Pacific Business Review International
Volume 1, Issue 1, June 2016

Efficiency, Productivity and Profitability Changes in the Indian Food Processing Industry: A Firm Level Analysis

Navreet Kaur
Senior Research Fellow,
Guru Nanak Dev University,Amritsar

Dr. Kuldip Kaur
Professor, Punjab School of Economics,
Guru Nanak Dev University, Amritsar

Abstract

This paper analyses efficiency and productivity changes in 50 firms of food manufacturing industry during the time period of 1988 to 2011.The firms included belong to different sectors of food processing which are mainly Sugar, Bakery Products, Beer and Alcohol, Dairy Products, Processed Food and Vegetable Oil and Products. The nonparametric Data Envelopment Analysis (DEA) approach is used to compute the Malmquist Total Factor Productivity (TFP) change, which has been further decomposed into efficiency and technical change. Profitability has been calculated with two different measures. Analysis has been done over four time periods that is 1988 to 1993, 1994 to 1999, 2000 to 2005 and 2006 to 2011. Based on the findings, the paper gives suggestions that can be used by policy makers and food processors in making decisions regarding various technical and managerial aspects to improve productivity and efficiency.

Keywords: Technical Efficiency, Total Factor Productivity, Profitability, Food Processing, Data Envelopment Analysis.

Introduction

In a country like India where more than half of the population is dependent upon agricultural sector, the Industry based on this sector for raw materials, is of utmost importance. This industry is also important from the Food Security point of view. India's strong agricultural base and accelerating economic growth holds a significant potential for the Food Processing Industry that provides a strong link between agriculture and consumers. Food processing is the transformation of raw ingredients into food, or of food into other forms. Food processing typically takes clean, harvested crops or butchered animal products and uses these to produce attractive, marketable and often long shelf-life food products.

Food and food products are the largest consumption category in India, with a market size of USD 181billion. Domestically, the spending on food and food products amounts to nearly 21% of the gross domestic product of the country and constitutes the largest portion of the Indian consumer spending more than a 31% share of wallet. Going forward, the Indian domestic food market is expected to grow by nearly 40% of the current market size by 2015, to touch USD 258 billion by 2015. (FICCI-EY Report, 2009)

Food processing industry in India is increasingly seen as a potential source for driving the rural economy as it brings about synergy between the consumer, industry and agriculture. It is widely accepted that the food processing sector is the most appropriate sector for creating jobs for rural poor, and thus reducing the burden on agricultural sector for creation of their livelihood. As non-farm sector is gaining importance, food industry can be seen as major part of non-farm sector. A well developed food processing industry is expected to increase farm gate prices, reduce wastages, ensure value addition, promote crop diversification, generate employment opportunities as well as export earnings. With proper investment in food processing, technical innovation and infrastructure for agriculture sector, India could well become the food basket of the world. (Meeta P, 2007)

The level and structure of the Indian food processing industry reflects that food production is mainly constrained due to the following reasons

1. Lack of comprehensive national policy on food processing sector.
2. Unavailability of trained manpower.
3. Expensive food machinery and packaging technologies.

4. Constraints in raw material production.
5. Inadequate infrastructure facilities
6. Less access to credit
7. Inconsistency in central and state policies. (FICCI Survey 2010)

Food processing accounts for about 14% of manufacturing GDP, i.e. Rs. 2,80,000 crore, and employs about 13 million people directly and 35 million people indirectly. Its employment intensity can be seen by the fact that for every Rs. 1 million invested, 18 direct jobs and 64 indirect jobs are created in organized food processing industry only. (GOI Report, 2011)

The food processing sector in India covers a wide range of food items such as meat and meat products, fish and fish products, fruits and vegetables, vegetable oils and fats, milk and milk products, grain milling, animal feed, confectionery products, bakery products, sugar processing, among others. The 50 firms included in the present paper belong to different sectors of food processing which are mainly from Sugar, Bakery Products, Beer and Alcohol, Dairy Products, Processed Food and Vegetable Oil and Products. Considering much important role of Food Processing Industry in India, this study evaluates the performance of various firms of the food processing industry in India in terms of TFP and efficiency change over the period of 1988 to 2011, in order to give some suitable suggestions to reap the benefits from this industry.

Objectives

With this background, the main objectives of this study are as follows:

1. To evaluate the performance of Food Processing Industry in India in terms of efficiency.
2. To calculate the productivity changes in Food Processing Sector in India by calculating total factor productivity.
3. And finally to analyze the profitability changes in the food processing industry in India.
4. To draw some conclusions and policy implications on the basis of the findings.

The study has been divided into five sections in total including the present one which is introductory in nature. Section III discusses data base and methodology used in the study. Next section presents the main results and discussions from the analysis. Sections V and VI draw conclusions and policy implications.

Data Base and Methodology

The study is based on cross sectional data from all the 51 firms under food processing industry taken from Prowess data base and various reports published by Centre for Monitoring Indian Economy (CMIE). Average Technical and scale efficiencies have been calculated at five periods of time i.e. 1988, 1993, 1999, 2005 and 2011. Efficiency change and total factor productivity has been calculated at four points of time i.e. from 1988-1993, 1994-1999, 2000-2005 and 2006-2011. Three inputs and one output have been used. The inputs used are net fixed capital, expenses and raw material. The output variable is net sales. These variables can be defined as follows:

Fixed Capital

Fixed capital comprises depreciated value of all fixed assets owned by the firm as on the closing day of the accounting year.

Raw Material

Raw material is the major input used by the firm. In food processing industry it constitutes raw agricultural produce of respective food unit, like food, spices, edible oils, vegetables, chemicals, ice and packing materials, etc.

Expenses

All the expenses of firm are included in this. Basically a sum of depreciation , interest payment, rent, wages of employees, cost of raw material, etc is used to estimate the expenses of a firm.

Net Sales

Net sales or total revenue is the key item and it is derived by deducting goods returned, allowances and discount from the gross amount received from sales.

The main analysis applied for computing the firm level efficiency is Data Envelopment Analysis (DEA) Model. DEA is a performance assessment tool useful for calculating patterns of dynamic efficiencies. The DEA methodology was initiated by Charnes, Cooper, and Rhodes (1978) whose work was largely based on the frontier concept pioneered by Farrell (1957). Thus, the DEA is a methodology directed to frontiers rather than central tendencies (Seiford and Thral 1990). The original model developed by Charnes, Cooper and Rhodes (CCR model) was applicable when technologies were characterized by constant returns to scale (CRS) and all firms operated at an optimal scale (Coelli, Prasada, and Battese 1998). But, imperfect competition may cause a Decision Making Unit(DMU) not to operate at optimal scale (Coelli 1996). Therefore, an input-oriented variable returns to scale (VRS) Data Envelopment Analysis

Model extended by Banker, Charnes, and Cooper (BCC Model) in 1984 has been used for measuring technical and scale efficiency. For estimating the TFP change in the Indian food processing industry, the Malmquist productivity index is used. The Malmquist productivity index was introduced by Caves, Christensen, and Diewert (1982) based on the distance functions developed by Malmquist, which is defined as the ratio of two output distance functions. In other words, the Malmquist TFP index measures the TFP change between two data points by calculating the ratio of the distances of each data point relative to a common technology. The Malmquist TFP index and efficiency scores have been obtained by using the Data Envelopment Analysis Program (DEAP) software (version 2.1) developed by Coelli (1996). The Malmquist TFP index measures the productivity changes over period t to period t+1. This output-based index explains the change in productivity level in given level of inputs. The TFP change in a firm occurs either due to technological progress (i.e., shift in the production frontier), or due to efficiency improvements in the firm (Hossain and Bhuyan 2000). A productivity value index larger than one indicates a productivity improvement and a value less than one indicates productivity decline.

Profitability of the firms has been calculated with two measures so there are two profitability ratios P1 and P2. P1 is defined as net profits as per cent of net sales and P2 is defined as net profits as per cent of total assets.

Results and Discussion

Performance of food processing industry in India

Food processing is an emerging sector of Indian economy and is growing at a rate of more than 10 percent per annum. The majority of the food processing units in the country are unorganized and are facing various kinds of challenges in the fast changing global scenario. The performance of Indian food processing industry is measured in terms of technical and scale efficiency (Table 1). The technical efficiency is the product of its scale efficiency and pure technical efficiency estimated under the assumption of constant returns to scale. The values of efficiency indices equal to unity imply that the industry is on best practice frontier, while values below unity show that the industry is below the frontier or technically inefficient. Analysis of the data shows that the average estimated technical efficiency score is 0.718 in 1988 under the CRS model and it has increased to 0.871 in 1993 which shows the immediate effects of Industrial reforms on industrial performance but after that i.e. in 1999 and 2005 it has decreased and reached at 0.747 in 2011. So if we look at the whole period ,technical efficiency has increased slightly from 0.718 to 0.747 in 2011 but it has shown decreasing trends after 1993 and similar is the case with technical efficiency scores under the VRS model. It has also increased from 0.757 in 1988 to 0.816 in 2011 but with similar trends in the middle years. The average scale efficiency in Indian food processing firms is estimated to be 0.954 in 1988 and it has increased in all the years except in 2005 but it has reached at 0.960 in 2011. The efficiency scores in the food processing industry vary significantly across different firms and over time. It is also evident that the average technical efficiency scores for the food processing industry as a whole have experienced declining trends during the whole study period. The average technical efficiency during 1988 i.e. the pre-liberalization period is low due to various restrictions on Indian industry. Though it has increased during 1993 i.e. the liberalization period, but after that in the post- liberalization period it has again declined. This phenomenon may be because of high gestation lag in capital investment. However, the scale efficiency has shown increasing trends in almost all the periods. This implies that market liberalization has facilitated the investment in capital and also its capacity utilization.

The relevance of returns to scale analysis in business decision-making is a well researched area (Kang and Kwon 1993; Segoura 1998; Butler and Li 2005). The analysis provides information about production performance and helps to determine the effectiveness of resource utilization. Table 2 indicates that number of firms operating under decreasing returns to scale has increased from 21 firms in 1988 to 38 firms in 2011. In 1988, 20 firms were operating under constant returns to scale, but in 2011 this number has decreased to 4. Majority of the firms have moved towards decreasing returns to scale during 2011. These results clearly indicate that liberalization process might have caused over-capitalization and hence capacity might not have been fully utilized as returns are increasing at decreasing rate. This finding has also been supported by the previous results of technical and scale efficiency, which have shown that after market reforms efficiency has increased at nominal rate.

Productivity Changes in the Food Processing Industry

Table 3 shows the estimated average annual rate of productivity and efficiency changes in the Indian food processing industry during the four different time periods which are 1988-1993,1994-1999, 2000-2005 and 2006-2011.

The Malmquist TFP index measures the productivity changes over period t to period t+1. This output-based index explains the change in productivity level in given level of inputs. The TFP change in a firm occurs either due to technological progress (i.e., shift in the production frontier), or due to efficiency improvements in the firm (Hossain and Bhuyan 2000). A productivity value index larger than one

indicates a productivity improvement and a value less than one indicates productivity decline.

Results revealed that during the study period, most of the firms of the food processing industry experienced positive change in Total Factor Productivity with varied magnitude. The overall TFP change in the Indian food processing industry has increased from 1.068 in 1988-1993 to 1.083 in 2005-11. Out of 51 firms only 21 firms have shown increase in TFP in 2011 as compared to 38 firms in 1993. So, the contribution of technological progress and efficiency change in various firms of food processing has shown mixed trends.

Profitability Changes in the Food Processing Industry

Profitability of the sample firms has been calculated with two measures. Profitability ratio P1 is defined as net profits as per cent of net sales and P2 is defined as net profits as per cent of total assets. Further depending upon the values, profitability has been divided into three ranges i.e. low, medium and high. Low range comprises of firms having profitability ranging up to 1%, medium range consists of firms having profitability ranging from 1.1% to 5% and high range consists of firms having profitability ranging from 5.1% to 10% or above.

Table 4.1 presents the profitability (P1) of Food industry in India. Results revealed that in 1988, 18 out of 50 firms are highly profitable. Of the total, 20 firms i.e. 40% firms lie in medium range and 24% firms have low profitability. But in 1993 there is a slighter improvement in profitability as percentage of firms under low range has decreased from 24% in 1988 to 20% in 1993 and under medium range it has increased from 40% in 1988 to 46% in 1993. But there after the profitability of firms has declined i.e. 48% belong to low range of profitability in 2011 as against 20% in 1993 and remaining 52% are equally divided in medium and high ranges.

Similarly table 4.2 presents the profitability (P2) of Food industry in India. Results revealed that in 1988, 44% firms are highly profitable. Out of the total firms, 17 firms i.e. 34% firms lie in medium range and 22% firms have low profitability. But in 1993 (similarly as P1) there is a slighter improvement in profitability, as percentage of firms under low range has decreased from 22% in 1988 to 18% in 1993 and under medium range it has increased from 34% in 1988 to 42% in 1993. However , again the profitability of firms has declined i.e. 44% firms belong to low range of profitability in 2011 as against 22% in 1993 and remaining 56% firms belong to medium and high ranges as 30% and 26% respectively.

So, the results of profitability of Food Processing Industry have somehow shown consistency with the above results of efficiency and productivity. With the advent of industrial policy reforms in 1991, firms have shown slighter improvement in profitability but after that the profitability of firms has shown declining trends.

There can be many reasons behind the low profitability of firms, some of which are India's problematic infrastructure, lack of proper storage facilities which leads to wastage of raw produce and last but not the least is inflation and changing commodity prices which hamper the growth and profitability of firms in this sector.

Conclusions

The food processing sector is the most appropriate sector for creating jobs for rural poor, and thus reduces the burden on agricultural sector for creation of their livelihood. This is due to their familiarity with the agricultural sector which would make it easier to train and place them in food processing enterprises. But the level of food processing in the country is at its initial stage and only a small quantity of agricultural produce is processed. The growth in the Indian food processing industry is mainly constrained due to lack of productivity enhancing technologies and limited resource utilization. Therefore, technology is the key to enhance growth and efficiency in the food processing sector.

The analysis suggests that the efficiency scores in the food processing industry vary significantly across different firms and over time. It is also evident that the average technical efficiency scores for the food processing industry as a whole have experienced declining trends during the whole study period. However the scale efficiency has slightly improved. This implies that market liberalization has not properly facilitated the enhanced investment in capital goods which could have resulted in greater capacity utilization. The analysis of returns to scale suggests that most of the firms have moved from Increasing returns to scale towards Constant returns to scale and Decreasing returns to scale. This result clearly indicates that additional investment in the food processing firms with increasing and constant returns to scale will give encouraging and profitable output, whereas firms with decreasing returns to scale need significant reorientation and modernization of the production process.

The food industry has experienced positive change in TFP with varied magnitude across different firms. Out of 51 firms only 21 firms have shown increase in TFP. So the contribution of technological progress and efficiency change in various firms of food processing has shown mixed trends and this needs attention for sustainable growth of the food processing sector.

Results of profitability analysis revealed that firms have shown little improvement in terms of profitability with the

advent of economic reforms but after that firms have shown declining trends. After economic reforms government has focused on food processing industry but still investment in this sector is very low.

Policy Implications

The study provides empirical evidence on efficiency, productivity and profitabiliy changes for different firms of the food processing industry over a period of more than two decades. Results have shown that firms with higher efficiency and productivity seem to be more attractive for investment. Given the contribution of the food processing industry for diversification of employment from primary sector to secondary sector, the government may plan a relief package for inefficient firms to enhance their performance. This sector is directly attached to agriculture sector, so, its improvement will help in reducing many problems related to agricultural sector like disguised unemployment. Government intervention in raw material sourcing for food processing units is quite critical, and policy reforms should be made to allow direct participation of food processors in procuring their raw material from the farmers, thus eliminating the middle men.

Food processing industry should be seen as priority sector because India having access to vast pool of natural resources and growing technical knowledge base, has strong comparative advantage over other nations in this industry. The development of infrastructure facilities like cold chain, road facilities and most important continuous supply of power will strengthen the food processing industry. The food processing industry is all set to drive Indian economy to higher growth, only need is to pay due attention on technological development of field, and generation of skilled manpower. Therefore, to fully leverage the growth potential of the sector, current challenges that are being faced by the industry need to be properly addressed and steps need to be taken to remove the bottlenecks hampering the sectoral growth.

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Table 1

Average Technical and Scale Efficiency in Indian Food Processing Sector (1988-2011)

	1988			1993			1999			2005			2011		
FIRMS	crste	vrste	scale	crste	vrste	scale	crste	vrste	scale	crste	vrste	scale	crste	vrste	scale
Agro Tech Foods Ltd.	0.679	0.680	1.000	0.951	0.996	0.955	0.964	1.000	0.964	1.000	1.000	1.000	0.959	1.000	0.959
Amrit Corp. Ltd.	0.625	0.815	0.780	0.928	0.981	0.946	0.917	0.958	0.957	0.846	0.911	0.929	0.862	0.866	0.995
Arthos Breweries Ltd.	0.419	0.431	0.971	0.690	0.731	0.945	1.000	1.000	1.000	0.738	0.740	0.997	0.673	0.674	0.999
Bajaj Hindusthan Ltd.	0.671	0.754	0.890	0.681	0.745	0.914	0.907	0.954	0.951	0.809	1.000	0.809	0.954	1.000	0.954
Balrampur Chini Mills Ltd.	0.550	0.550	1.000	0.727	0.728	1.000	0.891	0.944	0.943	0.633	0.831	0.762	0.595	0.678	0.878
Bannari Amman Sugars Ltd.	0.677	0.686	0.987	0.585	0.588	0.995	0.795	0.827	0.961	0.733	0.913	0.803	0.621	0.644	0.964
Brihan Maharashtra Sugar Syndicate Ltd.	0.717	0.761	0.942	0.872	0.876	0.995	0.928	0.944	0.983	0.441	0.442	0.997	0.994	1.000	0.994
Britannia Industries Ltd.	0.797	1.000	0.797	0.983	1.000	0.983	0.955	0.985	0.970	0.911	0.980	0.929	0.949	1.000	0.949
Cadbury India Ltd.	0.919	0.946	0.972	1.000	1.000	1.000	0.998	1.000	0.998	0.904	0.904	1.000	0.845	0.926	0.912
Dalmia Bharat Sugar & Inds. Ltd.	0.871	0.887	0.982	1.000	1.000	1.000	0.881	0.914	0.964	0.754	0.825	0.913	0.742	0.759	0.978
Dhampur Sugar Mills Ltd.	0.516	0.565	0.912	1.000	1.000	1.000	0.743	0.788	0.943	0.735	0.867	0.848	0.681	0.760	0.896
Dharani Sugars & Chemicals Ltd.	0.804	0.804	1.000	1.000	1.000	1.000	0.650	0.659	0.987	0.584	0.696	0.839	1.000	1.000	1.000
E I D-Parry (India) Ltd.	0.982	1.000	0.982	0.948	1.000	0.948	0.860	0.897	0.958	0.721	0.975	0.740	0.765	0.806	0.950
Foods & Inns Ltd.	0.848	0.874	0.970	0.982	1.000	0.982	1.000	1.000	1.000	0.776	0.797	0.973	0.631	0.656	0.962
Glaxosmithkline Consumer Healthcare Ltd.	1.000	1.000	1.000	0.926	0.948	0.977	0.948	0.953	0.994	1.000	1.000	1.000	0.948	1.000	0.948
Godfrey Phillips India Ltd.	0.768	0.929	0.826	1.000	1.000	1.000	0.913	1.000	0.913	1.000	1.000	1.000	0.483	0.869	0.555
Gwalior Sugar Co. Ltd.	0.690	0.727	0.950	0.780	0.780	1.000	0.957	0.964	0.992	1.000	1.000	1.000	0.547	0.682	0.802
Harinagar Sugar Mills Ltd.	0.651	0.652	1.000	0.815	0.815	1.000	1.000	1.000	1.000	0.736	0.839	0.878	0.670	0.676	0.991
Hindustan Breweries & Bottling Ltd.	0.571	0.624	0.916	0.741	0.762	0.972	0.664	0.665	0.999	0.546	1.000	0.546	0.492	0.494	0.996
I F B Agro Inds. Ltd.	0.690	0.691	0.999	0.841	0.843	0.998	0.904	0.904	0.999	0.435	0.435	0.999	0.555	0.593	0.936
India Sugars & Refineries Ltd.	0.559	0.559	1.000	0.667	0.672	0.992	0.541	0.547	0.989	0.703	0.732	0.96	0.797	0.977	0.998
Jagatjit Industries Ltd.	0.850	0.953	0.892	0.960	1.000	0.960	0.939	1.000	0.939	0.669	0.774	0.965	0.592	0.732	0.809
Kesar Enterprises Ltd.	0.658	0.683	0.963	0.798	0.804	0.992	0.973	0.982	0.991	0.619	0.676	0.916	0.799	0.849	0.941
Khandelwal Extractions Ltd.	0.677	0.798	0.848	0.990	1.000	0.990	1.000	1.000	1.000	0.928	1.000	0.928	0.831	1.000	0.831
Khoday India Ltd.	0.697	0.716	0.974	0.802	0.804	0.998	0.821	0.825	0.995	0.705	0.713	0.989	0.350	0.421	0.832
Milkfood Ltd.	1.000	1.000	1.000	0.969	0.996	0.973	0.932	0.962	0.969	1.000	1.000	1.000	0.873	0.904	0.966
Modi Naturals Ltd.	0.503	0.503	0.999	0.895	0.897	0.997	0.983	1.000	0.983	0.929	0.930	0.998	0.863	0.894	0.964
Mohan Breweries & Distilleries Ltd.	0.748	0.752	0.995	0.794	0.838	0.948	0.580	0.633	0.917	0.431	0.469	0.919	0.527	0.579	0.910
Mohan Meakin Ltd.	0.846	0.849	0.996	1.000	1.000	1.000	0.998	1.000	0.998	0.902	0.907	0.995	1.000	1.000	1.000
Motilal Padampat Udyog Ltd.	0.676	0.739	0.915	0.813	0.814	1.000	0.899	0.909	0.997	0.690	0.695	0.992	0.767	1.000	0.819
Oudh Sugar Mills Ltd.	0.713	0.741	0.962	0.911	0.912	0.999	0.743	0.775	0.958	0.653	0.796	0.920	0.794	0.812	0.977
P I I L Corporation Ltd.	0.498	0.498	1.000	0.961	0.965	0.996	0.810	0.843	0.960	0.406	0.428	0.949	0.249	1.000	0.249
Premier Industries (India) Ltd.	1.000	1.000	1.000	0.954	0.957	0.997	0.700	0.701	0.999	0.906	0.911	0.994	1.000	1.000	1.000
Prestige Foods Ltd.	0.686	0.686	1.000	0.935	0.964	0.970	0.830	0.856	0.969	0.706	0.706	0.999	1.000	1.000	1.000
Rasoi Ltd.	0.759	1.000	0.759	0.986	0.986	1.000	0.974	1.000	0.974	0.744	0.805	0.924	0.820	0.837	0.980
Ravalgaon Sugar Farm Ltd.	0.829	0.846	0.980	0.928	0.936	0.992	0.812	0.826	0.984	1.000	1.000	1.000	0.354	0.358	0.989
Ruchi Soya Inds. Ltd.	1.000	1.000	1.000	0.900	0.919	0.979	1.000	1.000	1.000	0.912	1.000	0.912	0.871	1.000	0.871
S M Dyechem Ltd.	0.756	0.756	1.000	0.896	0.996	0.899	0.646	0.683	0.946	1.000	1.000	1.000	0.999	1.000	0.999
Sakthi Sugars Ltd.	0.495	0.495	1.000	0.826	0.836	0.988	0.754	0.784	0.962	0.645	0.818	0.889	0.795	0.873	0.911
Simbhaoli Sugars Ltd.	0.738	0.738	1.000	0.748	0.750	0.997	0.705	0.733	0.961	0.596	0.711	0.938	0.628	0.681	0.923
Sir Shadi Lal Enterprises Ltd.	0.747	1.000	0.747	1.000	1.000	1.000	0.962	0.999	0.963	0.754	0.763	0.988	0.672	0.706	0.952
Sri Chamundeswari Sugars Ltd.	0.679	0.777	0.874	0.807	0.807	1.000	0.702	0.708	0.991	0.721	0.722	0.933	0.843	0.862	0.978
Tasty Bite Eatables Ltd.	0.054	0.054	0.999	0.463	1.000	0.463	1.000	1.000	1.000	0.834	0.834	0.999	0.861	0.870	0.989
Thiru Arooran Sugars Ltd.	0.419	0.420	0.999	0.786	0.787	0.998	0.801	0.831	0.964	0.634	0.757	0.937	0.769	0.797	0.965
Triveni Engineering & Inds. Ltd.	0.703	0.754	0.968	0.629	0.647	0.973	0.722	0.755	0.957	0.835	0.993	0.841	0.806	0.868	0.929
Ugar Sugar Works Ltd.	0.731	0.788	0.927	0.791	0.806	0.982	0.652	0.674	0.968	0.797	0.88	0.906	0.672	0.705	0.952
Upper Ganges Sugar & Inds. Ltd.	0.418	0.418	1.000	1.000	1.000	1.000	0.806	0.831	0.97	0.759	0.881	0.862	0.855	0.875	0.977
Vadilal Industries Ltd.	0.700	0.704	0.994	0.981	0.982	0.999	0.723	0.726	0.996	0.649	0.671	0.967	0.880	0.917	0.959
Venky'S (India) Ltd.	0.997	1.000	0.997	0.883	0.898	0.983	0.960	0.977	0.983	0.826	0.936	0.882	0.943	0.996	0.947
Vippy Industries Ltd.	1.000	1.000	1.000	0.913	0.913	1.000	0.870	0.899	0.968	0.705	0.818	0.862	0.937	0.982	0.954
Total Food Processing	0.718	0.757	0.954	0.871	0.896	0.974	0.856	0.878	0.975	0.763	0.949	0.967	0.747	0.816	0.960

Note: crste- Technical Efficiency Under Constant Returns to Scale.
vrste- Technical Efficiency Under Variable Returns to Scale.
scale- Scale Efficiency.

Source: calculated by DEA from Prowess data base

Table 2

Returns to Scale in Indian Food Processing Industry (1988-2011)

Sr.No	FIRMS	1988	1993	1999	2005	2011
1	Agro Tech Foods Ltd.	CRS	DRS	DRS	CRS	DRS
2	Amrit Corp. Ltd	DRS	DRS	DRS	DRS	DRS
3	Arthos Breweries Ltd.	IRS	IRS	CRS	DRS	IRS
4	Bajaj Hindusthan Ltd.	DRS	DRS	DRS	DRS	DRS
5	Balarampur Chini Mills Ltd.	CRS	CRS	DRS	DRS	DRS
6	Bannari Amman Sugars Ltd.	DRS	IRS	DRS	DRS	DRS
7	Brihan Maharashtra Sugar Syndicate Ltd.	IRS	IRS	DRS	IRS	IRS
8	Britannia Industries Ltd.	DRS	DRS	DRS	DRS	DRS
9	Cadbury India Ltd.	DRS	CRS	DRS	CRS	DRS
10	Dalmia Bharat Sugar & Inds. Ltd.	DRS	CRS	DRS	DRS	DRS
11	Dhampur Sugar Mills Ltd.	DRS	CRS	DRS	DRS	DRS
12	Dharani Sugars & Chemicals	CRS	CRS	DRS	DRS	CRS
13	E I D- Parry (India) Ltd.	DRS	DRS	DRS	DRS	DRS
14	Foods & Inns Ltd.	IRS	IRS	CRS	DRS	DRS
15	Glaxosmithkline Consumer Healthcare Ltd.	CRS	DRS	DRS	CRS	DRS
16	Godfrey Phillips India Ltd.	DRS	CRS	DRS	CRS	DRS
17	Gwalior Sugar Co. Ltd.	IRS	CRS	DRS	CRS	IRS
18	Harinagar Sugar Mills Ltd.	CRS	CRS	CRS	DRS	DRS
19	Hindustan Breweries & Bottling Ltd.	IRS	IRS	CRS	IRS	DRS
20	I F B Agro Inds. Ltd.	CRS	IRS	IRS	CRS	DRS
21	India Sugar & Refineries Ltd.	CRS	IRS	DRS	IRS	IRS
22	Jagatjit Industries Ltd.	DRS	DRS	DRS	DRS	DRS
23	Kesar Enterprises Ltd.	DRS	DRS	DRS	DRS	DRS
24	Khandelwal Extractions Ltd.	IRS	IRS	CRS	IRS	IRS
25	Khoday India Ltd.	DRS	DRS	DRS	IRS	DRS
26	Milkfood Ltd.	CRS	DRS	DRS	CRS	DRS
27	Modi Natural Ltd.	IRS	IRS	DRS	DRS	DRS
28	Mohan Breweries & Distilleries Ltd.	DRS	DRS	DRS	DRS	DRS
29	Mohan Meakin Ltd.	DRS	CRS	DRS	DRS	CRS
30	Motilal Padampat Udyog Ltd.	DRS	CRS	IRS	DRS	IRS
31	Oudh Sugar Mills Ltd.	DRS	DRS	DRS	DRS	DRS
32	P H I L Corporation Ltd.	CRS	DRS	DRS	IRS	IRS
33	Premier Industries (India) Ltd.	CRS	DRS	IRS	IRS	CRS
34	Prestige Foods Ltd.	CRS	DRS	DRS	CRS	CRS
35	Rasoi Ltd.	DRS	CRS	DRS	DRS	DRS
36	Ravalgaon Sugar Fram Ltd.	IRS	IRS	DRS	CRS	IRS
37	Ruchi Soya Inds. Ltd.	CRS	DRS	CRS	DRS	DRS
38	S M Dyechem Ltd.	CRS	DRS	DRS	CRS	IRS
39	Sakthi Sugars Ltd.	CRS	DRS	DRS	DRS	DRS
40	Simbhaoli Sugars Ltd.	CRS	DRS	DRS	DRS	DRS
41	Sir Shadi Lal Enterprises Ltd.	DRS	CRS	DRS	DRS	DRS
42	Sri Chamundeshwari Sugars Ltd.	DRS	CRS	DRS	DRS	DRS
43	Tasty Bite Eatables Ltd.	CRS	IRS	CRS	DRS	DRS
44	Thiru Arooran Sugars Ltd.	CRS	IRS	DRS	DRS	DRS
45	Triveni Engineering & Inds. Ltd.	DRS	DRS	DRS	DRS	DRS
46	Ugar Sugar Works Ltd.	DRS	DRS	DRS	DRS	DRS
47	Upper Ganges Sugar & Inds. Ltd.	CRS	CRS	DRS	DRS	DRS
48	Vadilal Industries Ltd.	IRS	IRS	DRS	DRS	DRS
49	Venky's india ltd.	IRS	IRS	DRS	DRS	DRS
50	Vippy Industries Ltd.	CRS	CRS	DRS	DRS	DRS

Note: CRS- Constant Returns to Scale.
IRS- Increasing Returns to Scale.
DRS- Decreasing Returns to Scale.

Table 3
Efficiency Change, Technological Progress and TFP change in Indian Food Processing Industry (1988-2011)

S. No.	Firms	1988-93			94-99			00-05			2006-11		
		effch	techch	tfpch	effch	techch	tfpch	effch	techch	tfpch	effch	techch	tfpch
1	Agro Tech Foods Ltd.	1.399	0.804	1.126	1.014	1.138	1.154	1.038	1.108	1.149	0.959	0.878	0.843
2	Amrit Corp. Ltd	1.460	0.762	1.112	0.988	1.030	1.017	0.923	1.054	0.973	1.019	0.975	0.993
3	Arthos Breweries Ltd.	1.648	0.864	1.424	1.449	1.337	1.938	0.738	0.839	0.620	0.912	1.089	0.993
4	Bajaj Hindusthan Ltd.	1.015	0.885	0.899	1.332	0.975	1.298	0.892	1.321	1.178	1.179	0.786	0.927
5	Balarampur Chini Mills Ltd.	1.322	0.837	1.107	1.224	0.968	1.185	0.711	1.373	0.976	0.941	0.812	0.764
6	Bannari Amman Sugars Ltd.	0.864	0.856	0.740	1.358	0.954	1.295	0.923	1.355	1.250	0.847	0.787	0.667
7	Brihan Maharashtra Sugar Syndicate Ltd.	1.216	0.815	0.991	1.065	1.022	1.088	0.475	1.105	0.525	2.254	1.349	3.039
8	Britannia Industries Ltd.	1.233	0.879	1.084	0.972	1.067	1.037	0.953	1.051	1.002	1.042	1.004	1.046
9	Cadbury India Ltd.	1.088	0.871	0.947	0.998	1.032	1.030	0.906	1.148	1.040	0.935	1.079	1.008
10	Dalmia Bharat Sugar & Inds. Ltd.	1.148	1.415	1.624	0.881	0.906	0.798	0.856	1.138	0.976	0.985	0.907	0.893
11	Dhampur Sugar Mills Ltd.	1.939	0.847	1.643	0.743	0.937	0.696	0.990	1.277	1.264	0.926	0.887	0.821
12	Dharani Sugars & Chemicals	1.244	0.856	1.066	0.650	0.956	0.622	0.898	1.346	1.209	1.712	0.816	1.397
13	E I D- Parry (India) Ltd.	0.966	0.870	0.841	0.907	1.015	0.920	0.839	1.395	1.170	1.061	0.785	0.833
14	Foods & Inns Ltd.	1.159	0.863	1.144	1.018	1.213	1.235	0.776	1.121	0.869	0.814	0.918	0.747
15	Glaxosmithkline Consumer Healthcare Ltd.	0.926	0.813	0.753	1.023	1.125	1.151	1.055	1.041	1.099	0.948	1.238	1.173
16	Godfrey Phillips India Ltd.	1.302	0.784	1.021	0.913	1.171	1.069	1.095	0.846	0.927	0.483	2.060	0.994
17	Gwalior Sugar Co. Ltd.	1.130	0.831	0.939	1.227	1.024	1.256	1.045	1.126	1.177	0.547	1.007	0.551
18	Harinagar Sugar Mills Ltd.	1.251	0.790	0.975	1.227	1.006	1.234	0.736	1.275	0.938	0.910	0.839	0.763
19	Hindustan Breweries & Bottling Ltd.	1.297	0.841	1.092	0.897	1.035	0.929	0.821	0.920	0.756	0.902	1.236	1.115
20	I F B Agro Inds. Ltd.	1.218	0.886	1.079	1.075	1.004	1.079	0.481	1.111	0.535	1.277	1.062	1.356
21	India Sugar & Refineries Ltd.	1.192	0.873	1.040	0.811	0.955	0.774	1.300	1.388	1.803	1.134	0.826	0.936
22	Jagatjit Industries Ltd.	1.128	0.865	0.976	0.978	0.980	0.959	0.713	1.151	0.821	0.885	1.141	1.010
23	Kesar Enterprises Ltd.	1.213	0.830	1.006	1.220	0.989	1.207	0.636	1.201	0.764	1.290	0.971	1.252
24	Khandelwal Extractions Ltd.	1.463	0.839	1.227	1.010	1.035	1.046	0.928	1.044	0.968	0.896	1.000	0.896
25	Khoday India Ltd.	1.151	0.822	0.947	1.024	1.022	1.047	0.858	1.141	0.979	0.497	1.408	0.700
26	Milkfood Ltd.	0.969	0.668	0.667	0.962	1.015	0.976	1.073	1.039	1.115	0.873	0.950	0.829
27	Modi Natural Ltd.	1.780	0.791	1.408	1.098	1.016	1.116	0.945	1.058	0.999	0.929	0.980	0.910
28	Mohan Breweries & Distilleries Ltd.	1.061	0.917	0.973	0.731	1.049	0.767	0.743	1.095	0.814	1.222	1.034	1.264
29	Mohan Meakin Ltd.	1.183	0.940	1.112	0.998	1.117	1.114	0.904	1.029	0.931	1.108	1.441	1.597
30	Motilal Padampat Udyog Ltd.	1.202	0.789	0.949	1.105	1.001	1.106	0.767	1.232	0.945	1.112	0.844	0.938
31	Oudh Sugar Mills Ltd.	1.278	0.810	1.035	0.816	0.992	0.809	0.879	1.310	1.151	1.216	0.810	0.985
32	P H I L Corporation Ltd.	1.931	0.748	1.444	0.842	1.030	0.867	0.502	1.234	0.619	0.613	0.950	0.582
33	Premier Industries (India) Ltd.	0.954	0.799	0.762	0.733	1.022	0.750	1.294	1.104	1.429	1.104	1.587	1.752
34	Prestige Foods Ltd.	1.363	0.812	1.107	0.888	1.010	0.897	0.850	1.179	1.002	1.417	4.112	5.827
35	Rasoi Ltd.	1.298	0.736	0.956	0.988	1.144	1.130	0.763	1.086	0.829	1.103	0.905	0.998
36	Ravalgaon Sugar Fram Ltd.	1.119	0.835	0.934	0.876	1.028	0.900	1.231	1.294	1.594	0.354	0.792	0.280
37	Ruchi Soya Inds. Ltd.	0.900	0.414	0.373	1.112	1.103	1.226	0.912	1.043	0.951	0.956	1.011	0.966
38	S M Dyechem Ltd.	1.185	0.849	1.006	0.721	0.955	0.689	1.548	1.635	2.531	0.999	0.814	0.813
39	Sakthi Sugars Ltd.	1.668	0.852	1.424	0.913	0.962	0.878	0.855	1.39	1.189	1.233	0.787	0.970
40	Simbhaoli Sugars Ltd.	1.013	0.867	0.878	0.943	0.989	0.933	0.845	1.203	1.017	1.054	0.876	0.924
41	Sir Shadi Lal Enterprises Ltd.	1.339	0.723	0.968	0.962	1.018	0.980	0.783	1.060	0.831	0.891	0.980	0.873
42	Sri Chamundeshwari Sugars Ltd.	1.188	0.824	0.979	0.869	1.021	0.888	1.027	1.256	1.290	1.169	0.781	0.913
43	Tasty Bite Eatables Ltd.	2.607	0.936	2.053	2.161	0.936	2.021	0.834	1.231	1.027	1.033	0.924	0.954
44	Thiru Arooran Sugars Ltd.	1.874	0.864	1.619	1.019	0.948	0.967	0.791	1.312	1.038	1.214	0.880	1.068
45	Triveni Engineering & Inds. Ltd.	0.862	0.813	0.701	1.148	1.021	1.172	1.156	1.134	1.312	0.965	0.837	0.807
46	Ugar Sugar Works Ltd.	1.083	0.783	0.848	0.824	1.008	0.831	1.222	1.144	1.397	0.843	0.942	0.794
47	Upper Ganges Sugar & Inds. Ltd.	2.391	0.827	1.978	0.806	0.977	0.788	0.942	1.241	1.169	1.126	0.837	0.942
48	Vadilal Industries Ltd.	1.401	0.885	1.241	0.737	1.032	0.761	0.898	1.223	1.097	1.356	0.879	1.192
49	Venky's India Ltd.	0.886	0.852	0.755	1.087	0.959	1.042	0.860	1.204	1.036	1.143	0.933	1.066
50	Vippy Industries Ltd.	0.913	0.558	0.509	0.953	1.019	0.971	0.810	1.164	0.943	1.329	0.936	1.244
Total	**Food Processing Industry**	1.283	0.833	1.068	1.005	1.023	1.031	0.902	1.175	1.066	1.014	1.123	1.083

Note: effch- Efficiency Change.
techch- Technical Efficiency Change.
tfpch- Total Factor Productivity Change.

Table: 4.1

P1: Profitability of Sample Firms under Food Processing Industry (1988-2011)

Total Firms = 50

YEARS	LOW	MEDIUM	HIGH	TOTAL
1988	12 (24%)	20 (40%)	18 (36%)	50 (100%)
1993	10 (20%)	23 (46%)	17 (34%)	50 (100%)
1999	19 (38%)	19 (38%)	12 (24%)	50 (100%)
2005	16 (32%)	19 (38%)	15 (30%)	50 (100%)
2011	24 (48%)	13 (26%)	13 (26%)	50 (100%)

Table: 4.2

P2: Profitability of Sample Firms under Food Processing Industry (1988-2011)

Total Firms = 50

YEARS	LOW	MEDIUM	HIGH	TOTAL
1988	11 (22%)	17 (34%)	22 (44%)	50 (100%)
1993	9 (18%)	21 (42%)	20 (40%)	50 (100%)
1999	19 (38%)	18 (36%)	13 (26%)	50 (100%)
2005	15 (30%)	19 (38%)	16 (32%)	50 (100%)
2011	22 (44%)	15 (30%)	13 (26%)	50 (100%)