Transport Equipment Industry of India in the Era of Globalization

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This paper concentrates on testing returns to scale, elasticity of substitution and efficiency wage hypothesis (according to which the co-efficient of wage rate is more than of capital intensity) in transport equipment industry. Augmented Dickey Fuller Test, Cobb-Douglas Production Function, Constant Elasticity of Substitution (CES) and Variable Elasticity of Substitution (VES) were applied for the period 1991/92 – 2008/09. The increasing returns to scale of the industry was proved with the significant co-efficient of labor input. There was neutral technical progress. Co-efficient of wage rate was statistically significant. Its numerical value was close to unity indicating unitary elasticity of substitution. The results of VES production function supported the hypothesis of efficiency-wage.

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Role of Transport

The role of transport in economic development is usually discussed in relation to its contribution to the development of domestic trade. Globalization has changed this perception. The ability of a country, and particularly the more isolated communities within a country, to participate in trade depends on the quality of the transport and communication infrastructure that allows them access to the world trading system. If liberalization of trade can open new markets, appropriate transport infrastructure, timely delivery and the quality of services provided are essential elements in determining the competitiveness of products for global markets.

Like many economic activities that are intensive in infrastructure, the transport sector is an important component of the economy impacting on development and the welfare of population. When transport systems are efficient, they provide economic and social opportunities and benefits that result in positive multiplier effects such as better accessibility to markets, employment and additional investments. When transport systems are deficient in terms of capacity or reliability, they can have an economic cost such as reduced or missed opportunities. Transport also carries an important social and environmental load, which cannot be neglected. Thus, from a general standpoint the economic impacts of transportation can be direct and indirect:

- Direct impacts related to accessibility change where transport enables larger markets and savings in time and costs.
- Indirect impacts related to the economic multiplier effects where the price of commodities, goods or services drop and/or their variety increases.

Mobility is one of the most fundamental and important characteristics of economic activity as it satisfies the basic need of moving from one location to the other, a need shared by passengers, freight and information. All economies and regions do not share the same level of mobility as most are in different stages in their mobility transition. Economies that possess greater mobility are often those with better opportunities to develop than those suffering from scarce mobility.

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Providing this mobility is an industry that offers services to its customers, employs people and pays wages, invests capital and generates income. The economic importance of the transportation industry can thus be assessed from macroeconomic and microeconomic perspectives:

- At the macroeconomic level (the importance of transportation for a whole economy), transportation and the mobility it confers are linked to a level of output, employment and income within a national economy. In many developed countries, transportation accounts for between 6% and 12% of the GDP.
- At the microeconomic level (the importance of transportation for specific parts of the economy) transportation is linked to producer, consumer and production costs. The importance of specific transport activities and infrastructure can thus be assessed for each sector of the economy. Transportation accounts on average between 10% and 15% of household expenditures while it accounts for around 4% of the costs of each unit of output in manufacturing, but this figure varies greatly according to sub sectors.

Transportation links together the factors of production in a complex web of relationships between producers and consumers. The outcome is commonly a more efficient division of production by an exploitation of geographical comparative advantages, as well as the means to develop economies of scale and scope. The productivity of space, capital and labor is thus enhanced with the efficiency of distribution and personal mobility. It is acknowledged that economic growth is increasingly linked with transport developments, namely infrastructures but also managerial expertise is crucial for logistics. The following impacts can be assessed:

- *Networks*. Setting of routes enabling new or existing interactions between economic entities.
- *Performance*. Improvements in cost and time attributes for existing passenger and freight movements.
- *Reliability*. Improvement in the time performance, notably in terms of punctuality, as well as reduced loss or damage.
- *Market size*. Access to a wider market base where economies of scale in production, distribution and consumption can be improved.
- *Productivity*. Increases in productivity from the access to a larger and more diverse base of inputs (raw materials, parts, energy or labor) and broader markets for diverse outputs (intermediate and finished goods).

Production Function

Production function shows the technological relationship between the maximum output obtainable from a given set of inputs and the relationship between the inputs themselves in the existing state of technological change. In this approach to productivity measurement, the various components of productivity can be estimated directly by econometric estimation. The direct estimation of production function has an advantage as it is not necessary to assume competitive equilibrium in order to derive estimates of productivity growth. Knowledge on Factor Substitution and Returns- to-Scale in the manufacturing sector helps to understand the ability of the economy to absorb the surplus labor available. It also enables the estimation of the demand for various inputs when the economy is experiencing an upward trend in production. (Hrushikesh Panda, 2001).

In view of the above discussions i.e the significant role of transport sector in various fields of development, this paper concentrates on testing Returns-to-Scale, Elasticity of Substitution and Efficiency Wage Hypothesis (according to which co-efficient of wage rate is more than that of capital intensity) in transport equipment industry which is the basis for the growth of transport sector in India.

Methodology

Net Value Added (NVA) was taken as output. Labor input (L) consisted of both workers directly involved in production and persons other than workers like supervisors, technicians, managers, clerks and similar type of employees. The invested capital (K) was taken into account as capital. Wages included remuneration paid to workers. The basic data source of the study was Annual Survey of Industries (ASI) published by Central Statistical Organization (CSO), Government of India covering the period from1991-92 to 2008-09. All the referred variables were normalized by applying Gross Domestic Product (GDP) deflator. The GDP at current and constant prices were obtained from Economic

Survey, published by Government of India, Ministry of Finance and Economic Division, Delhi.

Augmented Dickey Fuller Test

Econometric and time series models have been based on the assumption that the underlying data processes are stationary. Empirically it has been shown that most of the macro variables are non-stationary in nature. Hence, in the present study non-stationarity or the presence of a unit-root was tested using the Augmented Dickey Fuller (1979, 1981) tests. To test if a sequence Yt contains a unit-root, two different regression equations are considered:

$\Delta Yt = \alpha + \gamma Yt- + \theta t + \Sigma \beta \Delta Yt- + \varepsilon$ ....(1)

$\Delta Yt = \gamma Yt- + \Sigma \beta \Delta Yt- + \varepsilon$ ......(2)

The first equation includes both a drift term and a deterministic trend and the second does not contain an intercept but include the deterministic trend. In both the equations the parameter of interest is γ. If $\gamma = 0$, the Yt sequence has a unit-root. The estimated 't' statistic is compared with the appropriate critical value of Dickey Fuller tables to determine if the null hypothesis is valid.

Cobb-Douglas Production Function

One of the most commonly estimated functional forms is the Cobb-Douglas (CD) production function written as:

$V = A(t)\ K^{\alpha}\ L^{\beta} e^{u}$............... (3)

where α and β are coefficients of labor input and capital, A (t) is the efficiency parameter and eu is the stochastic disturbance term following the usual properties.

This function is linear in logarithm of the inputs, output and time. Under the assumption of Constant Returns to Scale this equation is derived from equation (3) as:

$Ln(V/L) = \alpha + \beta\ Ln\ (K/L) + \lambda t + \mu_i$................ (4)

When the assumption of constant returns to scale is relaxed we have:

$Ln(V/L) = \alpha + \beta\ Ln\ (K/L) + (\alpha + \beta - 1) LnL + \lambda t + \mu_i$. .... (5)

Here zero, positive or negative co-efficient of LnL denotes that the returns to scale are constant, increasing or decreasing.

The estimation of this equation yields value of α and β and λ. λ provides estimates of TFPG and is the rate of exponential technological change. The sum of the partial elasticities ($\alpha + \beta$) indicates the extent of economies or diseconomies of scale. The returns to scale are constant, increasing or decreasing if the value of $\alpha + \beta$ is equal to unity, more than unity or less than unity respectively.

Constant Elasticity of Substitution (CES) Production Function

The CES production function, which allows for non-unitary elasticity of substitution, may be written as:

$V = Aoe^{\lambda t} [\delta L^{-\rho} + (1 - \delta) K^{-\rho}]^{-\nu/\rho} e^{u}$........................ (6)

where λ is efficiency parameter, δ is the distribution or labor input intensity parameter, ν is the scale parameter, ρ is related to elasticity of substitution given by $\sigma = 1/(1+\rho)$, where σ is constant by assumption and its value lies between the range of 0 and ∞. Also ν, γ and δ are non-negative constants and δ must not exceed unity, i.e., $0 < \delta < 1$.

The marginal productivity theory gives an adequate explanation of wage determination. It is well known that the price of labor under the conditions of profit maximization is equal to its marginal product. The labor force would be increased up to a point at which the reward paid to the marginal unit of labor (marginal wage) would be equal to the contribution made by the unit (marginal productivity of labor). Hence, $MP_L = W/L = W$. Under the assumption of constant returns to scale ($\nu = 1$), we have:

$dV/dL = (1 - \delta) A^{-\rho}] (V/L)^{1+\rho}$.......(7)

From the above equation we get:

$V/L = aw^{\sigma}$.................(8)

where $a = A^{-\rho/1} - \delta$; $\sigma = 1/(1+\rho)$

Taking logarithms and introducing time trend, we get:

$Ln(V/L) = a_0 + \sigma \, Ln\, w + \lambda (1 - \sigma) t + u$ ....(9)

If the assumption of constant returns to scale is relaxed, the following relationship holds:

$Ln(V/L) = a_0 + a_1 Lnw + a_2 LnL + a_3 t + u$ ....(10)

Where

$a_1 = \nu/(\nu + \rho)$; $a_2 = \rho (\nu - 1) / (\nu + \rho)$; $a_3 = \lambda\rho/ (\nu + \rho)$

From this relationship, we can get the value of parameters (λ, σ, ν) as:

$\lambda = a_3 / (1 - a_1)$; $\sigma = a_1/ (1 + a_2)$; and $\nu = [a_2/(1 - a_1)] + 1$ ....(11)

A more direct approach may be considered by taking a Taylor series expansion about $\rho=0$ as shown by Kmenta (1967) and following linear approximation may be obtained:

$LnV = LnY + \nu \delta LnK + \nu (1 - \delta) LnL - \nu \rho \delta (1 - \delta) [LnK - LnL]^2$....... (12)

Variable Elasticity of Substitution (VES)

The VES production function explicitly permits the capital-labor ratio to be an explanatory variable of productivity. The estimation form of VES production function can be written as:

$Ln(V/L) = b_0 + b_1 Lnw + b_2 Ln (K/L) + b_3 Ln(t) + \mu$......................... (13)

where elasticity of substitution is given by $b_1 / (1-b_2/S_K)$ and S_K is the share of capital in output. The associated production function may be written as:

$V/L = A [\delta K^{-\rho} + (1 - \delta) \eta (K/L)^{-b3/1+\rho} L^{\rho}]^{-1/\rho}$ .... (14)

Results &Discussion

The Augmented Dickey Fuller (ADF) test for the variables involved in production function based on C-D, CES and VES models in their first difference of the natural logarithms of each series was estimated taking into account labor productivity (GVA/L) as dependent variable in all the models. Variables such as capital intensity (FC/L) and labor input (L) were the independent variables in C-D model, while wage rate (W) and labor input (L) were the independent variables in CES model. In VES model, on the other hand, capital intensity (FC/L) and wage rate (W) were taken as independent variables. Besides the above variables, time variable (T) was also included in the model.

The results of Augmented Dickey Fuller Test (ADF) for first difference is presented in Table 1.

Table : 1 Augmented Dickey Fuller Test (ADF) for first Difference –Manufacture of Transport Equipment Industry.

Variable	ADF- Value
Labour productivity(GVA/L)	4.8161*
Capital intensity(FC/L)	4.6880*
Wage rate(W)	5.9808*
Labour input (L)	3.9509*

Source: Estimation based on ASI data.
Note: * Significant at 5% level.

The above results indicated that the null hypothesis of the unit-root process could be rejected for all the variables, which implied that all the variables were stationary. After having established the stationarity of the variables the production function was fitted. The results are presented in Table 2.

Table : 2 Production Function Estimates –Manufacture of Transport Equipment Industry

Functional forms	Constant	Ln FC/L	LnW	LnL	LnT	R2	DW-statistic	F-ratio
CD	20.708*	0.349***	-	-0.992*	0.530*	0.9510	1.999	90.483
	(9.212)	(1.825)		(4.533)	(4.534)			
CES	2.086		1.099	-0.391	0.220	0.9666	2.720	154.545
	(0.602)	-	(2.984)	(1.212)	(0.790)			
VES	-1.825	-0.089	1.520*		-0.010	0.9555	2.166	107.454
	(2.267)	(0.525)	(5.004)	-	(0.153)			

Source: Estimation based on ASI data.
Notes: (i) Figures in parantheses are ‘t’ values of the estimates;
(ii) * Significant at 1% level;
(iii) *** Significant at 10% level.

The increasing returns to scale of the industry was proved with the significant co-efficient of labor input.

Production function estimates of manufacture of transport equipment industry showed that the co-efficient of capital intensity (LnFC/L) was significant in C-D production function. The increasing returns to scale of the industry was proved with the significant co-efficient of labor input (LnL). Introduction of time variable (LnT) to capture technological progress proved that there was neutral technical progress, since the co-efficient of trend factor (LnT) was statistically significant. Estimates of CES production function showed that the co-efficient of wage rate (Lnw) was statistically significant. Its numerical value was close to unity indicating unitary elasticity of substitution. Moreover, capital in the industry can be substituted with ease providing scope for employment generation in the industry. The results of VES production function showed that only wage rate (Lnw) was statistically related to labor productivity. The partial elasticity co-efficient of wage rate (Lnw) was more than the capital intensity (LnFC/L co-efficient. It explains the fact that the labor class is efficient enough to fight for more wages in accordance with the rising cost of living. Hence, the hypothesis of efficiency-wage was supported.

References

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