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TOTAL FACTOR PRODUCTIVITY IN CEMENT INDUSTRY

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ABSTRACT

Total factor productivity (TFP) is a variable which accounts for the effects in total output *that is not caused by traditionally measured inputs. TFP is a real variable and also independent in nature. Residual profit increases due to TFP growth. Profit is based on the ordinary economic calculation of cost and revenue but TFP growth is not anticipated so any gain and loss in terms of TFP growth is a return over and above the expected potential profit in the long run. Total factor productivity growth (TFP) is the best-known measure of productivity. TFP is a costless growth. It is disembodied technological progress; therefore, it cannot be attributed to any single factor of production. TFP is also dynamic as it can only be captured over a period of time. The focus of this study is on the Indian cement industry, which is the second largest producer in the world after China. The time period for this study is 26 years, i.e. from 1991 to 2016. It is observed that there is significant productivity growth in more than 60 percent of cement companies. The sign of TFP is negative in almost 77% of the companies under study. It depicts that the malleability of technologies needs to be kept in mind. It is on account of the rigidities in the case of the cement industry that real factor productivity is negative. It also appears that under such circumstances even the costless growth alternative of TFP is not available because TFP is the practice of technology but if the technology is rigid, it is not possible to have positive TFP growth.*

Key words: Total Factor Productivity, Productivity, Real Variables, CPI, WPI, GDP, CAGR, Deflators.

INTRODUCTION

TFP (Total factor productivity) growth is a popular measure of productivity. It is a real variable. Comin (2006) described TFP as "Total Factor Productivity (TFP) to be the portion of output not explained by the amount of inputs used in production". It is very dynamic in

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nature as its effect is captured over a period of time. This study highlights that total factor productivity growth is disembodied technological progress. The impact on TFP is not based on a single factor of production, rather it is based on multiple factors of production. Also, TFP is an indirect source of finance as it gives residual profits. Higher productivity is a consequence of opaque activity (Nucci, Pozzolo, and Schivardi [2005]). Research & development was considered as an opaque activity. As it is opaque so its effect is not known clearly. It can also be observed that TFP growth is not observable. The payment of the factors of production is made in real terms. Any residual growth, in real terms, is over and above the contribution that is accounted for. Therefore, it is unobservable.

OBJECTIVES OF THE STUDY

The objectives of the paper are as under:

a) The first objective is to measure the variables of TFP.

b) The second objective is to measure the productivity growth of the cement industry.

c) The third objective is to estimate the productivity of the cement industry.

HYPOTHESIS

The hypothesis for the study is:

- H_0: There is no productivity growth in the cement industry.
- H_A: There is productivity growth in the cement industry.

PROFILE OF CEMENT INDUSTRY

The cement industry in India has grown from strengths to strengths in the past few years on account of high growth of India. The demand for cement, being a derived demand, depends mainly on industrial activities, real estate business, construction activities and investment in the infrastructure sector. India is the second largest producer of quality cement in the world. The cement industry comprises of 183 large cement plants and more than 360 mini cement plants. Large producers contribute about 97% to the installed capacity while mini plants account for the rest. Among these, 98% of the capacity is in the private sector and the rest in

the public sector ***(Planning Commission Report 2011).*** The cement production is approximately 502 million tonnes per year as of 2018 and this capacity is estimated to touch 550 million tonnes by 2020. The initiatives provided by the Government of India to various infrastructure projects, road network, and housing activities have provided the required stimulus towards the growth of the cement industry in India. The construction pace has picked up from 11.7 km/day during FY14 to 27 km/day in FY18. ***(Financial Express)***

REVIEW OF LITERATURE

Bhanumurthy (2002) argued that Cobb-Douglas (CD) production function is a simple tool which can be handled easily and possesses advantages. The CD function can handle multiple inputs in their generalized form. Goldar (2004) represents an alternative set of estimates of TFP growth in Indian manufacturing in the last two decades. The estimates of the study indicate a slowdown in TFP growth in Indian manufacturing in the post-reform period. Goldar and Mitra (2008) analyzed, whether the effect of productivity increase and changing sectoral composition in India have contributed to accelerated economic growth in the post-1980 period. The productivity analysis revealed that a faster TFP growth in the services sector in the post-1980 period had been an important contributor to accelerated economic growth. According to Heshmati (2016), the technical change and TFP growth are negative across country groups and years in the technology index model influenced by the global economic crisis.

PRODUCTIVITY

It is assumed that production takes place through Cobb-Douglas technology. The function for the standard form for production of a good with 2 factors is:

$$Y = A L^{a} K^{b} \qquad \text{.....(1)}$$

where:

Y = Real Value Added
L = Labor input
K = Capital input
A = Total factor productivity

α and β are the output elasticities of labor and capital, respectively. These values are constants determined by available technology.

Further, If $\alpha + \beta = 1$, the production function has constant returns to scale

If $\alpha + \beta < 1$, the returns to scale are decreasing,

If $\alpha + \beta > 1$, the returns to scale are increasing.

In the case of a C-D function, constant returns to scale is there. It is clear that both 'A' (Technical efficiency) and 'b' (TFP growth) are parts of the same phenomenon and represents the residual output. As such this output is not measurable ex- ante. It is in the nature of 'unpaid' services of both capital and labor. Since it cannot be measured ex-ante it cannot be paid for. It is, therefore, TFP growth is both 'residual' and 'opaque'. The costing cannot be incorporated into the technology. It is therefore known as disembodied technological progress. In financial terms, the residual output gets added to the cash inflows but, since the TFP is 'unpaid' it is opaque.

TFP (Total Factor Productivity)

'Total Factor Productivity (TFP) is the portion of output not explained by the amount of inputs used in production. As such, its level is determined by how efficiently and intensely the inputs are utilized in production' Comin (2006).

In this study, a four-factor production function is used, i.e. Labor, Capital, Material, and Energy are used as four-factor inputs. The function will be represented as shown in Equation 2.

$$Y_t = A L^a K^b E^g M^d \quad \text{.....(2)}$$

Where, Y = total output, L = labor input, K = capital input, E = Energy input, M = Material input, A = total factor productivity, t = Time and α, β, g and d are the output elasticities of labor, capital, energy, and material respectively. These values are constants determined by available technology.

Data has been collected from prowess for the computation of total factor productivity.

The five variables which are needed for computation are as under:

i. Output: It is an amount produced or manufactured during a certain time. As per National income accounting, Choudhury (1995) and Miron and Zeldes (1987) output is defined as:

Output = Sales + Change in stock ...(3)

where,

Change in stock = Closing stock – Opening stock ...(4)

OR

Output = Sales + (Closing stock – Opening stock) ...(5)

ii. Wages and salaries: It is the factor payment (remuneration) made to labor for his services.

iii. Energy: It means the sources of energy like power, fuel, water, etc used by the manufacturers for the production of goods and services.

iv. Material: It is basically the raw material used for the production of finished goods. It is used for the primary production or manufacturing of a good.

v. Capital: It is a measure of the flow of capital services available for production from the stock of capital goods.

'Prowess' Database gives information on these five components of TFP as shown in Table 1.

Table 1: Heads of the Five Variables of TFP under Prowess

S.No.	Variable Name	Heads under Prowess***
1	Sales	Sales
2	Change in Stock	Change in the stock of finished and semi-finished goods
3	Wages	Salaries & Wages
4	Energy	Power, fuel (including wheeling charges paid by electricity companies) & water charges
5	Material	Raw material expenses

****All the above variables are denoted in '₹ Million'.*

TFP is calculated for a period of 26 years i.e. from 1991 to 2016. Time series analysis is used for measuring TFP.

THE MODELS FOR TFP MEASUREMENT

i. Total output, total wages, the total amount of material input used and the total amount of power input used is calculated from the above mentioned five variables

ii. As productivity is a real variable so it is required to convert output, wages, energy and material into real output, real wages, real energy, and real material by deflating the variables by their deflators.

iii. For finding out deflators, '*Handbook of Statistics*' from RBI website is used. The Consumer Price Index is used for finding the deflator of wages and the Wholesale Price Index is used for finding the deflators of output, energy, and material. The deflators are given in Table 2.

Table 2: Deflators Selection for each Variable

Variable	Index	Deflator Name
Wages	Consumer Price Index	IW (Industrial Worker)
Output	Wholesale Price Index	MP (Manufactured Products)
Energy	Wholesale Price Index	F&P (Fuel and Power)
Material	Wholesale Price Index	NF (Non-Food articles)

1993-94 is taken as the base year for all the deflators in the 26 years. For formulating the same base 'Splicing method' is used because the WPI and CPI indexes are based on different base years. Table 3 is the final table of deflators.

iv. The real output, real wages, real energy, and real material are calculated by dividing variables from their deflators shown as under:

Real Output = Total Output / Output Deflator

Real Wages = Total Wages / Wage Deflator

Real Energy = Total Energy / Energy Deflator

Real Material = Total material / Material deflator.

Table 3: Final Deflators

Year	Wage Deflator	Material Deflator	Energy Deflator	Output Deflator
1991-92	0.85	0.92	0.76	0.84
1992-93	0.93	0.91	0.87	0.93
1993-94*	**1**	**1**	**1**	**1**
1994-95	1.1	1.24	1.08	1.12
1995-96	1.21	1.35	1.14	1.21
1996-97	1.82	1.34	1.26	1.24
1997-98	1.95	1.37	1.43	1.28
1998-99	2.2	1.51	1.48	1.33
1999-00	2.28	1.43	1.62	1.37
2000-01	2.36	1.46	2.08	1.41
2001-02	2.46	1.52	2.26	1.44
2002-03	2.56	1.65	2.39	1.48
2003-04	2.66	1.86	2.54	1.56
2004-05	2.77	1.87	2.8	1.66
2005-06	2.88	1.81	3.18	1.7
2006-07	3.08	1.91	3.39	1.8
2007-08	3.28	2.14	3.39	1.89
2008-09	3.57	2.42	3.78	2
2009-10	4.02	2.55	3.7	2.05
2010-11	4.43	3.12	4.16	2.16
2011-12	3.5	3.43	4.74	2.32
2012-13	3.86	3.88	5.07	2.44
2013-14	4.24	4.06	5.43	2.52
2014-15	4.5	3.94	5.1	2.58
2015-16	4.76	4.05	4.1	2.53
2016-17	4.95	4.18	4.09	2.57

**Base year 1993-94*

v. After deducting real wages, real energy and real material from the real output, the value of real capital is calculated. So, real capital is residual value, i.e. the leftover after making all the other factor payments from the real output. It can be represented as:

[Real Capital = Real Output – (Real Wages + Real Material + Real Energy)] .....(6)

vi. After step five, LOG of all the five real variables, i.e. Real Output (LRO), Real Wages (LRW), Real Energy (LRE), Real Material (LRM) and Real Capital (LRK), is taken for all the 26 years (1991-2016). It gave a semi-log equation as under:

$$Y_t = e^{a+bt} L^{a} K^{b} E^{g} M^{d} \quad \text{..... (7)}$$

$$LogY_t = A + bT + a LogL_t + b LogK_t + g LogE_t + d LogM_t + U_t \quad \text{..... (8)}$$

vii. On the above semi-log equation, regression is applied by taking LRO as the dependent variable and the four inputs, i.e. LRW, LRK, LRE, LRM and Time (1991-2016) as independent variables.

viii. The output sheet of regression of each company gives the TFP coefficient. It gives 1 value of TFP for 26 years because TFP effect comes over a period of time.

Table 4: The Results of TFP: Total Factor Productivity Growth

S.No.	Company Name	Coefficient of TFP	P value
1	A C C Ltd.	**-0.001150662**	0.003269626
2	Andhra Cements Ltd.	0.007888109	0.074687887
3	Bheema Cements Ltd.	**0.012796721**	0.004734159
4	Birla Corporation Ltd.	-0.001467243	0.514974213
5	Cement Corpn. Of India Ltd.	**0.027089530**	0.01403376
6	Century Textiles & Inds. Ltd.	-0.000841771	0.55483721
7	Chettinad Cement Corpn. Ltd.	**-0.005743008**	0.000567606
8	Deccan Cements Ltd.	-0.000965433	0.881991362
9	Gujarat Sidhee Cement Ltd.	**-0.003354578**	0.008198571
10	Heidelberg Cement India Ltd.	**0.003302468**	0.026020259
11	India Cements Ltd.	**-0.003617183**	0.002763023
12	J K Lakshmi Cement Ltd.	-0.001405639	0.723490717

13	K C P Ltd.	**-0.005013016**	0.030906066
14	Kakatiya Cement Sugar & Inds. Ltd.	**-0.011419524**	0.000927219
15	Kalyanpur Cements Ltd.	**0.017784121**	0.000118753
16	Keerthi Industries Ltd.	**-0.002307206**	0.002705692
17	Madras Cements Ltd.	-0.001026537	0.540945666
18	Malabar Cements Ltd.	**-0.000693135**	0.004365928
19	Mangalam Cement Ltd.	-0.001708329	0.383807108
20	N C L Industries Ltd.	-0.002205722	0.517664768
21	Orient Paper & Inds. Ltd.	**-0.001384313**	0.003243769
22	Panyam Cements & Mineral Inds. Ltd.	**-0.015573723**	0.017303846
23	Rain Commodities Ltd.	**0.022111979**	0.018132945
24	Sagar Cements Ltd.	**-0.007211484**	0.001846891
25	Sanghi Industries Ltd.	0.006055057	0.342598069
26	Shree Cement Ltd.	-0.001630555	0.562320636
27	Shree Digvijay Cement Co. Ltd.	-0.001732631	0.632162495
28	Tamil Nadu Cements Corpn. Ltd.	**-0.011831013**	0.016430901
29	Travancore Cements Ltd.	-0.001164254	0.506173111
30	Vinay Cements Ltd.	**-0.002443072**	0.001321905

Source: Estimated by author
Note: Bold coefficients represents significant

Out of 30 cement companies, the TFP coefficient of 18 companies is significant at 5% level. It means TFP is significant for approximately 60% of the companies. Out of these 18 companies, the TFP coefficient for 5 companies is positive and for the remaining 13 companies, TFP coefficient is negative. In totality for 23 companies out of 30, the TFP coefficients are negative and for the remaining 7, the TFP coefficients are positive.

It shows that for the cement industry, approximately 77% of companies TFP coefficients are negative and for the remaining 23% of companies the TFP coefficients are positive. So, productivity growth has been noticed in the cement industry. This result rejects our null hypothesis:

$H1A_0$: There is no productivity growth in the cement industry.

CONCLUSION

It is observed that there is productivity growth in more than 50% of cement companies. It shows that for 77 % of companies, TFP is negative and for the remaining 23% of companies the TFP is positive. For a positive TFP, the malleability of technologies needs to be kept in mind. It is on account of the rigidities in the case of the cement industry that real factor (TFP) has not shown up as significant results in a few companies. It also appears that under such circumstances even the costless growth alternative of TFP is not available because TFP is the practice of technology but if the technology is rigid, it is not possible to have TFP growth. The residual growth due to TFP is a source of finance which has hitherto not been recognized.

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