of mandays employed in the corresponding industry of the nation), divided by the Total number of mandays employed of the nation. Mathematically, it can be written as: $(h_i * p_{ij})/(H)$

The Region Constant productivity is defined as the sum by industries of (Number of mandays employed in individual industries of the state multiplied by the productivity of the corresponding industry of the nation), divided by the number of mandays employed in the state. Mathematically it can be written as: $(h_{ij} * p_i)/(h_{ij})$.

For the various effects as defined in the present study the same abbreviations are used but the word 'ours' is added in brackets.

Method 1:

In this method the Structure and Region Effects as mathematically formulated do not add up to be equal to the Total Effect. It can be seen that:

T.E -(S.E + R.E) $\qquad$ T.E = $p_j - P$; S.E = $p_j - p_j(s)$; R.E = $p_j - p_j(r$

$= p_j - P - [\, p_j - p_j(s) + p_j - p_j(r) \,]$

$= -[P - p_j(s) + p_j - p_j(r) \,]$

The figure in brackets is called the interaction effect 'I', so that:

$$T.E.-(S.E. + R.E) = -(I), \text{ OR, } T.E. = S.E. + R.E. - I$$

$$-[I] = -\left[\frac{\sum h_i p_i}{H} - \frac{\sum h_i p_{ij}}{H} + \frac{\sum h_{ij} p_{ij}}{h_j} - \frac{\sum h_{ij} p_i}{h_j}\right] - \left[\frac{\sum h_{ij} p_i}{h_j} - \frac{\sum h_{ij} p_{ij}}{h_j}\right]$$

$$= -\left[\sum \frac{h_i}{H} (p_i - p_{ij}) - \sum \frac{h_{ij}}{h_j} (p_i - p_{ij})\right] - \left[\sum (p_i - p_{ij}) \left(\frac{h_i}{H} - \frac{h_{ij}}{h_j}\right)\right]$$

$$= -\left[\sum (p_{ij} - p_i) \left(\frac{h_{ij}}{h_j} - \frac{h_i}{H}\right)\right]$$

Method 2:

As noted earlier, in both methods, the Total Effect is the same, as is also the structure constant productivity, and region constant productivity in both the methods.

$$T.E. = p_j - P$$

$$S.E. = p_j(r) - P$$

$$R.E. = p_j(s) - P$$

$$T.E - [S.E + R.E]$$

$$= p_j - P - [p_j(r) - P + p_j(s) - P]$$

$$= p_j - P - p_j(r) + P - p_j(s) + P$$

$$= [p_j - p_j(r) - p_j(s) + P]$$

The figure in brackets is the Interaction Effect 'I', such that:

$$T.E -(S.E.+R.E.) = I, \text{ OR}$$

$$T.E. = S.E.+R.E.+I$$

It is evident that the value for the interaction effect is the same in both methods. The only difference is that in method 1, the interaction effect is subtracted from the Structure effect

+ Region Effect and in method 2 it is added to Structure Effect + Region Effect to make the Total Effect.

Our Method:

As mentioned above, in 'our' method, and the average of the Structure Effects in the two methods is calculated and used as our Structure Effect the average of the Region Effect in the two methods becomes our Region Effect. The Interaction Effect in our method is the average of the remaining term in the components of Total Effect in the two methods. As the remaining term is a negative Interaction Effect in the first method, and a positive Interaction Effect in the second method, the average of these remaining terms becomes zero. Thus, as mentioned earlier, there is no Interaction Effect in our method.

The Total Effect in both the methods is the same. Thus, when the average of the two is taken as our measure for Total Effect, the result is the same Total Effect as in the two methods.

Our measures for the various effects can be calculated as follows:

$$T.E(\text{ours}) = \frac{T.E \text{ method } 1 + T.E \text{ method } 2}{2}$$

$$= \frac{p_j - P + p_j - P}{2}$$

$$= p_j - P$$

$$I.E(\text{ours}) = \frac{+I - I}{2} = 0$$

$$S.E(\text{ours}) = \frac{S.E \text{ method } 1 + S.E \text{ method } 2}{2}$$

$$= \frac{p_j - p_j(s) + p_j(r) - P}{2} \qquad ---(1)$$

$$R.E(ours) = \frac{R.E\ method\ 1 + R.E\ method\ 2}{2}$$

$$= \frac{p_j - p_j(r) + p_j(s) - P}{2} \qquad \text{---------(2)}$$

It can be seen that:

$$S.E - \frac{(I)}{2} = (-p_j(s) + \frac{1}{2} p_j(s) - \frac{1}{2} (P - p_j(s) + p_j - p_j(r))$$

$$= p_j - (p_j(s) - \frac{1}{2} (P - p_j(s) + p_j - p_j(r))$$

$$\frac{p_j - p_j(s) - P + p_j(r)}{2} \qquad \text{----------(3)}$$

Evidently, equation (3) is same as equation (1). Thus it is obvious that:

$$S.E.(ours) = \frac{S.E.(method\ 1) + S.E.(method\ 2)}{2}$$

$$= S.E.(method\ 1) - \frac{(I)}{2}$$

When half of the Interaction Effect is subtracted from the Region Effect of method 1, we get:

$$R.E.(method\ 1) - \frac{(I)}{2}$$

$$= p_j - p_j(r) - \frac{1}{2} (P - p_j(s) + p_j - p_j(r))$$

$$= \frac{p_j - p_j(r) - P + p_j(s)}{2}$$

Again, it is clear that equation (4), is the same as equation (2).

Thus it is obvious that:

$$R.E(ours) = R.E\ (\frac{method\ 1 + method\ 2}{2})$$

$$= R.E.(method\ 1) - \frac{(I)}{2}$$

When half of Interaction Effect is added to the Structure

Effect(method 2), we get:

$$S.E.(\text{method } 2) + \frac{(I)}{2}$$

$$= p_j(r) - P + \frac{1}{2}\left(P - p_j(s) + p_j - p_j(r)\right)$$

$$= \frac{1}{2}p_j(r) - \frac{1}{2}P - \frac{1}{2}p_j(s) + \frac{1}{2}p_j$$

$$= \frac{p_j(r) - P - p_j(s) + p_j}{2} \quad \text{----------(5)}$$

Since equation (5) is the same as equation (1), it is obvious that:

$$S.E(\text{ours}) = SE\left(\frac{\text{method 1}+\text{method 2}}{2}\right)$$

$$= S.E(\text{method } 2) + \frac{(I)}{2}$$

Finally when half of the Interaction Effect is added to the Region Effect (method 2), we get:

$$R.E.(\text{method } 2) + \frac{(I)}{2}$$

$$= p_j(s) - P + \frac{1}{2}\left(P - p_j(s) + p_j - p_j(r)\right)$$

$$= \frac{p_j(s) - P + p_j - p_j(r)}{2} \quad \text{---------(6)}$$

It is evident that equation (6) is the same as equation (2). Thus, it is obvious that:

$$R.E(\text{ours}) = R.E\left(\frac{\text{method 1}+\text{method 2}}{2}\right)$$

$$= R.E.(\text{method } 2) + \frac{(I)}{2}$$

Conceptually, the structure effect in both expressions denotes the same thing, as also does the region effect. The sum of structure and region effects does not add up to be equal to the total effect in either case and the remaining term is called the interaction effect. What structure and region effect in both cases conceptually denotes can be expressed as follows.

If a region's labour productivity is greater than the national productivity, how much is because the higher productivity industries of the nation have more mandays-employed as a proportion of total employers in that state as compared to the nation is defined as the structure effect and how much is due to the specific industries in which the nation has higher proportion of manday employees to that of total mandays-employees having more productivity in State than nation is the region-effect.

Since the structure effect in both equations expresses the same thing, and the two equations are merely two different mathematical interpretations of it, there can be no objection to taking the average of the two as our measure of structure effect. By the same logic there can be no objection to taking the average of the two measures of regional effect as our measure of the same. The average of the remaining term of both, that is the interaction effect, is taken as our interaction effect. As will be seen later, this will turn out to be equal to zero.

As already noted the sum of structure and region effects do not add up to be equal to the total effect, and the remaining term is called interaction effect in both cases. This effect is said to be due to the mutual interdependence of the two effects. In practical or real life situations it is difficult to understand what interdependence there can be between the two effects. In our method of calculation, the interaction effect becomes equal to zero (see below), so this problem is satisfactorily resolved.

Ranks:

In this subsection the analysis focuses on the ranks of states according to their total effects, structure effects, and region effects, and the change in these ranks over time. First the Total Effect, is considered then the Structure and Region Effects, and then a comparison is made between the three. All of these results are shown in table 4.1.

Total Effect:

In 1978, the highest Total Effect was recorded by Haryana with 7.74 points, followed by Maharashtra with 6.59 and then Gujarat with 3.85 points. The lowest Total Effect was recorded by Orissa with -9.65 points, followed by Andhra Pradesh with -5.61 and Uttar Pradesh with -5.03 points. The states having positive Total Effect in this year were Haryana, Maharashtra, Gujarat, Karnataka, Madhya Pradesh, Rajasthan, Tamil Nadu and Bihar. Those with negative Total Effects in this year, were, Punjab, Kerala, West Bengal, Uttar Pradesh, Andhra Pradesh and Orissa. As mentioned earlier, these numbers are a sort of index with India equal to zero. Therefore the states with positive figures are better off in terms of labour productivity as compared to India taken as a whole, and those with negative figures are worse off in terms of productivity, than India taken as a whole.

In 1987 there were only three states where the Total Effect was positive. Amongst these the Maharashtra total effect was the highest with 13.54 points. There does not seem to be any relation between the ranks of the states, according to their Total Effects in 1978 and in 1987. The states with positive Total Effects in 1987 were Maharashtra, Gujarat and Kerala.

Those with negative Total Effects in the same year were Karnataka, Bihar and Haryana, Madhya Pradesh , Rajasthan, Uttar Pradesh, West Bengal, Punjab, Orissa and Andhra Pradesh.

Maharashtra and Gujarat were the only two states with positive Total Effects in both 1978 and 1987. Punjab, West Bengal, Uttar Pradesh, Andhra Pradesh, and Orissa had negative Total Effects in both the years. Karnataka, Madhya Pradesh, Rajasthan, Tamil Nadu, and Bihar had positive Total Effects in 1978 and negative Total Effects in 1987. Kerala with a negative Total Effect in 1978 had a positive Total Effect in 1987.

Structure Effect:

In 1978 there were eight states with positive Structure Effects. In other words there were eight states which had on the average a better mix of industries in terms of labour productivity, than that of all India. These were, Bihar, Maharashtra, Rajasthan, Karnataka, Gujarat, Tamil Nadu, Madhya Pradesh, and Punjab. The states having negative Structure Effect in this year were, Uttar Pradesh, Kerala, Orissa, West Bengal, Andhra Pradesh and Haryana. The highest Structure Effect in this year was that of Bihar with 1.89 points, followed by Maharashtra with 1.52 and Rajasthan with 1.39 points. Haryana had the lowest Structure Effect in this year of -8.66 points. This was considerably lower than Andhra Pradesh, which with -3.25 points had the second lowest Structure Effect.

In 1987 there were seven states with a positive Structure Effect. These were Gujarat, Maharashtra, Bihar, Karnataka, Haryana, Tamil Nadu and Kerala. Madhya Pradesh, Rajasthan, Uttar Pradesh, Punjab, West Bengal, Orissa and Andhra Pradesh had negative Structure Effects in the same year. There does not seem

to be any relation between the ranks of states according to Structure Effect in 1978 and 1987. The states with positive Structure Effect in 1978 as well as 1987 were: Bihar, Maharashtra, Karnataka, Gujarat, and Tamil Nadu. The states with negative Structure Effect in both the years were Uttar Pradesh, Orissa, West Bengal and Andhra Pradesh. Rajasthan, Madhya Pradesh, and Punjab with positive Structure Effects in 1978, had negative Structure Effects in 1987. Kerala and Haryana with negative Structure Effects in 1978 had positive Structure Effects in 1987.

Region Effect:

Haryana had the highest Region Effect in 1978 with 16.40 points. This figure was considerably higher than that of other states. Orissa had the lowest Region Effect of -7.47 points. In other words this was the state whose industries on the average had the lowest labour productivity compared with corresponding industries for the whole of India. The second lowest Region Effect was that of Uttar Pradesh with -3.71 points. In 1987 the highest Region Effect was shown by Maharashtra with 11.0 points. This figure was quite a bit larger than that of the other states. Orissa had the lowest Region Effect in this year with -8.76 points, followed by Andhra pradesh with -7.9 points, and Punjab with -6.57 points.

In 1978 five states recorded positive Region Effects, namely, Haryana, Maharashtra, Gujarat, Karnataka and Madhya Pradesh. The states with negative Region Effect in this year were Tamil Nadu, Rajasthan, Kerala, Bihar, West Bengal, Andhra Pradesh, Punjab, Uttar Pradesh and Orissa. Maharashtra and Gujarat had positive Region Effects in both the years, while

Haryana, Karnataka and Madhya Pradesh, with a positive Region Effect in 1978, had negative Region Effects in 1987. Kerala with a negative Region Effect in 1978, had a positive Region Effect in 1987. The rest of the states with negative Region Effects in 1978, also had negative Region Effects in 1987.

Analysis of ranks of states according to the change in total effect, structure effect, and region effect:

In this subsection the presentation sequence is the same as in the preceding one. First the Total Effect is considered then the Structure and Region Effects, and finally a comparison between the three is made.

Total Effect:

From table 4.1, it is clear that the Total Effect has improved in the decade from 1978 to 1987 in seven states. In other words the difference of the Total Effects in the two years is positive for these states. This implies that labour productivity in these states relative to that in India as a whole has increased. The remaining seven states show a negative change in Total Effect. In other words their labour productivity in relation to India's productivity has declined. The states with positive figures for change in Total Effect are Bihar, Maharashtra, Kerala, Gujarat, Madhya Pradesh, Uttar Pradesh and Karnataka. The states with negative figures for change in Total Effect are Rajasthan, West Bengal, Tamil Nadu, Punjab, Orissa, Haryana and Andhra Pradesh. It can be seen that the ranking of states according to their Total Effects in 1987, is roughly the same as the ranking of states according to their differences in Total Effects between the years 1978-87.

Structure Effect:

It is evident that nine states registered a positive change in Structure Effect between 1978 and 1987. Five states showed a negative change in the Structure Effect. The names of the states recording positive changes in Structure Effect are Haryana, Gujarat, Rajasthan, Maharashtra, Tamil Nadu, Madhya Pradesh, Kerala, Andhra Pradesh and Karnataka. The states whose Structure Effect decreased over the period were, Uttar Pradesh, Punjab, Orissa, West Bengal and Bihar. There does not seem to be much similarity between the ranks of states according to their Structure Effects in either of the years, and their ranks according to the change in Structure Effects during the period 1978-87. Since Haryana's rank according to the Structure Effect changed from the lowest in 1978 to the highest in 1987, it is to be expected that it has the highest change in Structure Effect in the period 1978-87. This figure for change in Structure Effect is much higher than the figures for any of the other states, and is equal to 16.05. Gujarat shows the second highest change in Structure Effect during this period of 2.69, followed by Rajasthan with 2.32. Bihar has the lowest figure for change in Structure Effect of -2.86. West Bengal has the second lowest figure of the same of -0.97, and Orissa has the third lowest figure of -0.83.

Region Effect:

There were six states that showed an increase in their Region Effect between 1978 and 1987; in eight the magnitude of the Region Effect declined. From the definition of Region Effect, it is evident, that the states that showed an increase in Region Effect over the years, are the states whose improvement

in industrial performance was better on the average than the corresponding industry for India as a whole.

Comparison:

There does not seem to be any similarity between the change in Total Effect and the change in Structure Effect between 1978 and 1987. However, there seems to be some correspondence between the change in Total Effect, and the change in Region Effect in this period.

Standard Deviation:

Here the behaviour of the standard deviation of total effect, structure effect and region effect between states over time is analysed. The Standard deviation instead of the coefficient of variation has been taken for measuring the dispersion between states, because, the value for the mean for all states, that is India's figures for Total, Structure and Region Effects is 0. It is clear, that the standard deviation is as good a measure as coefficient of variation for all the three Effects, because, the mean of all three Effects is 0 by definition.

From table 4.2, it can be seen that in 1978 the standard deviation between states, of the Total Effect was 4.75, while in 1987 the standard deviation between states for the same was 6.56. It may be noted that a similar result was obtained in a previous chapter, when it was found that the coefficient of variation between states of productivity increased at a rate of 1.91% per annum. It may be recalled that this result was significant at the 98% level of confidence. Since the variation in productivities between states increases over time, it is evident that the variation in productivities between states seen from a

different point of origin, will also increase over time. This is precisely what is being done in estimating the growth in Standard Deviation of the Total Effect over time. For the Total Effect is nothing but the difference between the productivities of individual states and the productivity of the nation.

The figures in table 4.2, indicate that the standard deviation of the Structure Effects of various states fell from 2.83 in 1978 to 2.02 in 1987. In other words, the variation between states of labour productivity, caused due to the mix of industries in each state, has decreased slightly from 1978 to 1987. The changes in the industry mix have led to some convergence in state level labour productivities.

From the same table, it emerges that the standard deviation between the Region Effects of various states, fell from 5.35 in 1978 to 5.01 in 1987. In other words, the variation amongst states in labour productivity caused due to the higher productivities of individual industries, has decreased over time.

Finally, it may be pointed out that the relationship between the various effects is that Total Effect = Structure Effect+Region Effect, and this by no means implies any relationship between the Standard Deviation of various effects, in 1978 and 1987, or the growth in standard deviation between these years.

Conclusions:

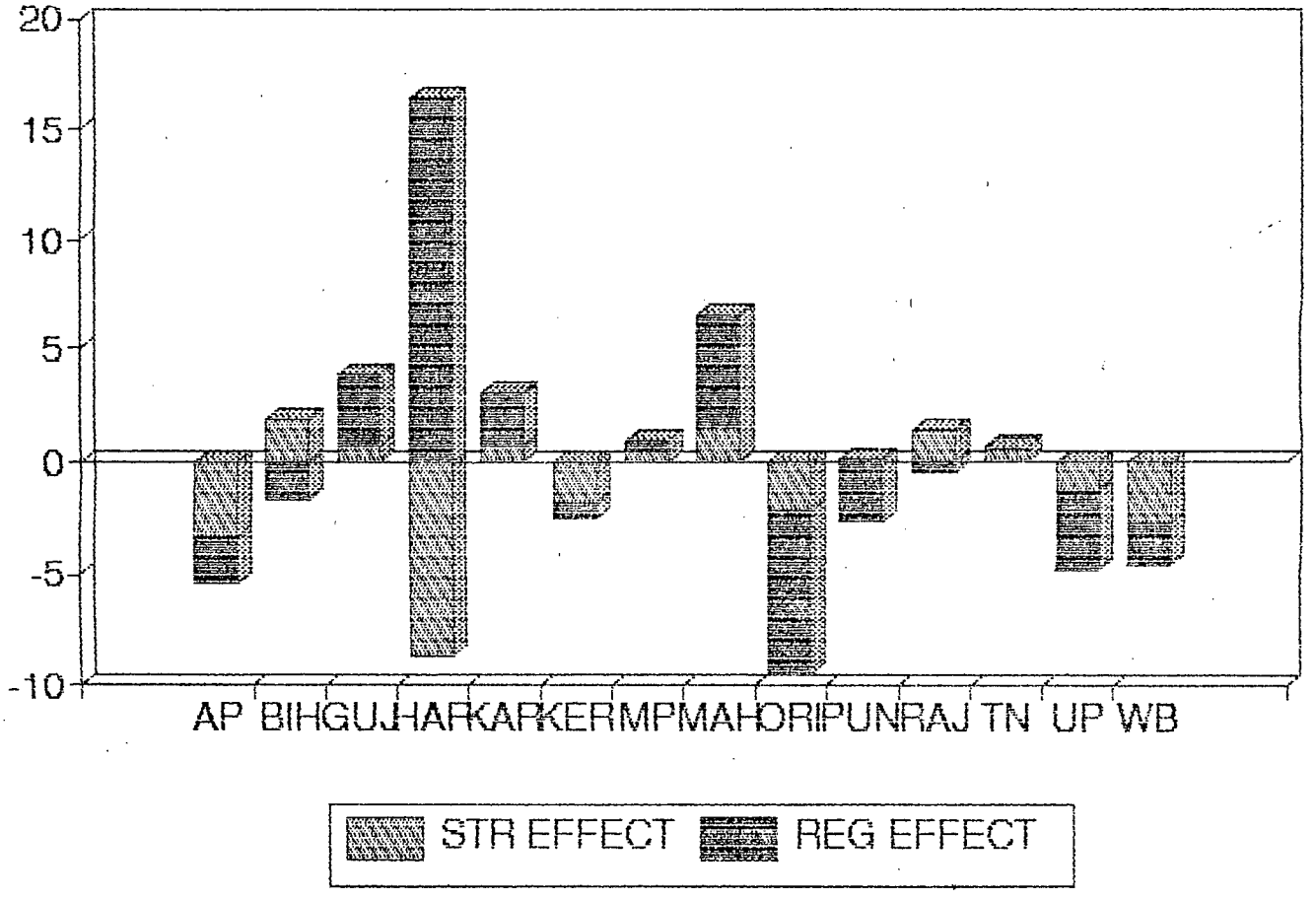
The ranks of states according to the change in Total Effect and Region Effect during the period 1978-87 are similar, but the ranks of states during the same period according to the change in Total Effect and Structure Effect, differ.

West Bengal, Uttar Pradesh, Gujarat, Kerala and Maharashtra have a positive change in their Total Effects, is their labour productivity in relation to that of India's, has improved from 1978-87. Rajasthan, Punjab, Andhra Pradesh, Haryana, Bihar Orissa, Madhya Pradesh, Tamil Nadu and Karnataka, record a negative change in their Total Effects, as their productivity in relation to India's productivity has declined.

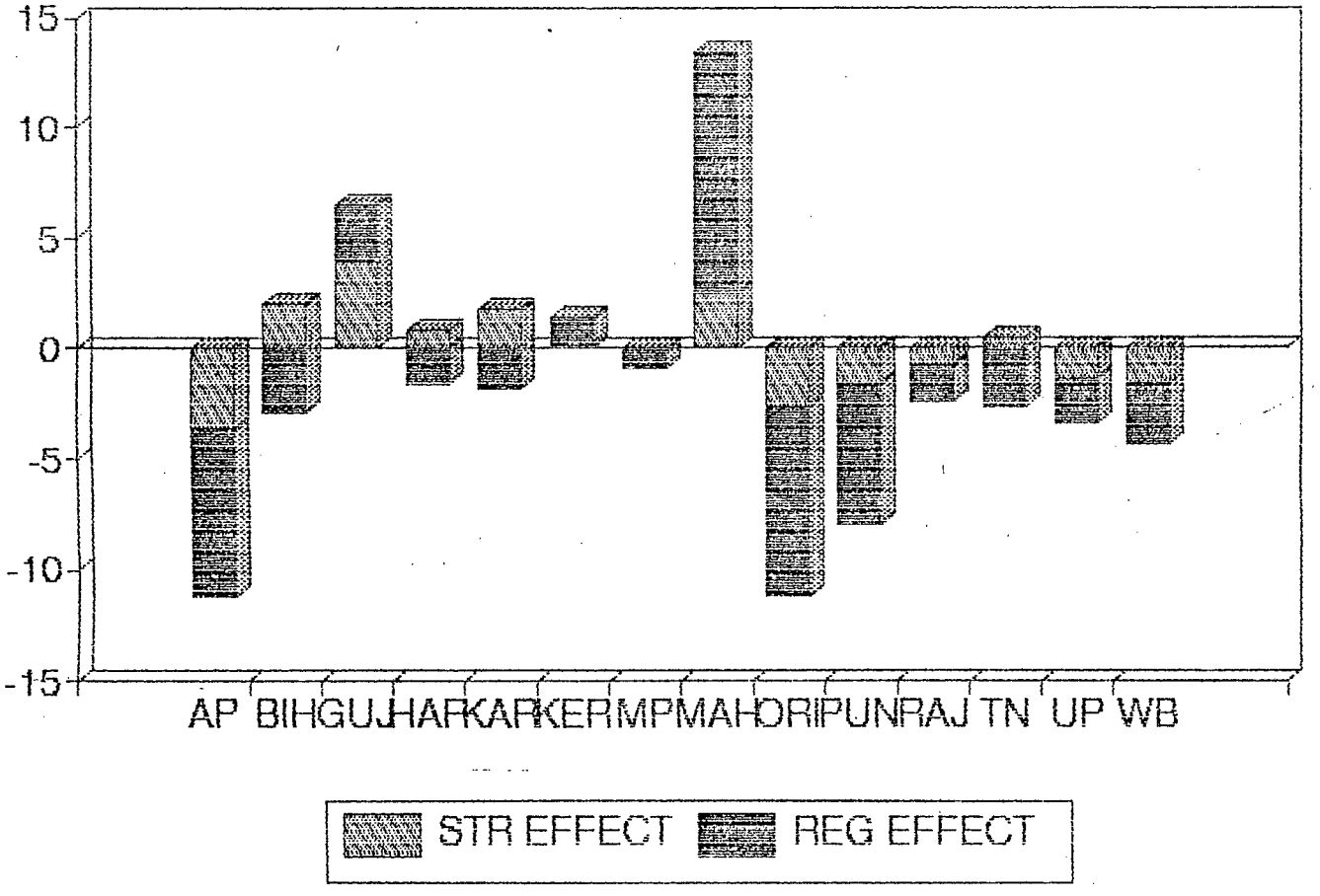
Haryana, Gujarat, Kerala, West Bengal, Karnataka, Maharashtra and Bihar register positive changes in their Structure Effects. In other words, the composition of industries in these states has improved such that, on the average, more mandays are employed in highly productive industries in these states in 1987 than in 1978. Uttar Pradesh, Tamil Nadu, Andhra Pradesh, Orissa, Madhya Pradesh, Punjab, and Rajasthan show a negative change in Structure Effect. In other words, the composition of industries in these states has deteriorated such that, on the average, more mandays are employed in less productive industries in these states in 1987 than in 1978.

In Maharashtra, Kerala, and Uttar Pradesh the magnitude of the Region Effect increased. In other words, the labour productivities of industries on the average, have increased from 1978 to 1987. On the other hand, Gujarat, West Bengal, Bihar, Rajasthan, Orissa, Madhya Pradesh, Tamil Nadu, Punjab, Kerala, Andhra Pradesh and Haryana record a decline in the Region Effect. In other words, labour productivities in these industries, on the average, has fallen from 1978 to 1987.

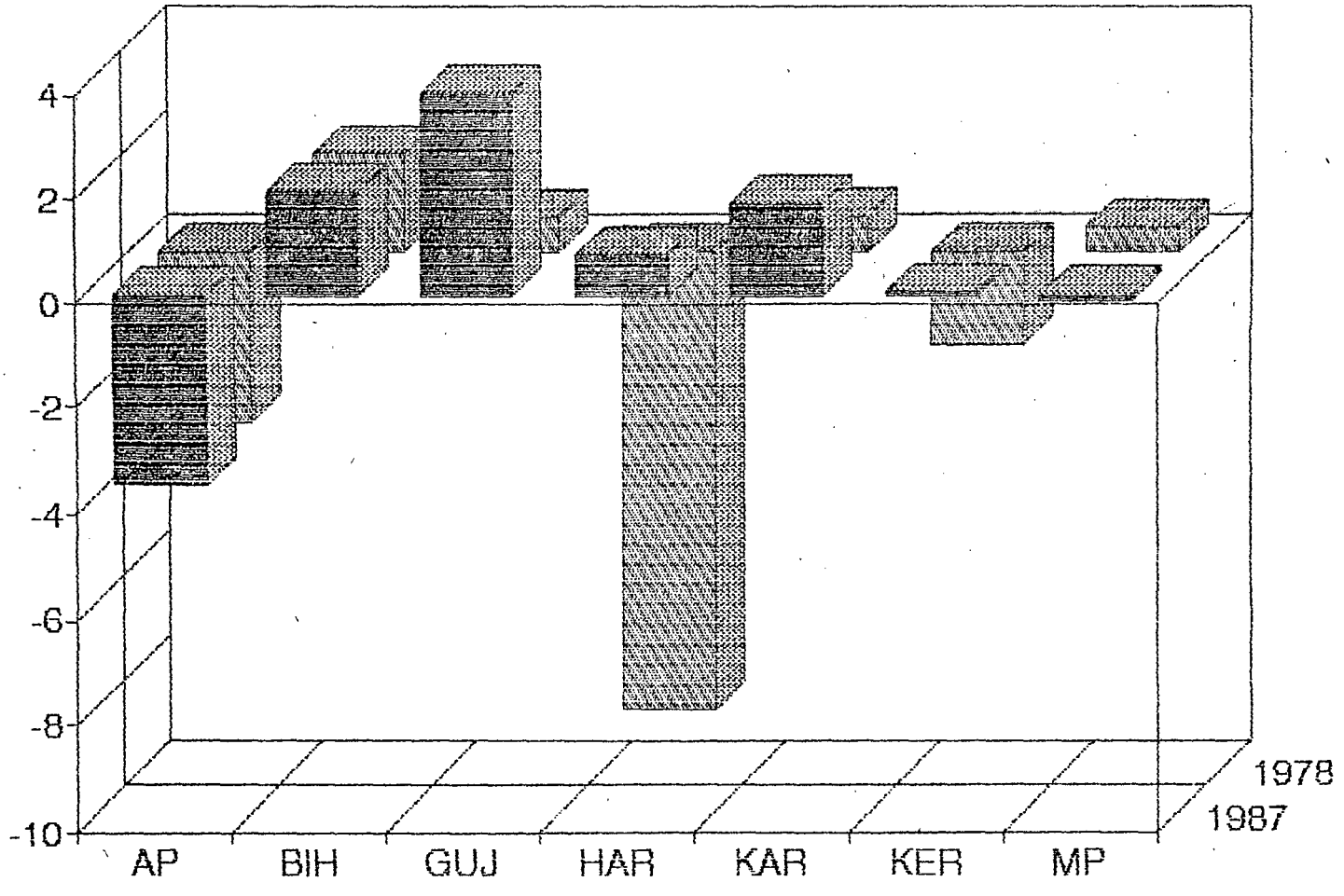
(1) TOT, STR, AND REG EFFECTS



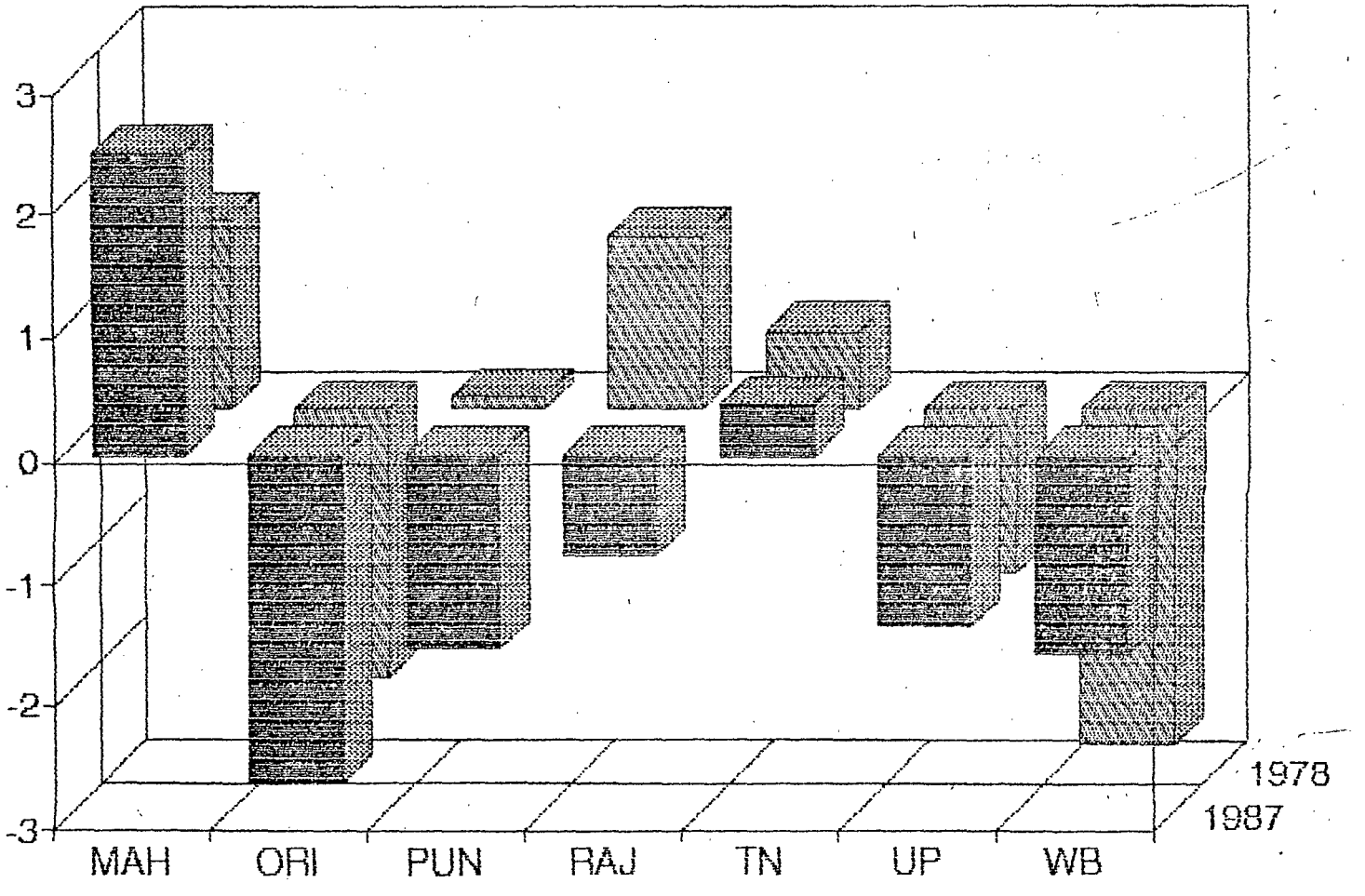
(2) TOT, STR, AND REG EFFECTS



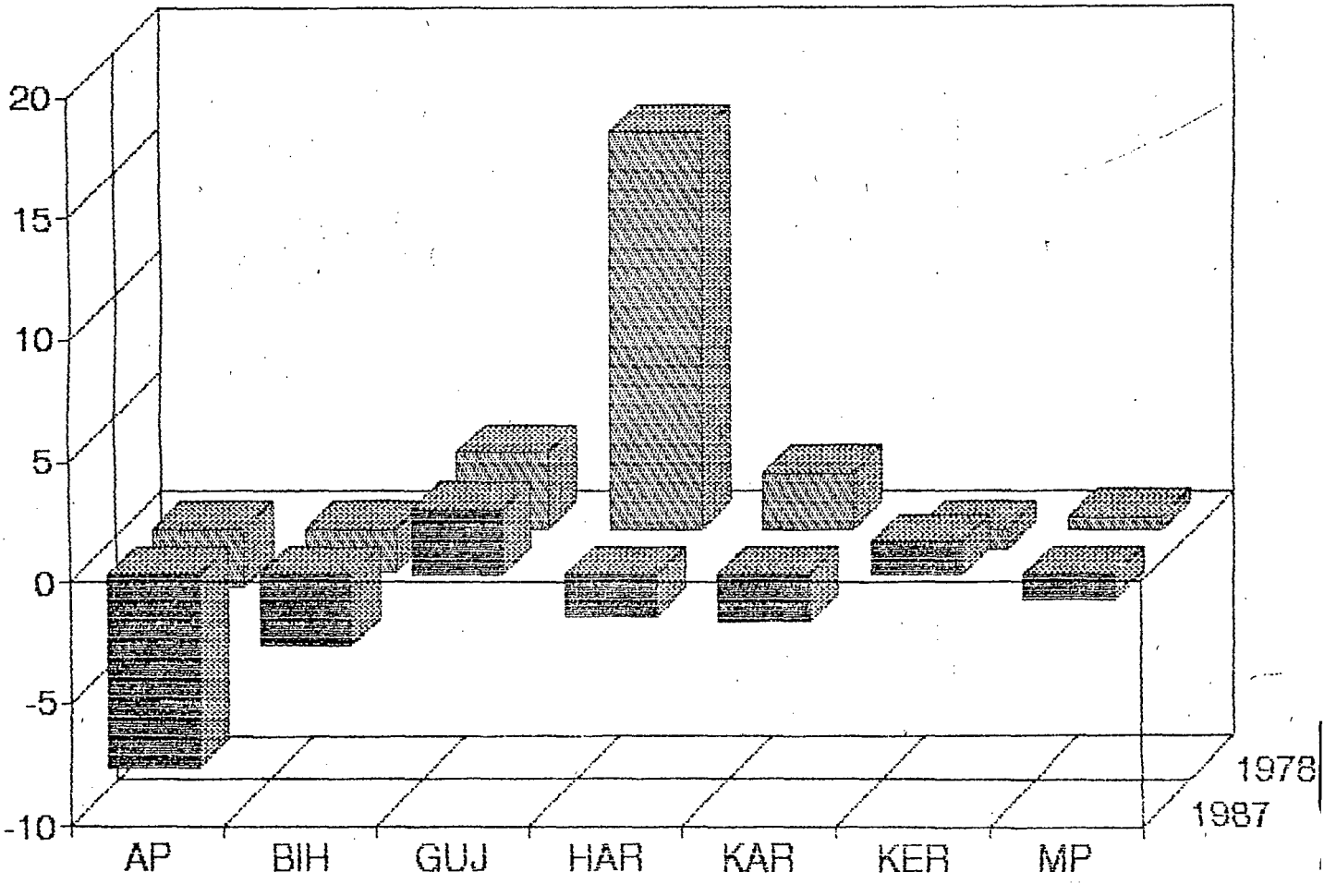
(3) STRUCTURE EFFECT



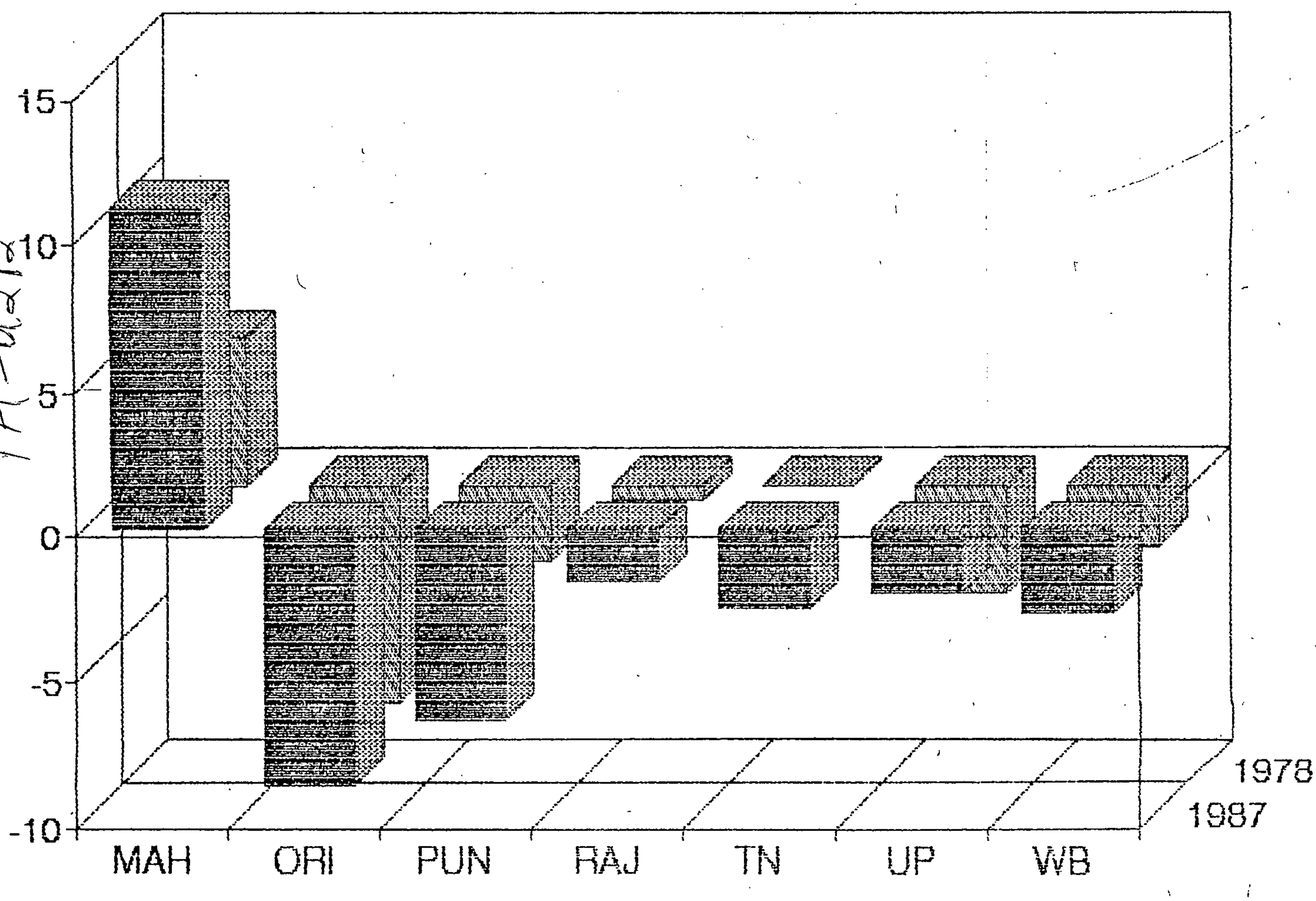
(4) STRUCTURE EFFECT



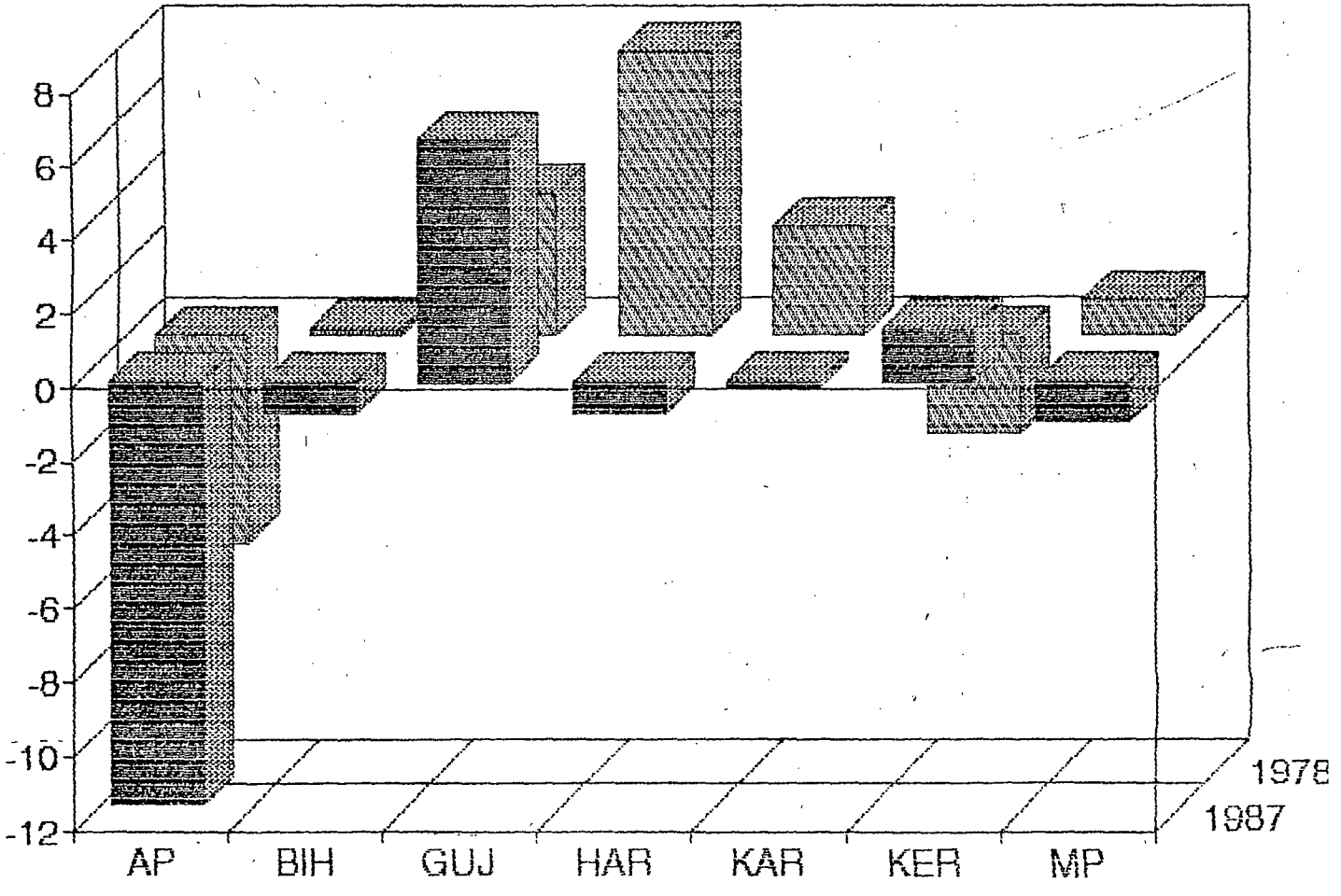
(5) REGION EFFECT



(6) REGION EFFECT



(ㄱ) TOTAL EFFECT



(8) TOTAL EFFECT

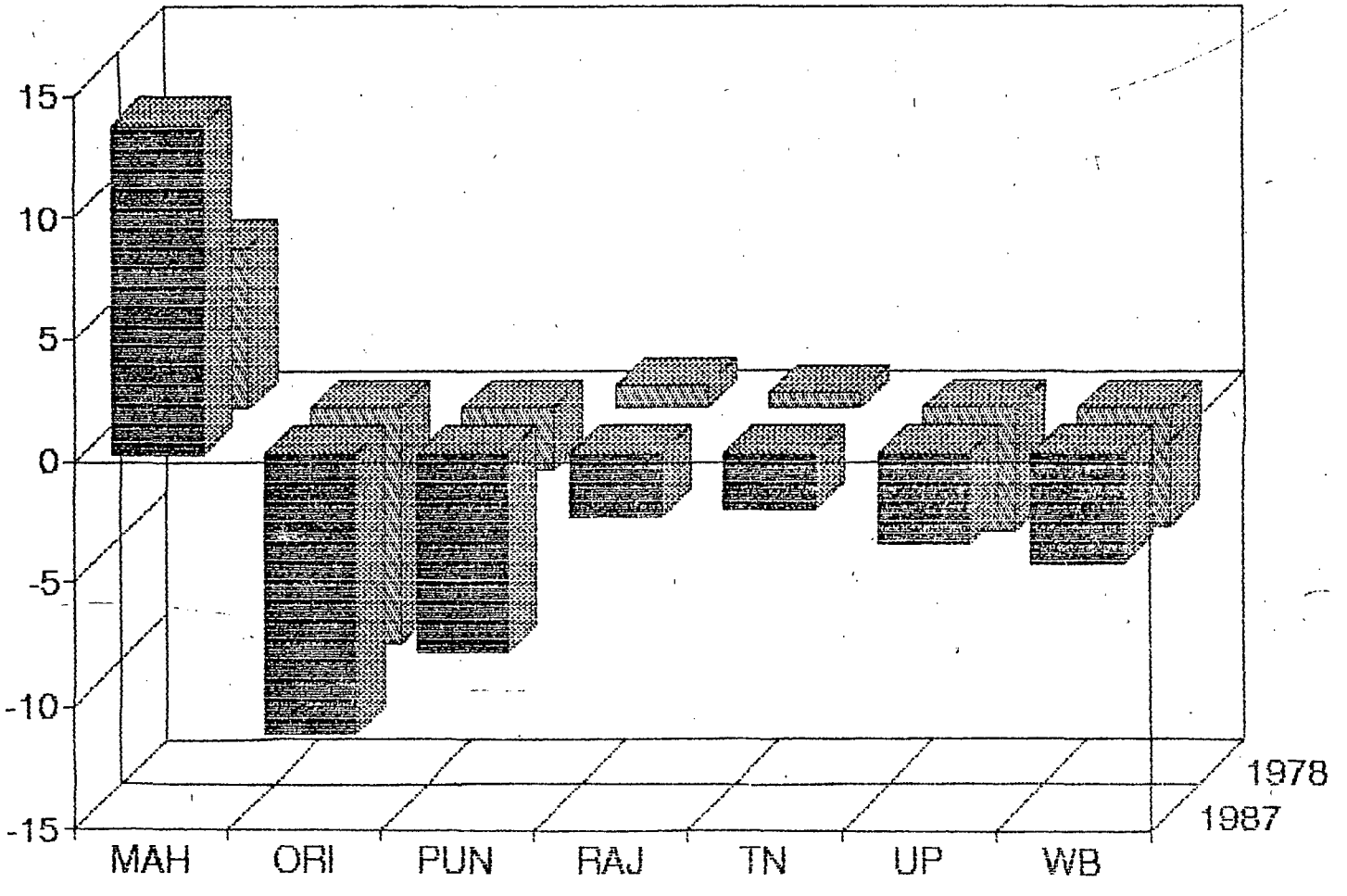


TABLE-4.11: STRUCTURE EFFECTS OF STATES', AND ITS RESPECTIVE CHANGE (IN DESCENDING ORDER)

Structure Effect (1978)		Structure Effect (1987)		Structure Effect (1978-87)	
State	Level	State	Level	State	Change
BIH	1.89				
MAH	1.52	GUJ	3.91	HAR	9.46
RAJ	1.39	MAH	2.45	GUJ	3.24
KAR	Ø.68	BIH	2.Ø2	KER	1.87
GUJ	Ø.67	KAR	1.78	WB	1.1Ø
TN	Ø.63	HAR	Ø.8Ø	KAR	1.Ø9
MP	Ø.47	TN	Ø.41	MAH	Ø.93
PUN	Ø.1Ø	KER	Ø.Ø7	BIH	Ø.13
IND	Ø.ØØ	IND	Ø.ØØ	IND	Ø.ØØ
UP	-1.32	MP	-Ø.Ø8	UP	-Ø.Ø9
KER	-1.8Ø	RAJ	-Ø.81	TN	-Ø.22
ORI	-2.18	UP	-1.41	AP	-Ø.35
WB	-2.72	PUN	-1.58	ORI	-Ø.51
AP	-3.25	WB	-1.62	MP	-Ø.55
HAR	-8.66	ORI	-2.69	PUN	-1.68
		AP	-3.6Ø	RAJ	-2.21

TABLE-4.12: REGION EFFECTS OF STATES', AND ITS RESPECTIVE CHANGE (IN DESCENDING ORDER)

Region Effect (1978)		Region Effect (1987)		Region Effect (1978-87)	
State	Level	State	Level	State	Change
HAR	16.40				
MAH	5.07				
GUJ	3.18	MAH	11.00	MAH	5.93
KAR	2.30	GUJ	2.65	KER	2.16
MP	0.50	KER	1.34	UP	1.53
IND	0.00	IND	0.00	IND	0.00
TN	-0.03	MP	-1.02	GUJ	-0.53
RAJ	-0.52	HAR	-1.68	WB	-0.77
KER	-0.82	RAJ	-1.78	BIH	-1.16
BIH	-1.70	KAR	-1.93	RAJ	-1.26
WB	-2.07	UP	-2.18	ORI	-1.29
AP	-2.36	TN	-2.68	MP	-1.52
PUN	-2.62	WB	-2.83	TN	-2.64
UP	-3.71	BIH	-2.88	PUN	-3.95
ORI	-7.47	PUN	-6.57	KAR	-4.23
		AP	-7.90	AP	-5.54
		ORI	-8.76	HAR	-18.08

TABLE-4.13: TOTAL EFFECTS OF STATES', AND ITS RESPECTIVE CHANGE (IN DESCENDING ORDER)

Total Effect (1978)		Total Effect (1987)		Total Effect (1978-87)	
State	Level	State	Level	State	Change
HAR	7.74				
MAH	6.59				
GUJ	3.85				
KAR	2.98			MAH	6.86
MP	Ø.97			KER	4.Ø4
RAJ	Ø.87	MAH	13.45	GUJ	2.71
TN	Ø.6Ø	GUJ	6.56	UP	1.44
BIH	Ø.19	KER	1.41	WB	Ø.33
IND	Ø.ØØ	IND	Ø.ØØ	IND	Ø.ØØ
PUN	-2.52	KAR	-Ø.16	BIH	-1.Ø5
KER	-2.62	BIH	-Ø.86	ORI	-1.79
WB	-4.79	HAR	-Ø.88	MP	-2.Ø6
UP	-5.Ø3	MP	-1.1Ø	TN	-2.86
AP	-5.61	TN	-2.27	KAR	-3.14
ORI	-9.65	RAJ	-2.6Ø	RAJ	-3.47
		UP	-3.59	PUN	-5.63
		WB	-4.46	AP	-5.89
		PUN	-8.16	HAR	-8.61
		ORI	-11.45		
		AP	-11.5Ø		

TABLE-4.21: STRUCTURE EFFECT OF STATES', AND ITS RESPECTIVE CHANGE (IN ALPHABETICAL ORDER)

State	Level (1978)	Level (1987)	Change (1978-87)
AP	-3.25	-3.60	-0.35
BIH	1.89	2.02	0.13
GUJ	0.67	3.91	3.24
HAR	-8.66	0.80	9.46
IND	0.00	0.00	0.00
KAR	0.68	1.78	1.09
KER	-1.80	0.07	1.87
MP	0.47	-0.08	-0.55
MAH	1.52	2.45	0.93
ORI	-2.18	-2.69	-0.51
PUN	0.10	-1.58	-1.68
RAJ	1.39	-0.81	-2.21
TN	0.63	0.41	-0.22
UP	-1.32	-1.41	-0.09
WB	-2.72	-1.62	1.10
SD	2.83	2.02	

TABLE-4.22: REGION EFFECT OF STATES', AND ITS RESPECTIVE CHANGE (IN ALPHABETICAL ORDER)

State	Level (1978)	Level (1987)	Change (1978-87)
AP	-2.36	-7.90	-5.54
BIH	-1.70	-2.88	-1.18
GUJ	3.18	2.65	-0.53
HAR	16.40	-1.68	-18.08
IND	0.00	0.00	0.00
KAR	2.30	-1.93	-4.23
KER	-0.82	1.34	2.16
MP	0.50	-1.02	-1.52
MAH	5.07	11.00	5.93
ORI	-7.47	-8.76	-1.29
PUN	-2.62	-6.57	-3.95
RAJ	-0.52	-1.78	-1.26
TN	-0.03	-2.68	-2.64
UP	-3.71	-2.18	1.53
WB	-2.07	-2.83	-0.77
SD	5.35	5.01	

TABLE-4.23: TOTAL EFFECT OF STATES', AND ITS RESPECTIVE CHANGE (IN ALPHABETICAL ORDER)

State	Level (1978)	Level (1987)	Change (1978-87)
AP	-5.61	-11.50	-5.89
BIH	0.19	-0.86	-1.05
GUJ	3.85	6.56	2.71
HAR	7.74	-0.88	-8.61
IND	0.00	0.00	0.00
KAR	2.98	-0.16	-3.14
KER	-2.62	1.41	4.04
MP	0.97	-1.10	-2.06
MAH	6.59	13.45	6.86
ORI	-9.65	-11.45	-1.79
PUN	-2.52	-8.16	-5.63
RAJ	0.87	-2.60	-3.47
TN	0.60	-2.27	-2.86
UP	-5.03	-3.59	1.44
WB	-4.79	-4.46	0.33
SD	4.75	6.56	

CHAPTER FIVE

THE FACTORS THAT INFLUENCE TOTAL, STRUCTURE AND REGION EFFECTS

This chapter is divided into three main parts: an introduction, the presentation of the results of a series of investigations into cause and effect relationships and further questions raised as a result of these investigations, and conclusions.

Introduction:

In this chapter, the basic concerns are with the impact of increases in the capital-labour ratio on the growth rate of labour productivity and the effect of growth of Value Added on labour productivity. The latter is in effect an attempt to study a version of Verdoorn's law, which tells us that the growth of Value Added in industry over a considerable time period, is directly related to the growth of productivity over the same period. This relationship is well established, and many variants of it have been studied. Also, it is well known that growth in the capital-labour ratio causes growth in labour productivity. The analysis is divided into two parts: (a) an analysis of the impact of rising economies of scale on the growth of labour productivity, and (b) an analysis of the growth of capital intensity and its implications for the growth of labour productivity.

Since the industrial revolution, some countries have experienced sustained growth in labour productivity, while others have shown little or no improvement. Verdoorn tried to explain the reason for this by proposing a law that linked the rate of growth of productivity to the rate of growth of output. The law

originally aimed to explain the differences in the productivity growth rates of twelve advanced countries over the early post war period. It is now agreed that the law explains the general process of growth and development, and is not restricted to a few countries.

Its simplest version states that there is a close link between the long run growth of productivity in manufacturing products and that of output. This is taken to indicate that a large part of productivity growth is due to economies of scale. The economies of scale are in turn considered to be endogenous to the growth process; in other words with the growth in output it is understood that there will be economies of scale. However, it must be pointed out that this law has been stated only for the long run.

It was due to Kaldor that attention was drawn in the late sixties to the relationship between productivity and growth of output. However, Verdoorn had first discussed this relationship in 1949. It was also Kaldor who realised that this law applied to the general process of growth and development.

When the Verdoorn law was estimated in the form of $p = a + bq$, where 'p' was the growth of manufacturing output per worker, and 'q' was output, 'b' or the 'Verdoorn coefficient' took a value of about 0.5. Similar results using cross country, time-series and regional data for both the developed and the less developed countries were found.

In 1776, Adam Smith had pointed out that the division of labour causes improvement in its productive powers. This division of labour depends on the extent of the market. Allyn Young, in 1928 elaborated on this. He argued that the capital-

labour ratio was not a response to relative factor prices, but was determined primarily by the scale of production.

It was also pointed out that a more rapid rate of growth of output causes 'learning by doing' to be faster. This 'learning by doing' refers to the increase in technical know-how. Substantial increases in productivity have been found to have arisen due to this, even if no gross investment had taken place.

Thus the growth of output causes both economies of scale and an increase in technical know-how, and these in turn cause growth of productivity.

The rate of growth is taken as a percentage of the absolute value of the arithmetic mean of the initial and final year figures in all cases.

Economies of Scale:

This part of the analysis is further subdivided into two subsections, which give firstly, a national picture and secondly, a regional picture.

The National Picture:

The effect of growth of Value Added at the all India level on the growth of labour productivity at the national level is studied here. As indicated earlier, this is one way of verifying Verdoorn's law. This well established relationship, asserts that the economies of scale, that are realized in every country as income increases over the years, cause labour productivity to rise. Thus the growth of Value Added is basically a proxy for the impact of increasing returns to scale and therefore from hereon, it will often be referred to as such.

The rate of growth of Value Added and of labour productivity is estimated here for the years 1978 to 1987, for each of the

industries. A linear regression is then run between the growth of Value Added of the various industries, and the corresponding growth of labour productivity in the industries.

The results are of considerable interest. It was found that the β value (0.65), was highly significant. The 't' value (4.70), was significant at a level of confidence even greater than 99%. Thus the operation of Verdoorn's law was resoundingly confirmed for the manufacturing sector of the nation taken as a whole.

The Regional Picture:

Scale economies were then subdivided into various components, and the impact of each of these components on labour productivity was then studied. Growth in labour productivity, was also divided into various components, which were analysed. The reasoning used for this regional analysis is as follows. The growth of national labour productivity is a function of the growth of national Value Added, (Verdoorn's Law), therefore the growth of (state productivity minus national productivity) is a function of growth of (state Value Added minus national Value Added). This amounts to the proposition that the growth of Total Effect is a function of the growth of (state Value Added minus national Value Added). A linear regression was then run between the two across industries. The results generated are discussed below. These results are shown in table 5.1.

Since the Total Effect is the sum of Structure and Region Effects, therefore, the regression with Total Effect is nothing but the composite of the regression with Structure Effect and regression with Region Effect. Taking this to its logical conclusion, a regression of the growth of Structure Effect as a

function of growth of (state Value Added minus national Value Added) was run; as also a regression of growth of Region Effect as a function of the growth of (state Value Added minus national Value Added). The results of these regressions are presented below, together with a comparison of the regressions against Total Effect, Structure Effect and Region Effect.

Verdoorn's Law-Total Effect:

Only five out of fourteen states show statistically significant results. In other words, it is these states only that confirm Verdoorn's law. Orissa has a β value of 1.47, which is significant at the 99% level of confidence. Other states with positive and significant β values are Andhra Pradesh, Gujarat, and Tamil Nadu, whose β values are 5.07, 2.86, and 2.82 respectively. A positive β value shows that, the state's Value Added is rising at a faster rate than that of the nation. Thus, it is clear that the Value Added of Andhra Pradesh grew the fastest as compared with the Value Added of the nation, followed by Gujarat, Tamil Nadu and Orissa. West Bengal shows a negative β value of -1.9, which is significant only at the 90% level of confidence. A negative β value means that, the nation's Value Added, grew at a faster rate than that of the states. It must be emphasized, that regardless of whether the β values are positive or negative, Verdoorn's law is confirmed whenever the 't' values are significant.

Verdoorn's Law-Structure and Region Effects:

As mentioned above, the growth of Total Effect as a function of growth of Value Added (state minus nation) is a variant of Verdoorn's law. Since the Total Effect is nothing but the sum of Structure and Region Effects, it is of interest to assess the

effect of growth in Value Added (state minus nation), on growth of Structure Effect, and growth of Region Effect. The regressions with growth of Structure and Region Effect on the same have been obtained on the lines of the regression taken with Total Effect.

For four states out of the fourteen, the regressions generate significant β values for the exercise involving the Structure Effect. It is interesting to note that all of them also produce significant β values with the Total Effect. These states are Andhra Pradesh, Gujarat, Orissa and West Bengal. On the other hand, it is worth noting that none of the β values for regressions against Region Effect are significant.

The implications of these results are important. What this implies is that Verdoorn's law, as applicable to India, really states that scale economies took place in regions where the productivity rise was due to an improvement in the mix of industries, with the result that on the average there were more mandays employed in highly productive industries in later years than in initial ones. The fact that Verdoorn's law did not apply to the Region Effect means that scale economies did not take place where the productivity rise in a state was due on the average to an improvement in the productivity of individual industries. In other words in Andhra Pradesh, Gujarat, Orissa and West Bengal, scale economies were influential on the average in highly productive industries. In Tamil Nadu, the growth in Total Effect, is due to reasons other than economies of scale for, neither the growth of the Structure Effect nor the growth of Region Effect, is significant even at the 90% level of confidence.

The highest positive β value for growth of Structure Effect is recorded by Gujarat at 5.63 followed by Andhra Pradesh at 3.51 and then Orissa at 1.19. On the basis of reasoning similar to that outlined above, it can be said that in these states the growth of Value Added (economies of scale) took place in states were the increases in labour productivity were due to improvements in the mix of industries, such that, on the average, there were more mandays employed in highly productive industries in later years than in earlier years.

The results also indicate that Verdoorn's Law is not applicable in many states. This means either that the basic assumptions underlying the law, i.e. that the growth of income over a reasonable time period leads to economies of scale is not applicable in many states; or that the time period taken was too short. Another possible reason is that the quality of product improved over the years, but that this was not reflected in the growth of Value Added, rather, its benefit went to the consumer.

The phenomenon of rising labour productivity combined with growth in value added gives the impression that wages will necessarily rise along with economies of scale. But this result need not follow. As mentioned earlier, productivity and wages are two different things. Therefore, rising labour productivity refers to greater efficiency, but need not cause the workers of the corresponding industry to have the same increase, or even any increase, in wages.

Capital-Labour Ratio or Capital Intensity:

This part of the analysis is further subdivided into two portions, firstly a national picture and secondly, a regional picture.

Gross capital stock at constant prices is used here as the measure for capital. The index used for deflation here is the one for machinery and machine tools.

The National Picture:

The effect of growth in Capital Intensity in the industrial economy as a whole on the growth of national labour productivity is studied here. As mentioned earlier, it is well known that the former affects the latter. The growth of Capital Intensity and labour productivity are measured between 1978 and 1987, for each of the industries. A linear regression is then run between growth of Value Added of the various industries, and the growth of productivity of the corresponding industries. It was found that the β value, (0.09) was insignificant. Thus, the result indicates that the growth of capital intensity at the national level had no impact on the growth of labour productivity.

The Regional Picture:

Capital Intensity was then subdivided into various components, and the impact of each of these components on labour productivity studied. The growth in labour productivity, was also divided into various components, which were analysed. The reasoning used for regional analysis runs as follows: since by hypothesis the growth of national labour productivity is a function of growth of national capital intensity, therefore, the growth of (state productivity minus national productivity) is a function of the growth of (state capital intensity minus national capital intensity). This is nothing but a statement that the growth of Total Effect is a function of the growth of (state capital intensity minus national capital intensity). A linear regression was run between the two across industries. (The

results are given in table 5.2). Further, since the Total Effect is the sum of Structure and Region Effects, therefore, the regression with Total Effect is nothing but the composite of regression with Structure Effect and regression with Region Effect. Therefore, a regression of growth of Structure Effect as a function of growth of (state capital intensity minus national capital intensity) was run; as also a regression of growth of Region Effect as a function of growth of state capital intensity minus national capital intensity). The results of these regressions are given below, as also is a comparison of the regressions against Total Effect, Structure Effect and Region Effect.

Capital Intensity-Total Effect:

Gujarat is the only state where the regression of growth of (K/L of state minus K/L of nation) with the growth of Total Effect, was found to be significant. The 't' value was significant at the 99% level of confidence. A positive β value of .07 obtained for Gujarat implies that the growth of capital intensity for Gujarat was greater than the same for the nation.

Capital Intensity-Structure Effect:

Andhra Pradesh and Bihar are the two states that produce significant β values for the regression of growth of (K/L of state minus K/L of nation) with the growth of Structure Effect. The level of significance for the β values of these states was 95% and 90% respectively. The β values for both of the states were negative, implying that the growth of capital intensity for Andhra Pradesh and Bihar was less than the same for the nation.

Capital Intensity-Region Effect:

Rajasthan and West Bengal are the two states that show significant β values for the regression of growth of (K/L of state minus K/L of nation) with the growth of Region Effect. The level of significance for the β values of both of these states is 90%. The β value of Rajasthan is positive, implying that the growth of capital intensity for Rajasthan is greater than that for the nation. The β Value for West Bengal is highly negative at -11.85, implying that the growth of capital intensity of West Bengal is far below that of the nation.

It is curious that the states that have significant values, are different for Total Effect, Structure Effect and Region Effect. This, and the fact that there is only one significant value for the relationship with growth of Total Effect, seems to indicate that there is something seriously wrong. Many possible reasons for this can be thought of. However, an attempt to confirm, or deny these reasons, is beyond the scope of this thesis. The possible reasons may however, be listed. First the linear relationship used for the regressions may be inappropriate. Secondly there may have been surplus labour generated by the growth process, which was not retrenched. Thirdly the quality of product may have improved, but this was not reflected in the rise of Value Added and hence the rise of productivity; rather, its benefit went to the consumer.

Further Questions Raised:

It would be interesting to see how much of the growth in productivity is due to (a) economies of scale that involve an increase in capital-labour ratio; (b) economies of scale that involve technical change which is not more capital intensive than previously,

and increase in output that involves the use of previously existing surplus capacity of capital and labour; and (c) an increase in capital-labour ratio not associated with an increase in output, for example, such increases that come from importing technology. Recently, this last factor has also been incorporated into the 'Verdoorn's equation. However its inclusion has not caused any major revision in the interpretation of the law.

In the analysis in this chapter, Verdoorn's equation without the last factor incorporated into it has been used. This last factor, that is , the rate of increase in capital-labour ratio not associated with an increase in output, along with the rate of increase in capital-labour ratio associated with an increase in output; in other words, the rate of total increase in capital-labour ratio, has been used as the independent variable in a regression against productivity.

Conclusions:

At the national level, the main result which emerged from these exercises was a strong confirmation of Verdoorn's Law. In India as a whole, the growth of value added has had a substantial and highly significant favourable impact on industrial labour productivity. At the state level, the results were significant for five states.

The investigation into the possible impact of rising capital-labour ratios on labour productivity, however, generated counter intuitive results. The findings suggest that the growth of capital intensity generally has had no significant impact on the rate of growth of labour productivity. Several reasons for such an outcome were considered, but to pursue the questions raised was beyond the scope of this thesis.

TABLE-5.1: REGRESSION RESULTS OF THE RATE OF GROWTH OF TOTAL, STRUCTURE AND REGION EFFECTS WITH THE RATE OF GROWTH OF VALUE ADDED

State	Total Effect		Structure Effect		Region Effect	
	β	't'	β	't'	β	't'
AP	5.Ø7	2.69**	3.51	1.96a	5Ø6	1.2Ø
BIH	Ø.93	Ø.5Ø	Ø.48	Ø.88	19.2	1.35
GUJ	2.86	2.35*	5.63	3.37***	-2.19	-1.42
HAR	1.72	Ø.63	Ø.91	Ø.88	-5.33	-Ø.19
KAR	2.52	Ø.35	2.Ø1	1.47	-2.36	-Ø.25
KER	1.77	1.57	417	1.53	1.93	1.Ø1
MP	-Ø.Ø3	Ø.Ø2	Ø.15	Ø.19	4.96	Ø.33
MAH	Ø.28	Ø.29	1.69	1.37	-Ø.75	-Ø.19
ORI	1.47	5.77***	1.19	2.Ø6a	Ø.94	Ø.25
PUN	Ø.73	Ø.36	1.42	1.16	Ø.49	Ø.13
RAJ	-Ø.33	-Ø.18	Ø.4Ø	Ø.19	-4.51	-Ø.79
TN	2.82	2.41*	15.5	1.38	2.79	Ø.Ø7
UP	-144	-1.25	-1.87	-1.6Ø	1.47	1.Ø8
WB	-1.9Ø	-1.84a	5.Ø4	-2.27*	2.63	Ø.1Ø

a Significant at 9Ø%
* Significant at 95%
** Significant at 98%
*** Significant at 99%

TABLE-5.2: REGRESSION RESULTS OF THE RATE OF GROWTH OF TOTAL, STRUCTURE AND REGION EFFECTS WITH THE RATE OF GROWTH OF CAPITAL-LABOUR RATIO

State	Total Effect		Structure Effect		Region Effect	
	β	`t´	β	`t´	β	`t´
AP	-0.01	-0.69	-0.03	-2.10*	-0.50	-0.13
BIH	0.08	-0.25	-0.18	-1.92a	0.25	0.09
GUJ	0.07	4.04***	0.01	0.39	-0.01	-0.25
HAR	0.22	1.09	-0.10	-1.28	0.26	0.12
KAR	0.04	0.10	-0.06	-0.82	0.15	0.31
KER	-0.15	-0.82	-37.28	-0.83	0.04	0.12
MP	0.14	1.57	0.07	0.97	0.39	0.31
MAH	0.04	0.64	0.03	0.35	0.35	1.22
ORI	0.00	-0.13	-0.05	-1.46	0.13	0.69
PUN	-0.05	-0.09	0.08	0.27	0.22	0.24
RAJ	0.00	0.00	-0.11	-0.39	1.45	1.98a
TN	0.01	0.11	0.11	0.15	-1.28	-0.55
UP	-1.13	-0.17	-0.06	-0.85	0.00	-0.02
WB	0.12	0.46	0.04	0.07	-11.85	-2.01a

a Significant at 90%
* Significant at 95%
** Significant at 98%
*** Significant at 99%

CHAPTER SIX

SUMMARY AND CONCLUSIONS

The regional analysis of industrial labour productivity undertaken in the present study has revealed that a number of important developments have taken place in recent years. Of these the fact that inter-regional differences in labour productivity have widened between 1970 and 1988 is perhaps the most crucial. The coefficient of variation of labour productivity between states, has grown at a rate of 1.9% per annum. Moreover, this result was significant at the 98% level of confidence. In short, the growing divergence between labour productivity in different states was a continuous process during this period.

Inter-industry contrasts in labour productivity also increased from 1977 to 1988. The relevant coefficient of variation, grew at the rate of 1.51% per annum. However, this result was not significant. In other words, although inter industry disparities in labour productivity rose during this period, the rate of change varied from year to year.

When the states were placed in descending order on the basis of their labour productivity growth rates, it was noticed that the ranking corresponded closely to another ranking, done on the basis of their relative productivity changes. This implies that the states whose relative industrial productivities improved the most, are the ones whose industrial labour productivity rose the fastest.

Furthermore, when individual industries were placed in descending order on the basis of their productivity growth rates,

it was seen that the ranking of industries was similar to a second ranking on the basis of their relative productivity changes. This implies that the industries whose relative productivities improved the most, are the ones whose labour productivity rose the fastest.

However, it must be pointed out that the correspondence was more marked for the state level rankings than for the industrial level rankings.

When the inter-regional labour productivity differences were studied further, it was found that West Bengal, Uttar Pradesh, Gujarat, Kerala and Maharashtra record a positive change in their Total Effects, that is, their labour productivity in relation to that of India's has improved from 1978-87. Rajasthan, Punjab, Andhra Pradesh, Haryana, Bihar Orissa, Madhya Pradesh, Tamil Nadu and Karnataka, registered a negative change in their Total Effects, that is, their labour productivity in relation to India's productivity has declined.

Haryana, Gujarat, Kerala, West Bengal, Karnataka, Maharashtra and Bihar show a positive change in their Structure Effect. In other words, the composition of industries in these states has improved such that, on the average, more mandays are employed in highly productive industries in these states in 1987 than in 1978. In Uttar Pradesh, Tamil Nadu, Andhra Pradesh, Orissa, Madhya Pradesh, Punjab, and Rajasthan the magnitude of the Structure Effect declined. In other words, the composition of industries in these states has deteriorated in such a way that on the average, more mandays are employed in less productive industries in these states in 1987 than in 1978. Maharashtra, Kerala, and Uttar Pradesh record a positive changes in the Region

Effect. In other words, the industrial labour productivity on the average, has increased from 1978 to 1987. On the other hand, Gujarat, West Bengal, Bihar, Rajasthan, Orissa, Madhya Pradesh, Tamil Nadu, Punjab, Kerala, Andhra Pradesh and Haryana, all record negative changes in the Region Effect. This means that the labour productivities of industries, on average, have decreased from 1978 to 1987.

The applicability of Verdoorn's law to India across industries was tested. It was found that the law was resoundingly confirmed, and that the β value of 0.65 was significant at a confidence level of even more than 99%. It may be noted that when the β value was estimated for a linear function such as used here, across twelve advanced countries over the early post war period, it was found to be equal to roughly 0.5. Thus the results for India are in line with earlier results. The slightly greater β value for India is a good sign, for it means that the growth of Value Added in India had a greater impact on the growth of labour productivity. Considering the fact that there is a lot of surplus labour in industry, this implies that either India's economies due to scale have risen at a faster pace along with its growth in Value Added, or that the favourable impact of these scale economies on labour productivity has been greater than that in other countries. A more detailed look into this matter could be the subject of further research.

Verdoorn's Law, as applicable to India, really states that scale economies took place in regions where the productivity rise was due to an improvement in the mix of industries, with the result that on the average there were more mandays employed in highly productive industries in later years than in initial ones.

The fact that Verdoorn's Law did not apply to the Region Effect means that scale economies did not take place where the productivity rise in a state was due on the average, to an improvement in the productivity of individual industries. In other words, in Andhra Pradesh, Gujarat, Orissa and West Bengal, scale economies were influential on the average in highly productive industries. In Tamil Nadu, the growth in Total Effect is due to other reasons than economies of scale for neither the growth of the Structure Effect nor the growth of the Region Effect is significant even at the 90% level of confidence.

The results also demonstrate that Verdoorn's Law is not applicable in many states. This means either that the basic assumptions underlying the law, that is that the growth of income over a reasonable time period leads to economies of scale is not applicable in many states; or that the time period taken was too short. Another possible reason is that the quality of product improved over the years, but that this was not reflected in the growth of Value Added; rather, its benefit went to the consumer.

When a linear regression was fitted for India across industries, with the rate of growth in capital-labour ratio as the independent variable, and the rate of growth of labour productivity as the dependent variable, the β value was found insignificant. In other words surprisingly the rate of growth of labour productivity was not affected by an increase in the rate of growth of capital-labour ratio.

The results also demonstrate that the rate of growth of the capital-labour ratio, influences the rate of growth of productivity only in Gujarat. They also show that when the effect of the rate of growth of the capital-labour ratio on the

rate of growth of productivity of the state was sought to be split up into two components; the states that recorded significant values for the total rate of growth of productivity were different from the states that recorded significant values for the various components of the growth of productivity. In other words, the states that recorded significant values for the growth rates of Total Effect, Structure Effect and Region Effect were different.

Both these findings seem to be counter intuitive. The possible explanations may be; first, that the linear relationship used for the regressions may be inappropriate. Secondly, there may have been surplus labour generated by the growth process, which was not retrenched. Thirdly, the quality of product may have improved, but this was not reflected in the rise of Value Added and hence the rise of productivity; rather, its benefit went to the consumer. To identify the reasons for such counter intuitive results further work would be necessary.

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