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CONTENTS

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INTRODUCTION

REVIEW OF LITERATURE

NEED/IMPORTANCE OF THE STUDY

STATEMENT OF THE PROBLEM

OBJECTIVES

HYPOTHESES

RESEARCH METHODOLOGY

RESULTS & DISCUSSION

FINDINGS

RECOMMENDATIONS/SUGGESTIONS

CONCLUSIONS

SCOPE FOR FURTHER RESEARCH

ACKNOWLEDGMENTS

REFERENCES

APPENDIX/ANNEXURE

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CONTRIBUTIONS TO BOOKS

- Sharma T., Kwatra, G. (2008) Effectiveness of Social Advertising: A Study of Selected Campaigns, Corporate Social Responsibility, Edited by David Crowther & Nicholas Capaldi, Ashgate Research Companion to Corporate Social Responsibility, Chapter 15, pp 287-303.

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- Schemenner, R.W., Huber, J.C. and Cook, R.L. (1987), "Geographic Differences and the Location of New Manufacturing Facilities," Journal of Urban Economics, Vol. 21, No. 1, pp. 83-104.

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NATURE OF PRODUCTION RELATIONS IN ORGANISED MANUFACTURING SECTOR OF INDIA

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ABSTRACT

The Indian manufacturing sector has come off age after passing through many hurdles and has largely become immune to the political ideologies. It has certain inherent strengths to deal with fast changing external sector. The availability of industry-wise year-wise data at two digit level allows us to estimate the production functions based on neo-classical assumptions in Indian setting. The present paper attempts to analyze the nature of production relations in organised manufacturing sector of India using translog production function with three input variables labour, capital and technology (represented by time in years). It means the 'technology' here means all factors other than labour and capital i.e. it includes effects of governance, legal systems, law & order, market conditions, availability of physical infrastructure & its quality. With this understanding, we have tried to capture the changing nature of the production function 1979-80 to 2010-11. The positive slopes of marginal products are indicators of the appetite of the economy to absorb large investments. The capital deepening technical progress has not reduced the employment generation potential of the economy. However, there is a need to focus on the sectors which have maximum vertical linkages.

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KEYWORDS
Capital, Production, Technical Progress, Total Factor Productivity.

1. INTRODUCTION

Manufacturing sector has long been the main source, user and diffuser of technical progress and associated skills and attitudes. Its special role can be understood only in a world of dynamic learning and technical change, where large enterprises strive to increase their size and capabilities to realize economies of scale and societies constantly transform their structures and habits. In this world, the manufacturing industry is not just an ingredient of development-it is the essential ingredient. It provides the direct demand that stimulates the growth of many modern services. It is often the largest customer for banking, transport, insurance, communications, advertising and utilities. It creates markets for new services and skills, particularly important for finance, education and logistics. It is the source of new service enterprises, many of them originally part of manufacturing enterprises and hived off to provide design, logistics, maintenance, training and other services. It is also a vital source of new skills and attitudes, transforming traditional economic structures. It creates an industrial work ethic, spreading the discipline and organization required in modern societies. It fosters entrepreneurial capabilities, with small enterprises as the springboard, and it develops new managerial and technological capabilities, the core of modernization and competitiveness.

India's development strategy placed greater emphasis on creation of a well-diversified industrial base to realize the dream of industry-led development. In order to maximize growth with limited resources, the importance of increasing productivity, efficiency and competitiveness needs no rationalization. It is the foremost duty of the economists to keep evaluating the technology continuously to generate warning signals for the policy makers. Recently, the technological changes in the Indian industries have gained momentum. This has many implications for share of labour, productivity, employment and future growth potential of the industry. In the present paper, the nature of production relations in organised manufacturing sector of India has been analysed using translog production function. The review of related literature, methodology used and data analysis have been discussed in the next sections.

2. REVIEW OF LITERATURE

There is no dearth of research on analysis of production related aspects. There have been many attempts to understand the nature of technical progress in manufacturing sector. Productivity studies gained prominence in India after 1950s and early 1960s, when development was basically growth oriented. In later part of 1960s, a number of studies have been conducted in the manufacturing sector in India. Several studies like Dholakia (1994)[04], Ahluwalia (1991)[01], Mohanty (1992)[10], Balakrishnan & Pushpangadan (1998,)[02], Balakrishnan, P, K Pushpangadan and M Suresh Babu (2000)[03] Majumdar (1996)[09], Rao (1996a)[11], Rao (1996b)[12], Srivastava (1996)[14], Krishna, K.L (1987)[08], Pradhan & Barik (1998)[13], Hulten & Srinivasan (1999)[07], Balakrishanan et al (2000)[06], Goldar (2000)[05], Trivedi et (2000)[16], Goldar & Kumari (2003)[06], Trivedi (2003)[15] have measured the productivity trends, employment trends and growth of Indian organized manufacturing sector during the post independence period. A significant number of studies have focused on the measurement of Total Factor Productivity Growth (TFPG) and found different figures within different underlying methodological framework. Recent studies like Balakrishnan and Suresh Babu (2003), find the growth rate of labour productivity and employment in the nineties has risen as compare to eighties. But at the same time, the growth rate of money wage, product wage and real wages has declined in the post-reform as compare to pre-reform period. Some of the indicators of their study do commensurate with the findings of Unel (2003) and Gangopadhyay and Wadhwa (1998). But Goldar (2004) finds a deceleration growth in Indian manufacturing during post-reform periods as compared to pre-reform period. He has compared his results with Unel (2003) and TSL (2003) and criticized their findings on the ground of measurement problems. Goldar's study also finds a negative employment growth in Indian organized manufacturing sector after 1997-98. The study by Bidhe and Kalirajan (2004) also shows a slow growth rate of employment in organized manufacturing sector in post-reform period as compare to pre-reform period. Indian government policies with regards to industry, foreign investment and trade have been sprouting over the years. In 1950s and 60s, the focus of the government was on attaining self-sufficiency in all sectors of the economy, generating employment, promoting small industries and preventing private sector monopolies. Over the years, however, these policies had detrimental effect on low productivity, lack of professional management in most of the Indian firms. In state owned enterprises and government ownership, the bureaucratic system delayed in decision-making process. The compulsory licensing for all the industries, price controls and subsidies removed motivation to improve performance. After the 1991 reforms, Indian manufacturing has been opened out to competition from global players. However, the pace of reform has been slow. The government should find out proper immediate action in order to enhance the

productivity, which will accelerate the growth process and competitiveness of the economy. In order to take various steps for increasing the productivity, it is more important to see the dynamic relationship between the key variables in the manufacturing sector. The present paper has a different dimension. It differs from the previous literature on the ground of specific focus on explaining the managerial and labor productivity in the manufacturing sector. It is well documented that the mutually reinforcing phenomena of low productivity in manufacturing sector is the cause for low income. Low income in turn leads to low standards of living, which constitute the root cause for poverty and unemployment in the country. So, the issue of labour productivity growth, the only route to enhance labour welfare in the long run has been under examined. In this paper, we have used the translog production function to analyse the nature of technical progress and its impact on labour productivity and share of labour.

3. IMPORTANCE OF THE PRESENT STUDY

The real innovation in an economy takes place in firms due to creativity of managers. The innovations change the nature of production functions reflected in the changes in the parameters. The technical progress of whole manufacturing sector depends upon the improvement in social, legal, physical, technological and administrative infrastructure. The relationships among labour, capital and technology keep on changing continuously. This is the job of economists to keep on evaluating these relationships by studying production functions. Recently, no such attempt has been made for whole of the Indian manufacturing sector. The present paper contributes towards this objective.

4. STATEMENT OF THE PROBLEM

The research problem selected in this paper is to analyse whole manufacturing sector as a single firm so that we can measure the changes in total factor productivity, marginal products of labour & capital, marginal rate of technical substitution, substitution elasticities, returns to scale and labour elasticity of output for periods 1979-80 to 1989-90, 1990-91 to 2001-02 and 2002-03 to 2010-11.

5. HYPOTHESES

The present study tests the following null hypotheses:

i) The total factor productivity during three phases as mentioned in the statement of the problem has been rising.
ii) The marginal rate of technical substitution is Hicks-neutral.
iii) There are constant returns to scale in the manufacturing sector.
iv) The labour elasticity of output has been increasing.

6. RESEARCH METHODOLOGY

Let us assume, that one business house is producing a homogeneous product called "value added **Q**" using capital **K** represented by investment in net fixed capital and labour **L** represented by number of total persons engaged with constantly and continuously improving technology **T** represented by time (year). All inputs have been allocated in thirteen different industries. We have used ASI data at two digit level from 1979-80 to 2010-11 for variables **Q**, **L**, **K**, share of labour and capital.

The Translog Production function is a twice differentiable function with assumptions of homogeneity, homotheticity, separability, continuity and additivity. It can be used for measuring the slope of isoquants showing the direction of technical progress. We have used the following form of the function in our analysis:

$$\ln Q = \alpha_0 + \alpha_L \ln L + \alpha_K \ln K + \alpha_T \ln T + 1/2\, \alpha_{LL} (\ln L)^2 + 1/2\, \alpha_{KK} (\ln K)^2 + 1/2\, \alpha_{TT} (\ln T)^2 + \alpha_{LK}(\ln L)(\ln K) + \alpha_{KT} (\ln T)(\ln K) + \alpha_{LT} (\ln T)(\ln L) + u \quad \text{.....(1)}$$

Where Q, L, K, T stand for Output, Labour, Capital and Technology; α_i 's are the parameters to be estimated and u is the random error term with usual assumptions of normality, zero mean, constant variance and absence of autocorrelation. The translog function has been defined with following restrictions:

$$\alpha_L + \alpha_K + \alpha_T = 1 \quad \text{.....(2)}$$
$$1/2\, \alpha_{LL} + \alpha_{LK} + \alpha_{LT} = 0 \quad \text{.....(3)}$$
$$1/2\, \alpha_{KK} + \alpha_{LK} + \alpha_{KT} = 0 \quad \text{.....(4)}$$
$$1/2\, \alpha_{TT} + \alpha_{KT} + \alpha_{LT} = 0 \quad \text{.....(5)}$$
$$\alpha_{ij} = \alpha_{ji} \quad \text{.....(6)}$$

The translog function has been estimated along with two share equations. If we differentiate the equation (1) with respect to L and then multiply with L we will get the share of labour, as shown below:

$$((\partial Q/\partial L) L)/Q = \alpha_L + \alpha_{LL} \ln L + \alpha_{LK} \ln K + \alpha_{LT} \ln T \quad \text{.....(7)}$$

Similarly, the share of capital will be:

$$[(\partial Q/\partial K) K]/Q = \alpha_K + \alpha_{KK} \ln K + \alpha_{LK} \ln L + \alpha_{KT} \ln T \quad \text{.....(8)}$$

We can get the marginal rate of technical substitution (i.e. the slope of isoquants or MRTS) from equations (7) and (8) as given below:

$$MRTS = (K/L)\{(\alpha_L + \alpha_{LL} \ln L + \alpha_{LK} \ln K + \alpha_{LT} \ln T)/(\alpha_K + \alpha_{KK} \ln K + \alpha_{LK} \ln L + \alpha_{KT} \ln T)\} \quad \text{.....(9)}$$

Whole data has been divided into three subsets from 1979-80 to 1989-90, from 1990-91 to 2001-02 and from 2002-03 to 2010-11 for analysis purpose.

If we get the all second order partial derivatives, we will get following expressions:

$$\partial^2 Q/\partial L^2 = (Q\, \alpha_{LL}/L^2) + (\partial Q/\partial L)^2 - (\partial Q/\partial L)/L \quad \text{.....(10)}$$
$$\partial^2 Q/\partial K^2 = (Q\, \alpha_{KK}/K^2) + (\partial Q/\partial K)^2 - (\partial Q/\partial K)/K \quad \text{.....(11)}$$
$$\partial^2 Q/\partial T^2 = (Q\, \alpha_{TT}/T^2) + (\partial Q/\partial T)^2 - (\partial Q/\partial T)/T \quad \text{.....(12)}$$
$$\partial^2 Q/\partial L\, \partial K = [Q\, \alpha_{LK}/LK] + [(\partial Q/\partial L)(\partial Q/\partial K)/Q] \quad \text{.....(13)}$$
$$\partial^2 Q/\partial K\, \partial T = (Q\, \alpha_{KT}/KT) + [(\partial Q/\partial K)(\partial Q/\partial T)/Q] \quad \text{.....(14)}$$
$$\partial^2 Q/\partial L\, \partial T = [Q\, \alpha_{LT}/LT] + [(\partial Q/\partial L)(\partial Q/\partial T/)Q] \quad \text{.....(15)}$$

Marginal Rate of Technical Substitution between any two inputs is given by the expression:

$$MRTS_{i,j} = (\partial Q/\partial X_i)/(\partial Q/\partial X_j) \quad \text{.....(16)}$$

The Allen Elasticity of Substitution between any two inputs has been computed by the expression:

$$\sigma_{i,j} = G/\alpha_{ij} + S_i S_j \quad \text{.....(17)}$$

where S_i is the share of i^{th} input and G is the determinant of the following matrix:

0	S_L	S_K	S_T
S_L	$\alpha_{LL}+S_LS_L$	$\alpha_{LK}+S_LS_K$	$\alpha_{LT}+S_LS_T$
S_K	$\alpha_{LK}+S_LS_K$	$\alpha_{KK}+S_KS_K$	$\alpha_{KT}+S_KS_T$
S_T	$\alpha_{LT}+S_LS_T$	$\alpha_{KT}+S_KS_T$	$\alpha_{TT}+S_TS_T$

If we take the total derivative of equation (1) and put dL/L=dK/K=dT/T=dX/X then the returns to scale (RTS) can be written as (dQ/Q)/(dX/X):

$$RTS=\alpha_L+\alpha_K+\alpha_T+\alpha_{LL}\,LnL+\alpha_{KK}\,LnK+\alpha_{TT}\,LnT+\alpha_{LK}\,LnLK+\alpha_{KT}LnKT+\alpha_{LT}LnLT \quad \textbf{.....(18)}$$

If we introduce all the restrictions in the equation (1), we need to estimate only six parameters i.e. α_0, α_K, α_T, α_{LK}, α_{KT} and α_{LT} The other parameters i.e. α_{LL}, α_{KK} and α_{TT} can be computed using the restrictions (2) to (5). After using the restrictions (1) becomes:

$$\textbf{Ln (Q/L)} = \alpha_0+\alpha_K\,\textbf{Ln (K/L)}+\alpha_T\,\textbf{Ln(T/L)}+\alpha_{LK}[\textbf{LnL. LnK}-(\textbf{LnL})^2-(\textbf{LnK})^2]+\alpha_{KT}[\textbf{LnK.LnT}-(\textbf{LnK})^2-(\textbf{LnT})^2]+\alpha_{LT}[\textbf{LnT.LnL}-(\textbf{LnL})^2-(\textbf{LnT})^2] \quad \textbf{.....(19)}$$

With restrictions, we get two forms of the share equations. For share of capital (S_K):

$$S_K=\alpha_K+\alpha_{LK}[\textbf{LnL}-2\,\textbf{LnK}]+\alpha_{KT}[\textbf{LnT}-2\textbf{LnK}] \quad \textbf{.....(20)} \qquad \text{and}$$

$$S_K=\alpha_K+\alpha_T+\alpha_{LK}[2\,\textbf{LnL}-\textbf{LnK}]+\alpha_{LT}[2\textbf{LnL}-\textbf{LnT}] \quad \textbf{.....(21).}$$

7. RESULTS & DISCUSSION

The equation (21) has been obtained by the share of labour from 1 (S_K=1-S_L). The equations (19), (20) and (21) have been estimated simultaneously with Zellner estimation method of seemingly unrelated regression equations (SURE). It is to be noted that no share has been allocated to the third input **T**. The estimated values of all parameters have been given in the Table 1:

TABLE 1: RESULTS OF TRANSLOG PRODUCTION FUNCTION

Parameters	1979-80 to 1989-90	1990-91 to 2001-02	2002-03 to 2010-11
α_0	-0.1189*	0.0076*	-0.1988*
α_L	0.3750*	0.4395*	0.2605*
α_K	0.5292*	0.5178*	0.8637*
α_T	0.0958*	0.0427*	-0.1241*
α_{LL}	0.0129*	0.011495*	0.01251*
α_{KK}	0.0104*	0.008429*	0.000833*
α_{TT}	-0.0181*	0.019286*	-0.05296*
α_{LK}	-0.0103*	-0.0098*	-0.0166*
α_{KT}	0.0052*	0.0056*	0.0162*
α_{LT}	0.0039*	0.0041*	0.0103*
R	0.9773	0.8611	0.8848
R^2	0.9546	0.7415	0.7830
DW	1.8002	1.7709	1.6923
F	1803*(5,423)	242*(5,423)	249*(5,345)

Source: Estimated by Researcher based on ASI Data

*Significant at 1% Level

TABLE 2: PARAMETERS OF TRANSLOG PRODUCTION FUNCTION

		1979-80 to 1989-90	1990-91 to 2001-02	2002-03 to 2010-11
MP_L	$\partial Q/\partial L$	1.5300	2.7793	3.4235
MP_K	$\partial Q/\partial K$	0.2379	0.3565	1.3664
MP_T	$\partial Q/\partial T$	1.0309	1.7789	4.4424
SLOPE OF MP_L w.r.t. L	$\partial^2 Q/\partial L^2$	2.3409	7.7247	11.7202
SLOPE OF MP_L w.r.t. K	$\partial^2 Q/\partial K^2$	0.0566	0.1271	1.8670
SLOPE OF MP_T w.r.t. T	$\partial^2 Q/\partial T^2$	-1863	3177	-25867
SLOPE OF MP_L w.r.t. K	$\partial^2 Q/\partial L\,\partial K$	0.0135	0.0231	0.0332
SLOPE OF MP_K w.r.t. T	$\partial^2 Q/\partial K\,\partial T$	0.0004	0.0008	0.0065
SLOPE OF MP_L w.r.t. T	$\partial^2 Q/\partial L\,\partial T$	0.0030	0.0051	0.0380
$MRTS_{L,K}$	$\partial K/\partial L$	6.4324	7.7958	2.5055
$MRTS_{L,T}$	$\partial T/\partial L$	1.4842	1.5624	0.7706
$MRTS_{T,K}$	$\partial K/\partial T$	4.3339	4.9897	3.2512
$AES_{\sigma LK}$		1202.4	-1231.9	333.4
AES σ_{KT}		26.3	-29.0	24.2
AES σ_{LT}		19.7	-21.2	15.4
RTS	(dQ/Q)/(dX/X)	1.1554	1.1904	1.0475
LABOUR ELASTICITY OF OUTPUT		0.3933	0.4471	0.1854

Source: Computed by Researchers based on ASI data and Table 1

*Marginal Products in Rs. Lakhs for L in number; in Rs. For K and Rs Lakh for T in years.

**All values have been computed for one set of Q, L, K and T for comparing MRTS in different time periods.

It can be seen from Table 1 that the estimated regression equation is very much meaningful since we have obtained reasonably high R^2 and F-ratio. The Durbin-Watson (DW) also indicates absence of autocorrelation. The choice of independent variables and the logarithmic form of the function has also ensured the escape from the problems of multicollinearity and hetereoscedascity. High level of significance of all the parameters allows us to use the estimated function as a good proxy of capturing the nature of technical progress underlying the production system of the manufacturing sector. Now we use the values of Table 1 to

compute the important parameters of the production function like Marginal Products, respective slopes, Marginal Rate of Technical Substitution (MRTS) and Allen's Elasticity of Substitution for three selected periods using average values of Q, L, K, T, S_L and S_K as shown in Table 1.

8. FINDINGS

The first hypothesis i.e. the total factor productivity during three phases as mentioned in the statement of the problem has been rising, is partially true. The values of the parameter α_0 during three phases show that the total factor productivity increased only during the middle phase and has come down in the third phase.

The second hypothesis i.e. the marginal rate of technical substitution is Hicks-neutral has been tested by computing MRTS for labour and capital which has been found falling. It indicates that technical progress in Indian manufacturing sector has been a capital deepening one and not the Hicks-neutral.

The third hypothesis i.e. there are constant returns to scale in the manufacturing sector is accepted. The value of RTS is approaching unity indicating the increasing competition among industries.

The fourth hypothesis i.e. the labour elasticity of output has been increasing is also rejected, because it increased only during middle phase.

A stylized fact about all the results given in Table 2 can be said that productivity and efficiency increased after liberalization but subsequently these benefits have slowed down in the later phase. It is clear that marginal products of the factors of production have increased sharply in early phase of liberalization and continued increasing in later phase also but at decreased pace. It is observed that slopes of the marginal products are also positive which means that more and more employment of labour and capital would lead to more productivity. This is indication of hidden potential of Indian economy.

The slope of marginal product of T with respect to T is negative in the pre-liberalization phase and later liberalization phase, it simply means that all other things other than labor and capital like social, legal, institutional infrastructure, investment climate and government policies have not been moving in pace with industrial productivity.

The early liberalization phase has shown a labour deepening technical progress as MRTS has gone up but in the later phase there has been intense capital deepening, creating concerns for employment. The values of labour elasticities of output also strengthen this view.

Observing values of AES, we can say that possibilities of substitution emerged in the early phase due to creative destruction process. The returns to scale for whole of the industry first increased due to expansion in sales and outputs, emergence of new opportunities and positive cross externalities and then have reached to nearly constant currently showing development of competitive markets.

9. RECOMMENDATIONS

The inherent potential of the manufacturing sector can be realised into sustained growth by improving the skill set of workers. The Indian youth is techno-friendly by nature and they can adopt the new technology very fast if cost-effective learning solutions are provided to them. Among four factors of production i.e. land, labour, capital and entrepreneurship we have strategic advantage only in first, and that also is slipping out of our hands fast. We should focus on creating a conducive business climate so that the flow of foreign capital can be increased. India should send clear policy signals to the investor community to gain advantage. Every state can also plan to develop land banks as we observe that it is becoming increasingly difficult to procure large tracts of land for industrial expansion. The entrepreneurship can be improved by improving the business ecology through a system of technical & management institutions, venture capitalists, angel investor networks, consultants and financial organisations. The industries which can absorb the technology faster like pharmaceuticals, IT & ITES, automobiles, heavy engineering, food processing where India has some core competence also should be given special thrust. They can act as drivers of productivity growth in short run. In the long run, we should focus on increasing the technology absorption capability of the industries like metals, metal products, non-metals, bulk chemicals etc. The flexible labour laws with proper safeguards of labour welfare is also need of the hour.

10. CONCLUSIONS

It can be concluded from the study that the benefits from economic reforms helped the Indian manufacturing sector to some extent for a certain period. However, we should not forget that many long term advantages were created during the protectionist regime also. The slopes of marginal products have decreased but they never have been negative. It means there is huge growth potential in the economy but it can be realised by making business nurturing policies meticulously.

11. LIMITATIONS AND SCOPE FOR FURTHER RESEARCH

In the present paper the study has been conducted at highly aggregate level, so it makes statements for whole sector and for general policies. To make specific sectoral policies, there is a need for estimating production functions for each industry. Here, we have used only one type of production function for analysis. The same hypotheses can be tested with alternative forms of production functions in further research.

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