Total Factor Productivity and its Determinants: the case of selected Coir Industries in Kerala

RASEENA K.K* & Dr. K.X. Joseph**
*Part Time Research Scholar, Department of Economics, Dr. John Mattai Centre, Thrissur, University of Calicut.
**Professor (Retd), Department of Economics, Dr. John Mattai Centre, Thrissur, University of Calicut.

Received: January 14, 2019 Accepted: February 26, 2019

ABSTRACT: *Extent and speed of industrialisation is governed by many factors and the efficiency of the activity has a major role in it. This efficiency itself is influenced by some other factors, both internal and external to the firm. The present study considers the total factor productivity as the measure of efficiency of a manufacturing firm. Here the coir industry was taken as the sourcing industry and the total factor productivity is estimated using log linear regression model under the frame work of Cobb- Douglas Production Function. Factors influencing the TFP was traced out using a multiple linear regression model and the results reveal that the factors like the average years of schooling and the pre-job and on-job training statuses of workers positively influences the TFP whereas, the method of operation and presence of the labour union were inversely affected. It was also evident from the regression result that the average age of the employees and average years of experience in manufacturing coir were not significant in influencing TFP in the Coir Industry of Kerala.*

Key Words: *: Coir Industry, Total Factor Productivity, Factors influencing Total Factor Productivity, Measurement of TFP.*

1. Introduction

The speed of industrialisation of an economy may depend on many factors, endogenous and exogenous. The efficiency of the manufacturing sector is one of the key factors determines the extent and speed of industrialisation. In principle, total factor productivity is a better indicator of efficiency. It measures how efficiently and effectively the main factors of production, labour and capital, combine to generate output. This is not only applicable to heavy industries, but also to small scale and traditional industries.

Productivity is the average measure of the efficiency of production. It is always expressed as a ratio of output to inputs or factors of production used in the production process. The ratio of output to one input factor measures single factor productivity and the ratio of an index of aggregate output to an index of aggregate inputs measures total factor productivity (TFP).Over the years, various methods have been developed to measure firm productivity across the globe. But there is no uniformity on the use of methods, and research on the identification of factors which determine productivity has been neglected (Satpathy, Chatterjee, & Mahakud, 2017). In the existing literature, single-factor productivity is not considered a true measure of productivity as it does not denote overall changes in the productive capacity of a firm. Total factor productivity tries to overcome this limitation by measuring changes in production due to changes in all inputs, such as labour, capital, technology, capacity utilisation and quality of factors of production (Kathuria, Raj & Sen, 2013). So the Total Factor Productivity is taken here as the measure of efficiency in the coir industry.

Total-factor productivity (TFP) is the portion of output not explained by traditionally measured inputs of labour and capital used in production. Total factor productivity is a measure of economic efficiency and thus can be used as a measure of economic performance. In literature, many methods are available to estimate the TFP and the present study uses the frame work of Cobb – Douglas production function for this. Total Factor Productivity of a firm is influenced by so many factors both internal and external. The factors determining the TFP of companies vary across the different sub-industries. Technology, size and competition in the form of imports of raw materials are the main sources of productivity for Indian manufacturing companies (Satpathy et al., 2017). A strongly monotonic relationship exists between TFP and many firm characteristics, including firm size and book-to-market ratios of firms. The market capitalization of firms monotonically increases with TFP (İmrohoroğlu & Tüzel, 2014). The present study focuses the characteristics of the human capital employed, as the new growth theory proposed, to influence

TFP such as, the average years of education, average years of experience in coir manufacturing, type of labour employed (pre-job status), on job training status of the workers, method of operation of the work, Average age of the Labour Force and the presence of labour union.

Coir industry is one of the oldest traditional agro based industries of Kerala. As a traditional industry, Kerala's coir industry recently faced many threats in the world market. The comparative advantages of this industry had shifted to other states of the nation like Tamil Nadu and Karnataka due to so many factors like better technology of production, cheaper availability of labour etc. At the same time, the labour market scenario of Kerala has changed a lot due to gulf migration and better educational attainment. These developments brought some changes in this traditional industry. Today it is considered as a decaying industry. The defibering and spinning activities are now nominal in Kerala where as the product manufacturing sector is struggling for its existence. In this scenario, the present paper tries to analyse the efficiency, in terms of Total Factor Productivity (TFP), of the coir industry of Kerala and to examine the factors affecting TFP.

2. Methods and Techniques

2.1 Data

The present study fully utilises the primary data collected from 115 coir manufacturing units of Alappuzha District by conducting a direct interview from March to May 2018. The population of the study were 3511 registered coir manufacturers of the district and a sample of 115 manufacturers were chosen using simple random sampling method. The sample size was fixed using the sample size calculator.

2.2 Total-factor productivity

Total-factor productivity (TFP) is the portion of output not explained by traditionally measured inputs of labour and capital used in production. It is also defined as the residual of the total output left after paying the factor rewards. Total factor productivity is a measure of economic efficiency and thus can be used as a measure of economic performance. As per the Cobb- Douglas production function, $Q= AL^{\alpha}K^{\beta}$ ..... (1)

Where,
Q = output
A= Total Factor Productivity
L= Labour input
K= Capital input
α, β =Respective output elasticities

The above model can also be expressed as

$$\text{Ln } Q = \text{Ln } A + \alpha \text{ Ln } L + \beta \text{ Ln } K + U_i \quad (2)$$

Or

$$Q^* = A^* + \alpha L^* + \beta K^* + U_i \quad (3)$$

Where, $Q^* = \text{Ln } Q$
$A^* = \text{Ln } A$
$L^* = \text{Ln } L$
$K^* = \text{Ln } K$

This is done by converting the production function into a linear model using natural logarithm and then applying the OLS method of regression to calculate the parameters of the model such as Total Factor Productivity, output elasticity of labour and output elasticity of capital, where as,

Total factor productivity (A) = Antilog (A^*),
Output elasticity of labour = α and
Output elasticity of capital = β

After estimating model (3) using OLS, the firm level Total Factor Productivity (log) is calculated using,

$$A^* = Q^* - \alpha L^* - \beta K^* \quad (4).$$

2.3 Factors determining Total Factor Productivity

Total Factor Productivity of a manufacturing firm is influenced by many factors outside and inside the firm. Endogenous growth theory holds that investment in human capital, innovation, and knowledge are significant contributors to economic growth and the effect of these variables are measured by TFP. Ozanne (2001) had analysed TFP as a function of openness (measured in terms of taxes on international trade), government (measured concerning non-complementary and complementary expenditure), and human capital. He finds that only our government-related variables have statistically significant influences on TFP. Non-complementary government expenditure has a statistically significant negative effect, while

complementary expenditure has a statistically significant positive effect. He also finds that, domestic tax revenues have a statistically significant positive effect on TFP level (Ozanne). Here an attempt was carried to derive some specific features of the labour employed in the industry to influence the total factor productivity of a traditional industry like coir.

For this purpose, some factors were identified on the basis of theoretical and empirical support. The analysis was carried on the frame work of new growth theory and thus the factors identified reflect the quality of human capital employed and their efficiency. Thus identified variables were the average years of education, average years of experience in coir manufacturing (reveals the skill in the activity), type of labour employed (trained or untrained – pre-job status), on job training status of the workers, method of operation of the work (mechanical or others), average age of the labour force and the presence of labour union. After identifying these factors, a multiple linear regression was fitted to examine the influence of these factors on the total factor productivity of the firm. The model used for this purpose is depicted in equation number (6).

$Yi = \beta_0 + \beta_1X_1 + \beta_2X_2 + \beta_3X_3 + \beta_4X_4 + \beta_5X_5 + \beta_6X_6 + \beta_7X_7 + Ui$.....(6).

Where,

Yi = Firm level Mean TFP

X_1 = Average years of education of Employees

X_2 = Average Years of experience

X_3 = Type of labour employed (1= Trained, 0= Untrained)

X_4= On Job Training Status (1= participated, 0 = not participated)

X_5 = Method of Operation (1= Mechanical operation, 0 = manual operation and for both Manual and mechanical)

X_6 = Average age of the Labour Force

X_7 = Presence of Labour Union

Ui = error term

3. Empirical Results

Here the results of the analysis of the primary data using the techniques explained in the previous section are presented.

For estimating the regression model (3) the basic assumptions of Normality, Homoscedasticity, No Autocorrelation and No perfect Multicollinearity were checked and satisfied. The normality is verified using the histogram, Homoscedasticity by scatter plot, Autocorrelation by Durbin-Watson statistic, and Multicollinearity by Karl Pearson's correlation matrix. After satisfying these basic assumptions, OLS method was used for estimating the Model (3) and the results were exhibited in table (1).

Table (1) Regression results (model-3)

Variables	coefficients	t	Sig.
(Constant)	2.641	4.970	.000
Log L	.689	10.550	.000
Log K	.249	3.813	.000
R Square = 0.795		F =217.26	

The results of the regression model (3) presented in table (1) reveal that we have significant results and thus can proceed with this model. So the mean TFP can be calculated from the model (3) as presented in the model (4) where as,

TFP = Antilog (A^*)..... (5).

Firm level Mean TFP were calculated using (5) and it can be presented against the ownership type of the coir manufacturing as in table (2).

Table (2): Estimated Mean TFP against type of ownership of the Firm.

Type of ownership	N	Mean	Std. Deviation
Government	2	1405.2216	1765.61151
Co-operative Sector	8	693.7912	766.65023
Private	105	615.8720	1880.53765
	Total		115

Source: Computed from Primary Survey

From the table (2), it is evident that the TFP in Government owned coir firms is more than twice that of the firms in cooperative and private sectors. However, it is also evident that there are only two firms under

government sector in the selected sample and between these two firms there is a high variation in TFP which is measured by the Standard deviation. Many variables influences this TFP of a firm and therefore a detailed analysis of this were done in using the regression model (6).

For estimating the regression model (6) here also the basic assumptions of Normality, Homoscedasticity, No Autocorrelation and No perfect Multicollinearity were checked and satisfied. The normality is verified using the histogram, Homoscedasticity by scatter plot, Autocorrelation by Durbin-Watson statistic, and Multicollinearity by Karl Pearson's correlation matrix. After satisfying these basic assumptions, the OLS method was used for estimating the Model (6) and results are exhibited in table (3).

Table (3) Regression results (model-6)

Variables	Coefficients	t	Standard Error	Sig.
(Constant)	774.153	.514	1505.995	.608
Average Years of Schooling	.196	1.848	97.092	.067*
Average years of experience	.178	.466	107.447	.642
Type of labour	.229	2.444	438.417	.016**
On Job Training	.431	3.807	695.604	.000***
Method of Operation	-.260	-2.274	612.981	.025**
Average age	-.281	-.749	78.114	.455
Presence of Labour Union	-.139	-1.621	312.027	.10*
R Square = 0.242 F = 4.88				

*** - significant at 1% level
**- significant at 5% level
*- significant at 10% level

The regression results presented in table (3) reveals the model adequacy with respect to F statistic and R^2 and thus we proceed with this model. The pre-job and on job training statuses and the average years of schooling of workers positively influences the TFP whereas, the method of operation and presence of the labour union were inversely affects the TFP. It is also noted that the average age of the workers and the average years of experience in the manufacture of coir not significant in influencing the TFP of coir manufacturing units. It is very interesting to note that the use of mechanical mode of operation adversely affects the TFP of coir manufacturing. This may be because of its traditional features and more than the method, the artisan skills matters in TFP. It is also important to note that the presence of labour union have negative impacts on the TFP. This reveal that the presence of labour union may cause better wages and other facilities for workers and thus an increased share of labour in the total output might reduce the TFP.

The pre-job and on job trainings attended by the workers of a firm have some beneficial impacts on the TFP as per the regression results and this necessitates the provision of training for workers even in a traditional industry like coir. Apart from the training, the conventional education, measured in terms of years of schooling, have positive impacts on TFP. Thus one can conclude that the human capital is one of the integral parts of efficiency in manufacturing and thus growth. Then one can infer that the predictions of the new growth theory are applicable even for coir industry.

4. Conclusion

Total Factor Productivity plays a crucial role in the profitability and long run survival of any industry. This necessitates the identification of the factors that determine the TFP of industry. Here the coir industry was taken as the case and TFP and its determinants were examined. The study reveals that the TFP is positively influenced by the pre-job and on job training statuses and the average years of schooling of workers whereas, the method of operation and presence of the labour union were inversely affected. This point out that mere adoption of modern techniques in a traditional industry is not the solution for increasing efficiency and thus profitability. Therefore much care should be given in training and education of the workforce to improve the scenario and if thrust is given in these areas we can save one of our traditional industries, coir, from its current decaying position.

References :

1. Satpathy, L. D., Chatterjee, B., & Mahakud, J. (2017). Firm Characteristics and Total Factor Productivity: Evidence from Indian Manufacturing Firms. Margin: The Journal of Applied Economic Research, 11(1), 77–98. https://doi.org/10.1177/0973801016676013
2. Dr. Thomas Issac TM and Ajith Mathai(2017). Kerala Coir: The Agenda for Modernisation, National Coir Research and Management Institute, Thiruvananthapuram.

3. Indu.K. (2015). An Inquiry into the Changing Market Conditions for Coir Products, Proceedings of Development Seminar, IV International Kerala Studies Congress 2015.
4. Reshmi Banga and Abhijith Das (2010). Role of Trade Policies in the Growth of Indian Manufacturing Sector, MRPA Paper No. 35198, UNCTAD, Centre for WTO Studies.
5. İmrohoroğlu, A., & Tüzel, Ş. (2014). Firm-Level Productivity, Risk, and Return. Management Science, 60(8), 2073–2090. https://doi.org/10.1287/mnsc.2013.1852
6. Ozanne, A. L. G(2001). The Determinants of Total Factor Productivity: The High-Performing Asian Economies Revisited, 302.
7. Karunaratne, N. D. (2013). Perspectives on Total Factor Productivity and Foreign Direct Investment in OECD Countries based on Panel Data Econometrics. Scientific Board Members, 25.
8. Pack, H. (1984). Total factor productivity and its determinants: Some international comparisons. Comparative development perspectives (Westview Press, Boulder, CO), 17-41.
9. Prescott, E. C. (1998). Lawrence R. Klein lecture 1997: Needed: A theory of total factor productivity. International economic review, 525-551.
10. Nishimizu, M., & Page, J. M. (1982). Total factor productivity growth, technological progress and technical efficiency change: dimensions of productivity change in Yugoslavia, 1965-78. The Economic Journal, 92(368), 920-936.
11. Hulten, C. R. (2001). Total factor productivity: a short biography. In New developments in productivity analysis (pp. 1-54). University of Chicago Press.
12. Coelli, T. J., & Rao, D. P. (2005). Total factor productivity growth in agriculture: a Malmquist index analysis of 93 countries, 1980–2000. Agricultural Economics, 32, 115-134.
13. Miller, S. M., & Upadhyay, M. P. (2000). The effects of openness, trade orientation, and human capital on total factor productivity. Journal of development economics, 63(2), 399-423.
14. Van Beveren, I. (2012). Total factor productivity estimation: A practical review. Journal of economic surveys, 26(1), 98-128.
15. Nehru, V., & Dhareshwar, A. (1994). New estimates of total factor productivity growth for developing and industrial countries (No. 1313). The World Bank.
16. Balakrishnan, P., & Pushpangadan, K. (1994). Total factor-productivity growth in manufacturing industry: a fresh look. Economic and political weekly, 2028-2035.
17. Chen, E. K. (1997). The total factor productivity debate: determinants of economic growth in East Asia. Asian-Pacific Economic Literature, 11(1), 18-38.
18. Kwon, J. K. (1986). Capital utilization, economies of scale and technical change in the growth of total factor productivity: an explanation of South Korean manufacturing growth. Journal of Development Economics, 24(1), 75-89.
19. Maudos, J., Pastor, J. M., & Serrano, L. (1999). Total factor productivity measurement and human capital in OECD countries. Economics letters, 63(1), 39-44.
20. Moomaw, R. L., & Williams, M. (1991). Total factor productivity growth in manufacturing further evidence from the states. Journal of regional Science, 31(1), 17-34.
21. Rosegrant, M. W., & Evenson, R. E. (1995). Total factor productivity and sources of long-term growth in Indian agriculture (No. 7). International Food Policy Research Institute (IFPRI).
22. Choudhry, M. T. (2009). 1 Determinants of Labor Productivity: An Empirical Investigation of Productivity Divergence.
23. Micallef, B. (2016). Determinants of Labour Productivity in Malta: Evidence from a Firm-Level Survey. Economics & Sociology, 9(4), 27.
24. Kurre, J. A., & Eiben, D. F. (2013, October). Determinants of Labor Productivity for Detailed Manufacturing Industries. In 67th Annual Fall Meeting of the Association for University Business and Economic Research, Richmond, VA.