# COST STRUCTURE OF INDIAN MANUFACTURING SECTOR, 1971-2003

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**Abstract**

In this paper an attempt is made to analyze the cost structure of Indian manufacturing sector. The study refers to the period 1970-2003. A separate analysis has been carried out for the post (1991-2003) as well as pre (1970-1990) liberalization periods. This analysis is done by estimating a translog cost function in which capital, labour, energy, materials and liberalization index (a proxy for technology, reduced trade restrictions, technology penetration) are the input determinants. The input substitution possibilities (pair-wise) have been obtained. Further, factors influencing cost of Indian manufacturing sector have also been identified. The results reveal that the marginal share of inputs remains the same in all the periods while the average share has increased during the post liberalization and overall periods. The substitution possibilities between capital and labor, labor and energy, energy and materials, have increased during the post-liberalization period and overall periods compared to the pre-liberalization period. The own price elasticities of capital, labor, energy, material and output have been negative, indicating that the demand curve for these inputs is downward sloping, and further that the nature of these inputs is highly elastic.

JEL Classification

Key Words: Productivity, Translog cost function, Elasticity, Liberalization

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## 1. Introduction

The Indian manufacturing sector has undergone significant changes during the past three and half decades. These changes may be traced back to policy changes initiated by the Government of India since mid 1971's. The policy changes primarily include changes in industrial policies such as an increase in number of imported items in the open general license (OGL) list. A further relaxation of industrial policy in 1985 due the second time rise in oil prices in 1979 has increased the debt servicing burden of the Indian Government. These changes have been followed by the adoption of new economic policy (NEP) in 1991. As a result of these initiatives, total productivity and cost of production of Indian manufacturing sector have come under sharp focus. Some recent studies [for example Unil (2003), Tata Service Limited, TSL (2003)] have concluded that the post reform period productivity growth is greater than that of pre-liberalization period. As against this conclusion, Bishwanath Goldar (2004) has concluded that the post liberalization period growth in total productivity is lesser than that of pre-liberalization period. This apparent lack of consensus on this important issue has motivated the present study. The twin objectives of the study are i) is to estimate a Translog cost function to find out substitution possibilities between pairs factor input**s,** and ii) to identify the factors that influence cost of production before and after liberalization.

In the past most researchers have used time variable as a factor that captures technology. In the present study we propose that the liberalization index as the right proxy to capture technology transfer, knowledge transfer, R&D expenditure, reduction in trade barriers and reductions in capital controls or other barriers. The proxy we propose is the import penetration ratio to GDP as a more direct measure of own- country economic liberalization. This reflects the degree to which trading barriers in the country have fallen (Mansori, 2001) Thus higher the import penetration, higher the degree of economic liberalization in a country. As the country reduces trade restrictions, (we would expect to see its) import penetration ratio is expected to rise and would help the manufacturing sector to import

new technology or lead to innovations. Most of the studies in the existing literature have focused on whether cost of production has decreased or increased after liberalization have but not concentrated on the factors that have influenced the cost of production. It is therefore felt that identification of the possible factors that influence the cost of production should be carried out systematically.

The remaining part of the paper proceeds as follows. Section II presents a brief literature review on production and cost, section III describes the methodology of translog cost function, section IV presents the results and a discussion followed by the concluding remarks in section V.

## 2. Review of literature

Traditionally, the estimation of an economy's production function has allowed for the influence of the technological change using time as one of the independent variable. The studies mainly aimed at analyzing the contributory factors of output growth, returns to scale, partial and total factor productivity indices, technical progress, elasticity of substitution etc.,

By using cross section data for the years 1773, 1974 and 1975 Kazi (1980) has estimated CES production function. The estimates obtained from VES and CES functions suggested that they varied across industries. In the case of Cement, Electricity, Iron & Steel and Cotton textiles industries, Jha, et.al. (1991) found evidence of substitution possibilities among factors of production. Their estimates of elasticity of substitution reveal that capital could be easily substituted by labor and/ or EM in all the industries except Cotton Textiles, implying that capital cannot be said to be the factor constraining growth of output.

In the Indian context Azeez (2002) has examined the performance of manufacturing sector in terms of economic capacity utilization (CU), over 1974 -1998 and also discussed the impact of policy changes. The study undertook the estimation of translog variable cost function and also examined the factors affecting capacity utilization in Indian manufacturing sector. The study concluded that the supply

side as well demand side factors affected the level of economic capacity utilization and the impact of economic reforms per se was not significant though the policy changes might influence supply and demand side factors determining the level of economic capacity utilization.

Pattnayak and Thangavelu (2003) examined the effect of the key economic reforms of 1991 on the Indian manufacturing industries using data for a panel of 121 Indian manufacturing industries for the period 1982-1998 using translog cost function. The study revealed the biased technical change in majority of the industries and has experienced capital using technical change. The study also observed there is the TFP improvement for most of the industries after the 1991 reform initiatives. Unel (2003) observed an accelerated total factor productivity (TFP) growth in Indian manufacturing sector. Tata Service Limited (TSL) (2003), observed a faster growth in TFP in Indian manufacturing sector.

Contradicting the studies of Unel (2003) and Tata Service Limited (2003), Bishwanath (2004) has concluded that the TFP growth in the post reform period had come down compared to pre-reform period. He analyzed the growth in employment and output in India's organized manufacturing sector since mid 90's and observed growth in employment in these period.

It may be clear from the literature that most of the studies considered 'time' as a variable in production functions as a proxy to captures to technology transfer. A better proxy for capturing the effect of technology transfer would however be the liberalization index which captures technology transfer, knowledge transfer, R&D expenditure, reduction in trade barriers and reductions in capital controls or other barriers. In this study we propose this variable which gives a clear view on import of new technology or lead to innovations in the manufacturing sector. In this study we propose this variable.

## 3. Methodology

The production characteristics of an industry may be examined either through production function or cost function, as there is duality between the two under certain regularity conditions. However, the cost function approach is preferred to production function approach when output level and input prices can plausibly be assumed to be exogenous (Berndt 1992).
In formal terms, a cost function may be specified as

$$C = f(Y, K, L, E, M, O) \qquad (1)$$

where Y is Output; K is Capital; L is Labor; E is Energy; M is Materials and O is the Liberalization of the economy.

***3.1 Translog Cost Function.*** In this study, we use a translog cost function as given in Christensen (1971) and Christensen (1973) and which can be viewed as a second order logarithmic approximation to an arbitrary twice-differentiable transformation surface. Since in its general form the translog cost function imposes no prior restrictions on the production structure, it allows the testing of various restrictions such as homotheticity, homogeneity, unitary elasticities of substitution and the assessment of the sensitivity of parameters of interest to those restrictions. Considering the general cost function given in equation (1), the translog cost function for Indian manufacturing takes the following logarithmic form:

$$\begin{aligned}\ln C = {} & \alpha + \alpha_Y \ln Y + \alpha_k \ln K + \alpha_L \ln L + \alpha_E \ln E + \alpha_M \ln M + \alpha_O \ln O \\ & + \tfrac{1}{2}\beta_{YY}(\ln Y)^2 + \beta_{YK}(\ln Y)(\ln K) + \beta_{YL}(\ln Y)(\ln L) \\ & + \beta_{YE}(\ln Y)(\ln E) + \beta_{YM}(\ln Y)(\ln M) + \beta_{YO}(\ln Y)(\ln O) + \tfrac{1}{2}\beta_{KK}(\ln K) \\ & + \beta_{KL}(\ln K)(\ln L) + \beta_{KE}(\ln K)(\ln E) + \beta_{KM}(\ln K)(\ln M) + \beta_{KO}(\ln K)(\ln O) \\ & + \tfrac{1}{2}\beta_{LL}(\ln L)^2 + \beta_{LE}(\ln L)(\ln E) + \beta_{LM}(\ln L)(\ln M) + \beta_{LO}(\ln L)(\ln O) \\ & + \tfrac{1}{2}\beta_{EE}(\ln E)^2 + \beta_{EM}(\ln E)(\ln M) + \beta_{EO}(\ln E)(\ln O) \\ & + \tfrac{1}{2}\beta_{MM}(\ln M)^2 + \beta_{MO}(\ln M)(\ln O) + \tfrac{1}{2}\beta_{OO}(\ln O)^2 \qquad (2)\end{aligned}$$

Shephard's lemma ensures that the cost minimizing level of utilization of any input is equal to the derivative of the cost function with respect to the price of that input. Using Shephard's lemma, we

get following a system of equations by differentiating the translog cost function (equation 2) with respect to each factor input

$$S_Y = \alpha_Y + \beta_{YY} \ln K + \beta_{YL} \ln L + \beta_{YE} \ln E + \beta_{YM} \ln M + \beta_{YO} \ln O$$
$$S_K = \alpha_K + \beta_{KK} \ln K + \beta_{KL} \ln L + \beta_{KE} \ln E + \beta_{KM} \ln M + \beta_{KO} \ln O$$
$$S_L = \alpha_L + \beta_{LK} \ln K + \beta_{LL} \ln L + \beta_{LE} \ln E + \beta_{LM} \ln M + \beta_{LO} \ln O$$
$$S_E = \alpha_E + \beta_{EK} \ln K + \beta_{EL} \ln L + \beta_{EE} \ln E + \beta_{EM} \ln M + \beta_{EO} \ln O$$
$$S_M = \alpha_M + \beta_{MK} \ln K + \beta_{ML} \ln L + \beta_{ME} \ln E + \beta_{MM} \ln M + \beta_{MO} \ln O$$
$$S_O = \alpha_O + \beta_{OK} \ln K + \beta_{OL} \ln L + \beta_{OE} \ln E + \beta_{OM} \ln M + \beta_{OO} \ln O$$

Where S indicates the cost share of each factor input. To correspond to a well-behaved production function, a cost function must be positively linearly homogeneous in input prices. As the sum of the six cost shares is expected to sum to unity, the problem of linear dependency and consequent singularity of residual covariance matrix is avoided by dropping one of the share equations. For this theoretical requirement, the following restrictions are imposed to the above system of equations for satisfying the linear homogeneity conditions on the translog cost function.

$$\Sigma\alpha_i = 1, \ \Sigma\beta_{ij} = \Sigma\beta_{ji} = 0 \qquad (3)$$

The cost share equations will be estimated together with the cost function (equation 2) using the Zellner seemingly unrelated regressions (SUR) model, which exploits correlations between the errors in each of the share equations to improve efficiency.

***3.2 Elasticities of Substitution :***Using the estimated parameters of the translog cost function the following Allen elasticities of substitution (AES) between inputs can be calculated as

$$\sigma_{ii} = (\beta_{ii} + S_i^2 - S_i) / (S_i^2) \qquad (4)$$
$$\sigma_{ij} = (\beta_{ij} + S_i S_j) / (S_i S_j) \qquad (5)$$

Here $\beta_{ii}$ represent the estimated second order derivatives on the diagonal of Hessain matrix. $\beta_{ij}$ represent parameter estimated of elasticities of cost share with respect to price of factor input service. $S_i$ and $S_j$ are the fitted cost share of factor inputs i and j .

***3.3 Factors affecting the Cost :***Towards fulfilling the supplementary objective of the present study, an attempt is made here to formulate a loglinear regression model to identify the factors that influence the total cost. Formally, the model is specified as follows:

$$\text{Ln } C = \beta_0 + \beta \ln Y + \beta_2 \ln SE + \beta_3 \ln AWRPW + \beta_4 AWRAE \qquad (6)$$

In the above function ( 6 ), C is cost index, Y is Ouput, SE is Salaried Employees as percentage of total work force, AWRPW is the Average Wage Rate of Productive Workers and AWRAE is the Average Wage Rate of All Employees. And also SE represents the level of entrepreneurial skills; AWRPW is the average skill level of productivity workers and AWRAW the average skill level of all workers. As the two variables AWRPW and AWRAW are highly correlated, they are used alternatively. We used the STATA software for all computations of this study.

## 4. Data and Empirical Findings :

***Data:*** The required data for the period 1970-2003 on the variables gross output, capital, labor, energy and material consumed are collected from Annual Survey of Industries (ASI), and presented in table 1. The base period is 1993-94. The data on imports and GDP is collected from Annual Reports of RBI. Using appropriate deflation techniques the data is transformed to constant prices. Data for other variables used in the analysis is included in the Annex.

The parameter estimates of the translog cost function are reported in table 2. The estimates of Allen elasticities of substitution between pairs of inputs at the sample mean level and the own price elasticities of input demand are reported in table 3 and finally the regression results of factors that affect the cost are reported in table 4.

Table 1. India (data at constant prices and Employees in thousands)

| Year | Output | Fixed Capital | Employees | Energy | Material | Lib |
|---|---|---|---|---|---|---|
| **1971** | **2,4247** | 3,197 | 4,093 | 2,736 | 3,361 | 3,573 |
| **1972** | **2,4873** | 3,169 | 4,134 | 2,829 | 3,449 | 3,622 |
| **1974** | **2,6629** | 3,188 | 4,202 | 3,034 | 3,598 | 3,675 |
| **1975** | **2,9306** | 3,056 | 4,241 | 3,227 | 3,609 | 3,872 |
| **1976** | **3,0193** | 3,134 | 4,294 | 3,370 | 3,605 | 4,018 |
| **1977** | **3,0583** | 3,292 | 4,335 | 3,414 | 3,652 | 4,077 |
| **1978** | **3,1381** | 3,459 | 4,400 | 3,431 | 3,735 | 4,055 |
| **1979** | **3,2036** | 3,534 | 4,422 | 3,494 | 3,703 | 4,137 |
| **1980** | **3,3564** | 3,485 | 4,479 | 3,626 | 3,805 | 4,262 |
| **1981** | **3,5051** | 3,459 | 4,484 | 3,790 | 3,912 | 4,281 |
| **1982** | **3,6036** | 3,572 | 4,492 | 3,896 | 3,990 | 4,243 |
| **1983** | **3,7296** | 3,720 | 4,522 | 4,032 | 4,059 | 4,171 |
| **1984** | **3,7456** | 3,832 | 4,498 | 4,186 | 4,117 | 4,150 |
| **1985** | **3,7845** | 3,858 | 4,504 | 4,230 | 4,152 | 4,238 |
| **1986** | **3,8303** | 3,897 | 4,452 | 4,316 | 4,206 | 4,180 |
| **1987** | **3,8447** | 3,965 | 4,448 | 4,326 | 4,209 | 4,155 |
| **1988** | **3,9205** | 4,026 | 4,493 | 4,440 | 4,299 | 4,191 |
| **1989** | **4,0170** | 4,043 | 4,488 | 4,369 | 4,440 | 4,272 |
| **1990** | **4,1589** | 4,138 | 4,538 | 4,534 | 4,597 | 4,356 |
| **1991** | **4,2392** | 4,251 | 4,540 | 4,586 | 4,641 | 4,375 |
| **1992** | **4,3337** | 4,304 | 4,544 | 4,615 | 4,635 | 4,422 |
| **1993** | **4,5192** | 4,517 | 4,605 | 4,626 | 4,577 | 4,520 |
| **1994** | **4,6052** | 4,605 | 4,605 | 4,605 | 4,605 | 4,605 |
| **1995** | **4,7142** | 4,745 | 4,649 | 4,738 | 4,759 | 4,663 |
| **1996** | **4,8499** | 4,895 | 4,748 | 4,810 | 4,923 | 4,766 |
| **1997** | **4,8232** | 4,934 | 4,714 | 4,805 | 4,817 | 4,747 |
| **1998** | **4,9343** | 4,990 | 4,736 | 4,799 | 4,832 | 4,760 |
| **1999** | **4,8425** | 4,887 | 4,591 | 4,481 | 4,721 | 4,758 |
| **2000** | **4,9151** | 4,885 | 4,542 | 4,614 | 4,844 | 4,761 |
| **2001** | **4,8964** | 4,847 | 4,519 | 4,639 | 4,870 | 4,766 |
| **2002** | **4,8985** | 4,894 | 4,489 | 4,614 | 4,878 | 4,780 |
| **2003** | **4,9843** | 2,868 | 4,507 | 4,638 | 4,898 | 4,797 |

***4.1 The Estimate of System of Equations:*** It may be observed from table 2 that most of the estimated coefficients of translog cost function for the period before liberalization, after liberalization and overall are significant. It is evident from the table that the factor shares of capital, labor, energy and materials remain almost same in all the periods whereas the average share of these inputs has increased in the post liberalization and overall periods when compared to the pre liberalization average share of these inputs.

**Table 2. Estimates of Translog Cost Function**

| | **Pre-Liberalization** | | **Post-Liberalization** | | **Overall** | |
|---|---|---|---|---|---|---|
| | **Coeff** | **t - value** | **Coeff** | **t - value** | **Coeff** | **t - value** |
| $\beta_{kk}$ | 0.0391 | 36.20 | 0.0305 | 122.57 | 0.0314 | 85.87 |
| $\beta_{kl}$ | 0.0039 | 2.19 | -0.0049 | -7.09 | -0.0049 | -8.05 |
| $\beta_{ke}$ | -0.0103 | -24.36 | -0.0056 | -17.79 | -0.0070 | -29.50 |
| $\beta_{km}$ | -0.0075 | -13.57 | -0.0069 | -29.78 | -0.0062 | -24.91 |
| $\beta_{ky}$ | -0.0087 | -10.88 | -0.0070 | -29.01 | -0.0074 | -31.62 |
| $\alpha_{k}$ | 0.1392 | 24.10 | 0.1680 | 128.49 | 0.1666 | 93.95 |
| $\beta_{ll}$ | 0.0113 $^{NS}$ | 1.74 | 0.0290 | 6.02 | 0.0211 | 6.83 |
| $\beta_{le}$ | -0.0007$^{NS}$ | -0.60 | -0.0138 | -4.57 | -0.0035 | -3.97 |
| $\beta_{lm}$ | -0.0047 | -3.34 | -0.0005 $^{NS}$ | -0.36 | -0.0035 | -2.69 |
| $\beta_{ly}$ | -0.0069 | -4.32 | -0.0009 $^{NS}$ | -0.88 | -0.0002 $^{NS}$ | -0.16 |
| $\alpha_{l}$ | 0.1859 | 10.77 | 0.1497 | 15.46 | 0.1680 | 17.64 |
| $\beta_{ee}$ | 0.0362 | 70.01 | 0.0376 | 14.84 | 0.0325 | 82.14 |
| $\beta_{em}$ | -0.0087 | -18.68 | -0.0092 | -8.59 | -0.0109 | -22.15 |
| $\beta_{ey}$ | -0.0067 | -10.81 | -0.0079 | -12.26 | -0.0029 | -6.64 |
| $\alpha_{e}$ | 0.1603 | 42.88 | 0.1829 | 29.14 | 0.1764 | 62.10 |
| $\beta_{mm}$ | 0.0375 | 56.08 | 0.0312 | 32.96 | 0.0356 | 33.50 |
| $\beta_{my}$ | -0.0107 | -17.51 | -0.0067 | -15.24 | -0.0078 | -10.17 |
| $\alpha_{m}$ | 0.1781 | 40.47 | 0.1642 | 52.31 | 0.1748 | 33.73 |
| $\beta_{oo}$ | 0.0318 | 14.58 | 0.0287 | 19.88 | 0.0351 | 18.74 |
| $\alpha_{o}$ | 0.2030 | 24.95 | 0.1692 | 57.56 | 0.1957 | 31.91 |
| $\beta_{yy}$ | 0.0402 | 37.22 | 0.0296 | 50.55 | 0.0312 | 36.66 |
| $\alpha_{y}$ | 0.1657 | 29.38 | 0.1605 | 67.37 | 0.1404 | 33.05 |

'NS' indicates Not Significant

One possible interpretation of this finding is that the managers must be operating in the rising portion of the average share curve indicating the overburden of the managers because of the Voluntary Retirement Scheme (VRS) in the sense that the managers could not get the opportunity of making division of labor and hence overburdened or owing to the introduction of the VRS the cost of VRS must be greater than that of retaining the employee. The average influence of liberalization index is high in post liberalization and overall period compared to the pre liberalization period indicating the positive influence of liberalization on manufacturing sector however the marginal influence of liberalization is almost same in all the periods. The marginal share of out put on cost has decreased in post liberalization and overall period compared to the pre-liberalization period similar observation is made in case of average share of capital.

***4.2 Estimates of AES and Price Elasticities :***It may be observed from table3 that the substitution possibilities between capital and labor, labor and energy, energy and materials have increased in the post-liberalization and overall periods compared to the pre-liberalization period indicating high capital investment.

**Table 3. Elasticities of substitution and own price elasticities**

| **Estimates of Allen Elasticities of Substitution between pairs of inputs (at the sample mean level)** | | | |
|---|---|---|---|
| | **Pre-Liberalization** | **Post-Liberalization** | **Overall** |
| $\sigma_{kl}$ | 0.84732 | 1.30401 | 1.28404 |
| $\sigma_{ke}$ | 1.74552 | 1.25933 | 1.40732 |
| $\sigma_{km}$ | 1.46878 | 1.37889 | 1.33172 |
| $\sigma_{le}$ | 1.05199 | 1.81391 | 1.18191 |
| $\sigma_{lm}$ | 1.19142 | 1.03496 | 1.18265 |
| $\sigma_{em}$ | 1.46934 | 1.49938 | 1.60564 |
| | **Own Price Elasticities between pairs of inputs** | | |
| $\sigma_{kk}$ | -1.1712 | -1.0724 | -1.0897 |
| $\sigma_{ll}$ | -0.8907 | -1.0394 | -0.9557 |
| $\sigma_{ee}$ | -1.1280 | -1.1587 | -1.0915 |
| $\sigma_{mm}$ | -1.1264 | -1.0589 | -1.1038 |
| $\sigma_{yy}$ | -1.2411 | -1.0452 | -1.0795 |

Whereas the substitution possibilities between capital and energy, capital and material consumed, and labor and material consumed have decreased in the post liberalization as well as overall periods compared to that of the pre liberalization period. The own price elasticities of capital, labor, energy, material and output are negative indicating that the demand curve for these inputs is downward sloping and further the nature of these inputs is highly elastic in nature.

***4.3 Factors Affecting the Cost:*** Though the share of inputs on cost remains same in all the periods, the average share of inputs has increased in post liberalization period as well as overall periods. Hence it is of interest to identify the factors that have influenced the total cost by dividing entire period into pre-liberalization and post liberalization periods.

**Table 4. Regression Estimates of Determinants of Cost**

| | ***Y*** | ***SE*** | ***AWRPW*** | **AWRAE** |
|---|---|---|---|---|
| **Pre-Liberalization** | 0.746<br>(16.31) | -0.523 $^{NS}$<br>(0.651) | 0.205<br>(6.1) | |
| | 0.780<br>(24.8) | -0.267 $^{NS}$<br>(0.43) | | -0.137<br>(8.01) |
| **Post-Liberalization** | 0.864<br>( 16.92 ) | -3.439<br>( 1.98 ) | -0.448<br>( 2.26) | |
| | 0.867<br>( 16.87) | -4.039<br>( 2.259 ) | | -0.476<br>( 2.29 ) |
| **Overall** | 0.918<br>( 37.24 ) | -3.587<br>( 2.765) | -0.222<br>( 3.04) | |
| | 9.037<br>( 2.79) | -3.729<br>( 2.76) | | -0.160<br>( 2.69) |

'NS' indicates not significant. Figures in parentheses are t - values

From the table 4 it is evident that the co-efficient of output has a positive sign in all the periods and is significant in all the periods. The coefficient of entrepreneual skill ratio has a negative sign in all

the periods and is significant only in the post-liberalization and overall periods.

The contribution of the skill ratio is positive and significant in the pre-liberalization period whereas it is negative and significant in the post liberalization and overall periods. This indicates that in Indian manufacturing sector, the skill of the managerial staff engaged as a result of modernization of the industries is poor in quality and hence the average share is high or the managers must be operating in the rising portion of the average share curve which indicates the over burden of the managers. That is, the managerial staff may not be having much required skill for running the industries especially after liberalization or because of higher salaries in service sector the talented managerial staff should have shifted to service sector and in turn the low level skill managerial staff must have continued in industries resulting in the increased cost or the post liberalization policies would have not helped the Indian manufacturing sector. These could be the some of reasons for low level skills of the managerial staff.The contribution of average skill levels of workers is negative and significant in all the periods. This indicates that the supply of the industrial skill has not kept pace with the increased demand.

## 5. Summary and conclusion:

In this paper an attempt is made to analyze the cost structure of the Indian manufacturing sector using the translog cost function in which liberalization of the economy (ratio of imports to GDP) is used as an independent input to captures technology, knowledge transfer and R& D expenditure.

The major finding of the study is that the marginal share of inputs remains the same in all the periods while the average share has increased in the post liberalization and overall periods compared to the pre liberalization.

The Allen elasticities of substitution which reveal that the substitution possibilities between capital and labor, labor and energy,

energy and materials have increased in post-liberalization and overall periods. The own price elasticities of capital, labor, energy, material and output are found to be negative indicating that the demand curve for these inputs is downward sloping and the nature of these inputs highly elastic.

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Table A1 . India

| | **Mk** | **Ml** | **Me** | **Mm** | **Mo** | **My** |
|---|---|---|---|---|---|---|
| **1971** | 0,1694 | 0,1898 | 0,1450 | 0,1781 | 0,1893 | 0,1285 |
| **1975** | 0,1501 | 0,1802 | 0,1585 | 0,1772 | 0,1901 | 0,1439 |
| **1980** | 0,1539 | 0,1814 | 0,1601 | 0,1680 | 0,1882 | 0,1482 |
| **1985** | 0,1564 | 0,1784 | 0,1715 | 0,1684 | 0,1718 | 0,1535 |
| **1990** | 0,1571 | 0,1732 | 0,1721 | 0,1745 | 0,1653 | 0,1579 |
| **1995** | 0,1674 | 0,1665 | 0,1672 | 0,1679 | 0,1645 | 0,1664 |
| **2000** | 0,1693 | 0,1673 | 0,1599 | 0,1679 | 0,1651 | 0,1704 |
| **2003** | 0,1067 | 0,1748 | 0,1725 | 0,1822 | 0,1784 | 0,1854 |

Table A2. India

| | **K11** | **K12** | **K13** | **K14** | **K15** | **K16** |
|---|---|---|---|---|---|---|
| **1971** | 3,197 | 4,093 | 2,736 | 3,361 | 3,573 | **2,4247** |
| **1975** | 3,056 | 4,241 | 3,227 | 3,609 | 3,872 | **2,9306** |
| **1980** | 3,485 | 4,479 | 3,626 | 3,805 | 4,262 | **3,3564** |
| **1985** | 3,858 | 4,504 | 4,230 | 4,152 | 4,238 | **3,7845** |
| **1990** | 4,138 | 4,538 | 4,534 | 4,597 | 4,356 | **4,1589** |
| **1995** | 4,745 | 4,649 | 4,738 | 4,759 | 4,663 | **4,7142** |
| **2000** | 4,885 | 4,542 | 4,614 | 4,844 | 4,761 | **4,9151** |
| **2003** | 2,868 | 4,507 | 4,638 | 4,898 | 4,797 | **4,9843** |

Table A3. India

| | **L21** | **L22** | **L23** | **L24** | **L25** | **L26** |
|---|---|---|---|---|---|---|
| **1971** | 3,197 | 4,093 | 2,736 | 3,361 | 3,573 | **2,4247** |
| **1975** | 3,056 | 4,241 | 3,227 | 3,609 | 3,872 | **2,9306** |
| **1980** | 3,485 | 4,479 | 3,626 | 3,805 | 4,262 | **3,3564** |
| **1985** | 3,858 | 4,504 | 4,230 | 4,152 | 4,238 | **3,7845** |
| **1990** | 4,138 | 4,538 | 4,534 | 4,597 | 4,356 | **4,1589** |
| **1995** | 4,745 | 4,649 | 4,738 | 4,759 | 4,663 | **4,7142** |
| **2000** | 4,885 | 4,542 | 4,614 | 4,844 | 4,761 | **4,9151** |
| **2003** | 2,868 | 4,507 | 4,638 | 4,898 | 4,797 | **4,9843** |

Table A4. India

| | **E31** | **E32** | **E33** | **E34** | **E35** | **E36** |
|---|---|---|---|---|---|---|
| **1971** | 3,197 | 4,093 | 2,736 | 3,361 | 3,573 | **2,4247** |
| **1975** | 3,056 | 4,241 | 3,227 | 3,609 | 3,872 | **2,9306** |
| **1980** | 3,485 | 4,479 | 3,626 | 3,805 | 4,262 | **3,3564** |
| **1985** | 3,858 | 4,504 | 4,230 | 4,152 | 4,238 | **3,7845** |
| **1990** | 4,138 | 4,538 | 4,534 | 4,597 | 4,356 | **4,1589** |
| **1995** | 4,745 | 4,649 | 4,738 | 4,759 | 4,663 | **4,7142** |
| **2000** | 4,885 | 4,542 | 4,614 | 4,844 | 4,761 | **4,9151** |
| **2003** | 2,868 | 4,507 | 4,638 | 4,898 | 4,797 | **4,9843** |

Table A5. India

| | **M41** | **M42** | **M43** | **M44** | **M45** | **M46** |
|---|---|---|---|---|---|---|
| **1971** | 3,197 | 4,093 | 2,736 | 3,361 | 3,573 | **2,4247** |
| **1975** | 3,056 | 4,241 | 3,227 | 3,609 | 3,872 | **2,9306** |
| **1980** | 3,485 | 4,479 | 3,626 | 3,805 | 4,262 | **3,3564** |
| **1985** | 3,858 | 4,504 | 4,230 | 4,152 | 4,238 | **3,7845** |
| **1990** | 4,138 | 4,538 | 4,534 | 4,597 | 4,356 | **4,1589** |
| **1995** | 4,745 | 4,649 | 4,738 | 4,759 | 4,663 | **4,7142** |
| **2000** | 4,885 | 4,542 | 4,614 | 4,844 | 4,761 | **4,9151** |
| **2003** | 2,868 | 4,507 | 4,638 | 4,898 | 4,797 | **4,9843** |

Table A6. India

| | **O51** | **O52** | **O53** | **O54** | **O55** | **O56** |
|---|---|---|---|---|---|---|
| **1971** | 3,197 | 4,093 | 2,736 | 3,361 | 3,573 | **2,4247** |
| **1975** | 3,056 | 4,241 | 3,227 | 3,609 | 3,872 | **2,9306** |
| **1980** | 3,485 | 4,479 | 3,626 | 3,805 | 4,262 | **3,3564** |
| **1985** | 3,858 | 4,504 | 4,230 | 4,152 | 4,238 | **3,7845** |
| **1990** | 4,138 | 4,538 | 4,534 | 4,597 | 4,356 | **4,1589** |
| **1995** | 4,745 | 4,649 | 4,738 | 4,759 | 4,663 | **4,7142** |
| **2000** | 4,885 | 4,542 | 4,614 | 4,844 | 4,761 | **4,9151** |
| **2003** | 2,868 | 4,507 | 4,638 | 4,898 | 4,797 | **4,9843** |

Table A7. India.

| | **Y61** | **Y62** | **Y63** | **Y64** | **Y65** | **Y66** |
|---|---|---|---|---|---|---|
| **1971** | 3,197 | 4,093 | 2,736 | 3,361 | 3,573 | **2,4247** |
| **1975** | 3,056 | 4,241 | 3,227 | 3,609 | 3,872 | **2,9306** |
| **1980** | 3,485 | 4,479 | 3,626 | 3,805 | 4,262 | **3,3564** |
| **1985** | 3,858 | 4,504 | 4,230 | 4,152 | 4,238 | **3,7845** |
| **1990** | 4,138 | 4,538 | 4,534 | 4,597 | 4,356 | **4,1589** |
| **1995** | 4,745 | 4,649 | 4,738 | 4,759 | 4,663 | **4,7142** |
| **2000** | 4,885 | 4,542 | 4,614 | 4,844 | 4,761 | **4,9151** |
| **2003** | 2,868 | 4,507 | 4,638 | 4,898 | 4,797 | **4,9843** |