

V. SUMMARY AND CONCLUSION

With the introduction of economic reforms since July, 1991, many changes have come upon in the industrial structure of India. Introduction of various reforms and gradual liberalisation of both domestic and international trade marked the beginning of the end of the earlier regulatory regime and recognition of the urgency on the part of the Indian industries to become efficient so as to be able to withstand successfully the pressure of foreign competition. Over the years several measures have been taken by the government to help domestic industries achieve efficiency. These include not only the fiscal and financial measures such as rationalisation of excise duties, liberalisation of tax laws and rates, reduction in interest rates and so on, but also such physical measures as those meant to remove infrastructural constraints in power, transport and telecommunications sectors.

Total Factor Productivity (TFP) is a key and major factor in the success of any socio-economic system because of its direct relationship with economic welfare. The Liberalisation, Privatisation and Globalisation (LPG) policies that started in early 1980s in India, and strengthened in the 1990s, opened the Indian manufacturing sector to greater competition from within as well as from outside. One of the major components of the economic reforms package has been the deregulation and delicensing in the manufacturing sector. The justification provided for this often centres on the reason of encouraging competition, which, in turn, is expected to enhance the efficiency and productivity performance of the manufacturing sector.

Also, the need for studying productivity growth arises due to the intimate link between productivity growth and economic growth. Economic growth has implications for resource use in general. Productivity growth is the basis of efficient economic growth. Economic growth has been defined as the process of a sustained increase in the production of goods and services with the aim of making available a progressively diversified basket of consumption goods to population. Scarcity of resources, which includes physical, financial and human resources, has been recognized as a limiting factor on the process of economic growth. While output expansion based on increased use of resources is feasible, it is not sustainable. Therefore, productivity of resources becomes a critical factor in economic growth. These terms, which will be defined more precisely in the following section, indicate ability to obtain a given amount of good or service by using a lesser amount of input.

Productivity growth, therefore, is critical for ensuring sustained increase in the production of goods and services. Economic growth has traditionally been associated with industrialization. At least that is what makes the diversity in the basket of consumption goods and services possible, when trading possibilities are limited. But industrialization in the initial stages has the effect of making resource scarcities more acute, making it all the more necessary that available resources are utilized more productively.

The measurement of efficiency of an industry is important both the economic theorist and economic policy maker. If economic planning is to concern itself with particular industries, it is important to know how far a given industry can be expected to increase its output by simply increasing its efficiency, without absorbing further resources. In developing economies like India, efficiency is a very important factor of productivity growth especially where resources are scarce and opportunities for developing and adopting better technology have lately started dwindling, where such economies can benefit a great deal from inefficiency studies. Past studies showed that productivity can be raised by improving efficiency, which usually is a neglected source of productivity, without increasing the resource base or without developing new technologies.

Recognition and strong evidence of real wages, inflation and productivity interrelationships can help shape policy formation for productivity enhancement, inflation control or consumption stimulation. From the macroeconomic perspective, changes in productivity have been associated with movements in real wages and inflation in the theoretical and empirical literature. In this framework, an analysis of the interrelationships among productivity, real wages and inflation is critical for authorities who plan structural reforms to enhance productivity and for policy makers who aim to control inflation.

The industrialisation process in India during the colonial period was highly uneven. As a result, regional disparity in industrial development was quite glaring at the time of independence. Faced with widespread disparity, the policymakers have advocated the strategy of 'balanced regional development' right in the first five-year plan and it has been carried forward in all the subsequent plans. To this direction, a series of policy measures were adopted to guide the regional industrialisation process with many industries reserved for the public sector and more preference given to the less developed States in distribution of these industries. Policies such as industrial licensing policy, industrial location policy, freight equalisation policy, etc. were designed and various fiscal and financial incentives were

introduced during the planning period to influence location of industries away from the large cities and towards the backward areas for a review of these regional policies.

The four southern states – Andhra Pradesh, Karnataka, Kerala and Tamil Nadu – contribute over 24 percent of the GSDP of the country. They are emerging as the major destinations for industrialization. Further the southern states are galloping much ahead of the poorest but populous northern states with higher economic growth rates. The industrial sector of Andhra Pradesh includes some of the key sectors like pharmacy, Auto mobile, textiles biotechnology, information technology, business management, pharmaceuticals, construction and real estate. According to 2011 census report, Andhra Pradesh's GSDP for 2011 was approximately ₹ 5,67,636 crores placing it second among the states. The state ranks second in terms of overall Gross State Product among all the states of the Indian Union. In terms of per capita GSDP the state compares very favourable to other large states.

The state of Karnataka is best known for its software industry and now biotechnology and the state has recorded the highest growth rates in terms of GSDP and per capita GSDP in the last decade compared to other states. In the last decade, Karnataka surpassed all other states in India, pushing Karnataka's per capita income in Indian Rupee terms to sixth place. Karnataka is the manufacturing hub for some of the largest public sector industries in India. The contribution of industrial sector to Karnataka's GSDP in 2010-11 census report has been 28.48 percent. The sectoral composition of Karnataka GSDP is comparable with sectoral composition of India's GSDP as 27.9 percent. The state evolved as the manufacturing hub for some of the largest public sector industries of India after independence. The major industrial sectors of Karnataka includes Aeronautics, Aerospace laboratories, heavy electrical and electronics, telephone industries machine tools, motor cycles, sugar factories, edible oil processing, pharmaceutical factors, textile processing units, steel producing units, petroleum refinery and fertilizer manufacturing firms.

Industry and infrastructure has been making rapid strides in Kerala. There are 1.8 lakh small scale industrial outfits and about five hundred and eleven medium sized and large scale industries in Kerala. Kerala produces traditional manufacturing items such as coir, handlooms, and handicrafts which employ around one million people. Around 180,000 small-scale industries employ around 909,859 Keralites, 511 medium and large-scale manufacturing firms are located in Kerala. The KSIDS has promoted more than 650 medium and large manufacturing firms in Kerala creating employment for 72,500 people. After

independence, the state was managed as a democratic socialist welfare economy. The industries in Kerala are fertilizer factory, roof tile and Beedi manufacturing firms.

Tamil Nadu is the eleventh largest state in India by area and the sixth most populous state in India. The state was ranked sixth among states in India in 2011 census report. Since 2012, it is the second largest state economy in India in terms of gross domestic product. The state has the highest number (10.56 percent) of business enterprises and stands second in total employment (9.97 percent) in India, compared to the population share of about 6 percent. In the 2013 Raghuram Rajan panel report, Tamil Nadu was ranked as the third most developed state in India based on a "Multi-dimensional Development Index". The major industries of Tamil Nadu include leather, textiles and engineering, automobiles, heavy industries such as iron and steel, cotton, silk and power electrical and electronic equipment, sterile industries, paper, watches and cement.

Following the change in the policy regime there has been a growing concern among the policymakers and researchers about the impact of economic reforms on regional industrialisation in India. While the supporters of the market reform argued for the positive role of the liberalised policies in reducing inter-regional disparity. Against this backdrop, this study aims to analyse the inter-state variation in the manufacturing sector of southern states before and after reform period with the following objectives. They are:

1. To measure technical, scale, cost and allocative efficiency in the manufacturing sector of southern states of India before and after reform period.
2. To analyse productivity change and decomposing the productivity change into technical efficiency change and technological change in the manufacturing sector of southern states of India before and after reform period.
3. To examine causal relationship among labour productivity, real wage and inflation in the manufacturing sector of southern states of India before and after reform period.
4. To estimate the contribution of labour, capital and technology in the manufacturing sector of southern states of India before and after reform period.

Hypothesis framed

1. There is no significant difference in the technical, scale, cost and allocative efficiency level in the manufacturing sector of southern states of India before and after reform period.
2. The growth of total factor productivity is not influenced by the sources of technical efficiency change and technological change in the manufacturing sector of the southern states of India before and after reform period.
3. The theoretical causal relationship existing among labour productivity, real wage and inflation are not proved in the manufacturing sector of southern states of India before and after reform period.
4. Significant differences are not observed in the growth of marginal productivity of labour, capital and marginal rate of technical substitution of labour for capital in the manufacturing sector of southern states of India before and after reform period.

Methodology

This study was based on secondary data at the aggregate level. The required data such as gross output, fixed capital, number of workers, wages were collected from various sources such as Annual Survey of Industries (ASI), published by the Central Statistical Organization maintained by Ministry of Statistical and Programme Implementation, Government of India, New Delhi, Economic survey and EPW Research Foundation. Productivity represents average labour productivity (gross output index/employment index) while the rate of inflation represents the growth of the State Domestic Product (SDP) deflator. Real wages are obtained by deflating the nominal wage index with the SDP deflator. Based on the objectives of the study the whole reference period (1970-71 to 2013-14) was divided in to two phases. The period from 1970-71 to 1990-91 was treated as pre reform period and the subsequent period from 1991-92 to 2013-14 was treated as post- reform period. Since the time period involved in the study was fairly long in both the periods, need to normalise the data has been recognised. All the referred monetary variables were normalised by applying Net State Domestic Product (NSDP) deflator for all the states under study. As the data was available with different base series , for the purpose of the study the data was converted into 1970-71 as base for pre reform period and 1991-92 base for post reform period by using base shifting methodology, in order to get the time series data with a single base.

DEA Model, Malmquist TFP index, Granger causality test, Unit-root test, Multi-variate, co-integration analysis, Vector Error Correction Model (VECM), Cobb-Douglas production function, exponential growth function, annual growth rate other tools such as percentages, graphs and diagrams were also used to analyse the data based on the major objectives of the study. To estimate different output, computer software such as DEAP version 2.1, Eviews, Spss and Microfit for windows were used.

Findings

The major findings of the study are summarised as follows:

A. Efficiency Analysis:

a. Technical efficiency

- Under Constant Returns to Scale (CRS) production technology, the average efficiency during pre-reform period were 0.898, 0.874, 0.789, 0.840 and 0.933 respectively in the aggregate manufacturing sector of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Southern states as a whole. This implied that the industries producing its output on the efficiency frontier would have needed only 89.8 percent, 87.4 percent, 78.9 percent 84.0 percent and 93.3 percent of the inputs currently being used. In other words, it would have needed 10.2 percent, 12.6 percent, 21.1 percent, 16.0 percent and 6.7 percent more inputs to produce the same output, which meant waste of resources to the extent mentioned above.
- In case of VRS production technology, the average efficiency during pre-reform period were 0.954, 0.947, 0.922, 0.988 and 0.985 respectively in the manufacturing sector of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and southern states as a whole. This implied that the industries producing its output on the efficiency frontier would have needed only 95.4 percent, 94.7 percent, 92.2 percent, 98.8 percent and 98.5 percent respectively of the inputs currently being used. Only negligible percent of waste of resources to the extent of 4.6 percent, 5.3 percent, 7.8 percent, 1.2 percent and 1.5 percent more inputs to produce the same output, which meant waste of resources to the extent mentioned above.

- During post reform period spreading between 1991-92 and 2013-14, the same trend of greater technical efficiency under CRS production technology was observed for all the states including the whole southern states average efficiency were low in Kerala (64.2 percent) followed by Andhra Pradesh (82.2 percent), Karnataka (86.4 percent), Tamil Nadu (91.6 percent) and southern states (92.2 percent). Inefficiency estimates under CRS production technology was maximum (55.8 percent) for the manufacturing sector of Kerala and minimum (9.2 percent) for Tamil Nadu in disaggregated level.
- In the case of VRS production technology, the percentage of technical inefficiency recorded more (12.4 percent) for the manufacturing sector of Andhra Pradesh and minimum technical inefficiency (5 percent) was observed for the state of Tamil Nadu. At aggregate level is observed inefficiency estimates CRS production technology and VRS production technology as (0.085) and (0.055). The Instability Index (C.V) explained the fact that stability in the growth of technical efficiency was high for Tamil Nadu (7.734 percent) and low for Kerala (16.245 percent) under CRS production technology and (5.654 percent) for southern states as a whole.

b. Scale Efficiency

- During pre-reform period the industries were not operating at an optimum scale since the average efficiency scores was less than one for all the states. The average scale efficiency was the maximum (94.3 percent) for the manufacturing sector, Andhra Pradesh followed by Karnataka (92.4percent), Kerala (85.2 percent), Tamil Nadu (85.1 percent) and it was (94.7 percent) for the southern states as whole. This trend explained the fact that additional production to the extent of 5.7 percent, 7.6 percent, 14.8 percent, 14.9 percent and 5.3 percent respectively in the above stated states and southern states as a whole by taking advantage of their scale characteristics.
- Scale efficiency during the post-period (1991-92 to 2013-14) showed that the manufacturing sector of Tamil Nadu took the maximum scale efficiency score (0.962) followed by Karnataka (0.947), Andhra Pradesh (0.924) and Kerala (0.685), which made the aggregate manufacturing sector of southern states as a whole to be scale efficient to the extent of 97.3 percent. The inefficiency score showed that it was more for Kerala (46 percent) and minimum for Tamil Nadu (4 percent).

- State wise Scale inefficiency estimates showed that Andhra Pradesh and Kerala were inefficient under decreasing returns to scale during pre and post reform period respectively. Also inefficiency was more under post reform period compared with the pre reform period under decreasing returns to scale the pre reform period inefficiency in the aggregate manufacturing sector no doubt was due to the inefficiency of Kerala.

c. Cost efficiency

- The cost efficiency of manufacturing sector of southern states of India for the entire pre reform period revealed that under Constant Returns to Scale (CRS) technology, the manufacturing sector of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and aggregate Southern states were efficient to the extent of 71.4 percent, 76.2 percent, 69.6 percent, 67.7 percent and 91.9 percent respectively. Under Variable Returns to Scale (VRS) production technology the same sectors of Southern states were more efficient to the extent of 93.1 percent, 87.9 percent, 86.5 percent, 92.9 percent and 97.1 percent respectively. Considering the cost efficient DMUs, it was found to be more under VRS production technology.
- Cost efficiency estimates during the post reform period (1991-92 to 2013-14) under CRS production technology revealed that the average scores ranged between 56.0 percent and 85.9 percent for overall in aggregate level southern scores 87 percent. The maximum efficiency was attained by the state of Tamil Nadu and minimum estimated value was observed in the state of Kerala. With regard to the efficiency estimates under VRS production technology, maximum efficiency (91.2 percent) was observed in the manufacturing sector of Tamil Nadu, followed by Kerala (84.6 percent), Andhra Pradesh (82.8 percent) and Karnataka (82.5 percent).
- With regard to inefficiency score under CRS production technology, it ranged between 16.4 percent (Tamil Nadu) and 78.6 percent (Kerala). This maximum inefficiency in the manufacturing sector of Kerala may be due to the inefficiency of the firms in the selection of cost minimizing input quantities. Under VRS production technology minimum of 9.6 percent (Tamil Nadu) and maximum of 21.2 percent (Karnataka) inefficiency was observed.

d. Allocative efficiency

- The allocative efficiency estimates during pre-reform period revealed that the southern states under CRS production technology had on an average allocative efficiency level of 78.9 percent, 87.3 percent, 86.8 percent and 79.3 percent respectively in the manufacturing sectors of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu which made the aggregate southern states manufacturing sector to reach the level of 98.5 percent, implying 21.1 percent, 12.7 percent, 13.2 percent, 13.4 percent wastage in terms of selection of combination of inputs. The overall inefficiency in the southern states as a whole recorded 20.7 percent based on the above figures.
- In the case of VRS production technology, an average allocative efficiency of 97.4 percent, 92.7 percent, 93.7 percent, 94.0 percent could be observed in the manufacturing sector of Andhra Pradesh, Karnataka, Kerala and Tamil Nadu implying that the sectors were on an average wasted (inefficiency) 2.7 percent, 7.9 percent, 6.7 percent and 6.4 percent of the resources based on ineffective selection of combination of inputs respectively in the above mentioned industries of the southern states.
- During the post reform period from 1991-92 to 2013-14, the maximum allocative efficiency of 95.4 percent was recorded by the manufacturing sector of Andhra Pradesh and the minimum efficiency of 87.5 percent was recorded in the manufacturing sector of Kerala under CRS production technology. Also, the maximum inefficiency score of 0.143 (14.3 percent) was observed in the manufacturing sector of Kerala and minimum score of 0.048 (4.8 percent) was recorded in the manufacturing sector of Andhra Pradesh. Under VRS production technology all southern states had allocative efficiency of more than 90 percent. With regard to inefficiency estimates, the maximum was recorded in the manufacturing sector of Kerala (11.0 percent) and minimum for the manufacturing sector of Tamil Nadu (4.5 percent).
- The co-efficient of variation for both the periods explained the fact that the inconsistency in the growth of allocative efficiency level was more under CRS technology which was approximately ranging between 11 percent (11.124) and 23 percent (23.18) across states and 2.77 percent at the aggregate level during pre-reform period. Whereas under post reform period the figure ranged between 4 percent (3.790)

and 13 percent (12.503) across the states which had made the aggregate level inconsistency to the extent of 6 percent (5.799).

Based on the findings the hypothesis framed as “there is no significant difference in the technical, scale, cost and allocative efficiency level in the manufacturing sector in the southern states of India before and after reform period” was rejected and the alternative hypothesis was accepted.

B. Decomposition of Total Factor Productivity Growth (TFPG)

- Productivity improvement has not been recorded in Andhra Pradesh during pre-reform period. MPI had shown a decline of 0.8 percent per annum. In the most cases, the improvement in productivity seems to be caused by an improvement in technological change. Improvement in both the components together was observed in the in the post reform period. This implied that implementation of economic reforms have shown an advancement in productivity growth in the case of aggregate manufacturing sector in the state of Andhra Pradesh during post reform period. In other words, technology (shift in production frontier) contributed much to the TFP growth during post reform period compared to technical efficiency change.
- The technical progress was the main contributor to TFPG in Karnataka during the pre-reform and post reform period with average efficiency score of 1.023 and 0.992. It showed 2.3 percent increases and 0.8 percent reduction in the productivity growth respectively during pre and post reform period. Turning to the mean overall technical efficiency, they indicated positive trend overtime for the sample period, (pre and post) indicating improvement in efficiency (value greater than unity). However, not all the years registered a similar performance during the period. Some years have experienced a big increase in overall technical efficiency, while some years experienced a negative growth in technical efficiency.
- The technical efficiency change decomposition showed that scale efficiency change (indicates whether the firm can increase its productivity by becoming large) and pure efficiency change have contributed to the growth of overall efficiency during pre-reform period while pure efficiency change was held responsible during post reform period.

- The positive value of the scale efficiency change suggested that the aggregate manufacturing sector of Karnataka has succeeded in taking advantage of the growth in size of the sector, while the improvement in pure technical efficiency over the reference period suggested that there was learning process, as predicted by theories of intra-firm diffusion, while analysing the trend of technical efficiency and its component, pure technical efficiency and scale efficiency during the study period, the study found that period-to-period fluctuation in pure technical efficiency had apparently contributed to the fluctuations in overall technical efficiency.
- The components of the Malmquist TFP index for the manufacturing sector of Kerala showed that the productivity increase was mainly attributed to the increase in technical change during pre reform period as whole, while efficiency change and technology change contributed together for the growth of productivity during post reform period.
- There was a mean increase in total factor productivity of 1.9 percent and 1.8 percent respectively in pre and post reform period of the state of Kerala. The technical change component increased more than the efficiency change component throughout the analysis period (pre and post) in this state. The productive efficiency and scale efficiency indices were >1 only during post reform period which was indicative of a. Improvement in productive efficiency had taken place and b. Comparison to the period t , period $t+1$ had become close to a constant scale of return, which was gradually to the optimal size of a long- term approach.
- The analysis of the sources of the TFP growth in the manufacturing sector of Tamil Nadu revealed that the contribution of technical progress was greater than technical efficiency change during pre reform period and technical progress was a driving force of productivity improvement. In other words in the state of Tamil Nadu technology updates were at higher rate than efficiency improvement in the manufacturing sector. The combined influence of both these components explained the fact that it was high in the pre reform period when it was compared with post reform period. Also productive efficiency figures showed that in most of the years it was equal to scale efficiency indices indicating that the major source of efficiency change was the improvement in pure technical efficiency and scale efficiency in the pre reform period.

- During post reform period productivity growth was fluctuating and finally productivity to decline over the whole period was observed manufacturing sector of Tamil Nadu. The productive efficiency and scale efficiency indices were <1 during pre and post reform period which was indicative of a. Improvement in productive efficiency had not taken place and b. Compared to the period t , period $t+1$ had become close to a variable scale of return, which was gradually opposite to the optimal size of a long- term approach.
- The estimates of different components of the Malmquist productivity index of total factor productivity for the southern states during pre and post reform period showed that at the aggregate level productivity growth were mostly driven by technological progress before and after the reform. The average productivity growth in both periods showed that though there was productivity increase; post reform period impact had no influence on it. In fact the productivity growth was reduced from 1.2 percent to 0.4 percent. The productive efficiency and scale efficiency indices were <1 during pre and post reform period which was indicative of a. Improvement in productive efficiency had not taken place and b. Compared to the period t , period $t+1$ had become close to a variable scale of return, which was gradually opposite to the optimal size of a long- term approach.
- The hypothesis framed as “The growth of total factor productivity is not influenced by the sources of technical efficiency change and technological change in the manufacturing sector of the southern states of India before and after reform period.” was rejected and the alternative hypothesis was accepted.

C. Relation among Real Wages, Inflation and Labour Productivity

i) Labour Productivity and Real Wage

- The unit root test applied showed that the test statistics for the log level of the variables productivity and real wages were less than the critical values in absolute terms. This implied that the null hypothesis cannot be rejected. The test statics for their first difference exceeded the respective critical values, implying rejection of null hypothesis. For inflation the test statistic showed its significance at the second difference. Hence the variables were stationary at first and second level difference.

- Based on the Trace statistic and Eigen value during pre-reform and period there was sufficient evidence to reject the null hypothesis in favour of alternative hypothesis excepting Tamil Nadu stating that there existed long run relationship among the variables Labour Productivity and Real Wage. Also 2 co-integrating equations for the states of Karnataka and southern states and one co-integrating equation for Andhra Pradesh and Kerala. Under post reform period based on the trace statistic and Eigen value supporting evidence to reject the null hypothesis was confirmed in Kerala at 5 percent level.
- The standard Granger causality test applied to determine the short run causal relationship between the variables labour productivity and real wage showed that showed that the null hypotheses of labour productivity does not Granger cause wage and wage does not Granger cause labour productivity for the state of Andhra Pradesh, Tamil Nadu and southern states cannot be rejected since the reported probabilities were greater than 0.05 implying that the relationship between labour productivity and real wage was independent of each other in these states during pre-reform period . Hence marginal productivity theory and bargaining theory was not proven since the causality runs from labour productivity to real wages was not established.
- The results of the Granger causality for the remaining states namely Karnataka and Kerala wage does not Granger cause labour productivity could be rejected proving the theory of efficiency wage hypothesis that higher real wages implied a higher cost of job loss for workers. When firms pay higher wages, workers exert greater effort to avoid being dismissed. Therefore, a rise in real wages will improve labour productivity by causing an increase in the cost of job loss in these two states. But the null hypothesis labour productivity does not Granger causality wage cannot be rejected. Therefore, one way Granger causation runs from labour productivity to wage in the short run.
- During post reform period indicated that the null hypothesis Labour Productivity does not Granger cause Real Wage and Real Wage does not Granger cause Labour Productivity cannot be rejected since the relationship between them are independent for all the states and for the southern states as a whole.

- The results of ECM during pre-reform period showed that the ecm (-1) for causal relationship existing between labour productivity and wage was negative for the states of Andhra Pradesh, Karnataka, Tamil Nadu and Southern states respectively -0.1864, -0.1663, -0.1159 and -0.1668 which signified that labour productivity, converge to long run equilibrium level in relation to wage during pre-reform period since the coefficient was significant at 1 percent level. In other words, 18.64 percent, 16.63 percent, 11.59 percent and 16.68 percent of disequilibrium from previous periods shock conveyed back to the long run equilibrium in the current period respectively in the above said manufacturing sectors.

- The long run relationship existed showed one way or unidirectional long run causal linkage between the variables labour productivity and real wage during pre-reform period of Andhra Pradesh, Karnataka, Tamil Nadu and Southern states. Also when there was deviation from the long term equilibrium, the error correction term had an opposite adjustment effect and the deviation degree was reduced.

ii) Labour Productivity and Inflation

- Based on the trace statistic and Eigen value during pre-reform period there was sufficient evidence to reject the null hypothesis in favour of alternative hypothesis. The test results clearly suggested all the test statistics are significant at 5 percent level indicating long run relationship. Both the statistics indicated 2 co-integrating equations for Karnataka, Kerala and for the southern sector at 0.05 level indicating two linear combination of the variable and one co-integrating equation for Andhra Pradesh and Tamilnadu.
- Under post reform period based on the trace statistic and Eigen value supporting evidence to reject the null hypothesis was confirmed for Andhra Pradesh Karnataka, Kerala and Tamilnadu. Both the statistics indicated 2 co-integrating equations for Karnataka and one co-integrating equations for Andhra Pradesh, Kerala and Tamil Nadu long run relationship was established between labour productivity and inflation for the manufacturing sector.
- During pre-reform period the null hypothesis Labour Productivity (LP) does not granger cause Inflation (INF) and Inflation (INF) does not granger cause Labour Productivity (LP) could not be rejected for all the states and southern states because of the reason that there was no evidence of causality flowing from labour productivity to inflation and inflation to labour productivity. On the other hand during post reform period bi-directional causality was observed between these two variables i.e. inflation and labour productivity in Kerala and Southern states while in the other 3 states there existed unidirectional causality. A unidirectional flow of causality running from productivity to inflation in the southern states as a whole proved the standard theoretical view productivity growth is exogenous and increases in worker's productivity bring about decreases in the rate of inflation by raising the economy's aggregate supply.
- The results of ECM during pre-liberalisation period showed that the ecm (-1) for causal relationship existing between labour productivity and inflation was negative for all states and aggregate manufacturing sector of southern states The ecm (-1) of -0.1646, -0.1371, -0.1108, -0.1206 and -0.1409 respectively in the states of Andhra Pradesh, Karnataka, Kerala, Tamil Nadu and Southern states bring out the fact that

16.46 percent, 11.08 percent, 12.06 percent and 14.09 percent of disequilibrium from previous periods shock conveyed back to the long run equilibrium in the current period respectively in the above said manufacturing sectors. The significant coefficient of the individual variables indicated that the past equilibrium errors played in determining the current outcomes and there is a need for short run adjustments for the relationship existing between labour productivity and inflation in the manufacturing sector of Andhra Pradesh and Kerala during post reform period.

iii) Real Wage and Inflation

- There was sufficient evidence to reject the null hypothesis was confirmed for the state of Karnataka and Tamilnadu at 5 percent level of significance indicating linear combination of the variables of 2 co-integrating equation for Karnataka at 10 percent level and one co-integrating equation for Tamilnadu at one percent level. There was sufficient evidence to reject the null hypothesis in favour of alternative hypothesis for the states of Andhra Pradesh, Karnataka and Kerala during post reform period indicating long run relationship at 5 percent level of significance between real wage and inflation. Also, both the statistics indicated one co-integrating equations for the above mentioned states based on the Trace statistic and Eigen value.
- There was absence of causal relationship between the variables in log difference form during pre and post reform period for causality among Causality between Real wage and inflation in all the southern states and at the aggregate level during the reference period under study.
- The results of ECM in relation to the relationship existing between real wage and inflation showed that ecm (-1) during pre-reform and post reform period was positive which showed that there was no evidence for the influence of past equilibrium errors playing a role in determining the current outcome and also convergence to long run equilibrium position in all the four states and southern states as whole.
- From the analysis of the above the hypothesis framed as “theoretical causal relationship existing among labour productivity, real wage and inflation are not proved in the manufacturing sector of southern states of India before and after reform period” was rejected only for the causal relation existing between among labour productivity

and real wage, and real wage and inflation. It was accepted for causal relation existing between real wage and inflation.

D. Cobb-Douglas production function

- Based on the Cobb-Douglas production function estimates it was found that there had been increase in the MP_K ratios during pre-reform from the beginning of the period to the end of the period excepting the state of Andhra Pradesh. The ratios had grown at a rate of 1.3 percent, 2.3 percent, and 3.8 percent respectively in the states of Karnataka, Kerala, and Tamil Nadu. No doubt this had made the southern states as whole to grow at the rate of 2.9 percent. The growth rate of Kerala had shown a decline of 1 percent. It was positive for all the states, which implied that capital had contributed positively to output by all the southern states. With regard to the stability in the growth of these ratios it was more for the state of Karnataka (13.00 percent), followed by Andhra Pradesh (15.20 percent), Kerala (17.66 percent) and Tamil Nadu (20.12 percent). Around 12 percent was observed for the southern states as whole.
- The post reform had positively influenced average MP_K ratios of Kerala. It was obvious based on the average figure that it was high among the four southern states of India with 34.1 percent which was statistically significant. But this growth rate was not stable because of high co-efficient of variation compared to all other states. Post reform had adversely affected the growth of MP_K ratios of the state of Tamil Nadu, showing negative growth rate to the extent of 4.4 percent. This was due to the reason that in this state labour was the main factor positively influencing the output during the period under study. Excluding Tamil Nadu all the other states were responsible for the slow growth of the MP_K ratios in the southern states of India.
- Additional productivity made to the total production of labour (MP_L) was negative in the manufacturing sector of Kerala and Tamil Nadu and which made the southern states as a whole to be negative in terms of marginal productivity of labour (MP_L) during pre-reform period. Trend rate calculated showed that for the whole period compared to Andhra Pradesh the performance in terms of marginal productivity Karnataka had 8 percent which was statistically significant. A decline was noted at the rate of 3 percent, 13 percent and 11 percent respectively in Kerala, Tamil Nadu and Southern states.

- During post reform period excepting the manufacturing sector of Kerala the performance of manufacturing sectors of southern states in terms of marginal productivity of labour were positive throughout the reference period under study during post reform period. Calculated trend rate showed that it was high for Tamil Nadu (14.8 percent) followed by Karnataka (2.3 percent) and Andhra Pradesh (1percent). These states were held responsible for 6.9 percent growth rate in the southern states as a whole. But it was found based on co-efficient of variation that there was instability in the growth of marginal productivity of labour to the extent of 31.51 percent, 34.88 percent and 23.82 percent in the above mentioned states. The overall picture for southern states as a whole was 36.57 percent.
- An analysis of Marginal Rate of Technical Substitution of Labour for capital ($MRTS_{LS}$) showed that during pre-reform period it was very clear that in the states of Karnataka and Kerala there was no need for capital input to be reduced for the sake of maintaining the same level of output since the ratios were negative in the sense it has to further increase the quantum if capital input. On the other hand the positive ratios in other two states showed that there was some amount of sacrifice. In other words, the substitution ratio of 1:1.0177 for Andhra Pradesh and 1: 0.9755 for Karnataka for the aggregate period showed that to maintain the same level of output the capital input has to be reduced to the extent of 1.0177 and 0.9755 units.
- During post reform period in the manufacturing sectors of Kerala and Tamil Nadu, there was no need for capital input to be reduced for the sake of maintaining the same level of output since the ratios were negative in the sense it had to further increase the quantum of capital input. On the other hand the positive ratios in other two states namely Andhra Pradesh and Karnataka showed that there is some minimum amount of sacrifice. In other words the substitution ratio of 1:0.0164 for Andhra Pradesh and 1: 0.7564 for Karnataka. Hence, the aggregate manufacturing sector of Andhra Pradesh and Karnataka would have sacrifice 0.0164 units and 0.7564 units respectively of capital input to maintain the output level over the reference period under study.
- The trend rate of substitution was only 1 percent for Andhra Pradesh where as it was 24 percent for Tamil Nadu and Karnataka with lower inconsistency compared with Andhra Pradesh. Kerala and Southern states as a whole. Substitution possibilities during the reference period were missing in these states. And looking at the substitution

possibilities of the southern states as whole, it was surprising to note that the rate was 1: 6.3703, which indicated during post reform period the capital input to the extent of 6.3703 units to be reduced to maintain the same level of output.

- During pre-reform period efficiency parameter 'A' or the organizational efficiency was positive and significant in the manufacturing sector of Andhra Pradesh. This implied that the contribution of entrepreneurship to output was positive. Capital co-efficient β_1 was positive in Andhra Pradesh which implied that there existed positive and statistically significant relationship between output and capital and also between output and wage in this state. Wage co-efficient β_2 , was also positive and statistically significant for Andhra Pradesh and Tamil Nadu and which implied that there existed positive relationship between inputs-outputs. The sum of co-efficient (s) β_1 and β_2 showed increasing returns to scale in the states Karnataka, Kerala and Tamil Nadu. The percentage share of factor inputs presented indicated that the percentage share of wage was higher in 2 out of 4 states than capital namely Kerala and Tamil Nadu.
- With regard to type of technology adopted by the states during pre-reform period, it could be observed that the manufacturing sector of Andhra Pradesh and Karnataka were adopting capital intensive technology since the coefficients of (β_1) was greater than wage co-efficient (β_2). The manufacturing sector of Tamil Nadu, Kerala and southern states as whole was known for Labour intensive technology based on the coefficients ($\beta_2 > \beta_1$) during pre-reform period.
- Efficiency parameter 'A' or the organizational efficiency was positive during post reform period in the manufacturing sectors of Andhra Pradesh, Karnataka, Tamil Nadu and for the aggregate sector of southern states which implied that the contribution of entrepreneurship to output was positive. Increasing return to scale was observed based on the sum of individual co-efficient of labour and wage for 3 out of four sectors including the whole of southern states excepting Tamil Nadu. With regard to the technology adopted by these states, it was noticed that Andhra Pradesh, Karnataka and Kerala were known for labour intensive technology while Tamil Nadu was adopting capital intensive technology.
- The hypothesis framed as "significant differences are not observed in the growth of marginal productivity of labour, capital and marginal rate of technical substitution of

labour for capital in the manufacturing sector in the southern states of India before and after reform period” was rejected and the alternative hypothesis was accepted.

Conclusion

Though the technical efficiency of the manufacturing sectors in the southern states varied considerably, all the sectors were estimated to be on the frontier at least once. In other words, both under CRS and VRS production technology, the number of inefficiency scores or levels exceeded the number of efficiency scores during the entire period, implying that the efficiency of the firm was not strongly influenced by the size of production. DEA results applied to know the scale efficiency of the firm revealed that the industries were not operating at an optimum scale and scale inefficiency prevailed in industries under decreasing returns to scale. Lack of price transparency might have prevented these industries from adopting cost saving devices, which in turn helped these industries to survive in the market. The cost and allocative efficiency estimates revealed that the inefficiency was more under CRS production technology than under VRS production technology. The inability of the firm to adopt cost minimising input quantities or adjust to new environment or high non-recurring costs might have caused these firms to experience low efficiency score.

The improvement in technical efficiency change is observed from pure technical efficiency alone and not from scale efficiency in both the periods in the manufacturing sector of Andhra Pradesh based on Malmquist productivity indices. Period-to-period fluctuation in pure technical efficiency had apparently contributed to the fluctuations in overall technical efficiency in the manufacturing sector of Karnataka. During post reform period productivity growth was fluctuating and finally productivity decline over the whole period was observed. The average productivity growth in both periods for the manufacturing sector of Tamil Nadu showed that though there was productivity increase, post reform period impact had no influence on it. Long run relationship was established between labour productivity and real wage in Tamil Nadu. Marginal productivity theory and bargaining theory was not proven since the causality runs from labour productivity to real wages was not established. A unidirectional flow of causality running from productivity to inflation in the southern states as a whole proved the standard theoretical view of productivity growth is exogenous and increases in worker productivity bring about decreases in the rate of inflation by raising the economy's aggregate supply. A decline in MP_L ratios was noted in Kerala, Tamil Nadu and Southern states.

Recommendations

1. As per the findings of the study in order to improve the efficiency level-technical, scale, cost and allocative inefficiency of manufacturing sector in all the states and southern states as a whole to a reasonable extent, the educational system must be reorganised to produce a profile of skilled manpower which corresponds to the profile of demand for various types of skills arising in the modern industrial sector. The stock of untrained and mis-trained manpower already employed in industry must be re-trained, so that it acquires the knowledge required to maximise its efficiency.

2. In order to boost the total factor productivity growth in the manufacturing sector of Andhra Pradesh during pre-reform period, Karnataka and Tamil Nadu during post reform period, there is a pressing need to harmonise the industrial relations between workers and management. In this context, requisite amendments in labour laws, greater participation of workers in management and rehabilitation of workers especially in case of disinvestment of public sector units are some spheres which require quick attention of the policy makers to create conducive environment.

3. Industries with low total factor productivity – Andhra Pradesh (pre reform period), Karnataka (post reform period), Tamil Nadu (post reform period) require introduction of new frontier technology. Government policy should encourage investments that can introduce newly developed production technology.

4. The inconsistency in the growth of allocative efficiency level was more under CRS production technology during the period under study in all the states. When allocative inefficiency is considerable, a policy to improve resource allocation should be pursued, which can be done by promoting free markets and lessening governmental intervention.

5. In order to increase the marginal productivity of labour in the manufacturing of Kerala, Tamil Nadu and Southern states, all other factors of production should not be held constant.

Areas of further research

The following thrust areas can be considered on comparative basis in the same sample states for further research:

1. Productivity convergence in manufacturing sector in southern states of India.
2. Financial development and manufacturing sector's growth in southern states of India.
3. Role of trade policies in the growth of manufacturing sector in southern states of India.
4. Impact of government policy on the performance of manufacturing sector in southern states of India.