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Effect of Trade Liberalization on the Efficiency of Indian Dairy Industry

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India is the largest producer of milk, and milk is the second largest agricultural commodity after rice in terms of its contribution to agricultural gross domestic product. Having achieved self-sufficiency in milk production, the emphasis now is shifting towards value addition to improve the share of dairy products in global trade, which hitherto has remained negligible. Most of the Indian dairy products are not export competitive. The lack of competitiveness is often attributed to inefficiency in the processing industry. Further, the international diary markets, remains distorted due to protectionist policies followed in the developed world. Under such a situation India has a daunting task to make its presence felt in the world market. Using data from Annual Survey of Industries, this study has analyzed the effects of trade liberalization on performance of dairy industry. Technical and scale efficiency were estimated using non-parametric approach called Data Envelopment Analysis (DEA). The effect of economic reforms on dairy industry was measured in terms of association between the effective protection coefficient and performance indicators of the industry. Except the employment, other indicators such as gross output, net value added, capital and labour productivity and technical and scale efficiency were negatively correlated with the protection level. This indicates that dismantling the protection structures would help improve the performance of the dairy industry.

Keywords: Trade liberalization, Dairy industry, Technical efficiency

1. INTRODUCTION

Indian agriculture is being gradually integrated with global markets. Dairy industry is no exception to this. India is the largest producer of milk in the world, and it is the largest agricultural commodity, which contributes about 20 per cent of the gross value of agricultural sector output in the country (Government of India 2005). Having achieved self-sufficiency in milk production, the emphasis now is shifting towards value addition to improve the share of dairy products in global trade, which hitherto has remained negligible. Nevertheless, since the initiation of the process of globalization in early 1990s, dairy products export has started to pick up. On the other hand, the international dairy markets remain distorted due to protectionist policies followed by the developed world. For example, dairy industry is one of the most protected industries in OECD countries (Andrews 2001) through various production and export support programmes (Chand and Philip 2001; National Dairy Development Board 2001). It may be noted that European countries account for a considerable share in world trade in dairy products. Under such a situation India has an undaunted task to make its presence felt in the world market.

Most of the Indian dairy products are not export competitive (Sharma and Sharma 2002; Sharma and Gulati 2003). The lack of competitiveness is often attributed to lack of scale-economies and inefficiency in processing. In order to improve these shortcomings, dairy industry was delicensed in 1991 with the expectation that it would encourage private investment and improved technology in this sector. Subsequently, other reforms in the form of creation of export promotion zones, reduction in tariffs and custom duties on machinery etc. were introduced. The question is: Have these measures led to an improvement in the

efficiency/productivity of dairy industry? This paper examines the efficiency of Indian dairy industry in the context of trade liberalization. The paper is organized as follows. The next section presents a brief overview of the dairy sector. Section 3 provides the data sources and method used to measure the efficiency of dairy industry. Section 4 examines the structure of Indian dairy industry, and the technical efficiency of the dairy industry is examined in section 5. The effects of trade liberalization on technical and scale efficiency are examined in section 6. Concluding remarks are made in the final section.

2. AN OVERVIEW OF THE DAIRY SECTOR: PRODUCTION AND POLICIES

Livestock sector in India makes substantial contribution to the agricultural economy. In 1980-81 the share of livestock sector in the agricultural gross domestic product was 16 percent, which increased to 25 percent in 2005-06. And milk is the single largest contributor to it with a share of about 70 percent. India has made tremendous progress in milk production over the last two decades. In 1980-81, milk production was 32 million tonnes, which increased to 97 million tonnes in 2005-06. The per capita availability increased from 128 gms/day in 1980-81 to 241 gms/day during 2005-06. Milk and milk products are income elastic in nature, and the demand for milk and milk products is to increase considerably over the next two decades. In India, about 60 percent of the milk output is consumed as beverages. The rest is consumed in the form of various traditional milk products such as curd*,* butte*r, khoa, burfi, gulabjamum,* etc. Though the number of organized manufacturing units increased from 279 in 1981-82 to 835 in 1999-2000, but only about 15 percent of the milk output undergoes commercial processing. The rest of the processing takes place at the household level (Gupta 1997).

The tremendous progress in milk production can be attributed to an enabling policy environment. A dairy development programme known as ‘Operation Flood’ was initiated in 1970 by the National Dairy Development Board (NDDB) with the aim to provide market access to the producers through development of cooperatives, and improve milk availability to the urban consumers in the major cities. The successful implementation of the ‘Operation Flood’ made the country self-reliant in milk production. However, all these developmental efforts took place in a protected policy environment, that is, the dairy industry was reserved for cooperatives until recently. Imports of dairy products were canalized through NDDB. Further, the commercial import of milk products also stopped from 1975-76 onwards. On the whole, the dairy industry was protected from private and foreign competition. As a part of the market reforms programme of 1991, the dairy industry was opened for private and international competition. The government enacted Milk and Milk Products Order (MMPO) in 1992 to regulate the production and maintain the quality of milk and milk products. The order was amended in March 2002, which laid stress on hygiene, sanitation, quality and food safety standards in the dairy sector. The registered units were no longer allotted the designated milksheds. The further amendment effected in 2006 modified the MMPO into Milk and Milk Products Regulations and is expected to ease the entry of potential private enterprises in this sector.

Being signatory to WTO agreement, it becomes mandatory for India to open the dairy sector to the world market. The import of dairy products was decanalized during 1994. All the milk products except malted foods are covered in the category of industries for which foreign equity participation up to 51 per cent is automatically allowed. Moreover, the capital

goods can be imported freely if it is financed through foreign equity. Ice- cream industry, which was earlier reserved for manufacturing in the small-scale sector, has now been dereserved. Licensing procedures have been simplified. Quantitative Restrictions (QRs) on all dairy products were removed from April, 2001. Initially, the import tariffs for most of the dairy products were reduced considerably with zero duty for skim milk powder and whole milk powder. However, India renegotiated the WTO bound rates with the duty of 15 per cent on milk powder upto 10,000 tonnes under the Tariff Rate Quotas (TRQ) and would attract the import duty of 60 per cent outside the TRQ.

3. DATA AND METHODOLOGY

3.1. Data

The study uses both time series and cross section data pertaining to manufacturing of dairy products in the organized sector. The four-digit level time series and five-digit cross section data were extracted from the Annual Survey of Industries (ASI) compiled by the Central Statistical Organization of the Ministry of Statistics and Programme Implementation. The study spans over a period from 1981-82 to 1999-2000. The cross section data pertain to the year 1999-2000. The data were deflated using 1981/82 prices.

3.2. Methodology

There are two commonly followed approaches to estimate the technical efficiency namely, parametric and non- parametric. The former follows econometric procedure, while the latter is a mathematical programming approach. The disadvantage of parametric approach is that it assumes a particular functional form for a technology. The estimates of the parameters are sensitive to the probability distributions specified for the disturbance terms. While, the non-parametric approach introduced as Data Envelopment Analysis (DEA) by Charnes, Cooper and Rhodes (1978) is a method of measuring efficiency of a firm (the firm is referred to as the Decision Making Unit –DMU- in the DEA literature) through mathematical programming. The DEA does not assume any functional form and the efficiency of a DMU is measured relative to all other DMUs with the simple restriction that all DMUs lie on or below the efficient frontier. That is, the DEA is a methodology directed to frontiers rather than central tendencies (Seiford and Thrall 1990). The DEA is also capable of handling multiple outputs. The present study employs input oriented variable returns to scale (VRS) DEA to measure technical and scale efficiency in Indian dairy industry by using DEAP software (version 2.1) developed by Coelli (1996). The input-output variables used include fixed capital, working capital, number of workers, fuel consumed, materials consumed and net value added. A brief outline of the method is given below.

The original model developed by Charnes, Cooper and Rhodes (CCR model) was applicable when technologies characterized by constant returns to scale (CRS). It is assumed that there are 'N' DMUs with K inputs and S outputs on each DMU. That is, DMU_j (j = 0, 1, ……, N) consumes x_{ji} amount of input i and produces y_{jr} amount of output r, where $x_{ji} \geq 0$ and $y_{jr} \geq 0$. The essential characteristic of the CCR construction is the reduction of the multiple outputs or multiple inputs to that of a "single virtual output" and "single virtual input" for each DMU (Seiford and Thrall 1990). For a particular DMU ratio of single virtual

output to single virtual input such as $u_r y_{jr}/v_i x_{ji}$ gives a measure of efficiency, where u_r and v_i are output weights and input weights, respectively. The mathematical programming involves the selection of optimal weights that maximizes the objective function of the ratio of outputs to inputs for each DMU being evaluated. Mathematically, for DMU_0 it can be expressed as follows.

$$\max_{u,v}\left(\sum_{r=1}^{S} u_r y_{r0} \Big/ \sum_{i=1}^{K} v_i x_{i0}\right)$$

subject to

$$\sum_{r=1}^{S} u_r y_{rj} \Big/ \sum_{i=1}^{K} v_i x_{ij} \leq 1 \qquad j=(0,1,2.....,N)$$

$$u_r \geq 0 \qquad r=(1,.....,S)$$

$$v_i \geq 0 \qquad i=(1,.....,K)$$

Here, the efficiency measure of DMU_0 is maximized with the constraint that the efficiency measure of every *DMU* be less than or equal to unity. However, the above formulation gives infinite number of solution. That is, if $(u*, v*)$ is an optimal solution, then $(\alpha u*, \alpha v*)$ is also an optimal solution. Thus, to overcome this problem, the constraint $\sum_{i=1}^{K} v_i x_{i0} = 1$ can be imposed. The transformed linear programming problem with the changed notations is as follows:

$$\max_{\mu,v}\left(\mu_r y_{r0}\right)$$

subject to

$$\sum_{i=1}^{K} v_i x_{i0} = 1$$

$$\sum_{r=1}^{S} \mu_r y_{rj} - \sum_{i=1}^{K} v_i x_{ij} \leq 1 \qquad (j=1,.....,N)$$

$$\mu_r \geq 0 \qquad (r=1,.....,S)$$

$$v_i \geq 0 \qquad (i=1.....,K)$$

The duality of the above multiplier form is called envelopment form, which is easier to solve as it involves fewer constraints than the multiplier form. The dual problem is

$\min_{\theta,\lambda} \theta,$

subject to

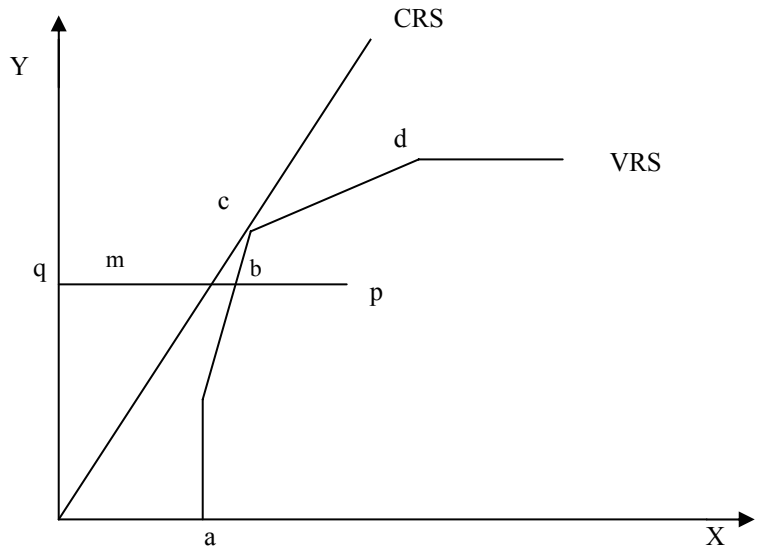
$Y_{rj}\lambda_J \geq Y_{r0}$
$\theta X_{i0} - X_{ij}\lambda_j \geq 0$
$\lambda_j \geq 0$

Where θ is a scalar. The value of θ gives efficiency score for a particular *DMU*, which satisfies $\theta \leq 1$. The DMUs for which $\theta < 1$ are inefficient while for $\theta = 1$ are on frontiers and hence efficient.

Imperfect competition may cause a DMU not to operate at optimal scale (Coelli 1996). Banker, Charnes and Cooper (1984), extended the CCR model to account for technologies that show variable returns to scale (VRS). The Banker, Charnes and Cooper (BCC model) can be developed by adding the convexity constraint to the constant returns to scale (CRS) linear programming problem.

i.e. $\sum_{j=1}^{N} \lambda_j = 1$
$\lambda \geq 0$

The CRS technical efficiency scores can be decomposed into pure technical efficiency and scale efficiency. This can be done by applying both CRS and VRS DEA on the same model. The difference between CCR model and BCC model can be illustrated as follows. We shall assume one input and one output situation. The CRS and VRS frontiers have been drawn in the following figure.



The inefficient DMU is represented by the point p. Under input orientation measure, the technical inefficiency of DMU 'p' is *mp* in CRS and *bp* in VRS. The difference between these two measures is expressed as scale inefficiency (SE). In ratio form, technical efficiency in CRS is *qm/qp* and in VRS it is *qb/qp*. Scale efficiency is *qm/qb*. Further, $TE_{CRS} = TE_{VRS} / SE$. Thus, technical efficiency (TE) obtained from CRS can be decomposed into 'pure' technical efficiency and scale efficiency. The point such as 'c' on the frontier is scale efficient.

The technical efficiency scores are used to examine the effect of trade liberalization, which is captured through effective protection coefficient, on Indian dairy industry.

4. STRUCTURE AND PERFORMANCE OF THE DAIRY INDUSTRY

4.1. Input and output trends

Trends in number of factories, per factory fixed capital, working capital, net value added (NVA), and employment are given in Table 1. The number of factories has increased

Table 1. Trend in the number of factories, and per factory capital and labour inputs

Year	No of factories	Fixed capital (Rs. lakhs)	Working capital (Rs. lakhs)	Net value added (Rs.lakhs)	No of employees
1981-82	279	45.03	18.77	19.86	137.17
1982-83	270	50.55	32.36	25.53	145.45
1983-84	304	51.54	63.14	17.67	142.46
1984-85	345	56.58	32.68	27.66	153.97
1985-86	317	57.48	40.59	17.02	156.54
1986-87	357	63.72	52.96	31.08	147.52
1987-88	357	72.46	34.93	36.56	143.14
1988-89	386	65.97	40.91	32.32	136.69
1989-90	426	67.91	39.05	56.10	141.50
1990-91	432	60.46	37.36	36.91	133.43
1991-92	465	51.55	43.17	28.15	127.55
1992-93	511	55.21	48.69	28.91	133.01
1993-94	513	60.97	48.03	28.15	143.39
1994-95	563	64.57	34.19	33.74	134.89
1995-96	630	95.03	32.29	33.88	134.02
1996-97	695	65.52	50.58	36.51	117.89
1997-98	737	143.08	35.40	47.93	108.66
1998-99	723	75.81	38.64	41.79	96.57
1999-00	835	89.31	25.02	15.64	66.55
Growth rates (%)					
1981-82 to 1989-90	5.31	5.55	5.01	11.32	-0.16
1990-91 to 1999-00	7.46	7.27	-3.50	-1.00	-5.77

overtime particularly during nineties with the growth rate of 7.46 per cent per annum. The per factory fixed capital increased moderately during eighties. In the beginning of the reform period, it showed a declining trend, but started increasing afterwards. This is also evident from the annual growth rates in the per factory fixed capital. The average working capital per factory recorded negative growth rate of 3.50 during 1990s while it was positive during the 1980s. The net value added also registered negative growth rates during 1990s. The number of employees per factory did not show any trend during 1980s. But, it showed a marked decline in 1990s. The growth in number of employees per factory was negative during 1980s as well as 1990s indicating that labour is being substituted by capital in an average Indian dairy DMU.

4.2. Technical coefficients and productivity ratios

Fixed capital/NVA ratio does not show any trend during the period 1981-82 to 1999-

Table 2. Technical coefficients and productivity ratios for Indian dairy products industry

Year	FC/ NVA	EMO/ NVA	NVA/ OUT	EMO/ FC	OUT/EMP (Rs.)	NVA/EMP (Rs.)	FC/ OUT	NVA/ PC
1981-82	2.27	0.75	0.06	0.33	226067	14476	0.15	0.31
1982-83	1.98	0.66	0.08	0.33	232440	17550	0.15	0.31
1983-84	2.92	0.92	0.05	0.32	269217	12405	0.13	0.15
1984-85	2.05	0.60	0.08	0.29	235986	17967	0.16	0.31
1985-86	3.38	1.18	0.04	0.35	277835	10875	0.13	0.17
1986-87	2.05	0.62	0.07	0.30	309263	21067	0.14	0.27
1987-88	1.98	0.55	0.09	0.28	298107	25543	0.17	0.34
1988-89	2.04	0.55	0.08	0.27	286138	23644	0.17	0.30
1989-90	1.21	0.37	0.12	0.30	334992	39650	0.14	0.52
1990-91	1.64	0.57	0.09	0.35	311890	27663	0.15	0.38
1991-92	1.83	0.69	0.07	0.37	309270	22072	0.13	0.30
1992-93	1.91	0.71	0.07	0.37	325966	21736	0.13	0.28
1993-94	2.17	0.81	0.05	0.37	364802	19635	0.12	0.26
1994-95	1.91	0.65	0.08	0.34	308190	25016	0.16	0.34
1995-96	2.81	0.65	0.08	0.23	332174	25277	0.21	0.27
1996-97	1.79	0.53	0.10	0.30	325608	30966	0.17	0.31
1997-98	2.99	0.40	0.11	0.13	384500	44106	0.34	0.27
1998-99	1.81	0.43	0.09	0.24	470249	43274	0.17	0.37
1999-00	5.71	0.74	0.05	0.13	432960	23500	0.31	0.14
Growth rates (%)								
1981-82 to 1989-90	-5.18	-6.96	6.64	-1.88	4.55	11.49	1.12	5.95
1990-91 to 1999-00	8.35	-2.96	1.04	-10.43	3.98	5.07	9.48	-4.46

Note: FC- Fixed capital, NVA- Net Value Added, OUT- Total output, EMO- Emoluments, EMP- Employees, PC- Productive capital

2000 (Table 2). The ratio of emoluments to NVA has registered negative growth rates during 1980s as well as 1990s. It indicates that the share of labour input in NVA is declining over time. The net value added per unit of output does not show any trend. The labour- capital ratio, which is defined as the ratio of emoluments to fixed capital, has been declining. The labour –capital ratio was 0.33 in 1981-82, which declined to 0.13 in 1999-2000. Decline in growth of labour-capital ratio was more visible during nineties than eighties. This implies that dairy industry is gradually becoming capital intensive.

The ratios of output to employees and NVA to employees show the simple measures of labour productivity. The ratio of output to employees is a measure of physical productivity, while NVA to employees provide the partial productivity ratio. The physical productivity ratio, by and large, has been increasing. Though, the partial productivity ratio is marked with considerable fluctuations, it has improved during late 1990s. The NVA per employee increased from Rs.14,476 in 1981-82 to Rs.23,500 in 1999-2000. The capital productivity ratios shown in the last column of table 2 did not show any trend. It almost remained constant during 1990s. The capital- output ratio, however, increased from 0.15 in 1990-91 to 0.31 in 1999-2000. The partial productivity ratio (NVA/ productive capital) declined from 0.31 during 1981-82 to 0.14 during 1999-2000. The declining capital productivity ratios indicate that capital is not being utilized efficiently. In India, only about 25 per cent of total milk procured by processing firms is processed into value added products like milk powder, ghee and cheese and the rest is sold as liquid after pasteurization. Only when surplus milk is available after meeting domestic demand for liquid milk, it is converted into to value added products. This often leads to underutilization of productive capital, which is documented in Birthal and Taneja (2006).

Table 3 examines the performance of dairy products industry in relation to the food industry. It is clear from the ratio of total emoluments to fixed capital that both the dairy industry as well as the food industry as a whole is capital intensive. However, the ratio of fixed capital to employee shows that dairy industry is more capital intensive than food industry as a whole. The fixed capital per employee in dairy industry was Rs.32,825 in 1981-82 increased to Rs.134,204 in 1999-2000. The emolument per employee in dairy industry is higher than food industry. The labour productivity as the ratio of net value added per employee does not show any marked trend in both the industries. However, capital productivity is higher in food industries than the dairy industry. The partial productivity of capital in dairy industry ranged between 0.14 and 0.31, while it was 0.31 and 0.42 in food industry. It is also evident from the table that ratios of NVA to total cost, and input to output

Table 3. Performance of dairy industry *vis-a-vis* food products industry

Particulars	1981-82		1990-91		1999-2000	
	Dairy	Food	Dairy	Food	Dairy	Food
Total Emoluments/Fixed capital	0.33	0.35	0.35	0.27	0.13	0.12
Emoluments/employee (Rs)	10874	3691	15640	7600	17369	8967
Working capital as % of productive capital	29.42	39.45	38.20	39.63	21.88	30.35
Fixed capital/ employee (Rs)	32825	10571	45310	28638	134204	76668
Net value added/employee (Rs)	14476	7308	27663	19513	23500	34672
Net value added/productive capital	0.31	0.42	0.38	0.41	0.14	0.31
Net Value added/total cost	0.07	0.10	0.10	0.12	0.06	0.11
Input/out put	0.92	0.89	0.89	0.87	0.93	0.89

that more inputs are used to produce one unit of output in dairy industry.

5. EFFICIENCY OF DAIRY INDUSTRY

The efficiency scores for an average dairy DMU are presented in Table 4. The average technical efficiency (TE) score for dairy industry is estimated at 0.73 under CRS model and 0.95 under VRS model. The average scale efficiency (SE) for the entire period is 0.73. The average technical efficiency under the CRS and VRS technologies was 0.67 and 0.94, respectively during 1981-82 to 1990-91 and improved to 0.73 and 0.95 respectively during 1991-92 to 1999-2000, i.e. the economic reform period. The scale efficiency also improved during the reform period. These results indicate that the trade reforms have helped improve the performance of Indian dairy industry.

Table 4. Efficiency scores for Indian dairy products industry over time

S. No.	Year	CCR Model (TE)	BCC model (Pure TE)	SE	Peer group	Peer weight
1	1981-82	0.74	1.00	0.74		
2	1982-83	0.64	1.00	0.64		
3	1983-84	0.45	0.94	0.48	1, 19	0.93, 0.07
4	1984-85	0.65	0.95	0.69	9, 19, 2, 1, 18	0.07, 0.02, 0.48, 0.31, 0.13
5	1985-86	0.36	0.84	0.43	11, 1, 19	0.39, 0.59, 0.02
6	1986-87	0.63	0.86	0.74	9, 18, 1, 11	0.18, 0.14, 0.45, 0.20
7	1987-88	0.76	0.92	0.82	9, 2, 17, 1, 18	0.27, 0.31,0.11, 0.21, 0.09
8	1988-89	0.67	0.94	0.71	9, 19, 2, 1	0.28, 0.18, 0.51, 0.03
9	1989-90	1.00	1.00	1.00		
10	1990-91	0.77	0.99	0.78	9, 19, 1, 11	0.45, 0.08, 0.33, 0.14
11	1991-92	0.66	1.00	0.66		
12	1992-93	0.63	0.94	0.68	9, 1, 11	0.05, 0.09, 0.86
13	1993-94	0.56	0.86	0.65	9, 1, 18, 11	0.003, 0.08, 0.04, 0.88
14	1994-95	0.69	0.93	0.74	9, 11, 1, 19, 18	0.30, 0.19, 0.33, 0.10, 0.09
15	1995-96	0.73	0.89	0.82	9, 1, 17, 19	0.22, 0.30,0.25, 0.23
16	1996-97	0.80	0.98	0.81	9, 18, 1, 11, 19	0.19, 0.30, 0.05, 0.39, 0.06
17	1997-98	1.00	1.00	1.00		
18	1998-99	1.00	1.00	1.00		
19	1999-00	0.51	1.00	0.51		
	Mean					
	1981-82 to 1999-00	0.70	0.95	0.73	-	-
	1981-82 to 1990-91	0.67	0.94	0.70	-	-
	1991-92 to 1999-00	0.73	0.95	0.76	-	-

The performance scores based on CRS model are equal to one during the years 1989-90, 1997-98 and 1998-99. The remaining all the years recorded the efficiency scores of less than one indicating that the resources are not used efficiently. However, the results based on VRS model indicate that the performance scores are close to one for more number of years than the CRS model. It is because the VRS-DEA scores are devoid of scale efficiencies. The VRS based TE scores are also called 'pure' TE scores. An average dairy DMU was scale inefficient during most of the years under study barring 1989-90, 1997-98 and 1998-99.

A peer is an efficient DMU/year, which acts as a reference point for inefficient DMUS/ years. The peer group defines where the relevant part of the frontier is and hence, defines efficient production for the inefficient DMUs (Coelli 1996). In the Table 4 peer group and their respective peer weights are given. For the year 1983-84, the years 1981-82 and 1999-2000 act as reference points for defining the frontiers.

Table 5 provides data on target inputs and the estimated slack inputs in an Indian average dairy DMU. Target inputs refer to what a particular DMU ought to have consumed if it was to on the efficient frontier. The slack inputs are the excess inputs. The slack is calculated as the difference between actual input consumed minus the target input a DMU ought to have consumed. An efficient DMU will have zero input-output slacks. The figures presented in Table 5 show that an average dairy DMU utilizes the fixed capital efficiently, but the working capital is being used excessively. If a DMU was to qualify for an efficient DMU in 1996-97, about Rs.11 lakhs of working capital had to be reduced. The labour input had

Table 5. Target inputs and estimated slack inputs (Rs. lakhs) in Indian dairy products industry (1981-82 prices)

Year	Fixed capital		Working capital		Workers (Nos.)		Fuels Consumed		Materials consumed	
	Target	Slack	Target	Slack	Target	Slack	Target	Slack	Target	Slack
1981-82	45.03	0	18.77	0	86.63	0	11.42	0	255.66	0
1982-83	50.55	0	32.36	0	94.44	0	12.37	0	261.80	0
1983-84	48.17	0	19.21	39.80	83.57	3.02	11.34	0	256.04	14.31
1984-85	54.00	0	29.29	1.90	85.83	0	12.27	0	281.72	0
1985-86	48.53	0	28.31	5.97	82.03	0	12.27	0	278.52	17.05
1986-87	54.81	0	30.12	15.43	80.63	0	12.96	0	303.50	7.38
1987-88	66.80	0	32.20	0	84.52	0.15	13.54	0	307.32	0
1988-89	62.19	0	32.62	5.94	83.20	0	13.42	1.18	287.25	0
1989-90	67.91	0	39.05	0	87.26	0	17.46	0	352.46	0
1990-91	59.64	0	31.82	5.04	82.18	0	14.35	0.29	307.79	0
1991-92	51.55	0	43.17	0	77.18	0	13.69	0	314.72	0
1992-93	51.85	0	40.81	4.92	78.55	0	13.69	0.88	311.54	28.71
1993-94	52.10	0	41.04	0	77.13	0	13.43	0.45	313.18	27.10
1994-95	59.96	0	31.75	0	78.38	0	13.55	0.54	307.63	0
1995-96	84.73	0	28.79	0	72.55	0	12.91	1.01	303.78	56.85
1996-97	64.14	0	38.64	10.88	71.46	0	13.44	0	337.60	0
1997-98	143.08	0	35.40	0	68.92	0	13.14	0	358.09	0
1998-99	75.81	0	38.64	0	57.36	0	11.55	0	386.77	0
1999-00	89.31	0	25.02	0	43.42	0	10.25	0	261.01	0

slacks in its utilization during early eighties, but not during late eighties and nineties. Slacks were also observed in the use of fuels. The highest slack was found in the materials consumed. In fact, the slack in materials consumed increased from Rs.14.31 lakhs in 1983-84 to Rs.56.85 lakhs in 1995-96.

The efficiency scores of the dairy industry at disaggregate level for the year 1999-2000 is given in Table 6. The subgroups of diary industry at 5-digit level with their respective codes are: (i) Manufacture of milk powder, ice cream powder and condensed milk except baby milk foods (15201) (ii) Manufacture of baby milk foods (15202) (iii) Manufacture of butter, cream, ghee, cheese and khoa, etc. (15203) (iv) Manufacture of pasteurized milk (15204) (v) Manufacture of ice cream and kulfi, etc. (15205) (vi) Manufacture of other dairy products (15209). The firm level data on baby milk foods is not available, hence the efficiency scores for that industry was not calculated. Even in the existing industrial groups, some firms were left out of the analysis because of data problems.

The average technical efficiency based on CRS model for the dairy industry as whole was 0.54 (Table 6). The average pure technical efficiency and scale efficiency are estimated 0.70 and 0.77, respectively. Of the five subgroups, the DMUs in ice cream and *kulfi* industry are more efficient in utilizing the resources. The DMUs in the pasteurized milk group are the least efficient. The pure technical efficiency of an average DMU in the pasteurized milk industry is 0.45, which means a DMU can reduce the consumption of all inputs by 55 per cent without reducing the output. All the dairy sub industrial groups are found to be scale inefficient.

The target inputs and estimated slack therein for different subgroups are presented in Table 7. There are slacks in all the inputs in most of the subgroups, except for labour input in the milk powder, ice cream and kulfi industry. The highest slack has been estimated in

Table 6. Efficiency scores in Indian dairy products industries (1999-2000)

Industry code	CCR model (TE)	BCC model (Pure TE)	SE
15201	0.61	0.82	0.75
15203	0.53	0.63	0.84
15204	0.28	0.45	0.67
15205	0.71	0.92	0.74
15209	0.58	0.70	0.84
Overall	0.54	0.70	0.77

Table 7. Target inputs and estimated slack inputs (Rs. lakhs) in dairy products industries (1999-2000)

Industry code	Fixed capital		Workers (Nos.)		Fuels consumed		Materials consumed	
	Target	Slack	Target	Slack	Target	Slack	Target	Slack
15201	222.85	11.54	178.25	0.00	110.68	21.21	2862.76	315.67
15203	99.89	158.20	67.90	9.75	29.11	34.86	447.21	702.68
15204	48.32	99.57	62.67	10.27	30.60	18.52	1095.46	548.44
15205	159.81	4.24	52.30	0.00	20.50	2.26	816.88	121.11
15209	1132.72	70.33	141.61	15.45	145.45	48.07	4139.67	959.42

materials consumed across all the subgroups. The time-series analysis also indicates inefficiency in the utilization of raw materials. To be on the frontiers, the DMUs should be able to reduce the excess inputs and use the target inputs while keeping the output constant. Comparatively, DMUs in ice cream and kulfi industry utilizes the resources efficiently, as the slacks in the inputs in this industry are the least.

6. EFFECTS OF TRADE LIBERALIZATION ON EFFICIENCY OF THE DAIRY INDUSTRY

Does trade liberalization influence productivity growth and/or technical efficiency of an industry? The empirical evidences are ambiguous. Some studies indicate that the firms in an industry fail to produce maximum possible output from a given input bundles because of the absence of foreign competition. Havyrlyshyn (1990) argues that there exists no relationship between productivity and openness. Tybout and Westbrook (1995) also observed little association between changes in openness and productivity growth in the Mexican manufacturing industries. They further argued that openness actually worsens scale efficiency. However, some studies indicate that trade liberalization helps improve productivity growth (Kruger and Tuncer 1982; Kim 2000).

To examine whether trade liberalization has influenced dairy industry and its efficiency, correlation coefficients were estimated between Effective Protection Coefficient (a measure of openness) and technical efficiency scores and other characteristics of the industry. Effective Protection Coefficients (EPC) for the dairy industry were compiled from Gulati and Bhide (1998), Saxena (2000) and Jha (2000). The average EPC for the dairy industry remained above unity during the period 1981-82 to 1999-2000, indicating the existence of protective structures in this sector.

The effects of trade reforms on the selected indicators of the Indian dairy industry and its efficiency are presented in Table 8. The correlation between level of protection and gross output and net value added is negative, but not significant. Nevertheless this suggests that reduction in protection would have a positive effect on dairy industry output. As expected, efficiency of the dairy industry improves with the reduction in protection level. The correlation between protection and technical efficiency is statistically significant at one per cent level. The scale efficiency also improves, but the coefficient is not statistically significant.

Table 8. Correlation coefficients between protection level and the performance indicators of dairy industry (1981-82 to 1999-2000)

Particulars	EPC	OUT	NVA	EMP	NVA/PC	NVA/EMP	TE	SE
EPC	1.00							
OUT	-0.10	1.00						
NVA	-0.33	0.09	1.00					
EMP	0.52*	-0.54*	-0.06	1.00				
NVA/PC	-0.29	-0.18	0.80**	0.18	1.00			
NVA/EMP	-0.46*	0.29	0.88**	-0.51*	0.39	1.00		
TE	-0.59**	0.21	0.28	-0.53*	0.27	0.46*	1.00	
SE	-0.42	0.02	0.92**	-0.18	0.56*	0.88**	0.38	1.00

* Significant at 5% level (2-tailed), ** significant at 1% level (2-tailed)

Removal of protective barriers also improves the capital and labour productivity. The correlation coefficients are negative, but significant only for labour productivity. The correlation between the protection and employment is positive and significant at 5 per cent level, implying that that reduction in protection may lead to decline in employment in the dairy sector. The reduction in employment can be attributed to increase in the labour productivity.

7. CONCLUSIONS AND IMPLICATIONS

India is the largest producer of milk in the world. Over the last two decades the milk output has increased considerably making India self sufficient in milk production. Concomitantly the demand for milk and milk products has also increased owing to sustained growth in per capita income, rising urbanization and changing lifestyles. Notwithstanding these achievements, processing remains a matter of concern. Only about 25 percent of total milk procured undergoes commercial processing. Meanwhile, there are apprehensions that cheap import flow of dairy products from the European countries that provide heavy protection to their industry would adversely affect the primary as well as the secondary industry. Evidences indicate lack of export competitiveness of Indian dairy products. And, this is often attributed to inefficiency in processing industry. In order to improve this a number of reforms have been underway since early 1990s. This study has examined the growth and efficiency of dairy industry in the context of trade liberalization.

The performance of dairy industry has been marked with fluctuations. The number of manufacturing units in the organized sector has increased considerably. The net value added per factory registered negative growth after the initiation of reforms. The number of employees per factory did not show any trend, however, it showed a marked decline in 1990s. The labour –capital ratio declined from 0.33 in 1981-82 to 0.13 during 1999-2000. It implies that dairy industry is capital intensive in nature and the labour absorbing capacity is declining overtime. The declining capital productivity ratios indicated that capital is not being utilized efficiently. During 1980s technical efficiency did not show any definite trend. However, during 1990s the technical efficiency showed an improvement.

The effects of economic reforms on dairy industry were measured in terms of association between the protection level and performance indicators of the industry. Except the employment, other indicators such as gross output, net value added, capital and labour productivity and technical and scale efficiency were negatively correlated with the protection level. These indicate that dismantling the protection structures would help to improve the performance of the dairy industry through infusion new capital and technology. The improved performance will make Indian dairy industry globally competitive.

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