INDIAN MANUFACTURING : A STUDY OF PRODUCTIVITY AND TECHNOLOGICAL CHANGE

AN ABSTRACT
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ABSTRACT

Indian Economic planning assigned a crucial role for industrial sector. Since last fifty years the Indian economy has undergone a considerable amount of structural transformation and the industrial sector played an important role in shaping the economy. Considering the different objectives that were to be achieved, complete assessment of the sector would be difficult. However, a number of studies have tried to analyse various aspects and the changes which took place in this sector. The fundamental aspect of the industrial sector, among other issues, is related to the productivity performance of the Indian industries. The studies relating to this aspect have gained much attention in recent times.

In Economic literature, the productivity growth is treated as complementary to economic efficiency and is treated as a source of high levels of output growth. Of late, improvements in productivity, as the major contributor for growth in developing countries, have been given due importance. The economic efficiency depends upon the productivity of factor inputs used in manufacturing sector. However, in most of developing countries production and productivity are often not distinguished properly. Production is the absolute amount of flow of output during a given period. Productivity is the indicator of efficiency of factors of production.

Generally productivity is considered as the measure of efficiency of factors of production or inputs. The productivity is measured by expressing output as a ratio to the amount of inputs required to produce it or by expressing the change in output as

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a ratio to the change in amount of input required to bring it about. If the productivity performance is improving in an economy, it means that its factors of production are manifesting into the incremental output efficiency. Therefore, along with increases in volume of factor inputs, productivity improvements will also be contributing to the growth. For example, for any given output a higher rate of productivity improvement, if obtained means, the economy is able to save some factor inputs. Such released factors can be efficiently utilised for increase in production in the same sector or can be used in some other sectors. In the absence of productivity growth, the economy has to depend largely upon higher intakes of capital accumulation and savings. It requires, continuously higher and higher proportions of saving to income. In a developing country like India, such continuous increases in the ratio of saving to income imply enormous hardships to the people. In such cases productivity improvements can reduce the overall burden on the people.

The Industrial Policy Resolutions of different periods laid down the basic framework and the roles to be played by the public sector and private sector. Large investments have been made in building up capacities over a wide spectrum of industries. As a result, Industrial production has gone up and the industrial structure has been widely diversified covering the entire range of consumer, intermediate and capital goods. Especially, the growth of public sector and capital goods industries developed the capacity to sustain the future growth of industries on its own effort. The first three five year plans characterised with liberal licensing policies. However later plans in the name of import substitution and self-sufficiency imposed restrictions, started with licensing and imposed

restrictions on import of capital goods. This pattern of industrialisation led to a position of favouring displacement of any imports by domestic production.

The broad objectives of industrial development in India have been formulated on the Industrial Policy Resolutions of 1948 and 1956. The objectives include increasing overall production and productivity, encouraging small scale industries with a view to generating more employment, bringing regional balanced industrial development, preventing concentration of economic power by MRTP Act, protection of domestic industries etc. How far these objectives are realised during planning period ? In the process of industrial development public sector played an important role by providing infrastructure and by establishing basic industries. The leadership role was played by public sector while the private sector played a complementary role. As a result, the industrial base of the economy has widened, huge investments were made and the share of industry in the economy has increased.

In the process of industrialisation four distinct periods can be noticed. The first period '1950-65' resulted in marked structural changes in the system and public sector played dominant role during this period. During the second period '1966-84' the emphasis on state ownership and control of strategic parts of Indian industries gradually declined. The third period '1985-91' is characterised by various policies leading to liberalisation of private sector and decontrol on private sector. The fourth period starts from 1991 with new economic policy for stabilising the growth and structural adjustment of the economy.

The present study analyses a number of these issues. In analysing various issues the following hypotheses are tested for.

(i)   The policies implemented by the government through various plans have resulted in capital - intensive techniques of production in Indian manufacturing sector.

(ii)   Is allocative efficiency applicable in Indian manufacturing where in a large part of the registered manufacturing sector is under public sector with administered product prices and employment of both capital and labour not being specifically related to profitability criteria ?

(iii)   Indian manufacturing sector has become more capital using without a significant positive impact on productivity.

(iv)   The new technologies introduced are not only capital intensive but are also fuel intensive. World over it has been observed that the new technologies lead to substitution of fuel for labour. It is hypothesised that the share of fuel in value added has remained more or less constant in Indian manufacturing.

(v)   The simplest indicators of productivity are the 'partial productivity measures' and there can be as many partial productivity ratios as the number of inputs. The commonly used indicator is the labour productivity index, though economists consider capital productivity as a better index. It is hypothesised that with efficient use of factor inputs both partial productivity measures improve over a period of time.

(vi)   There exists a positive relation between productivity growth and growth of output at the economy wide level. The high growth attained during certain periods in

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the economy can be attributed to the increasing productivity growth of the factor inputs (TFPG). The study examines this hypothesis dividing the study period into two sub periods.

(vii)   The factor inputs acting upon the material inputs produce output. The production process is said to be efficient if the returns to scale are increasing or at least constant. It is hypothesised that Indian manufacturing sector is efficient.

(viii)   In both growth accounting and the production function approaches, the technological change is treated as a residual. The technological change captures unexplained factors in the growth of output, beyond what can be accounted for by the growth of inputs. It is hypothesised that in the Indian manufacturing technological change has contributed positively towards the output growth.

This study is for the time period from 1973-74 to 1992-93 and the basic data source is Annual Survey of Industries (ASI). Gross value added is expressed at constant prices is taken as the measure of output. The mandays of labour is taken as the measure of labour input. Net Fixed Capital Stock (NFCS) at constant prices is taken as the measure of capital input. In this study all the monetary variables are expressed at 1980-81 prices. As mentioned earlier in the present study, the time series data covering 16 major industrial categories (2 digit level) for the time period 1973-74 to 1992-93 is analysed

The present study uses a number of tools to examine the productivity growth and contribution of technical change in the manufacturing sector. For analysing factor intensities like capital intensity, fuel intensity, partial labour and capital productivities, the

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ratio analysis is made use of. These are the conventional methods of measuring productivity, but these measures have certain limitations. These problems in partial factor productivity (PFP) can be overcome by using the Total Factor Productivity (TFP). There are various measures of TFP which differ from one another. In most of empirical studies of TFP use either the Kendrick Index or Solow Index. In this study also Kendrick and Solow indices have been used to measure TFP. The major differences between the alternative indices of TFPG arise from the different assumptions with respects to the elasticity of substitution i.e. how different factors may be substituted for each other in response to a change in the relative price of factors. Besides these, production functions viz. Cobb-Douglas (CD) and Translog production functions have also been fitted to estimate productivity growth, returns to scale, technical progress and elasticity of substitution.

The main results of this study are presented in the following paragraphs which is followed by policy options.

The use based classification in terms of value added show the share of consumer goods declined from 50 per cent in the year 1960 to 36 per cent during the year 1990. At the same time, the share of intermediate goods and capital goods increased from 46 per cent in 1960 to 62 per cent in 1990. The diversification of the industrial base made possible the production of a very broad range of industrial products.

The industry wise analysis show that in terms of value added, the relative share of textiles declined from 31 8 per cent in the year 1960-61 to 13.85 per cent by the year 1991-92. Most of consumer goods sector share remained almost constant and capital

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goods section showed increasing trend. Rubber, Plastic, Petroleum, Coal Products(30)
(3 5-36)
Machinery, (Electrical and Non-electrical) showed improvement in shares over this period.

In terms of employment, Cotton textiles (23) industry had a share of 19.14 per cent in the year 1973-74 which declined to 10.91 per cent by the year 1992-93. In case of Food and Food Products (20-21) and Beverages and Tobacco Products (22) employment proportion gradually increased over the period of study where as in other industries employment proportion compare to number of industries declined or improved marginally. The employment pattern in most of industries indicate that industries over a period of time became less of labour intensive and more of capital intensive.

The performance in terms of value added also shows that the share of the Cotton Textiles (23) was 19.14 per cent in the year 1972-73 which declined significantly to 9.38 per cent by the year 1992-93. In term of value added Rubber, Petroleum Products (30) and Chemical and Chemical Products (31) have improved its share over the study period. However out of 16 industries 9 industries showed a decline in their share in terms of value added over this period.

The overall picture shows that the manufacturing sector gained its importance in the field of economic development and the production pattern underwent a massive change and developed a bias infavour of capital goods. The industrial policies implemented during planning period led to capital intensive techniques of production without much improvements on the productivity front. This distinct aspect emerges from the analysis of the trends in capital output ratio, capital labour ratio and output-labour ratio. The analysis show that a sharp increase in capital intensity is accompanied by falling

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capital productivity and rising labour productivity. The steady rise in capital output ratio without proportionate growth in output can be considered as sign of inefficient use of factor inputs.

For most of the industries in the manufacturing sector K/L ratio increased more than 4 per cent per annum during the period of study. It is also seen that for almost all industrial categories, with the exception of Transport equipment (37) the growth of K/L ratio is higher than capital - value added ratio. It is observed that there is an increase in capital intensity and labour productivity in all industries. However, there is a divergence between these two ratios and that capital intensity rose higher than labour productivity. The important reasons for higher capital intensive growth rate is the rise in capital goods industries, rise in public sector investment and a rise in incremental capital output ratios. Application of larger doses of capital in the name of modernisation in most of the industries can be an important element for strong capital intensive industrialisation. The rising gap between K/L ratio and labour productivity suggests that inefficient use of resources has become prominent feature of Indian industrialisation.

An exercise is conducted to identify the main factor which led to growing capital intensity in Indian manufacturing using decomposition analysis. The results show that the growing capital intensity is due to changes (rise) in K/O ratio itself. The rise in K/O ratio accounts for over 176 per cent of variations during the period of study. Whereas the contribution through changes in value added is only around 10 per cent. It can be concluded that high rate of increase in K/O in Indian manufacturing industries is the

outcome of rising K/O ratio itself across industries irrespective of their technological status.

The process of capital intensive industrialisation also led to increase in fuel intensity in this sector. For 'All manufacturing' sector the fuel intensity was 0.0510 in the year 1973-74 and it increased to 0.0619 by the year 1992-93. The raise is observed to be 20 per cent during the period of study. The study also observes that for 9 out of 16 industrial categories the fuel intensities have increased and only for 3 industries it has declined. Both capital and fuel are substituted in place of labour which ultimately leads to less employment opportunities for labour in this sector.

The performance and economic efficiency of a country can be measured in terms of improvement in productivity performances. The productivity growth has been accepted as a vital factor for the rapid development of an economy during the 20th century. Most of developing countries initially gave importance to capital accumulation. However, a shift of labour and capital from less productive sectors can also accelerate growth through its productivity improvements. Therefore it is accepted by these countries that along with increases in factors of production, the productivity improvements can also contribute to the development of a country. The efficient processes enables economies save factor inputs and these can be utilised for the production in some other sector.

The partial and total productivity analysis conducted in this study show that the Indian manufacturing sector fetches benefits of productivity growth. The partial productivity growth measure is considered to be conventional and simple method of measuring productivity. Generally, labour and capital are used in partial productivity

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analysis. However these measures have limitation that if the inputs, labour and capital, do not vary in the same proportion, the relative share of the factors change and the analysis will show bias towards one particular factor. To overcome this difficulty TFPG is used to measure the productivity in the manufacturing sector.

In the partial productivity analysis the results show that labour productivity showed increasing trend and capital productivity displayed a declining trend. For 'All manufacturing' labour productivity has increased from Rs. 65.14 to Rs 121.56 from 1973-74 to 1992-93. The capital productivity for the sector in terms of value added per unit of capital declined from 0.4341 to 0.3379 over sample period. It is surprising that the capital productivity for all individual groups at ASI two digit level classification declined. It is noticed Paper and Paper Products (29) faced a negative growth -6.34 per cent capital productivity which is the highest and the lowest fall of capital productivity observed is -0.19 per cent for Electrical and Non-electrical Machinery industry (35-36).

The estimates of partial productivities during 1973-74 to 1992-93 show that labour productivity grew at the average annual rate of 3.29 per cent and the capital productivity fell at -1.81 per cent during this time period. The rise in capital intensity at the average of 5 per cent per annum has been observed. It is observed that most of growth in labour productivity has been achieved through capital deepening.

The estimates of TFP are analysed through Kendrick and Solow indices in this study. The estimates of TFPG using Kendrick index show that there is a slight increase in productivity for the period of study. The index has increased from 100 in 1973-74 to 103.26 by the year 1992-93. However within manufacturing sector different industries

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exhibited different trends in TFPG. Rate of growth in the Index ranges from -2.09 per cent per annum in Paper and Paper products (28) to 2.82 per cent per annum in Textile products (26). It is noticed that six industries showed positive growth and 10 industries indicated negative growth in Kendrick index. However 'all manufacturing' sector the growth rate was 0.39 and this growth rate is not statistically significant. This leads one to conclude that the TFPG using Kendrick's Index is not a major contributor to the performance of this sector.

The Solow index of productivity growth also show an increase for the period of study. This index exhibits a trend growth of 0.41 per cent over the period which is considered to be low and statistically not significant. The study of individual industries show that out of 16 industries 13 industries have negative growth and only 3 industries have positive growth rate. The study is also undertaken for two different sub-periods dividing 20 years into two sub-periods i.e. 1973-74 to 1982-83 and 1983-84 to 1992-93. The estimates for sub-period reveal that there was improvement in TFPG for later period both in terms of Kendrick and Solow indices. The trend growth of Solow index has improved in later period. It was -0.96 in the first period which has gone to +0.90 for the second period. Among individual categories also 9 industries out of 16 for the second sub-period showed a positive trend in the Index. The Indian industrial sector exhibited high growth rates during the period of eighties and this is accompanied by improvement of TFPG.

Kendrick and Solow indices of TFPG display a growth rates of +0.39 and +0.41 respectively. Eventhough these values are positive and can not be considered as

significant contributor to development of the economy as they are close to zero and are not statistically significant. The Finding of low growth in TFPG in the manufacturing sector is broadly in line with the earlier findings of different studies.

The growth of economy is very often constrained by the scarcity of certain crucial resources like capital and therefore, these resources should be utilised optimally through efficient allocation systems. The productive process should be so organised as to generate enough of surplus to make higher reinvestments in the future. For creating surpluses, better productivity performances are crucial for manufacturing sector. The concept of productivity is based on the assumption of a unique technological relationship between inputs and outputs. The production function approach can be applied to study the impact of technological progress and to estimate other parameters such as returns to scale, elasticity of substitution etc. A production function is a technical relationship between the inputs and output. The measure of productivity and its sources lies in the concept of a production function which refers to an efficient set of unique relationships between inputs and outputs. There are different forms of production function.

In this study CD production function and Translog production function are estimated. Most widely used production function in productivity studies is based on CD production function. However this function assumes unitary elasticity of substitution between factor inputs but in real situation it does not always remain unitary. To correct this, the translog production function which allows elasticity of substitution to vary is also fitted.

The results of CD production function show that most of Indian industries face decreasing returns to scale. The value is less than one for 10 out of 16 industries, which means that they are facing decreasing returns to scale and 4 are facing increasing returns to scale. For 'all manufacturings' the returns to scale is 1.1159 and the sector is facing overall increasing returns to scale. However this value is not very high. The elasticity of output with respect to labour is 0.2770 which is significant at 5 per cent level and elasticity with respect to capital is 0.8389 which is significant at 1 per cent level.

The rate of technical progress for 'all manufacturing' is 0.0079, which indicates that the contribution of technical progress to productivity is very low. This means technical change has little impact on output growth of this sector. The value of technical progress is less than one per cent for as many as 10 industrial categories. For five industries, the coefficient representing rate of technical progress (λ) is negative, therefore, all them facing negative technical progress.

In Translog production function $(1+\alpha_1)$ value gives the returns to scale. It shows that 13 out of 16 industries are facing decreasing returns to scale and 3 of them are facing increasing returns to scale. For 'all manufacturing' sector $(1+\alpha_1)$ value is 0.9213 which is nearer one and the industry is facing almost constant returns to scale. However the coefficient is not statistically significant. With exception of three industries, most of Indian industries are facing decreasing returns of scale.

In this study the elasticity of substitution is found to vary from 0.9668 in the case of Textile products industry (26) to 1.4920 in Beverages and Tobacco product industry (22). The 'σ' value for 'all manufacturing' sector is 0.9012, however, for most of the

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individual industries elasticity of substitution value is found to be close to unity, indicating

substitutability between labour and capital. Therefore it is possible to employ more labour

without making much loss to the productivity. The proper allocation of factors like labour

and capital will improve the overall productivity of the economy.

The coefficient corresponding to time 'λ' value gives the rate of technical progress

in the translog production function. The study shows that 5 out of 16 industrial categories

the 'λ' value is negative. However most of other industries face positive technical

progress. For 'all manufacturing' technical progress is accounted to be 0.0146 which is

statistically significant. Both CD and Translog production function show that the over all

technical progress is positive but statistically it is not significant. Therefore one can not

say with confidence that the technical progress will lead to increase in efficiency.

Various results presented in the preceding paragraphs show that over a period of

time Indian industry has become more broad based, the output growth has been

significantly high, industrial dispersal has taken place. It is said that India has much wider

industrial base even when compared to countries like Korea, Brazil etc. The government

and its policies played an important role in widening the base. However less priority had

been given to efficiency and profitability criteria. The public sector which accounts for 70

per cent of capital does not perform on pure efficiency criteria. The pricing of output of

the public sector is based on social objectives. Due to high protection for the industries,

the competition levels were low and even shortages persisted for a long time. These

conditions also did not encourage technological upgradation. The old technologies are

less efficient than the new technologies. The new technologies are said to be more capital

intensive but have higher TFP. In addition, the newer technologies are largely developed in advanced industrial economies which are labour scarce and capital abundant. To adopt the new technologies to the local conditions, the local R&D should be well developed. But the expenditure on R & D is only 0.9 per cent of GNP which is considered to be very low. The experience of eighties show that with lower restrictions, the industrial performance has improved and that even TFPG has increased.

Through out the planning period Indian planners aimed at self sufficiency and followed import substitution policies. India had occasions in the past to change its policy approach. In 1970's many countries took to export oriented growth but India refused to switch. During eighties more foreign capital borrowing was pursued with out making any substantial change in the economic structure and policies. The foreign capital borrowed was debt rather than equity and was frittered away in low yield projects. This dependence on debt capital creating flows and low regard for efficiency gave comprehensive leading disadvantage to the crisis during early nineties. Since past 1991, the scenario of inflow is more in the form of equity capital which is determined by efficiency criteria as the equity funds flow to high yielding projects. If India pursued to new economic policy in the right earnest the results will be growth of output, employment and could lead to improvements in the standard of living.

By adopting an export oriented policy an economy produces with the intention of selling in the world market rather than concentrating in the local market. In case of India the local market itself is very large. The outward looking policy may lead to competitive out-look and would lead to greater emphasis on efficiency criteria. Even if one segment of

the economy is highly efficient and is internationally competitive, it would have a cascading effect on rest of the economy. The efficiency criteria and competition would lead to upgradation of technologies and discard of inefficient technologies. The adoption of second-. best technologies would give way to the best and innovations would persist.

The world-wide experience of the Post-World War II has clearly shown that the greatest beneficiaries of international division of labour are labour rich countries like Korea, Taiwan and Thailand and not capital rich economies. India has the competitive advantage in skilled as well as unskilled labour. We have even greater advantage in artistic skills, which can make us to export high value of luxuries for which demand around the world is elastic. In today's world the need for flexibility and adjustment is great. This argues for higher education, greater skill formation and continuing education of the Indian labour force which may work infavour India's comparative advantage. The protectionist policies would only hamper the growth of efficiency and would only favour the second best.

If production processes are to be efficient and competitive, controls will have to be eliminated. During the post 1991 era, a good number of measures have been taken. The reservation for small scale industries have also been reduced. One area which needs attention is the case of 'exit policy'. India does not have a proper exit policy. The 'no exit' situation has resulted in inefficient firms continuing in the market. A proper exit policy may be used for phasing out of old, inefficient technologies and would faster competitive forces. The exit policy may work as an instrument which may release some

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factor inputs and accordingly these factors can be reallocated towards efficient utilization. This will also help free entry and introduction of new technologies which will go a long way in improving industrial sectors performance. This measure alongwith other market oriented policies can make the manufacturing sector a better performary. Competition should be encouraged rather than discouraged by policy and attempts to at collusion and restrictive behaviour must be thwarted.

The steriotyped views about ability to compete internationally can only serve to keep us poor and backward. Therefore India has to be pro active and persue its goals in the international market under ever changing conditions. The policies needs to be rationalised to achieve the desired results. An industrial policy can not be formulated and function in isolation rather, it must be consistent with overall national objectives and goals which supported by an institutional framework that will allow the realisation of pre-set targets. Any policy adopted must comprise both domestic and international objectives of the country especially to promote the exports earnings of the nation in a liberalised set-up. A comprehensive policy should domestically promote employment, efficient utilisation of resources, relative price stability, improvement of productivity, technological innovation, etc. In the external front industrial strategy must induce the competitiveness, encourage inflow of foreign investment and expansion of foreign market.