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ANALYSIS OF TOTAL FACTOR PRODUCTIVITY GROWTH OF AUTOMOBILE INDUSTRY IN INDIA

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Abstract

The present paper studies the analysis of factor intensifies of Automobile industry and all industries. This work analyzed the Kendrick total factor productivity growth of the industry. The empirical results revealed that the capital productivity (V/K) in the automobile industry is much higher compared to the capital productivity (V/K) of all industries during the study period. This concludes that the industry is a capital intensive industry. The low exponential growth rate of total factor productivity and insignificant p-values of time and dummy variables indicate that there is no positive growth of total factor productivity in the automobile.

Objectives:

1. To analyze the factor intensities of Automobile industry in India.
2. To evaluate the factor intensities of all industries in India.
3. To analyze the factor productivity growth of Automobile industry in India.
4. ***Key words:*** Productivity, Automobile industry, Growth, Factor intensities, significant.

1. Introduction

The automobile industry is one of the most dynamic revenue generators the world over. This industry offers a wide array of automobile jobs to choose from and plays a major role in maintaining a healthy GDP for a nation. The scope of employment in this industry is very broad and it offers a high tech, rapidly changing and innovative work environment. Very demanding, it requires its employees to meet the production deadlines on time and be competitive both qualitatively and quantitatively.

1.1. Various Types of Jobs in the Automobile Industry

Administration: Automobile administration encompasses a wide variety of occupations which includes car dealerships, vehicle and component manufacturing enterprises and small repair and servicing businesses to name a few. The job profile in case of dealerships and small businesses would involve reception and clerical chores, handling of vehicle finance and insurance matters and supervising vehicle stock movements. While on the other hand, the one on vehicle and component manufacturing enterprises would put more emphasis on the manufacturing process, liaison, warehousing and distribution of the finished products along with the above job profile.

Aftermarket: The profile of aftermarket jobs includes fitting of accessories, retail/sales operations, warehousing and distribution. With more buying power coming into the hands of the middle class, more cars are likely to roll out of the shed every year. As a result of this increase, the aftermarket service segment would profit immensely for more car sales would mean more aftermarket business of spare parts and enhancements. Hence it can be said that those related to automobile aftermarket jobs would see unprecedented growth in the near future.

Electrical: Technological advancements in the automobile industry have had tremendous effect on this segment. Though the positions are based in dedicated automobile electrical/ repair and servicing workshops and vehicle dealerships, this field offers tremendous potentiality to grow. The typical job profile involves electrical work on cars, trucks, caravans, trailers, agricultural equipment and boats. One is also required to do a thorough diagnosis, testing, repairing, servicing and replacing activities when required. Electrical wirings, batteries, generators, lightings, starter motors, alternators and every other kind of automobile electrical are being taken care of by the professionals of this sector.

With the growing technicalities in the vehicles, this sector is likely to witness a huge demand for skilled labors. Apart from the above listed sectors, job prospects also do exist in Bus, Truck and Trailer manufacturing, Management and Supervisory, Automobile Engineering and Sales.

2. Review of earlier studies

Agarwal, R.N.[1], (1988), attempted to explain the objective of the study is to pinpoint the main causes of the sickness of the industry and then to suggest remedial measures. It appears to us prima-facie that the industry is caught in the vicious circle of small size of the market; for its products and near absence of innovations in technology over the three decades. The industry has not developed its own vehicles and the export demand for its vehicles is negligible. Broadly we may classify the causes of sickness under the following heads.

(1) Technology and cost structure
(2) Government policies and

(3) Certain other economic factors

Bhat Sharipad, and Prof Setharaman, T.V.,[2] (1995), in their work attempted to explain the main objective of this work to evaluate the effects of technology transfer on the export performance and the determinants of the export intensity of the automobile industry. The empirical literature on technology transfer and export performance shows that no clear cut conclusion can be drawn regarding the relationship between the two.

This paper has been has divided into six sections. Section 2 presents the analytical background to the issue of technological transfer and export performance in the developing countries. Section 3 describes the methodology and hypothesis to be tested. Section 4 deals with data sources and definitions of the variables. The results and discussions are dealt with in section 5. The last section summarizes the main findings.

Chugan, P.K.,[3] (1995), in his work attempted to explain an investigation of the factors related to foreign technology vis-a–vis their role in determining the firms development, adaptation and absorption (DAA) capabilities reveals that while the number of foreign collaboration agreements (FCA) and foreign equity do influence DAA capabilities, the impact is limited; for, other technology transfer related factors restrict the firms freedom to operate in a manner it deems fit . A comparative analysis of FCA and non FCA units indicates that in spite of weaker R&D base; the non FCA units spend more on R&D in relative terms and develop /adapt larger number of products than the former.

Das Gupta Rajaram,[4] (1986), attempted to estimate demand for different categories of commercial vehicles up to the end of this decade (i.e. 1990). The author contends that the official demand forecasts are exaggerated because the assumptions about growth of traffic on which they are based are unrealistic. In the light of demand projection the author argues that the current policies of licensing a number of new units is likely to result in under utilization of capacity and consequent loss of economics of scale. A preferable policy would be to increase capacity in the existing units would achieve greater efficiency and introduce some competition in the industry.

Gumaste Vasant,[5] (1988), attempted to explain that the Indian industry has responded to the governments promotional measures to encourage in-house research and development units and the money they spend have grown considerably over the last four decades. But what are the concrete results? How strong is the technological capability of Indian industry today? How effective is it in enabling the country to be technologically self- reliant? This study is based on discussions with the principals, the men in the wings and those behind the scenes in the industry-the automobile and ancillary industry.

Kathuria Sanjay,[6] (1987), attempted to show that although Hindustan Motors and premier automobiles were established prior to independence, the real history of the Indian automobile industry begins with the Tariff Commission Report of 1953, when firms without a phased manufacturing programme were asked to withdraw from India. By 1965 there were seven firms manufacturing commercial vehicles, four of which also produced passenger cars/jeeps. In 1981, the Government approved the entry of four new firms (with Japanese collaborations) into the market for light commercial vehicles. This was followed by further liberalization in industrial policies, viz, broad-banding exemption from the provisions of section 21 and 22 of the MRTP Act, and the announcement of minimum economic scales.

Kesari Kumar Pradeep and Saggar Mridul,[7] (1989), in their work attempted to analyze the determinants of export performance for fifty five units in the "Machinery and Transport equipment" industry of India. The methodology adopted applies pooling of cross section and time series data over the years 1980-81, 1982-83, and 1983-84.

The study follows the neo-factor proportion and neo-technology approaches. These approaches came into vogue as the Heckscher (H-O) theorem, due to its restrictive assumptions, was found incapable of explaining real world phenomenon of monopolistic competition in the arena of International Trade and foreign investment. Under the assumptions of the H-O theorem, such as perfect competition and perfect foresight, constant returns to scale, absence of product differentiation, all firms in a n industry will have access to technology, factors and product markets. As a result they are expected to perform in similar fashion.

Mukherjee Avinandam and Trilochan Satry,[8] (1996), in their work attempted to explain the automobile industry in South Korea, Brazil, China, and India is currently going through impressive growth. Governments have played a key role in the evolution of the industry in all these countries. South Korea, a relatively amount to the automobile industry, has made the most significant progress, and is now exporting cars to developed countries. It is the only country that invested in research & development for product development, retained management control in ventures with multi-national companies, and had ambitious export targets. The industry in Brazil is much bigger than that in South Korea, but indigenous product development capabilities are lacking and manufacturing competitiveness is limited even though the industry is entirely controlled by NINCS. The Indian industry is experiencing with rapid growth and the entry of the largest number of MNCs

3. Methodology

This paper is devoted to analyze the total factor productivity growth besides studying factor intensities of the automobile industry. Apart from this the factor intensities of all industries is also analyzed. The detailed methodology is given below.

3.1. Kendrick's Total Factor Productivity Index of Automobile Industry

To have an overall view of the productivity in an industry or in a firm there must be a single indicator which should naturally be the ratio of net output to the combination of all the relevant inputs. With this idea in view, Kendrick evolved the concept of total factor productivity index and defined it as follows:

Total Factor Productivity = $\frac{Q_0}{al+bc}$ Where

Qo is the index of net output,
l is the index of labor input,
c is the index of capital input,
a is the relative share of labor,
b is the relative share of capital.

Kendrick's total factor productivity growth is estimated by using annual growth rates and exponential growth rates. The methodology is explained as follows:

3.2. Annual Growth Rates of Total Factor Productivity

Annual percentage changes were estimated by computing annual growth rates. These growth rates give the changes over the year.

$$G_t = \frac{(Y_t - Y_{t-1})}{Y_{t-1}} \times 100$$

Where,

G_t = growth rate of Kendrick's total factor productivity index for the year't'
t = time (year)
Y_t = **t^{th}** year total factor productivity index value
$Y_{(t-1)}$ = **$(t-1)^{th}$** year total factor productivity index value

These annual growth rates were computed by taking Kendrick's total factor productivity index values in constant prices (i.e. 2003-04 prices for industry variables). Since the data is time series in nature, this method can be used for preliminary analysis and to find the year-to-year changes of the total factor productivity growth in the industry. Hence the change in total factor productivity growth is estimated per unit of time. If $G_i>0$ it can be inferred that growth has taken place. In case, the $G_i<0$ or negative, then the retardation in the total factor productivity activity is supposed to have happened. If there is no change in G_i, then there is stagnancy in the total factor productivity.

3.3. Exponential Growth Rate of Total Factor Productivity

The compound growth rates are estimated by using regression method. In this, the log-linear model applied with dummy variable. The model is

Ln $Y_t = b_0 + b_1t$……....1
Ln $Y_t = b_0 + b_1t + b_2D$…….2

Where,
Y_t is the value of Kendrick's total factor productivity index,
t is time variable,
D is dummy variable (0=pre-liberalization, 1= post-liberalization),
b_0 is constant, and
b_1, b_2 are coefficients of time and Dummy variables respectively.

Here we drew growth rates of total period and pre and post liberalization changes from b_1 by applying the following method.

G_t = (Antilog of b_1-1)*100
G_t is Growth rate of total time period.

It is hypothesized that the there is no significant positive growth in total factor productivity in the automobile industry. To test this analysis is made on the basis of standard error, t-values and the significance of the coefficients b_1 and b_2 of the variables time and dummy. If the value of b_1 is significant, then it is concluded that there is a positive total factor productivity growth in automobile industry. All the estimations are made using the SPSS software.

However, this method (i.e. non-linear curve) is preferable over the average annual growth rates and linear curve one as this accepts that the change in the growth rate in this period is dependent on the change in output in the previous period. The regression statistics mentioned above are estimated in this case also to analyze the statistical reliability of the equation.

4. Empirical results

4.1. Factor Intensities of Automobile Industry

The factor intensities of automobile industry can be observed by analyzing the capital intensity (K/L), labor productivity (V/L) and capital productivity (V/K).

It can be observed from the data that the capital intensity (K/L) in the year 1985-86 is Rs.1,37,952 and has increased to Rs.1,47,536 in the year 1987-88. From the year 1988-89 to 2003-04 the capital intensity (K/L) has not exhibited much variation. From the year 2004-05 the capital intensity has decreased during the end of the study period. This indicates that the automobile industry is a capital-intensive industry; as a result the capital per labor is decreasing which is a interesting point in this analysis.

However, the labor productivity (V/L) and capital productivity (K/L) during the study period are showing an increasing trend which can be observed in the table 4.1.

In the year 1985-86 the labor productivity (V/L) is Rs. 2,95,726 and has increased to Rs. 7,72,877 in the year 1995-96. From the year 1996-97 onwards the labor productivity is decreased from Rs. 7,04,864 to Rs. 5,36,177 in the year 2006-07 with minor fluctuations. Hence we can see that the capital per labour is decreasing due to the decrease in labor productivity. However on the other hand the capital productivity in the year 1985-86 was 2.14 percent which has increased to 7 percent in the year 1995-96. However from the year 1996-97 the capital productivity has been decreasing from 6.31 percent to 4.9 percent in the year 2003-04. Again it has recovered in the year 2004-05 to 6.41 percent and increased to 7.83 percent in the year 2005-06 and again declined to 6.5 percent in the year 2006-07.

4.2. Factor Intensities of All Industries

In the year 1985-86 capital intensities (K/L) of all industries is Rs.2,39,459 and has increased to Rs. 12,18,349 in the year 2005-06 with small fluctuations and reached to Rs. 11, 57,640 in the year 2006-07. On the other hand the labor productivity (V/L) of all industries in the year 1985-86 is Rs. 1,23,404 and has increased to Rs. 3,01,263 in the year 1999-00. From the year 2000-01 onwards the labor productivity (V/L) is Rs. 2,72,305 and increased to Rs. 4,84,084 in the year 2006-07. This can be observed from the table 4.2.

If we look at the capital productivity (V/K) in the year 1985-86 it was 0.52 percent and has declined to 0.24 percent in the year 2001-02 with minor fluctuations in between these years. However, in the year 2003-04 the capital productivity (V/K) ratio is 0.26 percent and has increased to 0.42 percent in the year 2006-07.

The capital productivity (V/K) in the automobile industry is much higher compared to the capital productivity (V/K) of all industries during the study period. This clearly indicates that the automobile industry is more capital-intensive industry. The declining trend of the capital intensity (K/L) of the automobile industry reveals that the capital per labor employed is less than the capital per labor employed of all the industries. This indicates that the automobile industry is not a labor-intensive industry where capital per labor is high.

4.3. Total Factor Productivity

For calculating Kendrick's Total Factor Productivity index of automobile industry the year 1985-86 is taken as a base year with value 100. The index is showing an upward trend up to the year 1995-96 which is around 213.22 percent compared to the base year except with a small decline in the year 1987-88. However, from the year 1996-97 onwards the index is showing a declining trend with small up and downs till the year 2005-06 which is 227.43 percent and in the year 2006-07 it again declined to 170.93 percent.

4.3.1. Annual Growth Rates of Total Factor Productivity

To have a clear understanding of the trend of total factor productivity of automobile industry this study analyzed the annual growth rates of the total factor productivity. In the year 1986-87 the total factor productivity growth is 11.74 percent and has declined to -13 percent in the year 1987-88. Since then it has recovered to 17.11 percent in the year 1988-89. From the year 1991-92 the annual growth rates are showing declining trend up to the year 1993-94. In the year 1995-96 the total factor productivity growth rate is 50.59 percent as compared to 17.55 percent for the year 1994-95. Again with up and downs in the growth rates of total factor productivity, in the year 2003-04 it has increased to 30.93 percent from the previous year 11.43 percent. However, we can see the declining trend of total productivity growth with a negative growth rate of -17.25 percent in the year 2006-07. The Kendrick's total factor productivity annual growth rates can be seen from the table4.3.1.

4.3.2. Exponential Growth Rate of Total Factor Productivity

The exponential growth rate of total factor productivity of automobile industry is computed in this section. Apart from growth rate the impact of reforms is also analyzed by using the dummy variable. The regression equation for this analysis is given below.

$\text{Ln } Y_t = b_0 + b_1 t$……....1

$\text{Ln } Y_t = b_0 + b_1 t + b_2 D$…….2

Where,

Y_t is the value of Kendrick's total factor productivity index,

t is time variable,

D is dummy variable (0=pre-liberalization, 1= post-liberalization),

b_0 is constant, and

b_1, b_2 are coefficients of time and Dummy variables respectively.

Here we drew growth rates of total period and pre and post liberalization changes from b_1 by applying the following method.

G_t = (Antilog of b_1-1)*100

G_t is Growth rate of total time period.

The detailed explanation of this model to prove the hypothesis is furnished in the methodology of this chapter.

The exponential growth rate of total factor productivity of automobile industry is 2 percent during the study period. The 74.8 percent R^2 value indicates that this model is a good fit. The slightly positive value of coefficient of time (b_1) variable reveals that the time has very less impact on the growth of total factor productivity which is clearly indicated by the insignificant *p*-value. The same can be observed in case of dummy variable which shows the low positive coefficient (b_2) value of dummy variable and insignificant *p*-value indicates no impact of reforms on the growth of total factor productivity.

The very low positive value of exponential growth rate of total factor productivity is 2 percent and insignificant values of time and dummy variables indicate that there is no positive growth of total factor productivity of the automobile industry. Hence the null hypothesis cannot be rejected.
The results can be seen from the following analysis and from the table 4.3.2.

$$\textbf{Log } Y_t = 4.683 + 0.0198t + 0.356D$$
(TFP) (time) (dummy)

$$R^2 = 0.748 \text{ or } 74.8\%, \text{ growth rate } g_t = 2\%$$

5. Inferences

From the foregoing analysis the following general inferences can be drawn.

1. Capital intensity (K/L) in the year 1985-86 is Rs.1,37,952 and has increased to Rs.1,47,536 in the year 1987-88. From the year 1988-89 to 2003-04 the capital intensity (K/L) has not exhibited much variation. From the year 2004-05 the capital intensity has decreased during the end of the study period. This indicates that the automobile industry is a capital-intensive industry; as a result the capital per labor is decreasing which is an interesting point in this analysis.
2. In the year 1985-86 the labor productivity (V/L) is Rs. 2,95,726 and has increased to Rs. 7,72,877 in the year 1995-96. From the year 1996-97 onwards the labor productivity is decreased from Rs. 7,04,864 to Rs. 5,36,177 in the year 2006-07 with minor fluctuations. Hence we can see that the capital per labor is decreasing due to the decrease in labor productivity.
3. The capital productivity (V/K) in the automobile industry is much higher compared to the capital productivity (V/K) of all industries during the study period. This clearly indicates that the automobile industry is more capital-intensive industry.
4. The very low positive value of exponential growth rate of total factor productivity is 2 percent and insignificant *p*-values of time and dummy variables indicate that there is no positive growth of total factor productivity of the automobile industry.

6. Conclusion

The capital productivity (V/K) in the automobile industry is much higher compared to the capital productivity (V/K) of all industries during the study period. This concludes that automobile industry is a capital intensive industry. One of the serious concerns in this industry is that the low factor productivity growth rate which can be rectified by extensive use of labor and capital in this industry.

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Annexure:

Table 4.1: Factor Intensities of Automobile Industry

Year	K/L in Rs	V/L in Rs	V/K
1985-86	137952	295726	2.14
1986-87	141234	338067	2.39
1987-88	147536	303143	2.05
1988-89	127183	316473	2.49
1989-90	133678	371504	2.78
1990-91	127681	424160	3.32
1991-92	130506	452402	3.47
1992-93	127715	456100	3.57
1993-94	129836	495653	3.82
1994-95	121106	552028	4.56
1995-96	110364	772877	7.00
1996-97	111696	704864	6.31
1997-98	108440	592733	5.47
1998-99	112633	427010	3.79
1999-00	116933	506176	4.33
2000-01	128899	415051	3.22
2001-02	132989	437152	3.29
2002-03	121585	450810	3.71
2003-04	114952	563548	4.90
2004-05	98575	631923	6.41
2005-06	92590	725086	7.83
2006-07	82501	536177	6.50

Source: Computed based on Annual Survey of Industries Data (Factory Sector, Central Statistical Organisation, Government of India, New Delhi).

Table 4.2: Factor Intensities of All Industries

Year	K/L in Rs	V/L in Rs	V/K
1985-86	239459	123404	0.52
1986-87	267220	51543	0.19
1987-88	289310	123195	0.43
1988-89	323919	139336	0.43
1989-90	344434	153087	0.44
1990-91	384247	168480	0.44
1991-92	430869	179326	0.42
1992-93	460653	214655	0.47
1993-94	520779	252021	0.48
1994-95	551084	269130	0.48
1995-96	557416	280006	0.50
1996-97	635276	279175	0.44
1997-98	683226	277857	0.41
1998-99	882629	297538	0.34
1999-00	962917	301263	0.31
2000-01	1053259	272305	0.26
2001-02	1164017	274135	0.24
2002-03	1204964	299398	0.25
2003-04	1293720	333422	0.26
2004-05	1256730	363504	0.29
2005-06	1218349	372924	0.31
2006-07	1157640	484084	0.42

Source: Computed based on Annual Survey of Industries Data (Factory Sector, Central Statistical Organisation, Government of India, and New Delhi).

Table 4.3.1: Growth Rate of Total Factor Productivity of Automobile Industry

Year	Kendrick's TFP	TFPG
1985-86	100	-
1986-87	111.74	11.74
1987-88	97.21	-13.0
1988-89	113.84	17.11
1989-90	127.76	12.22
1990-91	152.77	19.58
1991-92	159.43	4.36
1992-93	164.75	3.33
1993-94	176.94	7.40
1994-95	207.99	17.55
1995-96	313.22	50.59
1996-97	286.55	-8.52
1997-98	249.1	-13.07
1998-99	166.27	-33.25
1999-00	180.7	8.68
2000-01	140.26	-22.38
2001-02	141.95	1.21
2002-03	158.18	11.43
2003-04	207.09	30.93
2004-05	267.55	29.20
2005-06	327.43	22.38
2006-07	270.93	-17.25

Source: Computed based on Annual Survey of Industries Data (Factory Sector, Central Statistical Organisation, Government of India, New Delhi).

Table 4.3.2: Exponential Growth Rate of Total Factor Productivity

Predictor	Coefficient	SE Coefficient	t	*p*-value
Coefficient (b_0)	4.683	0.114	40.94	0.000
Time (b_1)	0.0198	0.013	1.465	0.159
Dummy (b_2)	0.356	0.192	1.849	0.080

Source: Computed based on Annual Survey of Industries Data (Factory Sector, Central Statistical Organisation, Government of India, and New Delhi).