EFFICIENCY AND PRODUCTIVITY GROWTH OF FOOD PROCESSING INDUSTRY IN INDIA : A MALMQUIST INDEX APPROACH

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This paper examines sub-sectors wise total factor productivity growth and its components in the Indian Food Processing Industry during pre liberalization and the post liberalization period and also assesses the impact of new economic policy variables on the productivity and technical efficiency of the industrial sector in India. The study uses data envelopment analysis (DEA) to derive Malmquist productivity indexes. The result indicates that the distribution of employment in different types of food processing units shows that Other Food Items sub-sector employs 37.1 per cent persons out of the total employed in TE-2010. During the last three decades, all segments of the food processing industry experienced positive change in TFP with varied magnitude, but Meat/Meat Products, Fish/Fish products, Fruits and Vegetables and oils& fats experienced a negative change in TFP. The overall TFP change in the Indian food processing industry increased from 0.94 during the pre-liberalization period (1981-1989) to 0.95 during the post-liberalization period (1990-2000) and 1.05 during the liberalization/ globalization period (2001-2010). These results clearly indicate that after market liberalization the capital investments across the food processing industry had significantly increased, after having not been fully utilized in most of the food processing segments in the initial years. This emphasizes the need for identification and implementation of sustainable sources of productivity growth in agriculture sector of Indian food processing industry. Therefore, technology is the key to enhancing growth and efficiency in the food processing sector. It is also noticed that there is wide gap found across the states with respect to productivity growth and efficiency aspects.

Key Words: *Malmquist Index, Efficiency Change, Economic Reform and Productivity Growth*

INTRODUCTION

Agriculture has an important role in development because agriculture contributions for about 1/4th of the Indian economy, but employs about 2/3rd of its population. India's strong agricultural base and accelerating economic growth hold a significant potential for the Food Processing Industry (FPI) that provides inclusive growth between agriculture & other sectors. India's share in the global food trade has been just around 1.5 per cent. Food processing enhances shelf life and adds value even if agricultural produce is merely cleaned, sorted, and packaged. Further processing into high value-added products garners greater revenue for the producer . The food processing sector employed about 8.5 million persons in 2008, with about the 18% of the employment in the organized sector. Food Processing is also employed intensive in that for every Rs. 1 million invested, 1.8 direct jobs and 6.4 indirect jobs are created. The Indian food industry is characterized by smaller and

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unorganized sector that accounts for 75% of the total industry . Generation of productive and gainful employment with decent working conditions on a sufficient scale to absorb the growing labor force was a critical element in the Eleventh Plan strategy for achieving inclusive growth. The employment elasticity in India in the last decade declined from 0.44 in the first half of the decade 1999–2000 to 2004–05, to as low as 0.01 during the second half of the decade 2004–05 to 2009–10. In agriculture and manufacturing employment elasticity in the latter half of the decade has been negative. The negative employment elasticity in agriculture indicates movement of people out of agriculture to other sectors where wage rates are higher.

Economic development will be sustainable only if it is pursued in a manner which protects the environment. With the acceleration of economic growth, these pressures are expected to intensify, and we therefore, need to pay greater attention to the management of water, forests and land. The Twelfth Plan will consider all these issues, as well as the weaknesses of existing schemes as brought out in the Midterm Appraisal of the Eleventh Plan. Its thrust will be to move forward with the architecture of RKVY and, in particular, focus more on the issues of sustainable development. There is also a need to review the present state of agriculture education with the aim of improving and sustaining the quality of higher agricultural education for addressing emerging challenges for livelihood security and sustainable development .

After modernization of agricultural sector, consumers' shifts from traditional foods to high quality foods. So Indian consumers have preferred fresh and unprocessed food over processed and packaged food; however, the recent changes in consumption patterns, particularly in middle and high income groups, show ample opportunity for processing food segments in the country (Bhalla and Hazell 1998; Chand 2003; Chenggapa et al 2005). The food and agricultural sectors in developing countries have been significantly transformed in the way food is produced, processed, marketed and consumed. Consumers have also been responding to changes in quality of food intake and are becoming more conscious regarding nutrition, health, and food safety issues (FAO 2003). Food processing industry is increasingly seen as a potential source for driving the Indian rural economy as it brings about synergy between the consumers, industry and agriculture. A well developed FPI is expected to increase farm door prices, reduce wastages, ensure value addition, promote crop diversification, generate employment opportunities as well as export earnings. At the same time, though India is a key producer of food and food processing products, having an adequate production base for inputs, productivity levels are very low in the country.

Considering the criticality of the situation and the need to appropriately address the challenges faced by the sector likely; Comprehensive national level policy on FPI, Availability of trained manpower (skill human resource requirements), Processing plants with cost effective technologies, Cost effective food machinery & packaging technologies, Constraints in raw material production, Inadequate infrastructural facilities, Access to Credit, Market Intelligence, Inconsistency in central and state policies, Lack of Applied research, Adequate value addition, Lack of specific-plan to attract private sector investment across the value chain and Food safety Laws.

Objectives :

- To measure the impact of growing FPI on employment, wages&saleries and (Gross value output) income generation in sub-sectors of FPI i.e. this sector is the most important driver of inclusive growth in the economy.
- To measure the total factor productivity growth in the total factor productivity growth in Indian food-processing Industries.
- To examine the technical efficiency and technical change in the Indian food-processing Industries.

DATA AND METHODOLOGY

The data on input and output related to the registered/organized food manufacturing sectors has been compiled for the period of 1980-1981 to 2009-2010 from the Annual Survey of Industries published by the Central Statistical Organization (CSO), Ministry of Statistics and Program Implementation, Government of India. The data on the value of output and inputs of food processing sectors has been converted into constant prices, considering 2004-05 as the base year by using the appropriate price indices of the respective commodity groups and inputs.

The Data Envelopment Analysis (DEA) Approach is used for measuring productivity change and efficiency in the Indian food processing industry over the period of 1980-1981 to 2009-2010, with categorization of data into a pre liberalization period (1980-1981 to 1989-1990) and first phaseof liberalization period (1990-1991 to 1999-2000) and a second phaseof liberalization period (2000-2001 to 2009-2010). About three decade panel data have been used to capture the fairly long-term effects of the pre first phase and the second phase of market liberalization periods of productivity and efficiency, and also to assess the structural changes in the food processing industry. As the major economic reforms in the country took place during the 1990s, a comparison of productivity and efficiency between pre and post liberalization periods across the food processing sector provides practical insights on technical and managerial issues for policy makers, food processors and researchers in the changing market environment. Data Envelopment Analysis (DEA) is the most commonly used non-parametric method across the world for estimating the relative efficiency with reference to the best practice frontier. The advantage of using the DEA-based Malmquist index is that the estimation of the production frontier requires fewer observations and assumptions as compared to parametric methods such as stochastic frontier estimation. This method does not require specification of the underlying technology and has an advantage in dealing with disaggregated input and output variables. However, the parametric methods were questioned by many economists because of the limitation of choosing functional forms, biased estimates in the presence of measurement error, lack of statistical fit and dependency on the choice of variables.

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. This method attempts to measure the efficiency of Decision Making Units (DMUs)/firms through linear programming techniques which "envelop" observed input–output vectors as tightly as possible. 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 DMU not to operate at optimal scale (Coelli 1996). 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.

RESULTS AND DISCUSSION

Performance of Food Processing in India

Indian Food processing sector is an emerging sector of the country. Food processing sector forms a segment of the Indian economy in terms of its contribution to GDP, employment and investment. The sector contributes as much as 9.0 per cent of GDP in agriculture and 10.0 per cent of GDP in the manufacturing sector. During the last five years ending 2010-11, Food processing, industrial sector has been growing at an Average Annual Growth Rate (AAGR) of around 6.0 per cent as compared to around 4.0 per cent in agriculture and 9.0 per cent in the manufacturing sector.The

majorities of the food processing industries in the country are unorganized and are facing various kinds of challenges in the fast changing global development.The analysis of structural changes in food processing sub-sectors suggest that in terms of number of industries, the change in composition is significantly evident in the case of grain milling, which has increased from 26.8per cent during the TE-1983 to 49.0 per cent during the TE-2010 (Table 1). The share of all other types of food processing units, in terms of number of firms, has increased over time, but other food item processing sub-sector in terms of no of firms has decreased over the time, except sugar and vegetable oils. Processing units under these categories have closed down due to unfavorable policy environment and increased competition after market liberalization/globalization.The food processing sub-sector summarized in the "Other Food Items" category constitute 44.9per centin TE_1983 and 21.0 per cent in TE-2010 of total sub-sector, which include manufacturing of macaroni, noodles and similar products; processing and blending of tea; coffee curing, roasting, grinding and blending; processing of edible nuts; manufacturing of malted foods; grinding and processing of spices; manufacturing of papads, appalam and similar products; and manufacturing of vitaminis high protein food products and other semi-processed, processed or instant foods not included below. Food processing is an important employment generating segment within the agriculture sector in India. The distribution of employment in different types of food processing units shows that Other Food Items sub-sector employs 37.1 per cent persons out of the total employed in TE-2010 (Table 1), followed by grain milling (20.1 per cent), sugar (15.5 per cent), dairy & dairy products (5.8 per cent), and oil & fats (6.6 per cent).

Table 1 : Structural Composition of Indian Food Processing Industries during 1981-2010 (Percent)

Industry	No. of Factories				No. of Workers				Gross Value Added			
	TE-1983	TE-1993	TE-2003	TE-2010	TE-1983	TE-1993	TE-2003	TE-2010	TE-1983	TE-1993	TE-2003	TE-2010
Meat/Meat Products	0.1	0.1	0.2	0.3	0.2	0.3	0.7	1.0	0.6	0.5	0.8	1.6
Fish/Fish products	0.8	0.7	1.2	1.3	0.8	1.2	2.3	2.4	1.5	2.2	1.9	1.5
Fruits and Vegetables	0.6	0.8	2.0	2.8	0.8	1.1	2.1	3.2	0.6	0.6	2.1	1.8
Oils and fats	12.6	11.3	11.2	9.1	7.7	7.8	5.5	6.6	11.9	10.1	10.4	14.1
Dairy Products	1.0	1.6	3.3	4.1	2.7	4.5	5.2	5.8	5.0	5.4	13.1	9.0
Grain milling	26.8	33.2	48.1	49.0	11.8	15.2	20.9	20.1	8.1	7.3	12.0	14.7
Starch/Starch products	1.2	1.1	2.8	2.1	0.6	0.7	1.5	1.1	0.9	0.6	1.0	1.1
Animal Feeds	0.6	1.0	2.0	2.1	0.4	0.9	1.5	1.8	0.6	1.1	2.5	2.0
Bakery Products	2.0	2.5	4.0	3.7	1.5	2.4	3.0	3.7	1.6	1.9	3.1	5.9
Sugar	9.0	4.6	4.2	2.8	42.3	25.2	20.7	15.5	23.0	20.0	27.9	13.1
Confectionery	0.3	0.5	1.1	1.6	0.3	0.6	0.9	1.6	0.3	0.8	2.4	3.6
Other Food items	44.9	42.6	19.9	21.0	30.9	40.2	35.8	37.1	34.8	42.5	25.5	35.6
Total Food Industry	100	100	100	100	100	100	100	100	100	100	100	100

This sector has a total of 35835 registered firms with an invested capital of nearly Rs. 2.5 lakh crore producing an output of around Rs. 5.8 lakh crore in value terms. Major industries contributing this sector are grain mill, sugar, edible oils, and beverage and dairy products. The sector has generated employment to the tune of 16.75 lakh persons. Similarly, capital invested in Food processing industries has also increased significantly by 23.6 per cent.Per unit labour absorption capacity of sugar segment is high, which employed 253 persons in TE-2010 (Table 2). Animal based industries such as meat, dairy and fishery processing units are also labour intensive, employing 139, 65 and 83 persons, respectively, per unit on an average during the TE-2010. The composition of the gross value added (GVA) shows that other food processing firms constitute the major share (35.6 per cent), followed by grain milling (14.7 per cent), oil & fats (14.1 per cent), dairy and sugar (13.1 per cent) and dairy products (9.0 per cent). Gross value added per unit is higher in meat & meat products firms followed by sugar, confectionery, dairy products, other food items andoils & fats (Table 2).Moreover, capital investment has increased positively in all segments of the food processing industry. Per unit capital investment in sugar units has drastically increased in recent years for making these units more viable and sustainable through productivity & efficiency improvement and increased utilization of the by-products. The capital investment in meat and meat products has also increased to meet the emerging export demand.

Table 2 : Gross value Output, Number of Workers and Gross value Added in Indian Food Processing Industries (Per Units) at base prices, 2004-05

Industry	Output (` Lack)				No. of Workers				GVA (` Lack)			
	TE-1983	TE-1993	TE 2003	TE 2010	TE 1983	TE 1993	TE 2003	TE 2010	TE 1983	TE 1993	TE 2003	TE 2010
Meat/Meat Products	1226	1431	2089	5298	139	109	120	139	183	298	281	699
Fish/Fish products	707	1688	1542	1575	50	81	80	83	53	197	140	148
Fruits and Vegetables	203	204	374	563	71	68	45	52	26	49	90	86
Oils and fats	476	850	1477	3451	32	33	21	33	28	55	81	205
Dairy Products	1779	2285	2682	3178	142	131	67	65	143	203	345	290
Grain milling	136	190	342	476	23	22	19	19	9	13	22	40
Starch/Starch products	117	208	236	452	25	31	23	25	22	34	31	67
Animal Feeds	321	697	1118	1434	37	43	32	39	33	68	110	123
Bakery Products	141	247	389	1056	39	44	32	45	23	46	67	210
Sugar	419	1529	3025	5449	247	259	212	253	75	264	589	623
Confectionery	139	387	669	1058	40	62	35	45	23	102	197	291
Other Food items	101	246	574	899	36	45	77	80	23	61	113	224
Total Food Industry	239	441	716	1123	53	48	43	45	29	61	88	132

The annual growth performance of the food processing industry in terms of number of units, employment and the gross value added (GVA) during the pre and post reform periods is given in Table 3.It is clear from the table that the high value segments, such as fish and fish products, fruits and vegetables, dairy products, starches and starch products and confectionery, have significantly gained in terms of number of units, employment, investment and output growth during the first phase of liberalization period.Maximum growth in the number of units during the first phase of liberalization period has been experienced with starches and starch products, followed by grain milling, Confectionary and Other Food items.The number of persons employed in food processing units has also increased positively across the sector during the first phase of liberalization period but Oils and fats and Sugar have decreased.

Value addition across the food processing industry in the country has been growing at a very significant rate over the last two decades (Table 3). The rate of growth in the gross value added of the food processing industry was 9.7per cent during 1981-1990 (pre reform period), which has slightly declined during 1991-2000 (first phase of liberalization period) but is still higher at 8.3 per cent in the second phase of liberalization period. However, the growth in value added increased during the 1990s for most of the high-value food processing segments, such as meat and meat products, fruits and vegetables, grain processing, starches and starch products.The growth in output for meat and meat products and fruits and vegetables, Oils and fats and Starch/Starch has almost doubled/ triple during the last two decades.These growth trends in gross value added (GVA) for various food products suggest that there is vast scope for promoting high-value segments in the first and second liberalization period.

Table 3 : Compound Annual Growth Rate of Indian Food Processing Industries, 1981-2010

(Percent)

Industry	No. of Factories				No. of Workers				Gross Value Added			
	1981-1990	1991-2000	2001-2010	1981-2010	1981-1990	1991-2000	2001-2010	1981-2010	1981-1990	1991-2000	2001-2010	1981-2010
Meat/Meat Products	-0.6	-0.4	6.9	4.9	-4.8	5.8	7.9	5.5	-3.3	13.2	20.3	10.6
Fish/Fish products	-3.1	4.5	2.7	2.2	-1.2	10.0	3.9	4.5	7.4	4.8	4.2	5.1
Fruits and Vegetables	4.0	6.7	6.5	5.8	2.0	6.0	9.2	4.5	13.8	17.6	7.2	10.2
Oils and fats	-1.6	-1.5	-1.3	-1.1	-1.3	-1.9	5.1	-1.8	5.2	5.1	12.9	5.3
Dairy Products	5.0	6.9	4.7	5.5	5.2	1.1	4.4	1.5	13.8	11.2	2.4	8.4
Grain milling	2.9	1.4	2.2	2.3	3.1	2.7	2.4	1.3	11.1	8.9	11.7	6.8
Starch/Starch products	-1.5	4.8	-2.2	3.5	0.4	4.8	-1.6	2.6	2.3	13.8	9.4	6.7
Animal Feeds	5.3	5.9	2.7	5.5	7.3	7.5	6.4	5.3	14.4	5.5	5.1	10.2
Bakery Products	4.5	2.9	0.8	2.4	6.8	2.4	6.0	2.1	13.8	8.8	17.8	9.4
Sugar	-5.3	-2.0	-3.8	-4.2	-9.1	-3.0	-1.3	-3.6	11.3	6.5	-1.5	4.2
Confectionary	4.7	5.6	8.3	5.9	7.3	3.3	12.5	5.5	15.9	10.6	14.8	16.5
Other Food items	-1.8	-6.0	2.6	-3.5	-0.6	-8.1	3.2	-0.4	9.8	1.7	13.0	3.7
Total Food Industry	-0.3	-1.2	1.8	-0.1	-2.8	-1.9	2.8	-0.6	9.7	5.0	8.3	4.7

Productivity Change in Food Processing Industry

Table 4 shows the cost composition of the food processing industry in India, which would definitely help in formulating effective strategies for the development of various food segments. The major constraint in the development of the food processing industry is timely and quality procurement of raw material, i.e., agricultural produce for processing, which accounts for about 85-95per cent of the total input cost. Though the caste composition in various types of food processing sub-sectors varies, raw material consumption constitutes the major share. Table 4 also clearly illustrates that economic liberalization has increased the capital intensity in the Indian food processing industry, as the share of capital cost has increased during the post-liberalization period. Pattnayak and Thangavelu (2005) argue that the capital-using technical change has significant policy implications in terms of capital accumulation and increasing total factor productivity in the Indian manufacturing industry.

Table 4 : Percentage Share of Cost Composition in Indian Food Processing Industries during 1981-2010 (Percent)

Industry	Total Inputs				Wages and Salaries			
	TE-1983	TE-1993	TE-2003	TE-2010	TE-1983	TE-1993	TE-2003	TE-2010
Meat/Meat Products	92.0	93.3	94.8	97.3	8.0	6.7	5.2	2.7
Fish/Fish products	97.6	98.0	97.2	97.2	2.4	2.0	2.8	2.8
Fruits and Vegetables	93.0	89.9	91.2	93.4	7.0	10.1	8.8	6.6
Oils and fats	98.6	98.7	99.0	99.3	1.4	1.3	1.0	0.7
Dairy Products	95.9	95.8	95.7	96.7	4.1	4.2	4.3	3.3
Grain milling	97.4	97.9	98.0	98.3	2.6	2.1	2.0	1.7
Starch/Starch products	94.6	94.5	95.3	95.8	5.4	5.5	4.7	4.2
Animal Feeds	97.0	97.4	97.4	97.5	3.0	2.6	2.6	2.5
Bakery Products	92.4	92.6	92.2	94.9	7.6	7.4	7.8	5.1
Sugar	91.4	91.4	91.5	93.8	8.6	8.6	8.5	6.2
Confectionary	93.1	93.3	92.0	93.6	6.9	6.7	8.0	6.4
Other Food items	87.8	92.3	96.7	94.2	12.2	7.7	3.3	5.8
Total Food Industry	94.1	95.0	96.3	97.0	5.9	5.0	3.7	3.0

Table 5 shows the compound annual growth rate of cost composition of the food processing sub-sectors in India. The data show that Meat & meat products cost is higher in food processing industries followed by Confectionary, Animal feed and fruit and vegetables cost. The data also reveal that out of total input cost most of expenditure is on wages& salaries of all sub-sectors of Indian food processing industries. Further data shows that in fish/fish products per centage share of wage and salaries is very law only 3.2 per cent, but it is increased in 1991-2000 up to 13 per cent, but in the decade of 2001-2010 it further reduced up to 2.9 per cent, i.e. wage and salaries shared reduced by 10 points which is a big amount. The same trend is found in the Starch/Starch products, animal

feeds and in the confectionery products also. On the other hand, some of food products showan increasing trend in wage and salaries component in the total cost. But most of sub sectors show that in 2001-2010 wage and salaries shares is sharply declining. Most of the companies/industries to reducethe cost of production cut down the wage and salaries of the employee which is not a good sign because it is adversely affecting the livelihood of labor and the productivity of labor.

Table 5 : Compound Annual Growth Rate of Cost Composition in Indian Food Processing Industries during, 1981-2010

Industry	Total Inputs					Wages and Salaries		
	1981-1990	1991-2000	2001-2010	1981-2010	1981-1990	1991-2000	2001-2010	1981-2010
Meat/Meat Products	-5.0	17.4	19.1	12.6	2.5	7.7	8.3	6.9
Fish/Fish products	3.4	13.5	2.2	6.9	3.2	12.9	2.9	7.3
Fruits and Vegetables	2.8	19.6	14.6	8.5	8.2	10.1	9.2	8.0
Oils and fats	3.3	5.8	8.7	4.9	3.6	1.0	4.5	1.9
Dairy Products	10.3	10.6	5.5	6.2	9.1	6.3	2.3	5.7
Grain milling	7.5	10.7	6.8	5.6	2.2	5.1	5.6	4.5
Starch/Starch products	4.1	12.9	5.0	6.3	2.8	11.2	3.0	5.3
Animal Feeds	11.8	15.6	5.3	9.9	10.6	10.6	5.2	8.9
Bakery Products	8.2	8.9	7.7	6.5	11.6	-7.4	2.2	4.0
Sugar	5.3	4.5	3.1	3.6	4.7	1.6	-1.8	2.2
Confectionary	9.2	16.0	9.6	10.3	10.0	11.0	7.1	10.3
Other Food items	3.3	5.2	6.9	5.0	1.9	-6.1	15.0	0.9
Total Food Industry	5.6	7.6	7.3	5.8	3.9	1.4	4.3	2.9

Table 6 shows that the estimated average annual rate of productivity and efficiency change in the Indian food processing industry during the last three decades. The Malmquist TFP index measures the productivity change 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 (shift in the production frontier), or due to efficiency improvements in the firm. A productivity value index larger than one indicates a productivity improvement and a value less than one indicates productivity decline.During the last three decades, all segments of the food processing industry experienced positive change in TFP with varied magnitude, but Meat/Meat Products, Fish/Fish products, Fruits and Vegetables and oils& fats experienced a negative change in TFP.The TFP gain is basically due to change in technological progress, and the contribution of efficiency change in TFP is small.The overall TFP change in the Indian food processing industry increased from 0.94 during the pre-liberalization period (1981-1989) to 0.95 during the post-liberalization period (1990-2000) and 1.05 during the liberalization/globalization period (2001-2010).However, some of the segments have gained significantly in terms of TFP change during the liberalization/globalization period (2001-2010), such as animal feed (0.94), confectionery (0.98),

meat and meat products (0.93), fruits and vegetables (0.95), sugar (0.98), and other food items (1.09). A close look at the TFP results indicate that the food segments with high scope of value additions have shown positive TFP changes during the post-liberalization period.This provides an interesting and practical relevance to policy makers and food processors for enhancing investment in these segments of the food processing sector.

Table 6 : Efficiency Change, Technological Progress and Total Factor Productivity Change in Indian Food Processing Sector during, 1981-2010

Industry	1981-1989			1990-2000			2001-2010			1981-2010		
	EFFCH	TECHCH	TFPCH	EFFCH	TECHCH	TFPCH	EFFCH	TECHCH	TFPCH	EFFCH	TECHCH	TFPCH
Meat/Meat Products	1.00	0.84	0.84	1.05	0.90	0.94	1.02	0.91	0.93	1.00	0.84	0.84
Fish/Fish products	1.01	0.93	0.94	1.05	0.97	1.02	1.02	0.96	0.97	1.01	0.87	0.88
Fruits and Vegetables	1.03	0.92	0.95	0.97	0.99	0.96	1.02	0.94	0.95	1.01	0.92	0.93
Oils and fats	1.08	0.97	1.05	1.03	0.99	1.01	1.06	0.94	1.00	1.02	0.97	0.98
Dairy Products	1.16	0.95	1.10	1.06	0.99	1.04	1.04	0.96	1.00	1.02	1.00	1.02
Grain milling	1.09	0.93	1.01	1.03	0.95	0.97	1.04	0.94	0.98	1.01	1.00	1.01
Starch/Starch products	1.09	0.90	0.97	1.03	0.94	0.97	1.03	0.96	0.99	1.01	1.00	1.01
Animal Feeds	1.10	0.93	1.03	1.01	0.90	0.91	0.99	0.95	0.94	1.02	1.01	1.02
Bakery Products	1.06	0.91	0.96	1.02	0.93	0.95	0.99	0.96	0.95	1.01	1.03	1.03
Sugar	0.99	0.83	0.82	1.01	0.94	0.96	1.02	0.96	0.98	1.01	1.06	1.07
Confectionary	0.99	0.87	0.86	0.98	0.93	0.90	1.00	0.98	0.98	1.00	1.08	1.08
Other Food items	1.00	0.86	0.86	1.00	0.96	0.96	1.04	1.04	1.09	1.00	1.10	1.10
Total Food Industry	1.00	0.94	0.94	0.99	0.96	0.95	0.99	1.06	1.05	1.00	1.14	1.13

Note: EFFCH=Technical Efficiency Change, TECH=Technical Change, and TFPCH=Total Factor Productivity (TFP) Change.

[Note that all Malmquist index averages are geometric means]

The performance of the Indian food processing industry is measured in terms of technical and scale efficiency (Table 7). 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 implies that the industry is on the best - practice frontier, while values below unity show that the industry is below the frontier or technically inefficient. Analysis of this study shows that the average technical efficiency score is estimated to be 1.000 under the CRS model and 1.000 under the VRS model. The average scale efficiency in Indian food processing units for the entire period is estimated to be 1.000. This implies that the average technical inefficiency could be not improving scale efficiency and eliminating pure technical inefficiencies. The efficiency scores in the food processing industry vary significantly across various types of food processing units and over time.It is also evident that the average technical efficiency scores for the food processing industry as a whole have experienced an increasing trend during the third phase of liberalization periods (2001-2010) over the second phase of liberalization period (1999-2000) and compared to

over the pre-liberalization period (1981-1989). However, the scale efficiency has improved from 0.938 during 1990-2000 to 1.000 during 2001-2010. This implies that market liberalization has facilitated the enhanced investment in capital goods leading to greater capacity utilization.Based on a literature survey, Golany and Yu (1997) argue productivity improvements in five different scenarios, which include (a) producing the same output while consuming less resources; (b) producing more output without changing the level of resource usage; (c) producing more output with fewer inputs; (d) a large increase in the output for an increase in input; and (e) a smaller reduction in the output for an increase in input consumption. Out of these five scenarios, the first three are associated with technical efficiency while the remaining is associated with scale efficiency. Input-oriented variable returns to scale (VRS) Data Envelopment Analysis Model known as BCC Model identifies the decision making units (DMUs), operating in three regions: (i) a region of increasing returns to scale (IRS), (ii) a region of declining returns to scale (DRS), or (iii) a region of constant returns to scale (CRS).

Table 7 : Average Technical Efficiency and Scale Efficiency in Indian Food Processing Industries during 1981-2010

Industry	1981-1989			1990-2000			2001-2010			1981-2010		
	CRSTE	VRSTE	SCALE	CRSTE	VRSTE	SCALE	CRSTE	VRSTE	SCALE	CRSTE	VRSTE	SCALE
Meat/Meat Products	0.621	1.000	0.621	0.405	1.000	0.405	0.525	1.000	0.525	1.000	1.000	1.000
Fish/Fish products	0.508	0.942	0.539	0.657	1.000	0.657	0.539	1.000	0.539	0.789	0.942	0.838
Fruits and Vegetables	0.457	0.951	0.480	0.719	0.943	0.762	0.470	1.000	0.470	0.668	0.951	0.703
Oils and fats	0.382	1.000	0.382	0.774	1.000	0.774	0.590	0.879	0.671	0.521	1.000	0.521
Dairy Products	0.316	0.781	0.404	0.605	0.786	0.770	0.643	0.889	0.724	0.438	0.781	0.561
Grain milling	0.490	1.000	0.490	0.739	0.907	0.815	0.680	0.850	0.800	0.593	1.000	0.593
Starch/Starch products	0.520	1.000	0.520	0.718	0.857	0.838	0.698	0.829	0.842	0.600	1.000	0.600
Animal Feeds	0.458	0.862	0.532	0.846	0.969	0.873	0.983	1.000	0.983	0.543	0.861	0.631
Bakery Products	0.585	0.905	0.646	0.738	0.860	0.858	1.000	1.000	1.000	0.690	0.856	0.806
Sugar	1.000	1.000	1.000	0.782	0.872	0.897	0.786	0.847	0.928	0.648	0.758	0.854
Confectionary	1.000	1.000	1.000	1.000	1.000	1.000	0.980	1.000	0.980	0.935	1.000	0.935
Other Food items	0.940	1.000	0.940	1.000	1.000	1.000	0.677	0.774	0.875	1.000	1.000	1.000
Total Food Industry	0.986	0.990	0.996	0.938	1.000	0.938	1.000	1.000	1.000	1.000	1.000	1.000

Note: CRSTE = Technical Efficiency from CRS DEA, VRSTE = Technical Efficiency from VRS DEA and SCALE = Scale Efficiency = CRSTE/VRSTE

The relevance of returns to scale analysis in business decision-making is a well researched area. The analysis provides information for decision-makers to examine their production performance and determine the effectiveness of resource utilization.Table 8 indicates that most of the sub-sectors of the food processing industry were operating under increasing returns to scale during the pre-liberalization period (1980-81 to 1989-1990); except for Confectionary products and sugar, which had constant returns to scale, and Other Food items which had decreased returns to scale.However,

the majority of the segments of the industry has moved towards constant and increasing returns to scale during the post-liberalization period (1990-91 to 1999-2000), except for other food items moved towards decreasing returns to scale to constant returns to scale but total food industry moved towards increasing returns to scale to decreasing returns to scale. After 2000-01, all sub-sectors of food processing industries moved to increasing returns to scale, butthe total food processing and BakeryProductsmoved to constant returns to scale. These results clearly indicate that after market liberalization the capital investments across the food processing industry had significantly increased, after having not been fully utilized in most of the food processing segments in the initial years.

Table 8 : Returns to Scales in Indian Food Processing Industries during, 1981-2010

Industry	1981-1989	1990-2000	2001-2010	1981-2010
Meat/Meat Products	IRS	IRS	IRS	CRS
Fish/Fish products	IRS	IRS	IRS	IRS
Fruits and Vegetables	IRS	IRS	IRS	IRS
Oils and fats	IRS	IRS	IRS	IRS
Dairy Products	IRS	IRS	IRS	IRS
Grain milling	IRS	IRS	IRS	IRS
Starch/Starch products	IRS	IRS	IRS	IRS
Animal Feeds	IRS	IRS	IRS	IRS
Bakery Products	IRS	IRS	CRS	IRS
Sugar	CRS	IRS	IRS	IRS
Confectionary	CRS	CRS	IRS	IRS
Other Food items	DRS	CRS	IRS	CRS
Total Food Industry	IRS	DRS	CRS	CRS

India has the following advantages in the Food Processing Sector :

- India is one of the largest food producers in the world
- India has diverse agro-climatic conditions and has a large and diverse raw material base suitable for food processing companies
- India has huge scientific and research talent pool
- A largely untapped domestic market of 1000 million consumers
- 300 million upper and middle class consume processed food
- 200 million more consumers expected to shift to processed food by 2010
- Well developed infrastructure and distribution network
- Rapid urbanization, increased literacy, changing lifestyle, increased number of women in the workforce, rising per capita income- leading to rapid growth and new opportunities in food and beverages sector
- Strategic geographic location (proximity of India to markets in Europe and Far East, South East and West Asia)

Major challenges faced by the Indian Food Processing Industry

- Consumer education that processed foods can be more nutritious
- Low price-elasticity for processing food products
- Need for distribution network and cold chain
- Backward-forward integration from farm to consumers
- Development of marketing channels
- Development of linkages between industry, government and institutions
- Taxation in line with other nations

CONCLUSIONS

The distribution of employment in different types of food processing units shows that Other Food Items sub-sector employs 37.1 per cent persons out of the total employed in TE-2010, followed by grain milling (20.1 per cent), sugar (15.5 per cent), dairy & dairy products (5.8 per cent), and oil & fats (6.6 per cent).This sector has a total of 35835 registered firms with an invested capital of nearly Rs. 2.5 lakh crore producing an output of around Rs. 5.8 lakh crore in value terms.Major industries contributing this sector are grain mill, sugar, edible oils, and beverage and dairy products. The sector has generated employment to the tune of 16.75 lakh persons.The number of persons employed in food processing units has also increased positively across the sector during the first phase of liberalization period but Oils and fats and Sugar have decreased. Value addition across the food processing industry in the country has been growing at a very significant rate over the last two decades.

The growth in output for meat and meat products and fruits and vegetables, Oils and fats and Starch/Starch has almost doubled/triple during the last two decades.The major constraint in the development of the food processing industry is timely and quality procurement of raw material, i.e., agricultural produce for processing, which accounts for about 85-95 per cent of the total input cost.But most of sub sectors show that in 2001-2010 wage and salaries shares is sharply declining. Most of the companies/industries to reducethe cost of production cut down the wage and salaries of the employee which is not a good sign because it is adversely affecting the livelihood of labor and the productivity of labor. A productivity value, index larger than one indicates a productivity improvement and a value less than one indicates productivity decline. During the last three decades, all segments of the food processing industry experienced positive change in TFP with varied magnitude, but Meat/Meat Products, Fish/Fish products, Fruits and Vegetables and oils& fats experienced a negative change in TFP.

The overall TFP change in the Indian food processing industry increased from 0.94 during the pre-liberalization period (1981-1989) to 0.95 during the post-liberalization period (1990-2000) and 1.05 during the liberalization/globalization period (2001-2010).A close look at the TFP results indicate that the food segments with high scope of value additions have shown positive TFP changes during the post-liberalization period.The efficiency scores in the food processing industry vary significantly across various types of food processing units and over time. It is also evident that the average technical efficiency scores for the food processing industry as a whole have experienced an increasing trend during the third phase of liberalization periods (2001-2010) over the second phase of liberalization period (1999-2000) and compared to over the pre-liberalization period (1981-

1989).These results clearly indicate that after market liberalization the capital investments across the food processing industry had significantly increased, after having not been fully utilized in most of the food processing segments in the initial years.Food processing in India has immense potential in terms of income and employment generation through value addition, due to the availability of resources, labor, technology, the huge market and a favorable business environment. The level of food processing in the country is at the infancy stage and only a meager quantity of agricultural produce is processed. The growth in the Indian food processing industry is mainly constrained due to lack of productivity augmenting technologies and limited resource utilization. Therefore, technology is the key to enhancing growth and efficiency in the food processing sector.

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