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Productivity Trends Of Cooperative Sugar Mills In Tamil Nadu

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Introduction

This paper attempts to analyse the total factor productivity in Tamil Nadu cooperative sugar mills.

Productivity is measures as the ratio between the output of a given commodity or service and the inputs used for that output. Generally, labour and capital are the inputs in any industry sector. When all the inputs are added together and productivity ratio is calculated, it is termed as overall productivity ratio. This ratio is described as partial measure of productivity. N.K.Prasad observes 'factor productivity i.e. the productivity of individual factors can be determined provided two conditions are satisfied, viz, that both the input and output are expressed in terms of suitable units, and that it is possible to correlate each factor with specific output. Overall productivity i.e. the productivity of the business as a whole taking all inputs factor together, may be determined provided the different inputs are expressed in the same quantitative units'.[1]

The analysis of productivity growth has gained importance in applied econometric research in the context of industrial organization to sustain itself and succeed. Productivity growth is a measure that quantifies empirically the efficiency of the transformation of inputs into output. It is to be recognized theoretically that, productivity growth measures both movements along the production function and the shift in the production function. Hence rising productivity would help in higher production, greater consumption and better quality of life. Consequently productivity has become an important subject in the field of business operations.

The parametric Total Factor Productivity (TFP) model is estimated through the statistical analysis of a production function or a cost function that allows to consider the

whole relationship between inputs, products and the set of environmental influences related to the productivity process such as institutional and regulatory factors.

Usually TFP is the most adequate measure because it established a relationship between the main variables and the output. For instance, TFP is able to compare different firms or the same firm on different points in time. It may also be able to assess the performance of operational strategies. (Pani and Dibakar Nail 1997; Dhanajayan and Sasikala 1998; and Malik and Singh 1999). In recent times various methods of estimating total factor productivity indices are developed which differs from one another with regard to the weighting scheme involved (Goldar 1983).

This paper has used the familiar method of TFP of Solow, which is based on production function for cooperative sugar mills in Tamil Nadu.

Measurement of Total Factor Productivity

The measures of Total factor productivity are designed to provide on indication of the overall efficiency with which the resources are utilized in the production process. The total factor productivity is defined as the ratio between real output and all factor inputs. Total factor productivity is an essential instrument of growth, which plays a key role in ascertaining the various magnitudes of contributions by different factor inputs to output. There are various total factor productivity indices that differ from one another with regard to the weightage involved. The most commonly used one is Solow Index in empirical analysis.

Solow Index

This index is based on the Cobb-Douglas production function. Under the assumption of constant returns to scale, autonomous Hicks-neutral technical progress and payments to factors according to their marginal product, the following equation is obtained.

$$\frac{\dot{A}}{A} = \frac{\dot{Y}}{Y} - \left((1-\beta)\frac{\dot{L}}{L} + \beta\frac{\dot{K}}{K} \right) \qquad \ldots\ldots\ldots\ldots\ldots (1)$$

Where ‘Y’ denotes output, ‘L’ Labour, ‘K’ capital and ‘β’ the share of capital

‘Dot ‘ stands for the time derivatives.

From equation (1) the discrete form is obtained as

$$\frac{\Delta A}{A} = \frac{\Delta Y}{Y} - \left[(1-\beta) \frac{\acute{L}}{L} + \beta \frac{\acute{K}}{K} \right] \qquad \ldots\ldots\ldots\ldots (2)$$

Once computation of ΔA/A is done for different years with the help of equation (2) the Solow index is obtained using the following identity (Taking A (o) as unity)

$$A(t+1) = A(t) \left[1 + \frac{\Delta A}{A} \right] \qquad \ldots\ldots\ldots\ldots (3)$$

Solow index, being based on the Cobb-Douglas production assumes the elasticity of substitution to be unity. Although this appears quite restrictive this may not be serious draw back. Under the assumption of competitive equilibrium the Solow index is equal to small change in output and input.[2]

Solow's (1957) total productivity index is derived as follows:

Let us assume a Cobb-Douglas production function of the following forms.

$$V = A(t) \cdot L^{\alpha} K^{\beta} \qquad \ldots\ldots\ldots\ldots (1)$$

Where $\alpha + \beta = 1$
V is the value added at constant prices
L is labour input
K is fixed capital at constant prices
A(t), $\alpha + \beta$ are constants

Equation (1) can be written as

$$V = A(t) \cdot L^{1-\alpha} K^{\beta} \qquad \ldots\ldots\ldots\ldots (2)$$

i.e.
$$\frac{V}{K} = A(t) \left[\frac{K}{K} \right]^{\beta} \qquad \ldots\ldots\ldots\ldots..(3)$$

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By taking logarithms we get,

$$\text{Log}(V/L) = \text{Log}A(t) + \beta \text{ Log}(K/L) \quad \text{……..(4)}$$

$$\text{Log}A(t) = \text{Log}(V/L) - \beta \text{ Log}(K/L) \quad \text{……..(5)}$$

$$A(t) = \text{Antilog Log } \{ (V/L) = \text{Log}A(t) - \beta \text{ Log}(K/L) \} \quad \text{……..(6)}$$

The parameter 'β' required for computation of A(t) has to be calculated by fittings a logarithmic equation (Equation-4) between V/L and K/L by the method of least squares. Equation (6) gives an average total productivity index for the study period by removing the effect of capital intensity from the labour productivity. But this gives only an average figure for the whole period under study. It would be more useful to know the change of this index with respect to time also. For this following procedure is followed. By differentiating (Equation-4) and expressing it in terms of differentials of discrete from we get:

$$(\Delta V/L) / (V/L) = (\Delta A(t)) / A(t) + \beta \{(\Delta K/L) / (K/L) \} \quad \text{……..(7)}$$

Or

$$(\Delta A(t)) / A(t) = (\Delta V/L) / (V/L) - \beta \{(\Delta K/L) / (K/L) \} \quad \text{……..(8)}$$

Equation (7) expresses the proportional change in labour productivity (V/L) over time of sum of two components, viz., one due to proportional change in the factor {A(t)} and other due to proportional change in capital intensity (K/L). The weight for the latter term is 'β'. From the series of (ΔA(t)) / A(t), A(t) has been calculated for each year of the period under study using equation (8) by assuming the initial value of A(t) as unity. All A(t) values are expressed as percentage in terms of base year values.

In the case of products whose co-efficient of determination values were low. The following procedure is used to calculate the Solow Index of TFP. This index is based on rate of productivity changes and is obtained as follows:[3]

$$(\Delta A(t)) / A(t) = (\Delta V(t)) / V(t) - Wt\ (\Delta L(t)) / L(t) + \pi\ (\Delta K(t)) / K(t)$$

Where $(\Delta V(t)) / V(t)$ = rate of change of real value added
$(\Delta L(t)) / L(t)$ = rate of change of labour
$(\Delta K(t)) / K(t)$ = rate of change of capital
Wt = share of labour in value added in year 't'
Π = share of capital in value added in year 't'

To estimate 'β', we have used the following model:

$$O/L = f (K/L)$$

The estimating equation is

$$Ln\ O/L = \alpha + \beta\ (Ln\ K/L)$$

Results and Discussion

The estimated trends in total factor productivity growth indices of Tamil Nadu cooperative sugar mills for the reference period 2000-01 to 2012-2013 is analysed in detail.

Determinants of Labour Productivity

Regression results have been used to identify whether K/L ratios influences the O/L ratios or not. From the Table-1 it is clear that capital intensity (K/L) has significantly influenced the labour productivity in majority of the cooperative sugar mills except Amaravathi, Cheyyar, Kallakurichi, Maduranthakam and NPKRR cooperative sugar mills. In other words, in these cooperative sugar mills labour productivity was independent of capital intensity. The 'β' is greater than one in Subramania Siva, Dharmapuri and Chengalrayan cooperative sugar mills. It implies that one unit increase in capital intensity results in more than proportionate increase in labour productivity. Higher investment in gross block per unit of labour would be advantageous in these three cooperative sugar mills.

In the remaining cooperative sugar mills, eventhough K/L influences O/L. the rate of growth is less than proportionate.

Table-1 Results of Regression Equation $LnO/L = \alpha + \beta\ (Ln\ K/L)$

Sl. No.	Name of the Mill	α	β	R^2
1.	Amaravathi	0.917	0.131	0.281
2.	Ambur	0.339	0.908	0.758
3.	Chengalrayan	-0.605	1.035	0.604
4.	Cheyyar	0.990	0.536	0.144

5.	Dharmapuri	-0.350	1.215	0.783
6.	Kallakurichi	0.690	0.367	0.211
7.	Maduranthakam	0.653	0.304	0.405
8.	NPKRR	0.926	0.198	0.147
9.	Salem	-0.172	0.889	0.883
10.	Subramania Siva	-3.010	1.786	0.705
11.	Tirupattur	0.308	0.832	0.661
12.	Vellore	0.432	0.986	0.781

Total Factor Productivity in Tamil Nadu Cooperative Sugar mills

Table-2 presents inter-mill details of TFP indices. It is evident that capital intensity has increased in all cooperative sugar mills interestingly labour productivity has also increased in all cooperative sugar mills. In other words, K/L has contributed positively to output growth and labour productivity in majority of the cooperative sugar mills. The Solow index of total factor productivity indicates that the productivity has increased only in the Cheyyar cooperative sugar mill.

The following sugar mills indicate declining productivity trends.

1. Amaravathi
2. Ambur
3. Chengalrayan
4. Kallakurichi
5. NPKRR
6. Salem
7. Tirupattur

In the remaining cooperative sugar mills, the productivity trend was fluctuating.

Table-2 Inter-Mill Comparative Analysis

Sl.No.	Name of the Mill	K/L	O/L	Solow's Index	Remarks
1.	Amaravathi	Increasing	Increasing	Decreasing	Unstable
2.	Ambur	Increasing	Increasing	Decreasing	Unstable
3.	Chengalrayan	Increasing	Increasing	Decreasing	Unstable
4.	Cheyyar	Increasing	Increasing	Increasing	Stable
5.	Dharmapuri	Increasing	Increasing	Fluctuating	Unstable
6.	Kallakurichi	Increasing	Increasing	Decreasing	Unstable
7.	Maduranthakam	Increasing	Increasing	Fluctuating	Unstable
8.	NPKRR	Increasing	Increasing	Decreasing	Unstable

9.	Salem	Increasing	Increasing	Decreasing	Unstable
10.	Subramania Siva	Increasing	Increasing	Fluctuating	Unstable
11.	Tirupattur	Increasing	Increasing	Decreasing	Unstable
12.	Vellore	Increasing	Increasing	Fluctuating	Unstable

Conclusion

The raising K/L ratio indicates the capital intensiveness of the industry. The capital intensity has increased in all cooperative sugar mills over the years. The mean K/L ratio also increased. This could be able to higher re-investment in fixed assets. The growth rate provides empirical evidence that the Tamil Nadu cooperative sugar sector had made an attempt to increase capital intensity during the period under review.

The magnitude of O/L ratio and K/L ratio reveal whether the cooperative sugar mill is capital intensive or labour intensive. Higher the K/L ratio indicates the capital intensiveness of the sugar mill while the higher O/L ratio indicates higher labour productivity. In most of the cooperative sugar mills in Tamil Nadu the growth rate of K/L ratios were higher than the O/L ratios. This indicates higher capital intensity.

The growth rates provide the empirical evidence that the Tamil Nadu cooperative sugar sector made an attempt to increase labour productivity during the period of study. Regression results also show that K/L ratios had a significant influence over O/L ratios.

Total factor productivity does not present a satisfactory picture in Tamil Nadu cooperative sugar mills. The TFP index of all cooperative sugar mills were taken as 100 for the initial years. TFP index shows less than 10 implying low productivity in real terms. Positive TFP index was found only in Cheyyar cooperative sugar mill. The decline in TFP was caused by higher capital accumulation eventhough labour productivity was increasing. The fall in AP_K and MP_K pull down TFP. Some of the cooperative sugar mills showed fluctuating TFP index.

However the overall picture indicates that the cooperative sugar mills in Tamil Nadu were unable to maintain a stable growth during the period under review.

Suggestions

1. The cooperative sugar mills should take proper follow-up measure to minimize the time lag between resource mobilization and utilization. For this, the transport facilities may have to be provided by the government with the help of the mills, managements and local bodies. Otherwise they may at least provide road facilities up to the nearest junction points from the cane fields so that the cane can be transported at a speedier pace and recovery of sucrose can be increased.

2. The cooperative sugar mills may have to exercise control on some part of expenditure by implementing strict measures in reducing the mill over-heads and the surplus labour.

3. The cooperative sugar mills may establish the ancillary units in which the by-products are used as main raw-materials and could gain additional income so as to either increase their profits or reduce losses.

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