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The Role of Technological Conditions of Production in Explaining India's Manufacturing Growth, 1998-99 to 2007-08: Some Policy Perspectives

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Abstract:

In this paper we try to explain India's manufacturing growth performance in terms of the technological conditions of production, namely, the returns to scale (RTS) and the elasticity of substitution (ES) between capital and labour at two – digit level of industrial classification. We use for this purpose the unit (plant) - level data as provided by the *Annual Survey of Industries* for the years 1998-99 to 2007 - 08. Most of the earlier estimates on RTS and ES were based on studies using aggregate time series or state-wise data. Since the unit-level data are now available, it allows us to verify the robustness of the earlier estimates. Insofar as the technological parameters of production function are defined at the level of firm, this gives a justification of conducting the present study. Three alternate specification of production function (Cobb-Douglas, CES and the translog) were used in our study. Our findings generally confirm the findings of earlier studies. Interestingly, we find relatively high elasticity of substitution in the labour-intensive industries (textiles, tobacco products and leather and leather products etc.) and relatively low elasticity of substitution in capital – intensive industries (machinery and equipment, telecommunication equipment etc.). The results suggest that there are scope for policy interventions to increase employment and growth. For instance, lowering the hiring cost of labour via labour market reforms may help increasing employment in the labour – intensive industries. Similarly, reallocating new capital investment from the capital – intensive industries to labour – intensive ones may improve the profitability of new investment. Finally, a multiple regression analysis has been undertaken by using industry-level panel data for the years 1998 to 2007 to explain if the variations in the growth rate in real value added across industries and over time are related to the technological parameters like RTS and ES. The results reveal that the returns to scale have positive impact on growth. Similarly, high elasticity of substitution has a positive effect on growth, but only for the capital intensive industries. Thus, resource reallocation may be oriented to take advantage of the variations in the technological parameters to maximize manufacturing growth.

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Key words: Returns to Scale; Capital-labour Substitution; Plant-level Data; Indian Manufacturing Growth

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1. Introduction

The returns to scale (RTS) and the elasticity of substitution (ES) of a production function play an important role in the analysis of economic growth, employment and income distribution. The dismal performance of the Indian manufacturing sector both in creating output growth and employment has raised doubts in the minds of policy analysts whether certain technological constraints are responsible for the prevalence of such a situation. That is, if the technology of production displays limited substitution possibilities and production is at near constant RTS then these factors themselves can cause slower growth in output and stagnation in employment expansion as capital accumulation proceeds. Moreover, as the forces of globalization gradually unfold, the economy should tend to specialize according to the comparative advantage in production and in consequence we should expect certain structural changes in industries to occur which may contribute to the expansion of the labor intensive industries and growth in employment. Limited substitutability can prevent such structural transformation from happening. The present study therefore pertains to examining whether the prevalent technological conditions in Indian manufacturing do really act as stumbling block in generating growth and employment in India.

Of course, there are a fairly large number of studies that attempted to estimate the technological parameters of production function both at the aggregate as well as individual industry level for Indian manufacturing. An exhaustive survey of the earlier studies is available in Barua (1985). What then justifies the undertaking of yet another study now? We have three main reasons for conducting this study. First, almost all earlier studies are based on aggregate manufacturing sector of India whereas we really need *firm level data* to estimate the technological properties of a production function. Second, most of the previous studies do not cover the most recent periods which is particularly necessary to examine the impact of globalization on production in India. Third, the production functions used for estimation purposes in earlier studies were either C-D (Cobb-Douglas) or CES (Constant Elasticity of

Substitution) variety but we shall be using a translog production formulation in our study which is much more flexible in terms of its assumption of RTS and the elasticity.

Literature Survey:

The survey by Barua (1985) considers most of the studies of production function estimates for Indian manufacturing that span from l946 - l975. This was a period that had witnessed important historical discontinuities. In reporting the estimates, Barua distinguishes two epochs - the early epoch that runs from l946 to l958 and the later epoch from l958 1975. The two epochs are distinguished by the underlying data bases used for estimating the production functions. For instance, analyses pertaining to the first epoch were based on the CMI data and the studies for the second epoch were based on the ASI data. Apart from data, there was another important dimension that the CMI (Census of Indian Manufactures) had been replaced by the ASI (Annual Survey of Industries) at a time when technologically new and more sophisticated and relatively large industries have started to dominate the industrial spectrum in the country. Given the fact that these new industries were built up with the imported technology and that the ASI considers only the large industries leaving the smaller ones for the sampling sector, this distinction may be relevant. While the results on RTS based on the aggregate data for the first epoch showed CRS (Constant Elasticity of Substitution), studies based on disaggregated data showed evidence of IRS (increasing returns to scale). On the other hand, most results based on Cobb–Douglas or CES formulations of production function for the second epoch while showed CRS, the estimation of flexible forms of production function (Translog and GL) had shown evidence of IRS at disaggregated levels. Further, based on the disaggregated studies, it was evident that RTS varied across industries in both the epochs. Regarding the results of ES, Barua concluded that the substitution possibilities between capital and labor were limited and that the elasticities vary significantly across industries.

In contrast to the above studies surveyed by Barua, there exist a few important recent studies which are worth mentioning. The study by Jha et al. (1993) using aggregate time series data relating to four industries (viz. cement, electricity and gas, cotton textiles and iron and steel) as given by the ASI attempted to estimates RTS and ES for the Indian manufacturing for the period 1960–61 to 1982–83 by estimating a transom cost function with three factors of production (capital, labor and materials). They observed enough evidence of substitution possibilities among factors of production in all the four industries and significant economies of scale in electricity and gas industry. As against Jha et al (1993), Pattanayak and Thangavelu (2005) have considered aggregate ASI data for a relatively more recent period (1981–1998) and used a panel of 121 Indian manufacturing industries to estimates the RTS by using a translog cost function. They concluded that there were industries that displayed IRS (beverage, textile, nonmetallic minerals and metal products and parts) and CRS in (wool, silk and manmade fiber, food, and electrical and related equipment). In a recent study on the major sectors of the Indian economy covering a period of 1980-81 to 2008-09 by Golder et al (2014), we find seven sets of estimates of the elasticity of substitution by using alternative specification of model and econometric estimation technique. The authors have concluded that the elasticity of substitution in major sectors of the Indian economy is less than unity in most of the cases and that the elasticity is less in manufacturing than that of the service sector of the economy. This important finding echoes an earlier finding by Barua and Leech (1986) using state level cross section data for industries of the Indian economy that the substitution elasticity is limited in most of the cases.

An estimate of elasticity of substitution between capital and labour in various Indian industries has been made by Goldar et al. (2013) using aggregate time series data for two-digit industries. The period covered is 1980-81 to 2007-08. They have used the CES production function and have taken alternate approaches to the estimation of parameters. The results indicate that the elasticity of substitution between capital and labour is commonly less than one, with some variation across manufacturing industries.

It may be noted here that there are one or two studies that attempt to estimate production function by using firm level data. For instance, Fikkert and Hasan (1998) attempted to estimate RTS by using a panel of Indian manufacturing firms from 1976 to 1985.They also estimated translog production function and short-run cost functions using panel data from 232 firms belonging to six manufacturing industries (Auto Vehicles, Electrical Machinery, Non-electrical Machinery, Basic Chemicals, Pharmaceuticals and Paper). The sample of firms consists of large-scale and medium-scale firms. They observed evidence of unexploited economies of scale. That is, while the largest firms were operating at near constant RTS accounting for a very high percentage of industry outputs, the relatively smaller firms were operating on still a downward sloping average cost curve.

On the other hand, Kumar and Naidu (2014) have used PROWESS data for some selected Steel firms for the period 1989 to 2009 and estimated translog production function to measure the elasticities of substitution. They observed that while capital and labor tends to be quite substitutable in four companies (SAIL, MEL, HZL and BALXCO), in the remaining six companies (TSL, RINL, NALCO, HIL, HCL and GKW) they were showing complementarities.

In the backdrop of the above brief survey we are now in a position to provide a rationale for conducting yet another study on the estimation of returns to scale and the elasticity of substitution for Indian manufacturing. First, the fundamental point to be emphasized is that the parameters of a production function – the elasticity of substitution and the returns to scale – are essentially microeconomic phenomena which can only legitimately be estimated at the level of a firm. Therefore, if we are interested to estimate these parameters then we must have to depend on the firm level data for estimating the production function. As discussed above, barring the study by Fikkert and Hasan (1998), none of the works reviewed as above had used firm level data for estimating production function for the entire Indian economy. Secondly, except for the studies by Goldar et al. (2013, 2014) and Kumar and Naidu (2014) for Iron and Steel industries, the coverage of most of the studies ends by the 1990s. Our study covers the entire post liberalization period of the economy. Thirdly, our analyses are based on the ASI factory level data which implies that our estimates should actually conform to the characteristics of the production function. For instance, estimating the production function with aggregate industry data can at most give us some idea about the *existence of external economies of scale* but it certainly cannot provide any information on the *internal economies of scale* which can only be observed at the level of a firm. Thus, the chief motivation of our study was derive from the serious limitations of the existing studies on the estimation of production function for the Indian economy.

The rest of the paper is organized as follows. The next section, i.e. Section 2, discusses the data, variables and methodology. The empirical results are presented and discussed in Section 3. Section 4 presents the results of a multiple regression analysis undertaken to relate output growth achieved by various industries to elasticity of substitution and returns to scale. Finally, in Section 5, the main conclusions of the study are given and some concluding remarks are made.

2. Data and Methodology

2.1 Data and variables

The database used in this study to estimate the returns to scale and elasticity of substitution between capital and labour is the unit-level panel data of the *Annual Survey of Industries* (ASI) brought out by Central Statistical Office (CSO) for the period 1998-99 to 2007-08. It may be mentioned here that ASI covers industrial units registered as factories under the Factories Act. Thus, the analysis is confined to the organized sector of Indian manufacturing (covering relatively bigger industrial unit that employ 10 or more worker with the use of power or 20 or more workers without the use of power).

A two-input production function framework is used for the analysis and estimation of key parameters; value added is taken as the output and labour and capital are taken as two inputs. Three alternate specifications of the production function have been used in the study as explained later in Section 2.2.

Gross value added (calculated using formula given in tabulation program given by ASI) is used as a measure for output, net fixed capital stock (closing stock) for capital input, and the number for persons employed (average employment during the year) for labour input. Total wages and salaries has been divided by average number of persons employed to obtain the wage rate.

It should be pointed out here that the value of fixed capital is the book value of fixed assets, i.e. the assets are at historical prices and the depreciated value of fixed assets is aggregated to form the net fixed capital stock in ASI. While replacement value of fixed assets would be a better measure, it has not been possible to make the required price correction.

As mentioned above, the study uses a panel data set of factories for the period 1998-99 to 2007-08. Instead of using this dataset as a panel for the purpose of econometric analysis, estimation of production function parameters has been done separately for each two-digit industry group for each year. This enables us to study the inter-temporal and inter-industry variation in returns to scale and elasticity of substitution between labour and capital input. The number of factories in the dataset varies from year to year. There is almost a steady increase in the number of factories in the data set from one year to the next. The number of factories in the dataset in various years ranges from about 25 thousand for 1998-99 to about 67 thousand in 2006-07 and 57 thousand in 2007-08. Thus, the estimates of parameter for the years for the years 2005-06 to 2007-08 are based on a much larger sample than the estimates for the years 1998-99 to 2000-01.

2.2 Methodology

Three alternate models have been used for the analysis: the Cobb-Douglas production function, the SMAC function which is derived from the Constant Elasticity of Substitution (CES) production function and the Translog production function. Simple linear regressions are used to estimate the various models with robust standard errors (to take care of possible heteroscedasticity).

Cobb-Douglas production function has unitary elasticity of substitution. This specification has been used to get only an estimate of returns to scale. The production function may be written as:

$$In\, Y = In\, A + \alpha\, In\, L + \beta\, In\, K \qquad (1)$$

where, Y, K, L represent output, capital and labour respectively and A,α, and β are parameters to be estimated. The estimate of (α + β) gives the value of returns to scale.

The previous equation can also be written as,

$$In\, Y = In\, A + \beta\, In\left(\frac{K}{L}\right) + \gamma\, In\, L \qquad (2)$$

In this equation, γ (the coefficient of ln L) is the value of returns to scale. Using this, returns to scale has been estimated for all the 22 two-digit industries of the manufacturing sector for each year, from 1998-99 to 2007-08.

Let us now describe the second model. This is the SMAC model, which is derived from the CES (constant elasticity of substitution) production function. The SMAC function is based on the assumption that the marginal product of labour is equal to wage rate. The CES production function may be written as:

$$Y = A\,[\delta L^{-\rho} + (1-\delta)\, K^{-\rho}]^{\frac{-\upsilon}{\rho}} \qquad (3)$$

In this equation, Y, L and K are defined as above, ν represents returns to scale and the parameter ρ is related with the elasticity of substitution (σ) in the following way:

$$\sigma = \frac{1}{(1+\rho)} \qquad (4)$$

Given the production function in (3) above, an estimable equation is derived using the marginal productivity condition for labour (implicitly assuming competitive markets and factors being paid according to marginal products). The equation to be estimated is as follows, which is called here as the SMAC model:

$$In\left({}^{Y}/_{L}\right) = c + \varphi\ In\ (w) + \Psi In\ L \qquad (5)$$

In this equation (w) represents the wage rate. Given the estimates of φ and ψ, the estimates of returns to scale (ν) and the parameter ρ which is related with the elasticity of substitution (σ) can be derives by using the following two equations.

$$\varphi = \frac{\vartheta}{(\vartheta + \rho)} \qquad (6)$$

$$\Psi = \frac{\rho(\vartheta - 1)}{(\vartheta + \rho)} \qquad (7)$$

Equation (5) given above has been estimated for all the 2-digit industries for different years, and the estimates of returns to scale and elasticity of substitution have been derived using equations (6) and (7).

As mentioned earlier, in addition to the two models described above, the translog production function has been estimated. The translog production function is more general than the Cobb-Douglas and the CES production function. The translog production function for two inputs L and K may be written as:

$$In\ Y = \alpha_0 + \alpha_L In\ L + \alpha_K In\ K + 0.5\ \beta_{LL}(In\ L)^2 + 0.5\ \beta_{KK}(In\ K)^2 + \beta_{LK}(In\ L)(In\ K) \qquad (8)$$

This production function reduces to the Cobb-Douglas production function if

$$\beta_{LL} = \beta_{KK} = \beta_{LK} = 0 \qquad (9)$$

The translog production function will be subject to constant returns to scale if the following conditions are satisfied:

$$\alpha_L + \alpha_K = 1;\ \beta_{LL} + \beta_{LK} = 0; and\ \beta_{KK} + \beta_{LK} = 0 \qquad (10)$$

A linear regression applied to cross section data would provide the estimates of parameters in equation (8) above. The equation has been estimated separately for each two-digit industry for each year.

The following equations indicate how returns to scale and elasticity of substitution are calculated for this model.

Regression gives us the following equation,

$$lnY = \alpha_0 + \alpha_L lnL + \alpha_K lnK + \gamma_{LL}(lnL)^2 + \gamma_{KK}(lnK)^2 + \gamma_{LK}(lnL)(lnK) \qquad (11)$$

Clearly, $\gamma_{LL} = 0.5\beta_{LL,}\ \ \gamma_{KK} = 0.5\beta_{KK},\ and\gamma_{LK} = \beta_{LK}$

Returns to scale are defined as:

$$\left[\frac{\partial In\ Y}{\partial In\ L}\right] + \left[\frac{\partial In\ Y}{\partial In\ K}\right]$$

Thus, RTS may be derived as:

$$RTS = \alpha_L + [2 * \gamma_{LL} lnL] + \gamma_{LK}(lnK) + \alpha_K + [2 * \gamma_{KK} lnK] + \gamma_{LK}(lnL) \qquad (12)$$

The values of the variables included in the equation are taken at sample mean. Similarly, elasticity of substitution can also be calculated.

$$\sigma = \frac{f_L f_K (Lf_L + Kf_K)}{LK[f_{LL}f_K^2 + f_{KK}f_L^2 - 2f_L f_K f_{LK}]} \qquad (13)$$

where,

$$f_L = \frac{\partial V}{\partial L} = [\alpha_L + 2.\gamma_{LL} In\ L + \gamma_{LK}(In\ K)\frac{V}{L}]$$

$$f_K = \frac{\partial V}{\partial K} = [\alpha_K + 2.\gamma_{KK} In\ K + \gamma_{LK}(In\ L)\frac{V}{K}]$$

$$f_{LL} = \left[\left(2.\gamma_{LL}\frac{1}{L}\right)\frac{V}{L} + \alpha_L + 2.\gamma_{LL}InL + \gamma_{LK}In\,K\right]\frac{f_L L - V}{L^2}$$

$$f_{KK} = \left[\left(2.\gamma_{KK}\frac{1}{K}\right)\frac{V}{K} + \alpha_K + 2.\gamma_{KK}InK + \gamma_{LK}In\,L\right]\frac{f_K K - V}{K^2}$$

$$f_{LK} = \left[\left(\gamma_{LK}\frac{1}{K}\right)\frac{V}{L} + \alpha_L + 2.\gamma_{LL}InL + \gamma_{LK}In\,K\right]\frac{f_K}{L}$$

Before concluding this section, a few points may be made about the three production function described above. The Cobb-Douglas production function has the advantage of its simplicity. It is a convenient method for obtaining an estimate of returns to scale. But if the true production function is not Cobb-Douglas, the estimate of returns to scale obtained by using the Cobb-Douglas production function may not show the scale economies or diseconomies correctly. The SMAC model derived from the CES production function has the advantage that it does not require data on capital input and is therefore free from errors in the measurement of capital input. In cross-section ASI unit level data, the reported capital stock is at historical prices net of cumulative depreciation. The capital assets are depreciated at rates which may differ considerably from the true rate of depreciation of capital assets (because of income tax considerations). The data on capital stock is therefore subject to some degree of inaccuracy. The use of SMAC model helps in avoiding the parameter estimates getting affected by errors in the measurement of capital. But, there is a price to be paid. The method depends crucially on the assumptions of perfect competition and factors being paid according to their marginal product, and if these assumptions do not hold in reality, the estimates of parameters get affected. These assumptions on perfectly completive labour market are obviously hard to defend in the case of Indian manufacturing firms, considering particularly the prevalent labour market regulations. In comparison with the Cobb-Douglas and CES production functions, the translog production function is more general. Often in empirical studies using time-series data, the translog production function is estimated along with factor share equations using SURE or other such technique, involving assumptions of competitive factor markets (see, for instance, Goldar, 2012). But, with large cross-section data, the translog model can be estimated directly by applying ordinary least squares (OLS) technique without using the factor share equations. This is the approach taken in this study.

3. Empirical Results

The estimates of returns to scale obtained by using the Cobb-Douglas production function are presented in Table 1. The estimated parameter is more than one in most cases, and the gap is statistically significant. Thus, the results indicate significant economies of scale in Indian manufacturing. The estimated parameter is found is less than one, or close to one in two industries: Textiles and Wearing apparel. It appears that the majority of industrial units in these two industries are operating at such a level of production at which there are not much scale economies. Perhaps, only if the units in these industries go beyond a threshold, they can reap economies of scale.

The estimated parameters of the SMAC model are given in Annexure 1 and 2. The estimates of elasticity of substitution and returns to scale obtained from this model are shown in Tables 2 and 3. The estimates of returns to scale are found to be negative or very high positive, beyond plausible limit, in a number of cases. It appears that we cannot depend much on the estimates of the returns to scale obtained by the SMAC model. It is important to note, however, that if these odd cases are ignored, the remaining estimates are mostly more than one, suggesting economies of scale. Thus, the overall finding about returns to scale obtained from the estimated Cobb-Douglas function is supported by the results of the SMAC model.

As regards the estimates of elasticity of substitution obtained with the help of the SMAC model which are shown in Table 2, the estimated parameter is within the plausible range. The estimated elasticity is mostly in the range of 0.8 to 1.4. It is relatively high for Food products and beverages, Tobacco products, Wearing apparel, Chemicals and chemical products, and Non-metallic mineral products. On the other hand, it is relatively low for Rubber and plastic products, Basic metals, Fabricated metal products, and Machinery and equipment. In the case of petroleum products, a downward trend in elasticity of substitution over time is observed. But, in other cases, there is no general upward or downward trend in the elasticity of substitution.

Table 1: Estimates of Returns to scale using the Cobb-Douglas model

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
15	Food products and beverages	1.055 (0.0124)	1.071 (0.0113)	1.070 (0.0111)	1.077 (0.0111)	1.037 (0.0112)	0.991 (0.0099)	1.098 (0.0101)	1.026 (0.0094)	1.063 (0.0092)	1.026 (0.0105)
16	Tobacco products	1.244 (0.0211)	1.173 (0.0293)	1.168 (0.0221)	1.154 (0.0247)	1.204 (0.0255)	1.207 (0.0209)	1.201 (0.0189)	1.213 (0.0224)	1.187 (0.0234)	1.175 (0.0261)
17	Textiles	0.954 (0.0126)	0.954 (0.0119)	0.964 (0.0118)	0.954 (0.0119)	0.969 (0.0122)	0.994 (0.0108)	1.010 (0.0096)	1.029 (0.0099)	0.984 (0.0097)	0.976 (0.0112)
18	Wearing apparel: Dressing & dyeing of fur	0.908 (0.0320)	0.939 (0.0247)	0.983 (0.0255)	0.955 (0.0237)	0.940 (0.0212)	0.921 (0.0186)	0.961 (0.0172)	0.942 (0.0160)	0.969 (0.0164)	0.966 (0.0175)
19	Tanning & dressing of leather manufacture of luggage, handbags, saddlery, harness and footwear	1.099 (0.0274)	1.103 (0.0319)	1.076 (0.0253)	1.087 (0.0296)	1.029 (0.0231)	1.051 (0.0203)	1.088 (0.0216)	1.067 (0.0242)	1.081 (0.0175)	1.026 (0.0200)
20	Wood and of products of wood & cork except furniture; Articles of straw and plating materials	1.013 (0.0515)	1.057 (0.0373)	1.184 (0.0523)	1.285 (0.0449)	1.211 (0.0413)	1.187 (0.0324)	1.209 (0.0293)	1.226 (0.0389)	1.186 (0.0374)	1.223 (0.0347)
21	Paper & paper products	1.030 (0.0311)	1.008 (0.0305)	1.106 (0.0281)	1.040 (0.0252)	1.096 (0.0233)	1.095 (0.0221)	1.086 (0.0228)	1.116 (0.0205)	1.107 (0.0208)	1.104 (0.0318)
22	Publishing, printing and reproduction of recorded media	1.154 (0.0340)	1.164 (0.0263)	1.214 (0.0269)	1.178 (0.0255)	1.209 (0.0272)	1.220 (0.0235)	1.208 (0.0232)	1.177 (0.0236)	1.212 (0.0210)	1.190 (0.0276)
23	Coke, refined petroleum products and nuclear fuel	1.164 (0.0750)	1.225 (0.0647)	1.185 (0.0163)	1.194 (0.0623)	1.217 (0.0556)	1.261 (0.0474)	1.282 (0.0481)	1.299 (0.0484)	1.186 (0.0479)	1.313 (0.0459)
24	Chemicals and chemical products	1.159 (0.0179)	1.143 (0.0163)	1.121 (0.0161)	1.146 (0.0149)	1.163 (0.0148)	1.208 (0.0120)	1.118 (0.0128)	1.143 (0.0124)	1.147 (0.0121)	1.129 (0.0132)

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
25	Rubber and plastic products	1.135 (0.0256)	1.152 (0.0240)	1.167 (0.0219)	1.188 (0.0187)	1.146 (0.0185)	1.144 (0.0157)	1.159 (0.0170)	1.153 (0.0173)	1.155 (0.0155)	1.128 (0.0172)
26	Other non-metallic mineral products	1.183 (0.0191)	1.140 (0.0158)	1.153 (0.0164)	1.160 (0.0147)	1.150 (0.0146)	1.176 (0.0128)	1.173 (0.0122)	1.154 (0.0118)	1.185 (0.0112)	1.185 (0.0117)
27	Basic metals	1.046 (0.0481)	1.075 (0.0197)	1.083 (0.0187)	1.097 (0.0193)	1.118 (0.0179)	1.150 (0.0155)	1.182 (0.0183)	1.139 (0.0160)	1.103 (0.0157)	1.085 (0.0177)
28	Fabricated metal products, except machinery & equipment	1.144 (0.0195)	1.108 (0.0197)	1.127 (0.0190)	1.094 (0.0191)	1.161 (0.0178)	1.121 (0.0162)	1.111 (0.0161)	1.111 (0.0144)	1.124 (0.0145)	1.098 (0.0149)
29	Machinery & equipment	1.145 (0.0189)	1.139 (0.0164)	1.181 (0.0156)	1.206 (0.0146)	1.204 (0.0155)	1.272 (0.0122)	1.213 (0.0124)	1.228 (0.0120)	1.237 (0.0122)	1.210 (0.0125)
30	Office, accounting and computing machinery	1.321 (0.1395)	1.047 (0.0923)	1.246 (0.0141)	1.221 (0.1149)	1.247 (0.1037)	1.165 (0.0602)	1.178 (0.0815)	1.167 (0.0911)	1.011 (0.1095)	1.099 (0.0716)
31	Electrical machinery and apparatus N.E.C	1.150 (0.0279)	1.161 (0.0250)	1.191 (0.0222)	1.191 (0.0216)	1.210 (0.0211)	1.225 (0.0183)	1.238 (0.0202)	1.185 (0.0210)	1.223 (0.0201)	1.207 (0.0193)
32	Radio, television and communication equipment and apparatus	1.150 (0.0435)	1.152 (0.0466)	1.202 (0.0356)	1.180 (0.0336)	1.204 (0.0422)	1.275 (0.0393)	1.132 (0.0354)	1.097 (0.0505)	1.164 (0.0395)	1.163 (0.0416)
33	Medical, precision and optical instruments; watches and clocks	1.040 (0.0591)	1.071 (0.0431)	1.076 (0.0407)	1.167 (0.0403)	1.213 (0.0494)	1.203 (0.0427)	1.164 (0.0386)	1.106 (0.0386)	1.144 (0.0373)	1.166 (0.0409)
34	Motor vehicles, trailers and semi-trailers	1.149 (0.0249)	1.138 (0.0222)	1.180 (0.0232)	1.160 (0.0224)	1.165 (0.0199)	1.185 (0.0191)	1.178 (0.0167)	1.187 (0.0169)	1.146 (0.0168)	1.149 (0.0167)
35	Other transport equipment	1.075 (0.0271)	1.111 (0.0263)	1.075 (0.0248)	1.076 (0.0251)	1.123 (0.0231)	1.087 (0.0258)	1.133 (0.0213)	1.099 (0.0239)	1.084 (0.0247)	1.053 (0.0245)
36	Furniture; manufacturing N.E.C	1.148 (0.0364)	1.126 (0.0318)	1.190 (0.0267)	1.202 (0.0234)	1.161 (0.0254)	1.220 (0.0210)	1.187 (0.0193)	1.187 (0.0208)	1.190 (0.0203)	1.137 (0.0206)

Source: Authors' computation from unit level data of ASI.

Table 2: Estimates of Elasticity of Substitution using the SMAC model

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
15	Food products and beverages	1.110	1.113	1.227	1.299	1.348	1.345	1.33	1.331	1.238	1.310
16	Tobacco products	1.313	1.455	1.336	1.238	1.356	1.338	1.379	1.221	1.510	1.439
17	Textiles	1.019	1.095	1.182	1.043	1.096	1.074	0.935	0.943	0.983	1.01
18	Wearing apparel: Dressing & dyeing of fur	1.204	1.303	1.379	1.302	1.398	1.315	1.12	1.199	1.252	1.221
19	Tanning & dressing of leather manufacture of luggage, handbags, saddlery, harness and footwear	1.011	1.133	0.969	1.081	1.203	0.926	0.938	1.13	1.086	1.114
20	Wood and of products of wood & cork except furniture; Articles of straw and plating materials	1.04	0.924	0.935	0.779	0.907	0.978	0.963	0.784	0.904	0.877
21	Paper & paper products	1.101	1.155	1.231	0.994	1.063	1.045	1.088	0.96	1.027	1.021
22	Publishing, printing and reproduction of recorded media	1.055	0.86	0.872	0.872	0.863	0.797	0.895	0.913	0.873	0.921
23	Coke, refined petroleum products and nuclear fuel	1.32	1.418	0.979	1.309	1.205	1.045	1.080	0.832	0.800	0.849
24	Chemicals and chemical products	1.226	1.254	1.288	1.295	1.260	1.236	1.230	1.167	1.212	1.27
25	Rubber and plastic products	0.724	0.799	0.882	0.728	0.861	0.881	0.845	0.871	1.003	1.026
26	Other non-metallic mineral products	1.393	1.347	1.373	1.331	1.378	1.359	1.369	1.346	1.350	1.36
27	Basic metals	0.614	0.76	0.602	0.648	0.731	0.638	0.691	0.727	0.665	0.724
28	Fabricated metal products, except machinery &equipments	0.678	0.823	0.919	0.93	0.835	0.892	0.900	0.951	0.971	0.953
29	Machinery &equipments	0.947	0.894	0.942	0.934	0.934	0.885	0.938	0.884	0.873	0.839
30	Office, accounting and computing machinery	0.546	0.815	0.266	0.955	0.723	0.600	0.678	0.423	0.214	0.368

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
31	Electrical machinery and apparatus N.E.C	0.887	0.832	1.029	0.855	0.881	0.983	0.925	0.927	0.876	0.932
32	Radio, television and communication equipment and apparatus	0.464	0.874	0.797	0.929	0.788	0.767	0.711	1.132	0.692	0.736
33	Medical, precision and optical instruments; watches and clocks	1.016	0.903	0.811	0.671	0.986	0.994	0.879	0.863	0.89	1.006
34	Motor vehicles, trailers and semi-trailers	0.921	1.101	0.989	1.023	1.11	0.95	1.018	1.033	1.19	1.049
35	Other transport equipment	0.809	0.602	0.963	0.939	0.998	1.042	0.863	0.991	1.024	0.870
36	Furniture; manufacturing N.E.C	0.891	1.112	0.975	0.899	1.074	1.074	0.924	0.95	1.018	1.045

Source: Authors' computation from unit level data of ASI.

Table 3: Estimates of Returns to scale using the SMAC model

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
15	Food products and beverages	5.05	4.333	2.337	1.933	2.077	3.506	3.241	2.451	2.348	2.369
16	Tobacco products	1.212	1.287	1.448	1.756	1.289	1.541	1.282	1.53	1.424	1.315
17	Textiles	-0.187	-1.93	4.543	-0.514	-3.148	-34.5	0.692	0.836	0.281	-0.176
18	Wearing apparel: Dressing & dyeing of fur	2.346	1.879	1.378	1.729	1.856	1.936	53.5	3.125	1.631	1.827
19	Tanning & dressing of leather manufacture of luggage, handbags, saddlery, harness and footwear	1.222	0.924	0.566	0.901	1.302	0.628	0.772	2.103	3.24	2.326
20	Wood and of products of wood & cork except furniture; Articles of straw and plating materials	2.6	0.676	1.222	1.646	2.912	-1.211	-7.8	1.57	2.833	2.509
21	Paper & paper products	2.375	1.423	1.131	0.188	1.05	0.676	0.769	-2.471	0.394	0.275
22	Publishing, printing and reproduction of recorded media	10.4	1.153	1.43	0.992	1.237	1.412	1.627	1.5	1.776	1.952
23	Coke, refined petroleum products and nuclear fuel	1.38	1.408	0.267	2.382	2.44	4.778	0.93	1.306	0.961	5.767
24	Chemicals and chemical products	1.014	1.107	1.272	1.15	1.049	0.979	1.137	0.971	1.04	1.06
25	Rubber and plastic products	1.278	1.493	2.172	1.468	1.709	1.367	1.65	1.467	0.273	1.368
26	Other non-metallic mineral products	1.17	1.245	1.332	1.255	1.305	1.221	1.183	1.221	1.16	1.119
27	Basic metals	1.073	1.191	1.219	1.177	1.294	1.381	1.694	1.485	1.386	1.356
28	Fabricated metal products, except machinery & equipment	1.205	1.059	0.851	0.578	1.135	0.93	0.9	1.021	1.812	1.146
29	Machinery & equipment	2.5	1.138	1.018	1.1	1.048	1.297	2.133	2.016	1.875	1.638

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
30	Office, accounting and computing machinery	1.827	0.768	1.289	-6.714	2.188	1.705	1.255	1.264	1.113	1.105
31	Electrical machinery and apparatus N.E.C	1.616	1.316	0.517	1.742	1.775	-2.125	-407	4.278	2.217	2.958
32	Radio, television and communication equipment and apparatus	1.37	2.305	2.549	3.947	2.274	3.101	1.267	1.636	1.239	1.205
33	Medical, precision and optical instruments; watches and clocks	-0.556	0.932	0.824	1.208	-1.273	-0.207	1.33	1.053	2.81	0.171
34	Motor vehicles, trailers and semi-trailers	1.783	0.953	-0.393	0.49	0.819	-3.533	0.226	0.34	0.974	0.614
35	Other transport equipment	1.078	1.121	0.455	0.678	0.182	4.1	1.402	1	-2.3	0.895
36	Furniture; manufacturing N.E.C	1.302	1.222	5.0	1.272	1.259	0.704	2.394	2.6	0.783	14.333

Source: Authors' computation from unit level data of ASI.

The results of the Translog production function may be taken up next. The estimates of parameters are given in Annexure 3, while some key results are presented in Tables 4 through 7. The results presented in Table 4 bring out that in most cases, the test statistic rejects the hypothesis that the estimated Translog function can be reduced to the Cobb-Douglas function. Evidently, the data indicate that the production technology cannot be represented by a Cobb-Douglas production function. Rather a translog production function model is more appropriate. The implication is that the elasticity of substitution cannot be treated as unity. In the cases of Petroleum products, Electrical machinery, and medical, optical and precision equipment, the hypothesis of production function being Cobb-Douglas cannot be rejected for most years. Thus, for these three industries, Cobb-Douglas production function is not inappropriate.

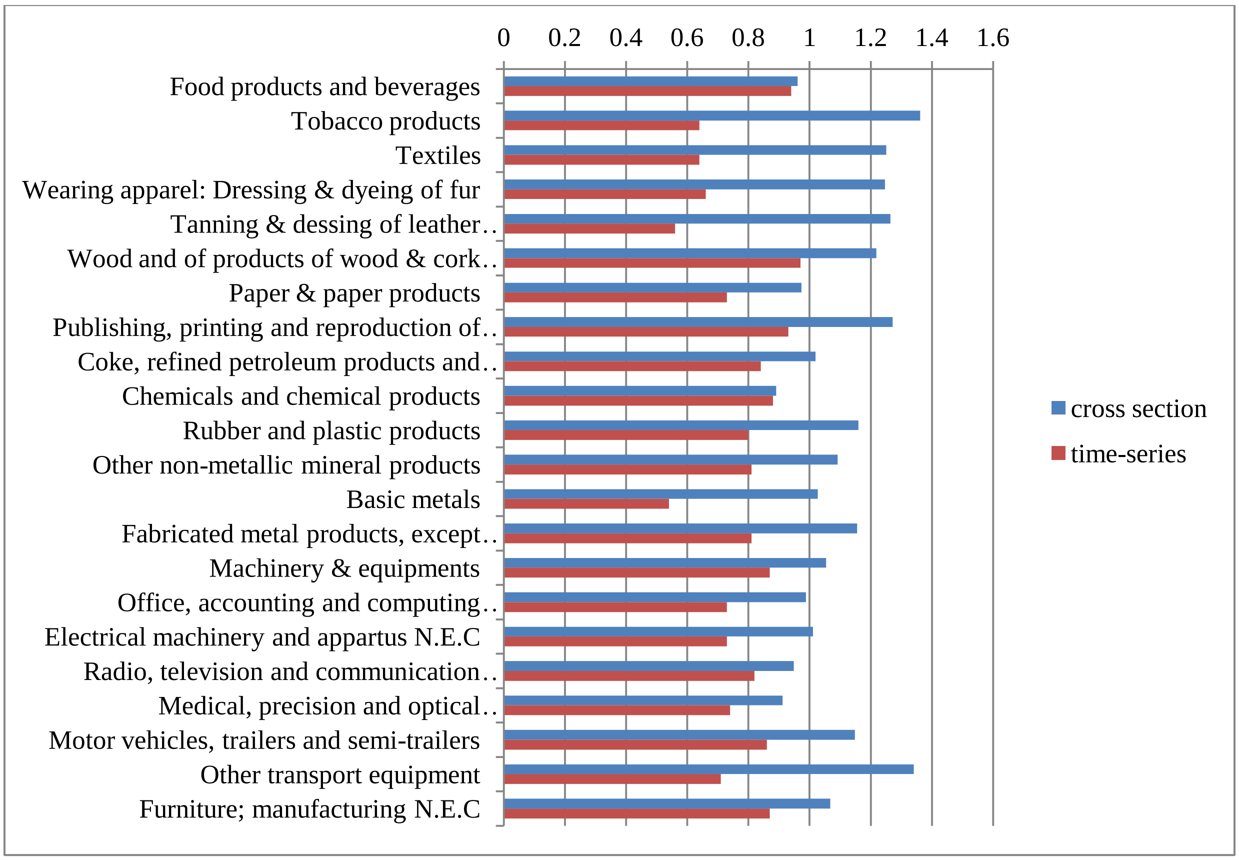
Table 5 presents results of the test of constant returns of scale. This hypothesis of constant returns gets rejected in most cases. Again it is sees that the estimates of returns of scale presented in Table 6 are generally more than one. This is consistent with the results of the Cobb-Douglas and CES production presented above. Thus, the results of all three production functions indicate the presence of significant scale economies in Indian manufacturing.

From the results, it appears that scale economies are not present in textiles and wearing apparel industries. These results are consistent with the estimates of the Cobb-Douglas function presented above.

As regard elasticity of substitution, it varies from industry to industry. It is mostly in the range of 0.8 to 1.5. The elasticity is found to relatively higher for some of the labour intensive industries, whereas it is found to be relatively lower for basic metals, and machinery and equipment. This is consistent with the results of SMAC function presented above.

Figure 1 presents a comparison of elasticity of substitution for two-digit industries (average for the period 1998-99 to 2007-08) obtained in this study with the estimates obtained by Goldar et al. (2013). The estimates of Goldar et al. (2013) are based on time-series data, and therefore it is interesting to find out if the cross-section data yield very different results. Indeed, the comparison brings out that while the estimates based on time-series tend to low (often less than one), the estimates based on cross section data are much larger. This is to be expected because arguably estimates based on time series data reflect short-term substitution possibilities whereas estimates based on cross section data shown long term substitution possibilities. It appears from the results obtained that the elasticity of substitution is more than one in the long run, especially for labour intensive industries.

Figure 1: Estimates of Elasticity of Substitution, comparison of estimates



Note: Estimates obtained in this study (plant wise cross section) are compared with the estimates obtained by Goldar et al. (2013) which are based on time-series data.

Table 4: Test of Cobb-Douglas Function (Testing If the assumed translog model is reducible to a Cobb-Douglas Function) (F-statistic and Prob.)

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
15	Food products and beverages	18.62 0.0000	18.90 0.0000	26.62 0.0000	37.14 0.0000	19.76 0.0000	22.51 0.0000	27.38 0.0000	54.55 0.0000	75.84 0.0000	19.19 0.0000
16	Tobacco products	35.56 0.0000	20.23 0.0000	13.48 0.0000	14.44 0.0000	21.31 0.0000	27.06 0.0000	29.49 0.0000	17.28 0.0000	21.26 0.0000	13.98 0.0000
17	Textiles	6.52 0.0002	11.02 0.0000	21.54 0.0000	15.24 0.0000	16.68 0.0000	8.25 0.0000	30.02 0.0000	14.71 0.0000	30.96 0.0000	9.51 0.0000
18	Wearing apparel: Dressing & dyeing of fur	4.96 0.0021	4.41 0.0044	5.41 0.0011	0.09 0.9636	5.91 0.0005	3.16 0.0239	5.42 0.0010	3.27 0.0206	13.96 0.0000	1.89 0.1297
19	Tanning & dressing of leather, manufacture of luggage, handbags, saddlery, harness and footwear	0.61 0.6085	2.41 0.0669	1.26 0.2891	0.82 0.4820	3.98 0.0080	3.51 0.0151	7.10 0.0001	2.39 0.0676	8.80 0.0000	4.96 0.0021
20	Wood and of products of wood & cork except furniture; Articles of straw and plating materials	0.74 0.5286	3.38 0.0180	11.29 0.0000	2.20 0.0871	3.44 0.0166	3.81 0.0099	8.18 0.0000	4.93 0.0021	5.85 0.0006	3.09 0.0264
21	Paper & paper products	2.59 0.0520	0.62 0.6040	4.34 0.0048	5.32 0.0012	4.17 0.0061	6.06 0.0004	15.34 0.0000	12.27 0.0000	5.62 0.0008	12.42 0.0000
22	Publishing, printing and reproduction of recorded media	8.47 0.0000	4.04 0.0073	11.47 0.0000	2.02 0.1090	4.72 0.0029	5.06 0.0018	7.73 0.0000	8.90 0.0000	12.65 0.0000	11.42 0.0000
23	Coke, refined petroleum products and nuclear fuel	1.17 0.3242	2.42 0.0682	3.71 0.0124	1.83 0.1418	0.88 0.4541	0.52 0.6692	1.89 0.1315	2.77 0.0417	1.96 0.1198	0.95 0.4154
24	Chemicals and chemical products	5.05 0.0018	13.29 0.0000	6.45 0.0002	8.35 0.0000	7.21 0.0001	23.88 0.0000	22.78 0.0000	17.77 0.0000	24.96 0.0000	5.26 0.0013
25	Rubber and plastic products	2.84 0.0372	4.78 0.0026	6.48 0.0002	3.86 0.0092	11.14 0.0000	3.57 0.0136	16.79 0.0000	15.92 0.0000	21.40 0.0000	6.01 0.0005
26	Other non-metallic mineral products	5.98 0.0005	12.05 0.0000	25.69 0.0000	17.05 0.0000	10.97 0.0000	32.79 0.0000	46.28 0.0000	54.57 0.0000	115.94 0.0000	91.45 0.0000

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
27	Basic metals	26.50 0.0000	1.88 0.1306	2.40 0.0665	1.39 0.2440	4.29 0.0051	11.47 0.0000	8.83 0.0000	4.31 0.0049	3.33 0.0188	1.15 0.3293
28	Fabricated metal products, except machinery & equipment	10.56 0.0000	5.93 0.0005	6.37 0.0003	4.98 0.0019	15.41 0.0000	12.05 0.0000	13.50 0.0000	22.05 0.0000	20.83 0.0000	13.03 0.0000
29	Machinery & equipment	2.38 0.0676	5.29 0.0013	4.07 0.0068	3.86 0.0091	5.91 0.0005	36.22 0.0000	8.10 0.0000	12.31 0.0000	14.78 0.0000	3.03 0.0282
30	Office, accounting and computing machinery	3.54 0.0244	1.83 0.1545	2.66 0.0562	6.42 0.0006	6.17 0.0008	2.12 0.1020	2.09 0.1075	2.73 0.0487	1.28 0.2868	0.15 0.9282
31	Electrical machinery and apparatus N.E.C	1.37 0.2519	2.15 0.0922	1.45 0.2245	0.35 0.7874	0.78 0.5077	1.14 0.3322	0.98 0.4019	0.83 0.4797	2.39 0.0675	6.68 0.0002
32	Radio, television and communication equipment and apparatus	1.07 0.3633	1.83 0.1414	4.22 0.0060	0.57 0.6361	1.43 0.2337	5.32 0.0013	0.82 0.4825	2.41 0.0662	2.33 0.0739	1.22 0.3033
33	Medical, precision and optical instruments; watches and clocks	1.10 0.3497	0.12 0.9491	2.68 0.0467	0.15 0.9284	3.38 0.0183	1.11 0.3435	1.68 0.1698	1.62 0.1837	1.09 0.3550	3.97 0.0082
34	Motor vehicles, trailers and semi-trailers	1.48 0.2188	4.61 0.0034	2.78 0.0402	3.96 0.0081	5.50 0.0010	27.36 0.0000	15.98 0.0000	5.53 0.0009	17.00 0.0000	22.40 0.0000
35	Other transport equipment	2.20 0.0875	2.58 0.0532	4.09 0.0069	8.70 0.0000	19.81 0.0000	30.82 0.0000	11.80 0.0000	14.50 0.0000	4.56 0.0036	0.99 0.3969
36	Furniture; manufacturing N.E.C	2.68 0.0465	4.44 0.0042	1.51 0.2114	17.49 0.0000	6.19 0.0004	10.89 0.0000	5.17 0.0015	4.44 0.0042	9.44 0.0000	1.96 0.1178

Source: Authors' computation from unit level data of ASI.

Table 5: Test of Constant Returns to Scale for the Translog Function (F-statistic and Prob.)

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
15	Food products and beverages	24.33 0.0000	24.48 0.0000	24.89 0.0000	32.64 0.0000	16.02 0.0000	17.74 0.0000	18.90 0.0000	37.12 0.0000	63.21 0.0000	14.10 0.0000
16	Tobacco products	57.39 0.0000	14.53 0.0000	21.65 0.0000	14.89 0.0000	32.96 0.0000	42.59 0.0000	52.26 0.0000	29.99 0.0000	26.28 0.0000	20.98 0.0000
17	Textiles	5.03 0.0002	8.53 0.0000	4.43 0.0041	5.84 0.0006	3.74 0.0107	1.08 0.3554	0.23 0.8775	2.64 0.0478	1.23 0.2960	1.95 0.1195
18	Wearing apparel: Dressing & dyeing of fur	9.62 0.0000	1.90 0.1289	0.63 0.5937	1.34 0.2613	2.12 0.0955	5.80 0.0006	1.53 0.2062	6.93 0.0001	2.42 0.0644	1.74 0.1569
19	Tanning & dressing of leather manufacture of luggage, handbags, saddlery, harness and footwear	7.15 0.0001	5.84 0.0007	5.65 0.0008	3.17 0.0240	3.63 0.0128	2.92 0.0334	8.42 0.0000	4.58 0.0035	10.79 0.0000	3.69 0.0118
20	Wood and of products of wood & cork except furniture; Articles of straw and plating materials	0.77 0.5088	1.54 0.2031	11.36 0.0000	17.93 0.0000	10.21 0.0000	11.64 0.0000	17.29 0.0000	11.18 0.0000	7.87 0.0000	14.47 0.0000
21	Paper & paper products	2.24 0.0829	0.46 0.7093	5.51 0.0010	3.06 0.0277	7.34 0.0001	8.64 0.0000	3.49 0.0153	8.11 0.0000	6.45 0.0003	13.56 0.0000
22	Publishing, printing and reproduction of recorded media	12.66 0.0000	14.18 0.0000	21.67 0.0000	19.20 0.0000	20.49 0.0000	30.86 0.0000	26.91 0.0000	20.28 0.0000	31.86 0.0000	14.77 0.0000
23	Coke, refined petroleum products and nuclear fuel	2.29 0.0818	4.33 0.0057	2.91 0.0353	5.14 0.0018	7.80 0.0000	10.39 0.0000	15.67 0.0000	19.83 0.0000	7.95 0.0000	17.19 0.0000
24	Chemicals and chemical products	23.59 0.0000	34.23 0.0000	22.16 0.0000	33.32 0.0000	39.47 0.0000	90.74 0.0000	31.77 0.0000	46.73 0.0000	53.68 0.0000	28.58 0.0000

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
25	Rubber and plastic products	13.29 0.0000	18.85 0.0000	18.39 0.0000	33.48 0.0000	19.42 0.0000	29.06 0.0000	26.92 0.0000	25.63 0.0000	31.87 0.0000	19.88 0.0000
26	Other non-metallic mineral products	21.16 0.0000	17.87 0.0000	20.61 0.0000	27.15 0.0000	24.91 0.0000	38.25 0.0000	33.42 0.0000	33.29 0.0000	62.07 0.0000	65.52 0.0000
27	Basic metals	15.67 0.0000	3.78 0.0103	5.61 0.0008	8.83 0.0000	14.74 0.0000	30.25 0.0000	31.95 0.0000	24.11 0.0000	17.85 0.0000	9.22 0.0000
28	Fabricated metal products, except machinery & equipment	18.49 0.0000	9.82 0.0000	14.46 0.0000	7.66 0.0000	31.12 0.0000	21.24 0.0000	25.34 0.0000	21.98 0.0000	27.33 0.0000	15.21 0.0000
29	Machinery & equipment	25.44 0.0000	31.26 0.0000	45.76 0.0000	65.18 0.0000	71.84 0.0000	166.51 0.0000	93.49 0.0000	113.08 0.0000	124.12 0.0000	95.16 0.0000
30	Office, accounting and computing machinery	7.05 0.0008	1.80 0.1583	3.34 0.0250	5.57 0.0017	7.07 0.0003	3.78 0.0131	3.11 0.0304	2.61 0.0566	1.05 0.3770	0.77 0.5131
31	Electrical machinery and apparatus N.E.C	11.18 0.0000	15.62 0.0000	22.57 0.0000	26.49 0.0000	41.67 0.0000	47.92 0.0000	46.18 0.0000	24.55 0.0000	40.21 0.0000	43.46 0.0000
32	Radio, television and communication equipment and apparatus	5.74 0.0008	4.12 0.0069	10.56 0.0000	11.14 0.0000	8.67 0.0000	23.04 0.0000	4.78 0.0028	6.38 0.0003	8.32 0.0000	5.52 0.0010
33	Medical, precision and optical instruments; watches and clocks	1.37 0.2538	0.98 0.4047	3.95 0.0086	6.55 0.0002	7.59 0.0001	9.53 0.0000	7.18 0.0001	4.45 0.0043	5.24 0.0015	6.80 0.0002
34	Motor vehicles, trailers and semi-trailers	14.74 0.0000	14.38 0.0000	21.82 0.0000	19.07 0.0000	24.77 0.0000	33.78 0.0000	36.49 0.0000	42.69 0.0000	20.75 0.0000	26.59 0.0000
35	Other transport equipment	3.43 0.0172	5.97 0.0005	3.94 0.0084	3.61 0.0132	10.45 0.0000	17.13 0.0000	16.08 0.0000	7.12 0.0001	4.49 0.0039	1.78 0.1502
36	Furniture; manufacturing N.E.C	6.53 0.0003	5.34 0.0012	17.85 0.0000	25.77 0.0000	14.83 0.0000	48.44 0.0000	33.33 0.0000	29.24 0.0000	33.81 0.0000	18.16 0.0000

Source: Authors' computation from unit level data of ASI.

Table 6: Estimates of Returns to scale using the Translog model

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
15	Food products and beverages	1.0457	1.068	1.0643	1.0619	1.0244	0.9878	1.0113	1.0177	1.0518	1.0226
16	Tobacco products	1.3052	1.1904	1.1864	1.1966	1.247	1.2208	1.2167	1.2109	1.2206	1.2068
17	Textiles	0.9547	0.9574	0.9652	0.9577	0.9701	0.9963	1.009	1.0313	0.9805	0.9748
18	Wearing apparel: Dressing & dyeing of fur	0.8872	0.9543	1.0023	0.9567	0.9528	0.9302	0.9741	0.9481	0.9816	0.9732
19	Tanning & dressing of leather, manufacture of luggage, handbags, saddlery, harness and footwear	1.112	1.1404	1.0774	1.0867	1.0382	1.0605	1.1204	1.0816	1.1015	1.0508
20	Wood and of products of wood & cork except furniture; Articles of straw and plating materials	0.994	1.0279	1.2066	1.2621	1.1756	1.1493	1.1912	1.193	1.1896	1.2031
21	Paper & paper products	1.0606	0.9911	1.124	1.0304	1.0621	1.0671	1.0687	1.0968	1.0872	1.1541
22	Publishing, printing and reproduction of recorded media	1.1588	1.1447	1.2235	1.1829	1.2134	1.2432	1.2058	1.1557	1.2061	1.1883
23	Coke, refined petroleum products and nuclear fuel	1.1354	1.2776	1.2037	1.2005	1.2151	1.2712	1.3154	1.2796	1.1469	1.3291
24	Chemicals and chemical products	1.1563	1.146	1.1159	1.1427	1.1537	1.1859	1.1112	1.1402	1.1444	1.1258
25	Rubber and plastic products	1.1068	1.1872	1.1877	1.1873	1.1458	1.1411	1.187	1.1988	1.1837	1.1694
26	Other non-metallic mineral products	1.1651	1.0864	1.1011	1.108	1.1178	1.1379	1.1353	1.0892	1.0829	1.0872
27	Basic metals	1.0969	1.0608	1.0857	1.1142	1.1306	1.1615	1.194	1.145	1.0925	1.0882
28	Fabricated metal products, except machinery & equipment	1.1291	1.1091	1.1329	1.0943	1.1621	1.1196	1.1063	1.1011	1.1278	1.094
29	Machinery & equipment	1.1334	1.1093	1.1676	1.2172	1.2086	1.2247	1.2264	1.2333	1.2444	1.2073
30	Office, accounting and computing machinery	1.1181	1.0621	1.363	1.2767	1.2315	1.207	1.2464	1.2651	1.0121	1.0872

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
31	Electrical machinery and apparatus N.E.C	NA	1.14	1.1832	1.1967	1.1951	1.2275	1.2576	1.2032	1.2426	1.2355
32	Radio, television and communication equipment and apparatus	1.1395	1.1678	1.207	1.171	1.2028	1.2909	1.1365	1.1133	1.1654	1.1732
33	Medical, precision and optical instruments; watches and clocks	1.0569	1.0769	1.126	1.1699	1.2481	1.2055	1.18	1.0912	1.1471	1.1912
34	Motor vehicles, trailers and semi-trailers	1.1361	1.1281	1.1747	1.1649	1.153	1.1745	1.1623	1.1747	1.1218	1.1418
35	Other transport equipment	1.0883	1.1266	1.0892	1.0839	1.133	1.0987	1.1504	1.1088	1.0848	1.0577
36	Furniture; manufacturing N.E.C	1.1482	1.1337	1.2215	1.2383	1.1746	1.2074	1.1958	1.2003	1.2148	1.1463

Source: Authors' computation from unit level data of ASI.

Table 7: Estimates of Elasticity of Substitution using the Translog model

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
15	Food products and beverages	0.9006	0.9315	0.9509	1.0037	0.967	0.9853	0.9948	0.9716	0.9424	0.9604
16	Tobacco products	1.431	1.4174	1.4026	1.2451	1.14	1.2653	1.6976	1.2624	1.4485	1.305
17	Textiles	1.1822	1.0447	1.2152	1.2741	1.2139	1.1454	1.4669	1.2802	1.4376	1.2474
18	Wearing apparel: Dressing & dyeing of fur	0.9429	1.345	1.4905	1.0206	1.3556	1.361	1.286	1.1502	1.4106	1.0982
19	Tanning & dressing of leather, manufacture of luggage, handbags, saddlery, harness and footwear	1.1104	1.3337	1.3654	0.9328	1.6859	1.3359	1.2027	1.3389	1.1732	1.1595
20	Wood and of products of wood & cork except furniture; Articles of straw and plating materials	1.3488	1.205	0.8642	0.8809	1.3415	1.2768	1.7525	1.1522	1.2296	1.1326
21	Paper & paper products	1.0072	0.9695	0.9682	0.867	1.1152	0.8892	1.0441	1.0295	1.0158	0.8317
22	Publishing, printing and reproduction of recorded media	1.1952	1.2031	1.4817	1.0771	1.156	1.1488	1.4409	1.4472	1.2611	1.3073
23	Coke, refined petroleum products and nuclear fuel	0.726	1.0356	1.1133	1.245	0.9654	0.8892	0.9435	0.9778	1.1742	1.125
24	Chemicals and chemical products	0.9019	0.8252	0.8901	0.8888	0.8888	0.8967	0.9118	0.889	0.8835	0.9346
25	Rubber and plastic products	0.9039	1.0222	1.342	1.1203	1.3435	1.1162	1.224	1.225	1.232	1.0652
26	Other non-metallic mineral products	1.0213	1.1015	1.0028	1.1062	1.1379	1.1085	1.1175	1.0925	1.159	1.0669
27	Basic metals	0.7149	1.1132	1.1529	0.9322	1.1953	1.0326	1.0519	1.0099	1.1264	0.9356
28	Fabricated metal products, except machinery & equipment	1.2228	1.2769	1.1823	1.1875	1.1707	1.0562	1.0197	1.2047	1.0889	1.1465
29	Machinery & equipment	0.9369	0.9683	1.1105	1.0853	1.0066	0.9991	1.1389	1.2143	1.0853	0.9995
30	Office, accounting and computing machinery	0.2512	0.9471	0.6747	0.4404	0.4756	0.5624	3.2188	1.4787	0.5536	1.2798
31	Electrical machinery and apparatus N.E.C	0.8705	0.9057	1.2098	0.9871	1.0214	0.9716	0.9252	1.0243	0.994	1.2028
32	Radio, television and communication	0.8319	0.9031	1.0486	0.9737	0.9516	0.8512	1.2087	0.7874	1.1129	0.8094

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
	equipment and apparatus										
33	Medical, precision and optical instruments; watches and clocks	0.7787	0.9653	1.0559	1.0829	0.6785	0.9646	0.7659	0.7828	0.917	1.1247
34	Motor vehicles, trailers and semi-trailers	1.0345	1.1913	1.2308	1.2573	1.2182	1.152	1.0356	1.0639	1.2557	1.0412
35	Other transport equipment	1.7397	1.184	1.4868	1.8377	1.3566	1.1585	1.0812	1.4907	1.0204	1.0489
36	Furniture; manufacturing N.E.C	1.0896	1.1965	0.9321	1.1627	1.0894	1.0642	1.0785	1.0023	1.0458	1.0129

Source: Authors' computation from unit level data of ASI.

4. Explaining Output Growth in Two-digit Industries

Having estimated returns to scale and elasticity of substitution between capital and labour in various industries in different years, it would be interesting to find out if these two important technological parameters have a bearing on the growth performance of the industries. To study how the return to scale and elasticity of substitution parameters impact industrial growth, a multiple regression analysis has been carried out. Panel data on 22 two digit-industries for 10 years, 1998-99 to 2007-08 are used for this purpose. The growth rate in real value added is taken as the explanatory variable. The estimates of returns to scale and elasticity of substitution obtained with the help of translog production function (presented in Table 6 and 7 above) are included among the explanatory variables. [1] In addition, the following variables have been used as explanatory variables: (a) growth rate in domestic GDP (to capture the influence of domestic demand growth), (b) growth rate in GDP in rest of the world (to capture the influence of increases in global demand which will have a favorable effect on Indian industries through increases in export demand, (c) growth rate in power generation (to capture the effect of easing of infrastructure bottlenecks) and (d) capital-labour ratio (to allow for the possibility that the increase in elasticity of substitution will be more beneficial for capital intensive industries, since the adverse effect of decline in marginal productivity of capital would pose a bigger problem in such industries). Thus, the model is specified as follows:

$$Gr\_GVA_{jt} = a + b_1 RTS_{jt} + b_2 ES_{jt} + b_2\left(ES_{jt} * KLR_{jt}\right) + c_1 GR\_GDP_t + c_2 GR\_GDPW_t + c_3 GR\_ELEC_t + c_4 lnGVA_{j,t-1} + \varepsilon_{jt} \qquad (14)$$

In the above equation, *j* is the subscript for industry and *t* is subscript for time (year). Gr_GVA_{jt} is the growth rate in real gross value added in industry *j* in year *t*. *RTS* denotes returns to scale and *ES* denotes elasticity of substitution. *KLR* denotes capital - labour ratio. *Gr_GDP* is the growth of India's real GDP. *Gr_GD PW* is the growth rate in GDP (in US dollar) of the world excluding India's GDP. *Gr_ELEC* is the growth rate in power generation in India. Logarithm of previous year's real value added ($lnGVA_{j,t-1}$) is introduced in the model as an explanatory variable to take into account the fact that there may be a base effect, i.e. a high level of value added in the previous year may pull down the growth rate in real value added. The last term in the above equation is the random error.

Data on India's real GDP have been taken from the *National Accounts Statistics*. Data on world GDP in US dollar have been taken from *World Development Indicators* database on the World Bank. Data on the growth rate in power generation in India have been taken from the

[1] For Industry 31, returns to scale estimate is not available for 1998-99. Therefore, the estimate for 1999-00 has been used also for 1998-99.

Economic Survey brought out by the Ministry of Finance, Government of India. Time series on real value added, employment and fixed capital stock at two-digit industry level have been constructed from ASI data. The methodology is the same as in Goldar (2012) and Goldar et al. (2013).

The estimates of the model are shown in Table 8. The estimation has been done by both the fixed effects model and the random effects model. The Hausman test results indicate that the results based on the fixed effects model are to be preferred.

The coefficient of return to scale is found to be positive and statistically significant. This indicates that an increase in returns to scale promotes growth. The coefficient of the elasticity of substitution is negative while the coefficient of the interaction term between the elasticity of substitution and capital-labour ratio is positive. The latter coefficient is statistically significant in several regressions. It appears therefore that a hike in elasticity of substitution will have a favourable effect on growth in capital intensive industries. In labour intensive industries, on the other hand, such an effect may not prevail.

The regression results indicate that the growth in domestic GDP and in World GDP (excluding India) have a favourable effect on India's industrial growth. The coefficient of domestic GDP is consistently positive and statistically significant. The coefficient of world GDP is consistently positive and is statistically significant in several regressions.

The coefficient of growth rate in electricity is negative when the growth rate in domestic GDP is included in the regression. This could be a consequence of a high correlation between growth rate in GDP and growth rate in power generation. When the growth rate in domestic GDP is dropped from the regression, the coefficient of the growth rate in power generation becomes positive and in some cases it becomes statistically significant too. Thus, it appears from the results that better availability of power enhanced industrial growth.

The coefficient of the lagged value added variable is negative as expected. Also, the coefficient is found to be statistically significant in almost all the regression. This, as pointed out earlier, captures the base effect. It seems that if the growth in output an industry goes up sharply in one year, it would be difficult for that industry to sustain such high growth in the following year, and the growth rate would have a tendency to slow down.

Table 8: Results of Multiple Regression Analysis, Explaining Output Growth at Two-digit Industry Level

Explanatory variable	Fixed effects model				Random effects model			
	Regression-1	**Regression-2**	**Regression-3**	**Regression-4**	**Regression-5**	**Regression-6**	**Regression-7**	**Regression-8**
RTS	0.693 (2.16)**	0.623 (1.85)*	0.913 (2.73)***	0.640 (2.34)**	0.167 (0.93)	0.150 (0.81)	0.217 (1.18)	0.162 (1.04)
ES	-0.096 (-1.30)	-0.112 (-1.43)	-0.088 (-1.10)	-0.118 (-1.85)*	-0.113 (2.06)**	-0.115 (-2.05)**	-0.095 (-1.70)*	-0.047 (-0.99)
ES*KLR	0.005 (1.43)	0.005 (1.55)	0.005 (1.50)	0.007 (2.65)***	0.002 (2.15)**	0.002 (2.17)**	0.002 (2.12)**	0.0003 (0.34)
Gr_GDP	5.53 (4.49)***			4.00 (5.19)***	4.39 (3.50)***			2.52 (3.41)***
Gr_Electricity	-1.69 (-1.24)	2.51 (2.43)**	3.22 (3.10)***		-2.80 (-2.04)**	0.71 (0.73)	1.41 (1.55)	
Gr_GDPW	0.50 (1.28)	1.26 (3.41)***		0.56 (1.71)*	-0.01 (-0.03)	0.67 (2.09)**		0.32 (1.00)
$\ln(GVA)_{t-1}$	-0.34 (-5.63)***	-0.30 (-4.78)***	-0.202 (-3.53)***	-0.246 (-4.65)***	-0.036 (-2.50)**	-0.035 (-2.35)**	-0.029 (-2.02)**	-0.012 (-0.94)
constant	3.55	3.22	1.61	2.36	0.34	0.42	0.25	0.359
Dummy variable for exceptionally high growth rate in GVA	no	no	no	yes	no	no	no	yes
R-squared	0.047	0.037	0.040	0.162	0.135	0.085	0.066	
Hausmantest statistic (Chi-square and prob. value)					32.14 (prob>chisqr =0.000)	22.64 (prob>chisqr =0.009)	14.59 (prob>chisqr =0.012)	12.02 (prob>chisqr =0.100)

Notes: t-ratios shown in parentheses. Data for 22 two-digit industries for 10 years, 1998 to 2007 have been used. The number of observations is 220. In five cases, the annual growth rate in real value added exceeds 75%. A dummy variable has been used for such observations in regressions (4) and (8). *,**, *** statistically significant at ten, five and one percent respectively. GDPW is world GDP excluding India.

5. Conclusion

This paper is chiefly motivated to contribute to the literature of the estimation of the elasticity of substitution and returns to scale in Indian manufacturing industries by using unit (plant)-level data of the *Annual Survey of Industries* and covering a recent period viz. 1998-99 to 2007-08. We assume two-factor production models with capital and labour as factors of production for various two-digit manufacturing industries of India for the period as mentioned above. A major justification of our study is that almost all of the previous researches on returns to scale and substitution elasticity for Indian manufacturing industries were based on aggregate level time series data or state-wise aggregates.Moreover, there was no study that covers the post liberalization period particularly since 1995 when India became a member of the WTO. Thus, there were two-fold limitations of the previous studies. First, the previous studies attempted to measure the parameters of a production by using aggregate data for Indian manufacturing whereas one needs strictly firm level data for such analysis. Second, while there were a few firm level studies that attempted to estimate the returns to scale (e.g., Fikkert and Hasan, 1998), the coverage of the period unfortunately was only up to 1985 when India was a highly regulated economy. Similarly, the study by Kumar and Naidu (2014) though covers a more recent period (1989 to 2009), it deals with estimation of the elasticity of substitution only for a few selected firms of the Iron and Steel industry. In contrast, our study attempts to measure both the returns to scale and the elasticity of substitution for the entire manufacturing sector of the Indian economy by considering the data covering the most recent years.

Our estimations of the parameters based on the translog formulation of production function indicate presence of significant scale economies in Indian manufacturing. The estimated elasticity of substitution shows significant variation across industries and over time. The elasticity is found to be mostly in the range of 0.8 to 1.5. Regression analysis was undertaken to explain output growth of various two-digit industries reveal a positive relationship between returns to scale and industrial growth. Also, a positive relationship between the elasticity of substitution and output growth is indicated for relatively more capital intensive industries.

There are indications from our results that the elasticity of substitution is relatively high in the labour intensive industries such as textiles, tobacco products and leather and leather products, whereas it is relatively low in machinery and equipment, including telecommunication equipment. These results along with other results mentioned above seem to have interesting implications for the Indian economy. One, the existence of increasing returns to scale in most industries imply that perhaps most industries in India are operating on the downward slope of the average cost curve and hence there is scope for rationalization of production by increasing competition and efficiency. Second, by enhancing the pace of trade liberalization, resource allocation may move in favour of the labour intensive industries which will facilitate the growth of employment as these industries provide easy substitution of labour for capital. In order to be able to achieve the full benefits of this, reforms have to be initiated in removing the outdated labour laws. Further, the country must follow a vigorous trade liberalization policy by implementing the FTA agreements since market access for our labour intensive goods in the west is still a major unsettled problem. Of course, India also has comparative advantage in machinery and engineering goods where even if the scope for employment expansion may be limited due to limited substitutability, the increasing returns might be an advantage from specialization.For such capital intensive industries, our results indicate that an increase in substitution possibilities will be growth enhancing probably because it prevents the marginal productivity of capital from falling sharply. Hence, policies that encouragecapital intensive industries to go for such technological changeswhich raise the substitution possibilities between capital and labourwill promote their growth and also possibly increase employment at the same time.

But, we must not fail to mention some of the limitations of our study. First, the estimates are sensitive to the measure of capital and hence the estimation of cost function might be of some help at least in cross checking our results. Second, the two-digit industries may involve certain heterogeneity and as Fikkert and Hassan (1998) had observed: “The use of cross-sectional data does not enable the econometricians to control for unobserved heterogeneity across observations, relegating unobserved heterogeneity to the error term where its likely correlation with the regressors could lead to inconsistent estimates”.

Thus we are indicating some future direction of research on the issues taking account of the limitations.

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Annexure 1: Estimates of SMAC Model Parameter: coefficient of ln(W/L)

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
15	Food products and beverages	1.02 (0.0259)	1.024 (0.0253)	1.086 (0.0223)	1.135 (0.0182)	1.142 (0.1906)	1.079 (0.0192)	1.083 (0.0221)	1.113 (0.0189)	1.089 (0.0194)	1.111 (0.0205)
16	Tobacco products	1.245 (0.0520)	1.321 (0.0680)	1.210 (0.0438)	1.123 (0.0686)	1.256 (0.0585)	1.196 (0.0474)	1.273 (0.0502)	1.134 (0.0557)	1.311 (0.0517)	1.302 (0.0722)
17	Textiles	0.909 (0.0153)	0.957 (0.0529)	1.035 (0.0434)	0.926 (0.0417)	0.973 (0.0412)	0.998 (0.0381)	0.909 (0.0354)	0.933 (0.0343)	0.943 (0.0337)	0.949 (0.0365)
18	Wearing apparel: Dressing & dyeing of fur	1.078 (0.0767)	1.141 (0.0668)	1.249 (0.0627)	1.155 (0.0528)	1.181 (0.0440)	1.141 (0.0455)	1.002 (0.0703)	1.056 (0.0494)	1.141 (0.0478)	1.110 (0.0419)
19	Tanning & dressing of leather manufacture of luggage, handbags, saddlery, harness and footwear	1.009 (0.0959)	1.145 (0.0819)	0.947 (0.0955)	1.091 (0.1132)	1.149 (0.0778)	0.887 (0.0808)	0.921 (0.0640)	1.058 (0.0900)	1.025 (0.0573)	1.046 (0.0751)
20	Wood and of products of wood & cork except furniture; Articles of straw and plating materials	1.015 (0.1038)	0.892 (0.0729)	0.946 (0.0602)	0.853 (0.0495)	0.966 (0.0743)	1.019 (0.0500)	1.005 (0.0599)	0.851 (0.0656)	0.964 (0.0559)	0.947 (0.0712)
21	Paper & paper products	1.040 (0.0725)	1.104 (0.0761)	1.199 (0.1261)	0.968 (0.0613)	1.060 (0.0611)	1.068 (0.0553)	1.117 (0.0494)	1.017 (0.0414)	1.071 (0.0466)	1.080 (0.0451)
22	Publishing, printing and reproduction of recorded media	1.005 (0.0647)	0.876 (0.0650)	0.907 (0.0602)	0.871 (0.0554)	0.886 (0.0558)	0.847 (0.0474)	0.933 (0.0476)	0.940 (0.0483)	0.924 (0.0478)	0.958 (0.0478)
23	Coke, refined petroleum products and nuclear fuel	1.213 (0.2019)	1.265 (0.1423)	0.925 (0.1750)	1.110 (0.0972)	1.075 (0.0934)	1.009 (0.0738)	1.086 (0.1118)	0.866 (0.1008)	0.794 (0.1021)	0.970 (0.0855)
24	Chemicals and chemical products	1.222 (0.0356)	1.224 (0.0341)	1.213 (0.0252)	1.247 (0.0229)	1.245 (0.0218)	1.242 (0.0194)	1.197 (0.0206)	1.173 (0.0214)	1.202 (0.0221)	1.251 (0.0241)
25	Rubber and plastic products	0.770 (0.1209)	0.856 (0.0671)	0.942 (0.0562)	0.797 (0.0586)	0.914 (0.0508)	0.910 (0.0459)	0.900 (0.0411)	0.908 (0.0516)	1.011 (0.0399)	1.019 (0.0470)

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
26	Other non-metallic mineral products	1.318 (0.0329)	1.261 (0.0281)	1.256 (0.0276)	1.247 (0.0252)	1.266 (0.0225)	1.276 (0.0182)	1.295 (0.0185)	1.267 (0.0204)	1.288 (0.0183)	1.310 (0.0191)
27	Basic metals	0.631 (0.0876)	0.7904 (0.0797)	0.648 (0.0609)	0.684 (0.0710)	0.779 (0.0544)	0.709 (0.0448)	0.791 (0.0508)	0.798 (0.0469)	0.733 (0.0544)	0.781 (0.0510)
28	Fabricated metal products, except machinery & equipment	0.717 (0.0696)	0.831 (0.0096)	0.906 (0.0524)	0.884 (0.0485)	0.852 (0.0416)	0.885 (0.0393)	0.890 (0.0385)	0.952 (0.0363)	0.984 (0.0325)	0.959 (0.0352)
29	Machinery & equipment	0.978 (0.0330)	0.906 (0.0428)	0.943 (0.0461)	0.940 (0.0413)	0.937 (0.0444)	0.909 (0.0367)	0.970 (0.0302)	0.939 (0.0354)	0.928 (0.0302)	0.895 (0.0331)
30	Office, accounting and computing machinery	0.687 (0.4186)	0.772 (0.2012)	0.318 (0.2916)	1.007 (0.2453)	0.851 (0.1909)	0.719 (0.2188)	0.725 (0.1983)	0.481 (0.2695)	0.233 (0.2112)	0.392 (0.2320)
31	Electrical machinery and apparatus N.E.C	0.927 (0.0733)	0.867 (0.0657)	1.058 (0.0659)	0.911 (0.0619)	0.929 (0.0540)	1.008 (0.0392)	1.000 (0.0498)	0.982 (0.0546)	0.940 (0.0498)	0.976 (0.0462)
32	Radio, television and communication equipment and apparatus	0.543 (0.2319)	0.941 (0.0878)	0.909 (0.0789)	0.981 (0.0770)	0.894 (0.1122)	0.911 (0.0745)	0.757 (0.0851)	1.077 (0.1203)	0.736 (0.1556)	0.771 (0.1070)
33	Medical, precision and optical instruments; watches and clocks	0.973 (0.1444)	0.897 (0.1489)	0.779 (0.0885)	0.711 (0.1513)	1.011 (0.0765)	1.029 (0.0589)	0.906 (0.0782)	0.869 (0.1081)	0.958 (0.0709)	1.035 (0.0841)
34	Motor vehicles, trailers and semi-trailers	0.954 (0.0962)	1.107 (0.0818)	1.028 (0.0605)	1.049 (0.0613)	1.138 (0.0666)	1.015 (0.0583)	1.084 (0.0528)	1.103 (0.0509)	1.196 (0.0555)	1.083 (0.0523)
35	Other transport equipment	0.820 (0.1374)	0.629 (0.0995)	0.923 (0.0786)	0.913 (0.0765)	0.989 (0.0631)	1.010 (0.0671)	0.898 (0.0689)	0.991 (0.0658)	0.990 (0.0635)	0.857 (0.0780)
36	Furniture; manufacturing N.E.C	0.914 (0.0929)	1.090 (0.1222)	0.995 (0.0710)	0.919 (0.0535)	1.058 (0.0598)	1.108 (0.0449)	0.967 (0.0487)	0.980 (0.0521)	1.023 (0.0558)	1.003 (0.0683)

Source: Authors' computation from unit level data of ASI.

Annexure 2: Estimates of SMAC Model Parameter, coefficient of lnL

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
15	Food products and beverages	-0.081 (0.0126)	-0.08 (0.0116)	-0.115 (0.0108)	-0.126 (0.0106)	-0.153 (0.0104)	-0.198 (0.0098)	-0.186 (0.0102)	-0.164 (0.0092)	-0.12 (0.0092)	-0.152 (0.0102)
16	Tobacco products	-0.052 (0.0131)	-0.092 (0.0169)	-0.094 (0.0152)	-0.093 (0.0180)	-0.074 (0.0155)	-0.106 (0.0122)	-0.077 (0.0118)	-0.071 (0.0155)	-0.132 (0.0161)	-0.095 (0.0173)
17	Textiles	-0.108 (0.0153)	-0.126 (0.0147)	-0.124 (0.0140)	-0.112 (0.0133)	-0.112 (0.0134)	-0.071 (0.0123)	-0.028 (0.0111)	-0.011 (0.0112)	-0.041 (0.0105)	0.06 (0.0112)
18	Wearing apparel: Dressing & dyeing of fur	-0.105 (0.0280)	-0.124 (0.0224)	-0.094 (0.0253)	-0.113 (0.0207)	-0.155 (0.0187)	-0.132 (0.0164)	-0.105 (0.0179)	-0.119 (0.0140)	-0.089 (0.911)	-0.091 (0.0151)
19	Tanning & dressing of leather manufacture of luggage, handbags, saddlery, harness and footwear	-0.002 (0.0300)	0.011 (0.0285)	-0.023 (0.0276)	0.009 (0.0277)	-0.045 (0.0245)	-0.042 (0.0229)	-0.018 (0.0225)	-0.064 (0.0226)	-0.056 (0.0166)	-0.061 (0.0197)
20	Wood and of products of wood & cork except furniture; Articles of straw and plating materials	-0.024 (0.0505)	-0.035 (0.0364)	0.012 (0.0521)	0.095 (0.0460)	0.065 (0.0443)	0.042 (0.0341)	0.044 (0.0358)	0.085 (0.0433)	0.066 (0.0385)	0.08 (0.0394)
21	Paper & paper products	-0.055 (0.0340)	-0.044 (0.0286)	-0.026 (0.0293)	-0.026 (0.0259)	-0.003 (0.0265)	0.022 (0.0212)	0.027 (0.0215)	0.059 (0.0204)	0.043 (0.0211)	0.058 (0.0191)
22	Publishing, printing and reproduction of recorded media	-0.047 (0.0422)	0.019 (0.0324)	0.04 (0.0335)	-0.001 (0.0294)	0.027 (0.0325)	0.063 (0.0266)	0.042 (0.0271)	0.03 (0.0250)	0.059 (0.0257)	0.04 (0.0293)
23	Coke, refined petroleum products and nuclear fuel	-0.081 (0.1086)	-0.108 (0.0813)	-0.055 (0.1069)	-0.152 (0.0738)	-0.108 (0.0718)	-0.034 (0.0592)	0.006 (0.0631)	0.041 (0.0573)	-0.008 (0.0534)	0.143 (0.0508)
24	Chemicals and chemical products	-0.003 (0.0186)	-0.024 (0.0167)	-0.058 (0.0159)	-0.037 (0.0148)	-0.012 (0.0147)	0.005 (0.0124)	-0.027 (0.0130)	0.005 (0.0124)	-0.008 (0.1205)	-0.015 (0.0131)

Two digit Code (NIC 98)	Industry	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
25	Rubber and plastic products	0.064 (0.0323)	0.071 (0.0278)	0.068 (0.0224)	0.095 (0.0218)	0.061 (0.0225)	0.033 (0.0185)	0.065 (0.0188)	0.043 (0.0184)	0.008 (0.0162)	-0.007 (0.0181)
26	Other non-metallic mineral products	-0.054 (0.0196)	-0.064 (0.0167)	-0.085 (0.0174)	-0.063 (0.0143)	-0.081 (0.0140)	-0.061 (0.0120)	-0.054 (0.0118)	-0.059 (0.0113)	-0.046 (0.0112)	-0.037 (0.0117)
27	Basic metals	0.027 (0.0462)	0.04 (0.0263)	0.077 (0.0235)	0.056 (0.0264)	0.065 (0.0222)	0.111 (0.0194)	0.145 (0.0198)	0.098 (0.0189)	0.103 (0.0183)	0.078 (0.0196)
28	Fabricated metal products, except machinery & equipment	0.058 (0.0221)	0.01 (0.0213)	-0.014 (0.0195)	-0.049 (0.0193)	0.02 (0.0179)	-0.008 (0.0161)	-0.011 (0.0149)	0.001 (0.0140)	0.013 (0.0133)	0.006 (0.0145)
29	Machinery & equipment	0.033 (0.0191)	0.013 (0.0176)	0.001 (0.0196)	0.006 (0.0184)	0.003 (0.0196)	0.027 (0.0150)	0.034 (0.0140)	0.062 (0.0145)	0.063 (0.0132)	0.067 (0.0141)
30	Office, accounting and computing machinery	0.259 0.1441)	-0.053 (0.0667)	0.197 (0.1183)	0.054 (0.0945)	0.177 (0.0748)	0.198 (0.0630)	0.07 (0.0690)	0.137 (0.0868)	0.087 (0.1107)	0.064 (0.0697)
31	Electrical machinery and apparatus N.E.C	0.045 (0.0277)	0.042 (0.0272)	0.028 (0.0278)	0.066 (0.0245)	0.055 (0.0253)	0.025 (0.0195)	0.082 (0.0212)	0.059 (0.0232)	0.073 (0.0205)	0.047 (0.0205)
32	Radio, television and communication equipment and apparatus	0.169 (0.0647)	0.077 (0.0463)	0.141 (0.0375)	0.056 (0.0382)	0.135 (0.0424)	0.187 (0.0343)	0.065 (0.0381)	-0.049 (0.0564)	0.063 (0.0362)	0.047 (0.0381)
33	Medical, precision and optical instruments; watches and clocks	-0.042 (0.0539)	-0.007 (0.0459)	-0.039 (0.0412)	0.06 (0.0428)	0.025 (0.0452)	0.035 (0.0351)	0.031 (0.0395)	0.007 (0.0435)	0.076 (0.0323)	0.029 (0.0355)
34	Motor vehicles, trailers and semi-trailers	0.036 (0.0235)	0.005 (0.02690	0.039 (0.0243)	0.025 (0.0232)	0.025 (0.0239)	0.068 (0.0231)	0.065 (0.0183)	0.068 (0.0163)	0.005 (0.0168)	0.032 (0.0178)
35	Other transport equipment	0.014 (0.0335)	0.045 (0.0310)	-0.042 (0.0265)	-0.028 (0.0259)	-0.009 (0.0230)	-0.031 (0.0286)	0.041 (0.0228)	0 (0.0239)	-0.033 (0.0233)	-0.015 (0.0249)
36	Furniture; manufacturing N.E.C	0.026 (0.0409)	-0.02 (0.0375)	0.02 (0.0289)	0.022 (0.0284)	-0.015 (0.0268)	0.032 (0.0232)	0.046 (0.0212)	0.032 (0.0230)	0.005 (0.0227)	-0.04 (0.0243)

Source: Authors' computation from unit level data of ASI.

Annexure 3: Estimates of the Translog Production Function Parameters (coefficient and standard errors)

Two digit code	Industry	Coefficient & Robust Std. Error	1998-99	1999-00	2000-01	2001-02	2002-03	2003-04	2004-05	2005-06	2006-07	2007-08
15	Food products and beverages	lncapital	0.1801	0.1843	0.1779	0.145	0.1756	0.2282	0.1782	0.138	0.0747	0.2104
			0.0316	0.0295	0.03	0.0286	0.0304	0.0249	0.0259	0.0229	0.0238	0.027
		lnlabour	0.9662	0.9154	0.9287	0.8737	0.853	0.8375	0.8185	0.8351	0.9014	0.8465
			0.0648	0.0578	0.0639	0.0638	0.0613	0.0521	0.0547	0.0494	0.0527	0.0584
		sqr_lncapital	0.0061	0.0086	0.0135	0.019	0.013	0.0146	0.0156	0.018	0.0186	0.0103
			0.0044	0.0041	0.0034	0.0028	0.0032	0.0029	0.003	0.0027	0.0027	0.0028
		sqr_lnlabour	-0.0627	-0.0505	-0.0493	-0.0336	-0.0387	-0.0367	-0.0327	-0.0424	-0.0567	-0.0387
			0.0103	0.0112	0.0108	0.0101	0.0101	0.0083	0.0085	0.0081	0.0088	0.0092
		lncapital_lnlabour	0.034	0.0273	0.0195	0.0086	0.015	0.0029	0.0082	0.0152	0.028	0.0133
			0.0101	0.0114	0.0098	0.0082	0.009	0.0076	0.0081	0.0076	0.0078	0.008
16	Tobacco products	lncapital	0.4073	0.3574	0.3669	0.3139	0.3208	0.2866	0.3192	0.3225	0.3832	0.3565
			0.0448	0.0658	0.0539	0.0579	0.0596	0.0452	0.04	0.0511	0.0477	0.056
		lnlabour	1.269	1.1744	1.1018	1.1965	1.3643	1.2819	1.2667	1.2038	1.1967	1.2164
			0.0763	0.128	0.1019	0.1177	0.0904	0.0697	0.0753	0.0915	0.0977	0.1122
		sqr_lncapital	0.0423	0.045	0.0403	0.0346	0.0233	0.0294	0.0388	0.0295	0.0411	0.0321
			0.0084	0.0087	0.0085	0.0077	0.0087	0.0071	0.0069	0.007	0.0067	0.0086
		sqr_lnlabour	-0.0272	-0.0183	-0.0048	-0.0271	-0.0446	-0.0342	-0.0247	-0.027	-0.0093	-0.0216
			0.0128	0.0182	0.0138	0.016	0.0124	0.0105	0.0116	0.0138	0.0131	0.0173
		lncapital_lnlabour	-0.0674	-0.0635	-0.0691	-0.0452	-0.0313	-0.036	-0.0582	-0.0401	-0.0785	-0.055
			0.0186	0.0234	0.0203	0.021	0.0168	0.015	0.0164	0.0184	0.0171	0.0231
		lncapital	0.2373	0.2129	0.2168	0.2497	0.2234	0.2502	0.2223	0.2565	0.2214	0.2507
			0.0375	0.031	0.0316	0.0328	0.0339	0.0344	0.028	0.0316	0.0271	0.0331
		lnlabour	0.6919	0.7648	0.7212	0.7554	0.7355	0.7611	0.8	0.8235	0.747	0.7102
			0.0793	0.0728	0.0724	0.0633	0.0736	0.0631	0.0592	0.0698	0.0655	0.0852

17	Textiles	sqr_lncapital	0.022	0.0166	0.0285	0.0294	0.0278	0.0206	0.039	0.0285	0.0358	0.0227
			0.0063	0.0058	0.0047	0.005	0.0049	0.005	0.0047	0.0046	0.0041	0.0049
		sqr_lnlabour	0.0108	-0.0173	0.0103	0.0158	0.0106	0.0038	0.0374	0.0208	0.0381	0.0245
			0.0139	0.0145	0.0136	0.0128	0.0132	0.013	0.0119	0.0123	0.0104	0.0139
		lncapital_lnlabour	-0.0325	-0.0077	-0.04	-0.0524	-0.0411	-0.0296	-0.078	-0.0556	-0.0723	-0.0456
			0.0168	0.0168	0.0147	0.0148	0.0146	0.0147	0.014	0.0134	0.0119	0.0151
18	Wearing apparel: Dressing & dyeing of fur	lncapital	0.2994	0.23	0.3528	0.3605	0.2181	0.2636	0.1856	0.1603	0.0579	0.1396
			0.1298	0.0746	0.067	0.1092	0.0679	0.0661	0.0536	0.0575	0.0572	0.0633
		lnlabour	1.1388	0.619	0.6608	0.6067	0.6481	0.7442	0.7283	0.9067	0.8136	0.838
			0.184	0.1487	0.1619	0.1316	0.1492	0.1318	0.1091	0.0932	0.1107	0.0984
		sqr_lncapital	0.0128	0.0328	0.0314	-0.001	0.0304	0.0244	0.0247	0.0188	0.0391	0.0148
			0.0136	0.0091	0.0081	0.0094	0.0074	0.0083	0.0062	0.0084	0.0061	0.0075
		sqr_lnlabour	-0.0653	0.03	0.0515	0.0089	0.0322	0.028	0.0236	-0.0099	0.0219	-0.0075
			0.0324	0.0208	0.0231	0.019	0.0198	0.022	0.015	0.0152	0.0154	0.018
		lncapital_lnlabour	-0.0115	-0.053	-0.081	-0.0073	-0.0544	-0.059	-0.0431	-0.0243	-0.0545	-0.0116
			2.2069	0.0218	0.022	0.0203	0.0175	0.0228	0.0141	0.0196	0.0152	0.019
19	Tanning &dessing of leather manufacture of luggage, handbags, saddlery, harness and	lncapital	0.4214	0.3368	0.4176	0.117	0.4513	0.2128	0.096	0.2655	0.0493	0.2255
			0.1045	0.0938	0.09	0.1004	0.0962	0.0608	0.0788	0.1317	0.071	0.0774
		lnlabour	0.8155	1.0822	0.6955	1.0146	0.638	0.8267	1.3	0.8968	1.1497	1.1389
			0.1627	0.1919	0.1421	0.1596	0.1348	0.11	0.1399	0.183	0.1049	0.1252
		sqr_lncapital	0.0051	0.0262	0.0166	0.0015	0.0307	0.0322	0.0337	0.0325	0.0362	0.022
			0.0167	0.0144	0.0174	0.0129	0.0124	0.01	0.011	0.014	0.0095	0.0099

	footwear											
		sqr_lnlabour	0.0197	0.0163	0.067	-0.046	0.0843	0.0278	-0.0388	0.0252	-0.0295	-0.0213
			0.0315	0.0341	0.0372	0.036	0.0285	0.0198	0.0242	0.0315	0.0173	0.023
		lncapital_lnlabour	-0.0351	-0.0746	-0.0766	0.0302	-0.1094	-0.0588	-0.0385	-0.0674	-0.0316	-0.0395
			0.0371	0.0357	0.0467	0.0386	0.0317	0.0231	0.0267	0.0304	0.0209	0.0256
20	Wood and of products of wood & cork except furniture; Articles of straw and plating materials	lncapital	0.3702	0.1435	-0.1191	0.0347	0.247	0.2384	0.2049	0.0574	0.1305	0.0543
			0.1062	0.0696	0.0831	0.0853	0.0672	0.057	0.0574	0.0688	0.0734	0.0727
		lnlabour	0.5125	0.8341	1.541	1.187	0.7684	0.7842	0.9496	1.0817	1.1464	1.1172
			0.1992	0.1205	0.2008	0.2066	0.1864	0.1397	0.125	0.1565	0.135	0.1443
		sqr_lncapital	0.0156	0.0274	0.0163	0.001	0.0275	0.0258	0.051	0.0253	0.0333	0.0251
			0.0159	0.01	0.0113	0.0119	0.01	0.0098	0.0104	0.0091	0.0095	0.0104
		sqr_lnlabour	0.0745	-0.0061	-0.1946	-0.085	0.0592	0.0414	0.0648	-0.0311	-0.026	-0.0368
			0.0651	0.0395	0.0663	0.056	0.0471	0.0379	0.0346	0.0456	0.043	0.0379
		lncapital_lnlabour	-0.0601	-0.0192	0.1025	0.0709	-0.0564	-0.0444	-0.1068	0.0003	-0.0354	-0.0001
			0.0553	0.0344	0.0525	0.0416	0.0356	0.0347	0.0321	0.0375	0.0367	0.0336
21	Paper & paper products	lncapital	0.2551	0.2795	0.0988	0.1238	0.162	0.1146	0.1097	0.0885	0.1663	0.1012
			0.0807	0.0963	0.0826	0.0771	0.0789	0.0635	0.057	0.0553	0.0633	0.0542
		lnlabour	1.0207	0.6669	1.1811	0.9196	0.8052	0.9267	1.0321	1.0367	0.9242	1.302
			0.1397	0.1862	0.1492	0.1445	0.1524	0.1205	0.1346	0.1052	0.1104	0.1162
		sqr_lncapital	0.0125	0.0052	0.0149	0.0092	0.0212	0.0086	0.0302	0.0241	0.0184	0.0068
			0.0107	0.0128	0.01	0.0118	0.0095	0.0083	0.0081	0.008	0.008	0.0086
		sqr_lnlabour	-0.0436	-0.0189	-0.073	-0.0786	-0.0016	-0.0725	-0.049	-0.0501	-0.0367	-0.1321
			0.0339	0.041	0.0309	0.0406	0.0402	0.0273	0.0349	0.0301	0.0298	0.0313

		lncapital_lnlabour	-0.006	0.012	0.0186	0.0442	-0.0162	0.0445	-0.011	0.0017	0.0018	0.0595
			0.0331	0.0375	0.0297	0.0384	0.0337	0.0247	0.03	0.0278	0.028	0.0299
22	Publishing, printing and reproduction of recorded media	lncapital	0.1321	0.2556	0.2639	0.2218	0.2292	0.218	0.2996	0.2153	0.1251	0.1567
			0.0676	0.048	0.0473	0.0594	0.0549	0.0461	0.0435	0.0521	0.0486	0.055
		lnlabour	1.0996	0.797	1.0349	0.9734	1.1138	1.2481	0.9454	0.8343	1.0812	1.0951
			0.1252	0.108	0.134	0.1342	0.1524	0.1239	0.1135	0.1306	0.1157	0.1591
		sqr_lncapital	0.0404	0.0229	0.0392	0.0162	0.0221	0.0233	0.0323	0.0352	0.0362	0.0377
			0.0117	0.0083	0.0067	0.0102	0.0083	0.0095	0.0067	0.0079	0.0073	0.0079
		sqr_lnlabour	-0.0288	0.0252	0.0428	-0.0132	-0.0106	-0.0269	0.0554	0.0581	0.0024	0.0099
			0.0408	0.0256	0.0252	0.0319	0.0386	0.0321	0.0262	0.034	0.0304	0.0371
		lncapital_lnlabour	-0.0354	-0.0357	-0.0903	-0.0111	-0.0334	-0.0341	-0.0865	-0.0754	-0.048	-0.0621
			0.0401	0.027	0.0199	0.0304	0.0324	0.0322	0.0224	0.0286	0.0253	0.0294
23	Coke, refined petroleum products and nuclear fuel	lncapital	0.1914	0.1721	0.0834	0.2515	0.3604	0.3341	0.2338	0.7387	0.6122	0.2762
			0.2107	0.1543	0.1104	0.1149	0.1149	0.104	0.2048	0.1578	0.1468	0.1006
		lnlabour	0.8994	1.507	1.2719	1.1321	0.6793	0.9187	0.7048	0.2711	0.6187	1.2089
			0.4143	0.32	0.3763	0.2712	0.2836	0.2194	0.3454	0.2342	0.2552	0.2424
		sqr_lncapital	-0.0132	0.0281	0.0348	0.0317	0.0053	-0.0055	0.0081	-0.0221	-0.0041	0.0185
			0.0319	0.0216	0.0164	0.0146	0.0185	0.0135	0.0364	0.021	0.018	0.0145
		sqr_lnlabour	-0.1219	-0.0723	-0.0419	0.0059	-0.014	-0.0496	-0.0233	0.063	0.087	-0.004
			0.0959	0.0763	0.0701	0.0555	0.0671	0.045	0.0724	0.0463	0.0484	0.0538
		lncapital_lnlabour	0.1113	-0.0213	-0.0295	-0.0624	0.0191	0.0435	0.0374	0.0115	-0.06	-0.0356
			0.0904	0.07	0.0574	0.049	0.0637	0.0433	0.0956	0.0561	0.0501	0.0512
		lncapital	0.2732	0.2623	0.2994	0.2805	0.2898	0.2355	0.2143	0.2333	0.2022	0.3303
			0.051	0.0431	0.0434	0.0417	0.0453	0.0339	0.0318	0.0324	0.0336	0.0378
		lnlabour	0.9434	0.9688	0.7304	0.8903	0.9033	0.7716	0.9525	0.9404	0.9556	0.7995

24	Chemicals and chemical products		0.1097	0.0884	0.0998	0.0931	0.0892	0.0747	0.0743	0.0741	0.0786	0.0795
		sqr_lncapital	0.0034	-0.0036	-0.0006	0.0034	0.0032	0.0054	0.0123	0.0068	0.0108	0.0053
			0.0055	0.0055	0.0051	0.0044	0.0041	0.0038	0.0036	0.0037	0.0039	0.0041
		sqr_lnlabour	-0.0552	-0.0841	-0.0404	-0.0564	-0.0568	-0.0461	-0.0612	-0.0654	-0.071	-0.0364
			0.0192	0.0153	0.0163	0.0166	0.0157	0.0137	0.0136	0.014	0.0155	0.0159
		lncapital_lnlabour	0.033	0.0607	0.0402	0.0364	0.0358	0.0442	0.025	0.0364	0.0363	0.019
			0.0155	0.0145	0.0136	0.0135	0.0127	0.0112	0.0111	0.0115	0.0128	0.0136
25	Rubber and plastic products	lncapital	0.2167	0.1886	0.1779	0.1734	0.1828	0.1865	0.1123	0.0758	0.1241	0.2568
			0.0689	0.0764	0.0646	0.0579	0.0505	0.0653	0.0431	0.0525	0.04	0.066
		lnlabour	0.7027	1.1355	1.1402	1.005	0.9942	0.9314	1.2261	1.3282	1.1919	1.1391
			0.1362	0.1115	0.1229	0.1106	0.0898	0.1075	0.0964	0.0899	0.0851	0.123
		sqr_lncapital	-0.0012	0.0153	0.0371	0.0206	0.0376	0.0221	0.0353	0.0366	0.0362	0.0174
			0.0173	0.0138	0.0101	0.0084	0.0074	0.0127	0.0073	0.0102	0.0056	0.0135
		sqr_lnlabour	-0.0288	-0.0486	0.0116	-0.0076	0.0232	-0.008	-0.0229	-0.0351	-0.0149	-0.0339
			0.0476	0.0277	0.0333	0.027	0.0233	0.0254	0.022	0.0237	0.0195	0.0278
		lncapital_lnlabour	0.0432	0.0003	-0.0698	-0.02	-0.068	-0.0203	-0.0456	-0.0447	-0.0508	-0.0219
			0.0558	0.037	0.0349	0.0264	0.0245	0.033	0.0231	0.0293	0.01845	0.0378
26	Other non-metallic mineral products	lncapital	0.2717	0.2489	0.1689	0.2656	0.3614	0.2641	0.2397	0.1608	0.1067	0.0937
			0.0433	0.0366	0.039	0.0346	0.033	0.0296	0.032	0.0297	0.0276	0.0286
		lnlabour	1.0476	0.793	1.0466	0.787	0.7283	1.0226	1.0419	1.0099	0.9847	1.025
			0.121	0.0858	0.1136	0.0888	0.0903	0.0817	0.0888	0.0803	0.0719	0.0742
		sqr_lncapital	0.0158	0.0223	0.0233	0.0218	0.0189	0.0284	0.0321	0.0335	0.043	0.0367
			0.005	0.0046	0.004	0.0039	0.0036	0.0031	0.0034	0.0035	0.0028	0.003
		sqr_lnlabour	-0.0414	-0.0057	-0.0555	-0.0012	0.0135	-0.028	-0.0313	-0.0383	-0.0284	-0.0454

			0.023	0.0172	0.0214	0.0161	0.0151	0.0143	0.0174	0.0154	0.0135	0.0141
		lncapital_lnlabour	-0.0037	-0.0161	0.0051	-0.0179	-0.03	-0.0283	-0.0304	-0.0181	-0.0279	-0.0104
			0.0154	0.013	0.0141	0.0118	0.0115	0.0096	0.0119	0.0112	0.0093	0.0098
27	Basic metals	lncapital	0.1683	0.2559	0.2383	0.2744	0.2793	0.1585	0.1294	0.2022	0.299	0.3302
			0.0612	0.0518	0.0478	0.073	0.0473	0.0363	0.0519	0.0398	0.0431	0.057
		lnlabour	0.9657	0.77	0.9	0.9487	1.0117	1.1078	1.1265	0.9518	0.7161	0.7268
			0.1067	0.1023	0.1003	0.1193	0.0877	0.0724	0.1119	0.0792	0.0873	0.1007
		sqr_lncapital	-0.024	0.0152	0.0198	-0.0005	0.021	0.0165	0.0202	0.0094	0.0142	0.0014
			0.0073	0.0098	0.0105	0.0118	0.008	0.0064	0.0107	0.0074	0.0077	0.0095
		sqr_lnlabour	-0.1127	0.0075	0.0028	-0.0412	0.0072	-0.041	-0.0385	-0.0252	0.02	-0.0286
			0.0151	0.0244	0.0265	0.0284	0.0223	0.0191	0.0331	0.0221	0.0253	0.0295
		lncapital_lnlabour	0.1112	-0.0211	-0.0321	0.0207	-0.047	-0.0016	-0.0042	0.0047	-0.0254	0.0206
			0.0137	0.0277	0.031	0.032	0.0246	0.0206	0.0355	0.0241	0.0262	0.0322
28	Fabricated metal products, except machinery & equipments	lncapital	0.1245	0.2126	0.175	0.1639	0.061	0.0881	0.0935	0.1331	0.0952	0.1762
			0.0412	0.045	0.0537	0.0546	0.046	0.0449	0.0373	0.0362	0.0373	0.0389
		lnlabour	0.983	0.9095	1.0018	0.9317	1.0836	1.0106	0.9819	0.8882	1.0112	0.8673
			0.0934	0.0904	0.127	0.1121	0.1105	0.1062	0.1063	0.0836	0.0897	0.0923
		sqr_lncapital	0.0286	0.0287	0.0258	0.0273	0.031	0.0224	0.0206	0.0323	0.0269	0.0259
			0.0091	0.0081	0.0084	0.0095	0.0077	0.0076	0.0068	0.0069	0.0065	0.0064
		sqr_lnlabour	-0.0056	0.0148	-0.0088	-0.0037	-0.0232	-0.0395	-0.0452	0.001	-0.0313	-0.0018
			0.0253	0.0234	0.0289	0.0265	0.025	0.0267	0.0191	0.0204	0.0195	0.0201
		lncapital_lnlabour	-0.0272	-0.0482	-0.0299	-0.0309	-0.0185	0.0047	0.0127	-0.032	-0.0084	-0.0263
			0.0287	0.0256	0.0278	0.0285	0.0251	0.0245	0.0191	0.0216	0.0198	0.0199
		lncapital	0.2143	0.195	0.1763	0.1868	0.1396	0.0707	0.2005	0.1582	0.1055	0.2327
			0.0533	0.0458	0.0447	0.0409	0.0513	0.0329	0.0401	0.0378	0.0391	0.0427
		lnlabour	0.8894	0.8023	0.9393	1.1442	1.1651	0.9912	1.1384	1.1475	1.2116	0.9617

			0.1087	0.0835	0.0881	0.0855	0.0994	0.0715	0.0765	0.0694	0.0749	0.0771
29	Machinery &equipments	sqr_lncapital	0.0026	0.0071	0.0174	0.0146	0.0137	0.0166	0.0227	0.029	0.024	0.0083
			0.0093	0.0117	0.0086	0.007	0.0071	0.0057	0.0063	0.0062	0.0068	0.0075
		sqr_lnlabour	-0.036	-0.0241	-0.0028	-0.0227	-0.0497	-0.0385	-0.0169	-0.0053	-0.0401	-0.0244
			0.0362	0.0351	0.0229	0.0197	0.0324	0.0183	0.0192	0.0179	0.0204	0.0186
		lncapital_lnlabour	0.0284	0.0226	-0.0135	-0.0129	0.0108	0.0254	-0.0282	-0.0406	-0.0087	0.0083
			0.0351	0.0401	0.0258	0.0206	0.0284	0.0178	0.0191	0.019	0.0213	0.0215
		lncapital	0.3177	0.2462	-0.4837	-0.1391	-0.4669	0.1029	-0.52	-0.5058	0.2697	0.1689
			0.3713	0.3396	0.2806	0.2972	0.2869	0.1703	0.2912	0.3011	0.5987	0.1504
		lnlabour	1.9657	1.7333	2.0178	1.8297	2.3859	1.1812	1.9618	2.3013	1.1583	0.9034
			1.0045	0.4396	0.718	0.7378	0.523	0.3873	0.6671	0.609	0.65	0.4805
30	Office, accounting and computing machinery	sqr_lncapital	0.3657	0.0232	0.0049	-0.0624	-0.0517	-0.0534	0.0609	0.0596	-0.0526	0.0164
			0.184	0.0805	0.0427	0.0528	0.0619	0.0246	0.0547	0.0687	0.0556	0.0288
		sqr_lnlabour	0.7301	0.0246	-0.3125	-0.3358	-0.4364	-0.215	-0.0777	-0.1464	-0.2203	0.0343
			0.2852	0.1669	0.1446	0.0813	0.141	0.0959	0.0725	0.1462	0.123	0.0756
		lncapital_lnlabour	-1.1166	-0.1353	0.2065	0.2872	0.3314	0.2199	-0.0363	-0.0168	0.1927	-0.0447
			0.4846	0.2383	0.1656	0.1401	0.1802	0.0874	0.1316	0.1928	0.1392	0.0834
		lncapital	0.3008	0.1836	0.3295	0.2714	0.3398	0.238	0.2628	0.3194	0.2123	0.3127
			0.0769	0.0676	0.055	0.0589	0.0621	0.0542	0.0657	0.0626	0.0608	0.0609
		lnlabour	0.7487	0.854	0.8497	0.9681	0.7207	1.0091	1.1011	1.0006	1.1594	1.2339
			0.1456	0.1319	0.1002	0.1131	0.1222	0.1024	0.1316	0.1216	0.121	0.1162
31	Electrical machinery and appartus N.E.C	sqr_lncapital	-0.0272	0.0003	0.0185	0.0019	-0.0002	0.0033	-0.0033	0.0063	0.0084	0.0201
			0.0184	0.0166	0.0091	0.0111	0.0099	0.0083	0.0089	0.0106	0.0087	0.0081
		sqr_lnlabour	-0.737	-0.042	0.0331	-0.0178	0.024	-0.0296	-0.0443	-0.0168	-0.0435	0.0014
			0.0432	0.0486	0.0257	0.0268	0.03	0.025	0.0275	0.0308	0.0293	0.0298

		lncapital_lnlabour	0.0999	0.0426	-0.0476	0.0066	-0.0042	0.0157	0.0261	-0.0075	0.0082	-0.0563
			0.0539	0.0551	0.0291	0.0319	0.0319	0.0262	0.0259	0.03291	0.0278	0.0278
32	Radio, television and communication equipment and appartus	lncapital	0.2232	0.1152	0.1247	0.2725	0.1437	0.2558	0.077	-0.112	-0.084	0.0451
			0.0939	0.1223	0.0942	0.0966	0.107	0.1162	0.1529	0.1463	0.1474	0.1737
		lnlabour	0.8462	1.1703	1.1207	0.7353	1.1171	1.6062	1.0842	1.5194	0.9849	1.1708
			0.1446	0.2455	0.1844	0.1543	0.2684	0.2366	0.2084	0.2793	0.2431	0.2749
		sqr_lncapital	-0.0099	0.0066	0.021	0.0001	0.0089	-0.0119	0.026	0.0029	0.0205	-0.0089
			0.0179	0.0164	0.0117	0.0144	0.0187	0.0164	0.0251	0.017	0.0228	0.0251
		sqr_lnlabour	-0.0612	-0.08	-0.0359	-0.0009	-0.0556	-0.1015	-0.0057	-0.1677	-0.0177	-0.097
			0.0403	0.044	0.0414	0.0389	0.0529	0.053	0.0512	0.08	0.0483	0.0581
		lncapital_lnlabour	0.0654	0.0407	-0.0026	0.0157	0.0254	0.0392	-0.0309	0.0935	0.0107	0.0789
			0.0572	0.0466	0.0421	0.0462	0.0609	0.0522	0.066	0.0683	0.0597	0.0669
33	Medical, precision and optical instruments; watches and clocks	lncapital	0.2246	0.3534	0.2344	0.2882	-0.0274	0.1747	0.2147	0.1375	0.1511	0.0195
			0.1297	0.1226	0.1144	0.1129	0.1335	0.0961	0.1439	0.119	0.1329	0.1192
		lnlabour	1.0581	0.807	1.3676	0.9216	1.7596	1.222	1.2244	0.8986	1.0542	1.5014
			0.2734	0.2297	0.2483	0.2404	0.3078	0.2788	0.2282	0.2111	0.2763	0.2306
		sqr_lncapital	-0.0108	-0.0016	0.0127	0.0108	-0.0202	0.0091	-0.0187	-0.0079	0.0075	0.0353
			0.0258	0.0234	0.0262	0.0197	0.0209	0.0138	0.0233	0.019	0.0254	0.0188
		sqr_lnlabour	-0.1062	-0.018	-0.0596	0.0015	-0.2373	-0.0658	-0.1181	-0.0968	-0.0667	-0.0695
			0.0698	0.0641	0.0449	0.0626	0.0908	0.0498	0.0641	0.0514	0.0676	0.0642
		lncapital_lnlabour	0.0728	0.0071	-0.0196	-0.0187	0.1562	0.0178	0.0848	0.0873	0.0345	-0.0256
			0.0835	0.0736	0.0646	0.0639	0.084	0.0458	0.0644	0.0593	0.0752	0.0648
		lncapital	0.1462	0.1279	0.2055	0.2334	0.1762	0.0457	0.089	0.1545	0.1061	-0.0079
			0.0964	0.0727	0.0729	0.0625	0.0708	0.0587	0.0493	0.0567	0.0612	0.052

34	Motor vehicles, trailers and semi-trailers	lnlabour	0.8938	0.9627	0.9764	1.1148	0.8815	1.1257	1.074	0.9358	0.8785	1.1191
			0.1649	0.1193	0.1558	0.1169	0.1198	0.1329	0.1029	0.1155	0.123	0.1106
		sqr_lncapital	0.009	0.0283	0.0232	0.027	0.0287	0.0371	0.024	0.0167	0.038	0.0271
			0.0195	0.013	0.0101	0.0105	0.0105	0.0094	0.007	0.0074	0.0095	0.0076
		sqr_lnlabour	-0.0092	0.0002	0.0198	0.0086	0.0176	-0.0238	-0.0393	-0.0118	0.0159	-0.0432
			0.039	0.0343	0.0378	0.0312	0.0291	0.0358	0.0227	0.0214	0.0289	0.025
		lncapital_lnlabour	0.0055	-0.0315	-0.0445	-0.0567	-0.0405	-0.0279	-0.0001	-0.0045	-0.0478	0.0003
			0.0498	0.0394	0.0357	0.0343	0.0326	0.0343	0.0227	0.0202	0.0291	0.0247
35	Other transport equipment	lncapital	0.1984	0.13	0.2058	0.2131	-0.0144	-0.0516	0.0184	-0.0707	0.0742	0.2342
			0.1098	0.0803	0.0663	0.0683	0.0696	0.0589	0.0589	0.0658	0.0733	0.0693
		lnlabour	1.0053	1.1149	0.9907	0.9717	1.3066	1.3235	1.2475	1.2736	1.0463	0.884
			0.1728	0.1354	0.1285	0.1398	0.125	0.0948	0.1185	0.1214	0.1378	0.1325
		sqr_lncapital	0.0482	0.0231	0.0373	0.0512	0.0491	0.0504	0.0276	0.0554	0.0198	0.0111
			0.0209	0.0163	0.012	0.0122	0.012	0.0102	0.0096	0.0147	0.0143	0.0129
		sqr_lnlabour	0.0448	-0.0157	0.0315	0.0592	-0.0202	-0.0582	-0.0562	-0.0098	-0.0449	-0.0138
			0.0446	0.0428	0.0334	0.04	0.0381	0.0291	0.0292	0.0388	0.0378	0.0366
		lncapital_lnlabour	-0.1055	-0.0279	-0.0809	-0.1187	-0.0599	-0.0352	-0.0026	-0.0707	0.0056	-0.009
			0.0567	0.0516	0.0389	0.0435	0.0424	0.034	0.0316	0.046	0.0436	0.0417
36	Furniture; manufacturing N.E.C	lncapital	0.1981	0.1259	0.1543	0.0639	0.1522	0.1632	0.1105	0.1285	0.1029	0.2421
			0.0696	0.0666	0.0697	0.0482	0.0603	0.0462	0.0483	0.0489	0.0465	0.0541
		lnlabour	0.9244	1.0225	1.1681	1.3743	1.025	0.8376	1.0818	1.0954	1.228	1.0207
			0.157	0.1134	0.1818	0.1169	0.1192	0.1203	0.101	0.1265	0.112	0.1051
		sqr_lncapital	0.0235	0.0305	0.0017	0.0313	0.0227	0.0203	0.0181	0.0117	0.0205	0.0082
			0.0112	0.0103	0.014	0.0066	0.0075	0.0065	0.0077	0.008	0.0065	0.0076
		sqr_lnlabour	-0.0177	-0.0155	-0.0587	-0.0519	-0.0223	-0.0055	-0.0261	-0.041	-0.0494	-0.0275

			0.0276	0.0231	0.033	0.0196	0.0199	0.0188	0.0171	0.0254	0.018	0.0185
		lncapital_lnlabour	-0.0094	-0.0261	0.0327	-0.0188	-0.0098	0.0022	-0.0007	0.0153	0.0017	-0.0002
			0.0271	0.0245	0.0323	0.0185	0.0203	0.0174	0.0183	0.0247	0.0167	0.019

Source: Authors' computation from unit level data of ASI.