

CHAPTER 5

PRODUCTIVITY CHANGE WITH DECOMPOSITION OF TECHNICAL CHANGE, EFFICIENCY CHANGE, SCALE CHANGE AND PURE EFFICIENCY CHANGE

In this study we calculate productivity change as the geometric mean of two Malmquist productivity indexes. The Malmquist index was introduced by Caves et al. (1982) who dubbed it the (output-based) Malmquist productivity index after Sten Malmquist, who earlier proposed constructing quantity indexes as ratios of distance functions (Malmquist, 1953). Distance functions are function representations of multiple-output, multiple-input technology which require data only on input and output quantities. Consequently, our Malmquist index is a "primal" index of productivity, productivity change that, in contrast to the Tornqvist index, does not require cost or revenue shares to aggregate inputs and out-puts, yet is capable of measuring total factor productivity growth in a multiple-output setting.

In this study, Malmquist productivity index (MPI) a non parametric DEA based approach is used to estimate Total Factor Productivity and its sources. TFP is defined as the ratio of weighted sum of output to the weighted sum of inputs. It can be increased either due to technical change or due to increase in technical efficiency or due to both. The MPI is based on the distance function approach, which is defined in terms of inputs and outputs. With the given input vector, an output distance function maximize the proportional expansion of the output vector, while an input distance function minimize the input vector, given the output vector. In present study we apply output oriented MPI approach, which maximize the output at a given level of inputs. $MPI > 1$ indicates the positive TFPG or increasing productivity trend. $MPI < 1$ indicates the decline in productivity. If MPI is equal to 1 it indicates the no change in productivity. Total Factor Productivity Change (TFPCH) is a geometric mean of

Technical Efficiency Change (EFFCH) and Technical Change (TECHCH). The EFFCH index measures changes in technical efficiency between period t and t+1, which compares to closeness of a firm in each period to that period's efficient boundary. The TECHCH index measures the technology frontier shift between time period t to t+1. These indices can be interpreted as progress when a value is greater than 1, no change when value is equal to 1 and regress when value is less than 1.

Table No 5.1: MALMQUIST PRODUCTIVITY INDEX SUMMARY							
Sr. No	Years	EFFCH	TECHCH	PECH	SECH	TFPCH	TFPGR
1	1998-1999	-	-	-	-	-	-
2	1999-2000	1.000	0.983	1.000	1.000	0.983	-
3	2000-2001	1.000	0.982	1.000	1.000	0.982	-1.8
4	2001-2002	1.000	1.018	1.000	1.000	1.018	1.8
5	2002-2003	1.000	0.976	1.000	1.000	0.976	-2.4
6	2003-2004	1.000	0.986	1.000	1.000	0.986	-1.4
7	2004-2005	1.000	1.025	1.000	1.000	1.025	2.5
8	2005-2006	1.000	0.988	1.000	1.000	0.988	-1.2
9	2006-2007	1.000	1.022	1.000	1.000	1.022	2.2
10	2007-2008	1.000	0.938	1.000	1.000	0.938	-6.2

11	2008-2009	1.000	0.962	1.000	1.000	0.962	-3.8
12	2009-2010	1.000	1.017	1.000	1.000	1.017	1.7
13	2010-2011	1.000	1.019	1.000	1.000	1.019	1.9
14	2011-2012	1.000	0.973	1.000	1.000	0.973	-2.7
15	2012-2013	1.000	0.989	1.000	1.000	0.989	-1.1
16	2013-2014	1.000	0.995	1.000	1.000	0.995	0.5
17	2014-2015	1.000	1.007	1.000	1.000	1.007	0.7
Calculated by the Researcher in DEAP 2.1							

In above table 5.1 depicts the summary total factor productivity change (TFPCH), technical change (TECHCH) and efficiency change (EFFCH) indices during the period from 1998-99 to 2014-15. In the study period technical efficiency is equal to one which showing that there is efficiency in sugar industry of India. Pure change (PECH) and Scale change (SECH) also equals to 1 which showing that there is no change in the scale and pure efficiency of the industry. Total Factor productivity change (TFPCH) changed during the study period because of only the change in technical change (TECHCH). In 1999-2000 TFPCH value 0.9383 which is less than 1 so the productivity is declined during the year. And technological change also shows the same value. In 2000-01 TFPCH value is 0.982 which again showed the declined productivity condition in the industry and same change shown in TECHCH. In 2001-02 TFPCH growth is increased with the 1.8% and its value was 1.018 and there was increasing productivity shown during that year. In 2002-03 and 2003-04 TFPCH shows again negative or decreasing productivity and TECHCH trend. In 2004-05 TFPCH is increased

with 2.5% and it shows the value 1.025 which shows increasing productivity trend. In 2004-05 TFPG rate is highest during the study period. In 2005-06 productivity trend is declined with the TFPCH value is 0.988. In 2006-07 TFPCH is 1.022 which is again greater than one and shows the increasing productivity growth. In 2007-08 noticed a high declined in the TFPG rate with -6.2% and TFPCH value is 0.938 in 2007-08 and 0.962 in 2008-09, just showed the declined in the productivity. In 2009-10 and 2010-11 TFPCH is again showed the value greater than one. From 2011-12 to 2013-14 productivity decreasing trend. In 2014-15 TFPCH showed the value 1.007 and again increasing trend in productivity. So we can conclude that there is fluctuation in Total factor productivity of sugar industry in India.

In the study we see that there is change in productivity is effected only by the change in technological change and both consist the same values and trend. So there is direct relation with TFPCH and TECHCH in the study area.

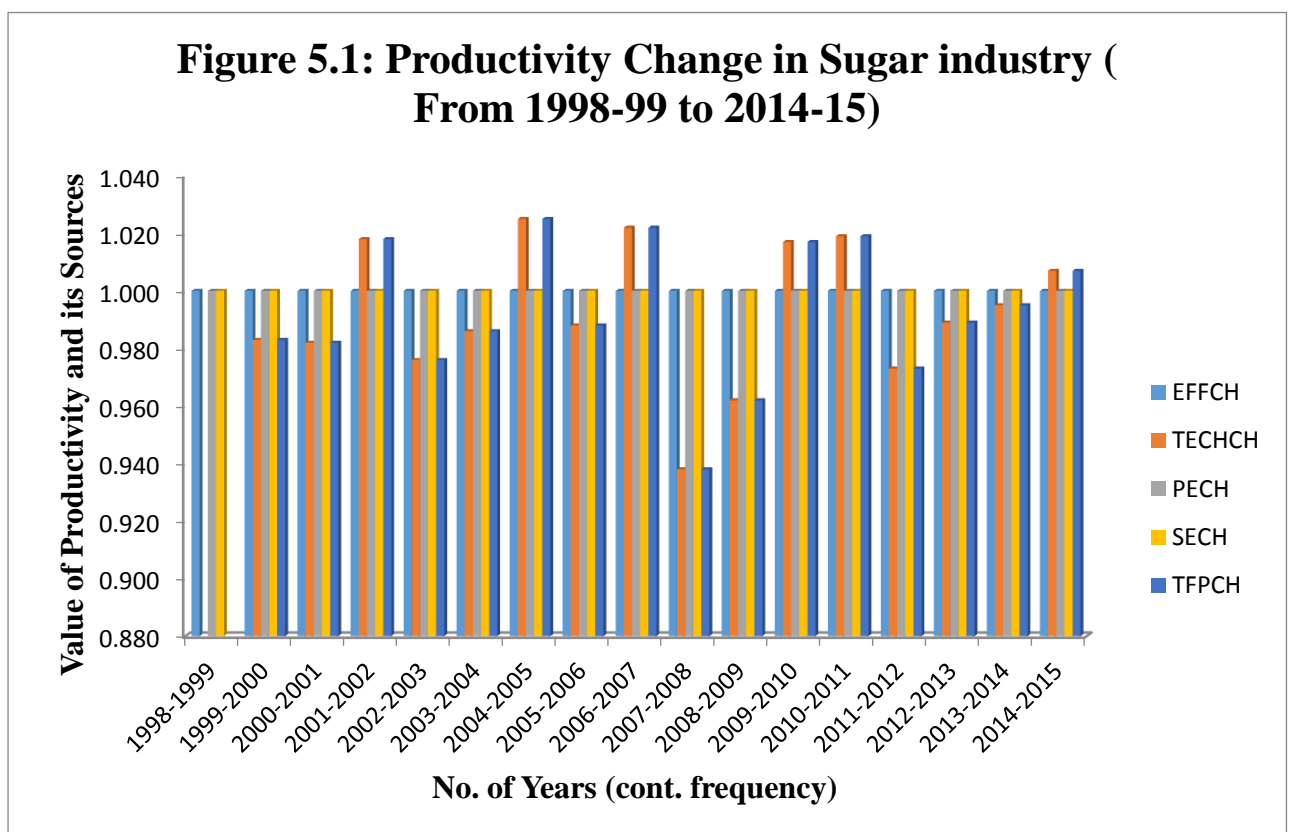


Figure 5.1 depicted the Productivity Change in the Sugar Industry of India from 1998-99 to 2014-15. On the Horizontal Axis no of Years and on the Vertical Axis value of Productivity and its sources showed in the above figure. We can analyze that there is no change in the efficiency change, Pure change and Scale change. All are at their efficient level and gives the value equal to 1. The total factor productivity change which is the productivity of total factors shows variation in the sugar industry and Technological change also fluctuation in the industry during the study Period.

Table 5.2: Malmquist Productivity index summary of Mean				
EFFCH	TECHCH	PECH	SECH	TFPCH
1.00	0.992	1.00	1.00	0.992
Calculated by the Researcher in DEAP 2.1				

Table 4.2 depicts the mean of Malmquist Productivity Index in the study period. Technical efficiency (EFFCH) mean of the study is equal to 1 which shows the efficiency in the industry. Mean of Pure change and scale change during the study period showing no change. Mean of Technical change (TECHCH) showing the regression in technological change which is the main cause in the decline of mean in Total Factor Productivity Change (TFPCH).

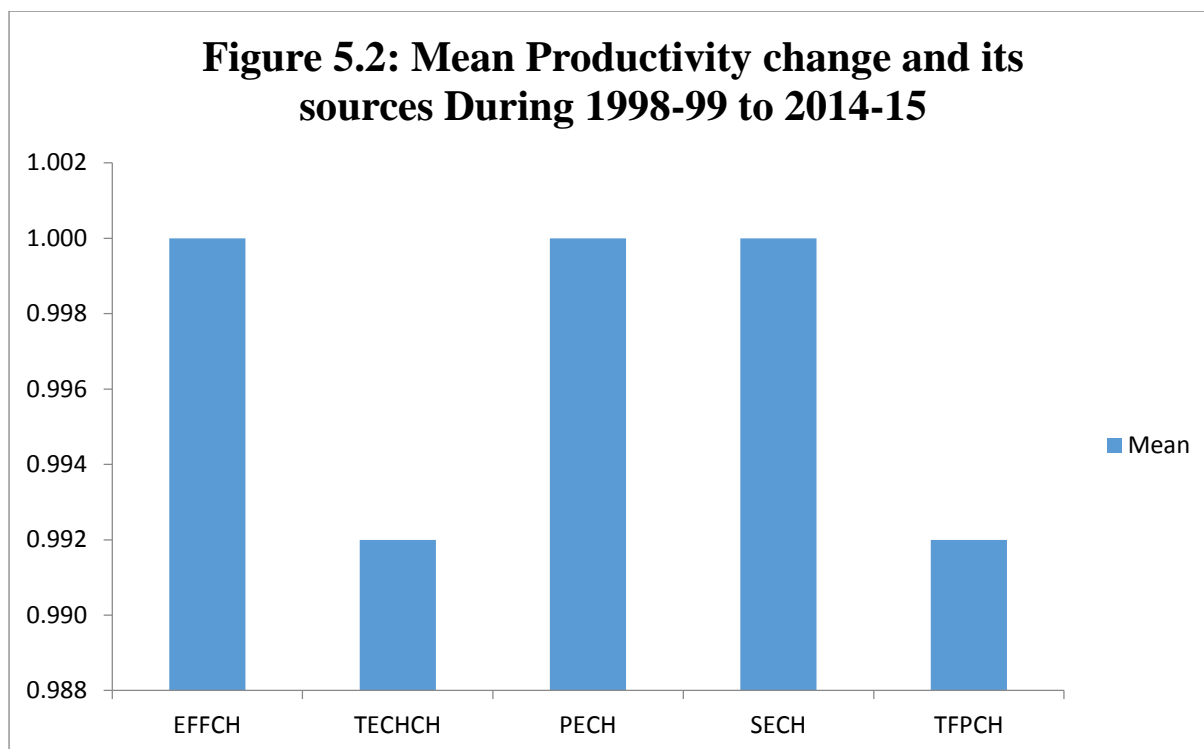


Figure 5.2 shows the average of Productivity trend during the study Period from 1998-99 to 2014-15. And we can that there is declined productivity trend showed in the sugar industry of India. And the Efficiency Change (Catching Up) which shows the efficiency level in the sugar industry. Pure Change and Scale Change does show no change during the study period Technological Change is less than 1 and just shows the regress trend in the sugar industry. Total Factor Productivity is also changed with same value and showed the declined trend in the productivity of sugar industry in India.

Conclusion

On the bases of above tables, we analyzed that there is found the regress in the productivity of sugar industry in India. And there is need to improve in TECHCH which is directly related with the innovation, research and development in the industry. There is no change in the efficiency of the sugar industry. Managerial efficiency (Pure efficiency) and Scale change is also shown no change. It means firms are working on Constant Return to Scale. By this chapter researcher fulfilled two Objectives of the study which are: the Productivity trend and

Total Factor Productivity with technical efficiency and technical change in Sugar Industry of India.