Food Science and Quality Management www.iiste.org
ISSN 2224-6088 (Paper) ISSN 2225-0557 (Online)
Vol 3, 2012

Reviewing Performance of Indian Sugar Industry: An Economic Analysis

Sarbapriya Ray
Dept. of Commerce, Shyampur Siddheswari Mahavidyalaya,
University of Calcutta, West Bengal, India.
Tel:+91-33-9433180744,E-mail:sarbapriyaray@yahoo.com

Abstract:

This paper attempts to measure the economic performance of Indian sugar industry in terms of capacity utilization measured econometrically at aggregate level over a period from 1979-80 to 2008-09. In this study, Optimal output is defined as the minimum point on the firm's short run average total cost curve and the rate of capacity utilization is merely ratio of its actual output to capacity output level. Under Choice theoretic framework, the results suggest that a significant variation in the capacity utilization rates over years within same industry was found. There has been diminishing capacity utilization growth rate in this industry during post reform period. The impact of liberalization on economic capacity utilization of Indian sugar industry is noticed to have significant negative impact.

Key words: Capacity, utilization, India, sugar, industry, liberalization.

1. Introduction:

With the introduction of economic reforms since July, 1991, many changes have come upon industrial structure in India. Relaxing of licensing rule, reduction in tariff rates, removal of restriction on import of raw materials and technology, price decontrol, rationalization of customs and excise duty, enhancement of the limit of foreign equity participation etc are among those which have been introduced at early 1990s. The major objectives of such policy reforms were to make Indian industries as well as entire economy more efficient, technologically up-to-date, competitive and ready to face global challenges with a view of attain rapid growth. It was obviously expected that liberalization would enhance competition and at the same time, this would increase the competitiveness of the domestic firms so that they can thrive despite facing global pressure of competition. A significant improvement in industrial production began since 1993 with the liberalization policy becoming effective with industrial deli censing. Easy availability of imported inputs eliminated the difference between actual and potential productive capacity. The believers of liberalization suppose that this policy reform will improve industrial growth and performance significantly while critics argue that total withdrawal of restrictions on several matters will have a negative effect on future growth and performance of the industry.

Under the structured Industrial Development Policy, sugar industry was part of the Five-Year Plans of Indian Planning system introduced in 1951 and has been under the direct control of the Government ever since. Sugar industry is highly politicized and so closely controlled by the Government which has no parallel in the industry. Government control covers all aspects of sugar business i.e. licensing/capacity/cane area, procurement/pricing/sugar pricing/distribution and imports and exports. Sugar scene in India has been that of protectionism. The mills, the farmers and the consumers all have been protected one way or another. Whereas the protection to farmer and consumer has been consistent, it has not been so consistent for the mill owners. But, winds of liberalization have touched sugar industry also. Due to relaxation of licensing rule after economic liberalization took place in 1991, the imports of sugar was freely allowed and exports were deregulated to some extent. Competition became intense and customers are more demanding on quality and service. Sugar however remains insulated; liberalization and reforms touched sugar limiting to only imports and in some way in exports.

Concept of capacity utilization plays an important role in evaluating economic activities by means of explaining the behaviour of investment, inflation, productivity profit and output. The concept of capacity utilization (CU) has been basically analyzed in economics from diverse dimensions, both theoretically and empirically, and has been very often used to explain changes in macroeconomic indicators like inflation rate, rate of investment or labour productivity. Many alternative capacity utilization measures have also been developed, but due to interpretation problems, there is no unanimous acceptance regarding the most appropriate way of defining and measuring capacity utilization. If market demand grows, capacity utilization will rise. If demand weakens, capacity utilization will slacken. Economists and bankers often watch capacity utilization indicators for signs of inflation pressures. Therefore the estimation of capacity output and its utilization will be very useful to evaluate the variations in the performance of an industry over a period of time.

In this backdrop, the article tries to evaluate the performance of Indian sugar industry in terms of capacity utilization measured econometrically over a period of 30 years from 1979-80 to 2008-09.However, SWOT and PESTEL analysis also have been conducted to observe the overall performance and prospects of the sugar industry.

The paper is analyzed by applying choice theoretic framework. This paper is divided into the following sections: Section 2 depicts brief review of literature on concept of capacity. Section 3 provides data base and methodological issues. Section 4 estimates capacity and its utilization and analyses the results. Impact of liberalization on capacity utilization is also presented in this section. Section 5 depicts SWOT and PESTEL analysis and section 6 presents summary & conclusions.

1.1. Brief overview of Indian Sugar industry:

In India, sugar industry is the second largest industry after textiles. The country is the second largest sugar producer in the world (accounting 13% of the world's sugar production). The sub-tropical region (Uttar Pradesh) contributes almost 60% of India's total sugar production, while the balance comes from the tropical region, mainly from Tamil Nadu, Karnataka, Maharashtra and Madhya Pradesh. The sugar industry is one of the world's major agro-based industries. Around 75% of the global sugar production comes from the top 10 producers, of which the top three (Brazil, India and the European Union) contribute 40% of the total. The Indian sugar industry is marked by co-existence of different ownership and management structures since the beginning of the 20th century. At one extreme, there are privately owned sugar mills in Uttar Pradesh that procure sugarcane from nearby cane growers. At the other extreme, there are cooperative factories owned and managed jointly by farmers, especially in the western state of Gujarat and Maharashtra. There are state owned factories in both the states and state-managed cooperatives in Uttar Pradesh. Sugar is India's second largest agro-processing industry, with around 400 operating mills as of March 2005. The 203 cooperatives are a dominant component of the industry, which accounts for over 56% of the total capacity [@19 mt per annum] nearly 83 [or 41% of total cooperatives] are concentrated in Maharashtra, followed by Uttar Predesh with 28 mills. Regarding the structure of sugar industry in India, data for the year 2005 show that there are 20 sugar producing states in India but the combined share of 12 major states is about 97.72 percent. Among 12 major sugar producing states, the sugar firms of Uttar-Pradesh (UP) and Maharashtra are contributing about 27.06 percent and 30.12 percent, respectively to the total sugar production of India.

[Insert Table 1 here]

The sugar manufacturing industry is highly fragmented with none of the players having a market share greater than 3%. Although cooperatives account for around 43% of the total production in the sugar industry, their share has gradually declined.

[Insert Table 2 here]

Sugar plant size (in terms of cane crushed per day) is the main criteria for determining the productivity and viability of the sugar industry. In India, because of traditional industry like *Gur* and *khandsari* manufacturers fragmentation, lesser cane availability, and competition for cane, has resulted in lower plant sizes. Sugar mills in India have capacities ranging from below 1,250 tonnes crushed per day (tcd) of sugarcane to 10,000 tcd. The Government has now established minimum capacity criteria for new sugar mills standing at 2,500 tcd. Capacity limits have increased considerably over the duration of the industry, between 750 tcd in the oldest factories to 10,000 tcd in the most recent factories. In Indian sugar industry, the government regulates raw material cost (estimated to account for 75 percent of the operating cost of the sugar manufacturers) and announces a statuary minimum price (SMP) for the purchase of sugarcane by the sugar firms before the start of the sugar year1. Over the years, SMP has followed continuous upward revisions. It has been observed that although SMP serves the political interests of the government but prove to be uneconomical for the sugar firms. Further, the government controls over the supply of sugar and compels the sugar firms to follow a dual price system. Under the ‘levy-sugar quota’, the sugar firms have to surrender a soaring amount of their output to the government at unremunerative prices which are lower than the market-oriented price. However, the remaining proportion of sugar output can be sold at free market prices without any government restriction. It is noteworthy that upward revisions in SMP induced only the expansion of area under sugarcane production, and did not provide any incentive to improve the quality of sugarcane in terms of sucrose contents. This is evident from the fact that the sugar recovery content of cane has remained stagnant at around 10 percent for the last two decades as compared with 12 to 13 percent in some other major sugar producing countries.

Sugar has historically been classified as an essential commodity and has been regulated across the value chain. It is a highly politicized commodity in India covered by the Essential Commodity Act,1955.The excess government control and participation over the industry play a major role in determining the industry’s performance. The heavy regulations in the sector artificially impact the demand-supply forces resulting in market imbalance.

Sensing this problem, since 1993 the regulations have been progressively eased. The key regulatory milestones include de-licensing of the industry in 1998 and the removal of control on storage and distribution in 2002.
However, policy still plays an important role in the industry.

Legislation influencing Indian Sugar industry:

The following are some legislation which affects Indian sugar industry.

1.1.1. Licensing:

- Sugar Industry is a schedule industry under Industrial Development Regulation Act requiring license to manufacturer.
- Gestation period has been reduced from 3 years to one.
- Minimum capacity of a new sugar mill is 2500 TCD and expandable upto 5000 TCD.
- Minimum distance between 2 sugar mills is now 15 kms which used to be 40 km.
- Cane availability is now not so critical requirement.
- Government gives incentives where in new mills can sell upto 100% of the sugar in free market against 60% of existing mills - Government has also announced such incentive for expansion upto 5000 TCD.
- The impact has been horizontal growth-causing cane shortage-higher per unit processing cost etc. etc.

1.1.2. Sugarcane procurement:

- Concept of Command Area which binds Cane farmers and Sugar mills to sell and buy from each.
- Sugar mills have to purchase all the Cane sold to them, even if it exceeds their requirement.
- In case of capacity expansions at existing Sugar mills, there is uncertainty regarding allocation of additional area based on the expanded capacity.

1.1.3. Sugarcane pricing:

- Government administered Statutory Minimum Price (SMP) which acts as a floor.
- States like UP, Haryana and Punjab fix a higher price for cane, called the State Advised Price (SAP). Historically, the SAP has been as high as 20-30% above SMP.

1.1.4. Dual Sugar Pricing Policy:

Under the provision of the Sugar Control Order, Govt. has been regulating the sugar supplies for distribution under PDS and free market. Several times in the past, industry has gone through complete control or partial control to complete decontrol and back to partial control. (Annexure XII).Under the current policy 40% of the sugar produced is to be delivered by mills, for public distribution, at a price fixed from season to season. Balance 60% can be sold in the free market as per quantity decided by Govt. on month to month basis for each mill. Also mill has to sell minimum 47.5% in the first fortnight and 52.5% in second.

1.1.5. Sugar sales:

- Government mandates 10% of sugar to be sold as levy quota sugar at prices much lower than the market.
- The government also specifies monthly release quotas for free sale sugar.

1.1.6. Capacity and Production:

- Sugar producers are not allowed to own cane fields in India.
- New sugar mills cannot be set up within 15 km of existing units.

1.1.7. Exports & Imports:

- Imports of both raw and white sugar attract a basic duty of 60% and a countervailing duty of Rs.910 per ton.
- In periods of sugar shortage, under the Advanced License Scheme (ALS), license holders can import raw sugar without paying any duty, subject to the condition that they re-export white sugar within a fixed period.

2. Brief review of literature on concept of Capacity:

Capacity utilization is an economic concept which refers to the extent to which an enterprise or a nation actually uses its installed productive capacity. Thus, it refers to the relationship between actual output produced and potential output that could be produced with installed equipment, if capacity was fully used. Capacity utilization measures as a procyclical indicator have been widely used to explain economic fluctuations. Unlike many well defined concepts, capacity has been subjected to alternative definition and misconceptions.

Engineer’s idea of capacity may differ from economist’s idea because if certain volume of production is technically possible, it may not be economically desirable. One of the most used definitions of CU rate is as the ratio of actual output to potential output. Concerning the potential output, there are several ways to define it. One is the engineering or technical approach according to which potential output represents the maximum amount of output that can be produced in the short run with existing stock of capital (see Nelson, 1989, p273). A similar discussion can be found in Johansen (1968, see Fare,Grosskopf &Kokkelenberg,1989,p655) where the author defines the capacity as being “…. the maximum amount that can be produced per unit of time with existing plant and equipment ,provided that the availability of variable factors of production is not restricted”. Following the last definition, in one of his paper, Fare (1994) describes the necessary and sufficient conditions for the existence of plant capacity as defined by Johansen. In a similar fashion, Fare, Grosskopf and Kokkelenberg (1989) developed measures of plant capacity, plant capacity utilization and technical change in the short run for multi product firms, based on frontier models using non parametric linear programming methods(DEA).

But, operating manager’s notion of installed capacity may differ which assumes a variety of considerations such as number of shifts in work, quality of managerial staff, and availability of repair and replacement parts all of which suppose to modify the engineering estimation of plant capacity. Concept of installed capacity particularly is linked to the shift work decision problem which associates the problem of selecting an optimal number of shifts of work - single, double or triple shift. If a firm desires to operate on a single shift basis, the capacity output can be based on this assumption and it would be possible to have 100% capacity utilization rate if time utilization rate of capital is nearly 33% (as because firms operates on a single shift basis of eight hours for each shift assuming that there exists maximum three shifts).Whether decision of capital expansion or multi-shift operation will be undertaken depend ,by and large ,on the matter of weighing the alternative costs and gains both in short –run and long- run. Between two alternatives- expansion of new plant facilities or moving towards multi-shift operation, it is inevitable that most of the developing countries like India would favour the use of multi-shift operation in comparison with the further expansion of investment project because if customers’ demand is rising gradually and new equipment is not available or is costly to replace, multi-shift operation would save additional capital outlay and at the same time generates employment opportunities without involving additional capital expenditure. It is also true that where there is underutilization of capacity, there is ample scope of utilizing capital more extensively by increasing working shifts in the industry. Nevertheless, a major lacuna in this engineering approach is that it does not explain the variations in capacity utilization mainly due to lack of any economic foundation.

The economic approach, on the other hand, defines the potential output as being the optimum level of output from the economic point of view. This alternative considers capital as a quasi fixed input and allows for distinction between short and long run cost curves. In the long run , capital can be adjusted in order to achieve optimal (cost minimizing/ profit maximizing) level. In the short run, capital is fixed and only the variable inputs can be varied. The short run equilibrium output , for a competitive firm , is then given by the equality between exogenous output price and the short run marginal cost curve (SRMC), Y*. The potential output would then correspond to that level of output at which short run average total cost (SRATC) is minimized-Y**(and equal to long run average total cost, LRATC).

The definition of output as Y** corresponds to the cost-minimization problem while Y* corresponds to the profit-maximization. As pointed out in Berndt, Hesse & Morrison(1981), this difference can affect short run equilibrium in the sense that it may or may not occur at the level of output were the SRATC reaches its minimum:Y* > Y** OR (Y*< Y**) when the output price greater than (lower than) the minimum level of SRATC. The authors address also the issue of how variations in input prices might affect the minimum point of the SRATC and hence Y**.

The economic approach was first analyzed by Cassel (1937) and latter on two more definitions have been introduced. The first was suggested by Klein(1960) and Friedman(1963) and recently Segerson & Squires(1990) who define the potential output as being the output level at which the long run and short run average total cost curves are tangent. Klein (1960) argued that long run average cost curve may not have a minimum and proposed the output level where the short run average cost curve is tangent to the long run average cost curve as an alternative measure of capacity output.

The second approach supported by Cassel (1937) and Hickman (1964) takes as reference the output level at which the short run average total cost curve reaches its minimum. Therefore, an economically more meaningful definition of capacity output originated by Cassel (1937) is the level of production where the firms long run average cost curve reaches a minimum. As we consider the long run average cost, no input is held fixed. For a firm with the typical 'U' shaped average cost curve, at this capacity level of output, economies of scale have been exhausted but diseconomies have not set in. The physical limit defines the capacity of one or more quasi-fixed input. Klein defined capacity as the maximum sustainable level of output an industry can attain within a very short time, when not constrained by the demand for product and the industry is operating its existing stock of capital at its customary level of intensity.

Hickman (1964) suggests that capacity is defined as that output which can be produced at minimum average total cost, given the existing stock of plant and equipment and existing techniques and factor prices. The level of capacity is inferred from observed investment behavior. Regression methods are used to estimate a relationship between desired capital stock and several explanatory variables including output, relative prices and time, on the hypothesis that net investment occurs in proportion to the excess of desired over actual stock. The relationship between desired capital stock and output is then inverted to yield a corresponding relationship between capacity and actual capital stock for given prices and techniques. The method is used to calculate aggregate capacity annually for 1949-60 and the properties of the resulting estimates are discussed. New estimates of capacity and its utilization in manufacturing are also presented and compared with those of other investigators.

The relationship between the two economic measures of capacity utilization (CU) depends on the degree of scale economics for the unit that is being analyzed. Berndt and Hesse(1986) advocate that under the assumption of prevailing constant return to scale in the long run , the tangency point between the long run and short run curves will coincide with the point where the long run and short run average total cost curve reach their minimum. Hence, two economic measures of CU would be equivalent. Nelson (1989) argued that Capacity utilization (CU) is usually defined as the ratio of actual output to the output corresponding to (i) the minimum point on the SRATC curve, (ii) the point of tangency between the LRATC and SRATC curves. In practice, however, CU is often measured as the ratio of actual to the maximum potential output consistent with a given capital stock. This paper demonstrates how to estimate the theoretical measures of CU, and examines the correlation between the three measures of CU, and the McGraw-Hill estimates of CU, using data from a sample of US privately owned electric utilities for 1961-83. Nelson(1989,p274), using data from a sample of US privately owned electric utilities reaches the conclusion that : 'The choice of a particular measure of CU may be little consequence if all of the measure are highly correlated, and if the correlation is constant over time and across firms. If this is not the case, however, the choice may influence the conclusions to be drawn from a study".

Questions about the definition and construction of capacity utilization measure are often based on distinctions between "engineering" or "technical" as compared to "economic" measures, "maximum" versus "optimal" usage of capacity, and "primal" as contrasted to "dual" representations of the notion of "best", or optimum. The many combinations and permutations of these concepts offered in the literature often differ in terms of the definition and treatment of the stocks defining the capacity base, and the variable inputs determining their utilization. The basic conceptual issue is that engineering or technical measures represent the most output that can physically be produced given the existing input base, whereas one might think a policy-relevant measure of potential output should instead be founded on some notion of (economic) "optimization" rather than (physical) "maximization". By contrast, economic measures are founded on the idea of an optimum amount of output that might be produced, in terms of the costs or profits emanating from production. This alternative perspective can be represented by a dual cost (or profit) function, defined in terms of the minimum possible input costs required to produce a given amount of output, taking both technological and behavioral optimization into account.

In India, a few attempts have been made to evaluate the trends of capacity utilization in Indian manufacturing sector (see, for example, Gulati (1959), Nag (1961), Koti (1968), Mathur (1969), Sandesara (1969), Paul (1974), Gupta and Thavaraj (1975), Nayar and Kanbur (1976), Sastry (1980), Mohandoss and Subrahmanyam (1981), Subba Rao (1981), Burange (1992), Goldar and Ranganathan (1992), Ajit (1993), Burange (1993), Pohit and Satish (1995), Azeez(2002) and Ray and Pal (2008). The existing studies concentrated either on a particular industry or on a set of industries. The present study is an attempt in this direction and aims to enrich the literature on capacity utilization in Indian industries. In particular, we intend to study the trends in capacity utilization in Indian sugar industry at aggregate level using the time series data from 1979-80 to 2008-09.

3. Methodological issues:

This paper covers a period of 30 years from 1979-80 to 2008-09. The entire period is divided into two phases as pre-reform period (1979-80 to 1991-92) and post-reform period (1991-92 to 2008-09).

Considering variations in CU as a short-run phenomenon caused by the quasi-fixed nature of capital, an econometrically tractable short-run variable-cost function which assumes capital as a quasi-fixed input has been used to estimate CU.

3.1. Econometric Model:

Considering a single output and three input framework (K, L, E) in estimating CU, we assume that firms produce output within the technological constraint of a well-behaved [1] production function.

Y = f (K, L, E) where K, L and E are capital, labour and energy respectively. Since capacity output is a short-run notion, the basic concept behind it is that firm faces short-run constraints like stock of capital .Firms operate at full capacity where their existing capital stock is at long-run optimal level. Capacity output is that level of output which would make existing short-run capital stock optimal.

Rate of CU is given as

$$CU = Y/Y^* \cdots\cdots\cdots (1)$$

Y is actual output and Y* is capacity output.

In association with variable profit function, there exist a variable -cost function which can be expressed as

[1]A production function is considered to be well-behaved if it has positive marginal product for each input and it is quasi concave and also satisfies the conditions of monotonocity. Quasi-concavity required that the bordered Hessian matrix of first and second partial derivatives of the production function be negative semi definite.

$VC = f(P_L, P_{E,} K, Y)$---(2)

Short run total cost function is expressed as

$STC = f(P_L, P_{E,} K, Y) + P_{K.}K$---(3)

P_K is the rental price of Capital.

Variable cost equation [2] which is variant of general quadratic form for (2) that provide a closed form expression for Y* is specified as

$$VC = \alpha_0 + K_{-1}\left(\alpha_K + \tfrac{1}{2}\beta_{KK}\left[\frac{K_{-1}}{Y}\right] + \beta_{KL.}P_L + \beta_{KE.}P_E\right)$$
$$+ P_L(\alpha_L + \tfrac{1}{2}\beta_{LL.}P_L + \beta_{LE.}P_E + \beta_{LY.}Y)$$
$$+ P_E(\alpha_E + \tfrac{1}{2}\beta_{EE.}P_E + \beta_{EY.}Y) + Y(\alpha_Y + \tfrac{1}{2}\beta_{YY.}Y) \text{ ------------------------------------(4)}$$

K_{-1} is the capital stock at the beginning of the year which implies that a firm makes output decisions constrained by the capital stock at the beginning of the year.

Capacity output (Y*) for a given level of quasi-fixed factor is defined as that level of output which minimizes STC. So, the optimal capacity output level, for a given level of quasi-fixed factors, is defined as that level of output which minimizes STC. So, at the optimal capacity output level, the envelop theorem implies that the following relation must exist.

$$\partial STC/\partial K = \partial VC/\partial K + P_K = 0 \quad \text{---------------- ---(5)}$$

In estimating Y*, we differentiate VC equation (4) w.r.t. K_{-1} and substitute expression in equation (5)

$$Y^* = \frac{-\beta_{KK.}K_{-1}}{(\alpha_K + \beta_{KL}P_L + \beta_{KE}P_E + P_K)} \quad \text{--------------------(6)}$$

The estimates of CU can be obtained by combining equation (6) and (1).

3.2. Description of data and variables:

Complexity faced by researchers in conducting studies on CU in Indian industries is that available official data on Industrial capacities are quite unsatisfactory. The present study is based on industry-level time series data taken from several issues of Annual Survey of Industries, NAS and Economic Survey ,Monthly statistics of foreign trade, Govt. of India, Statistical Abstracts (various issues), RBI bulletin, CMIE etc covering a period of 30 years commencing from 1979-80 to 2008-09. Selection of time period is largely guided by availability of data [3]

Output and Variable cost:

Details of methods employed for the measurement of variables are given in Appendix. Output

[2] Similar functional form has been previously estimated by Denny et al (1981). The variable cost function is based on the assumption that some input like capital cannot be adjusted to their equilibrium level. Therefore, the firm minimizes variable cost given the output and the quasi-fixed inputs.

[3] Till 1988 – 89, the classification of industries followed in ASI was based on the National Industrial classification 1970 (NIC 1970). The switch to the NIC1987 from 1989-90 and also switch to NIC1998 requires some matching. For price correction of variable, wholesale price indices taken from official publication of CMIE have been used to construct deflators.

is measured as real value added [4] produced by manufacturers ($Y = P_L L + P_K.K_{-1} + P_E.E$) suitably deflated by WIP index for manufactured product (base 1981-82 = 100) to offset the influence of price changes variable cost is sum of the expenditure on variable inputs ($VC = P_L L + P_E.E$).

Labour and price of labour:

Total number of persons engaged in Indian sugar sector is used as a measure of labour inputs. Price of labour (P_L) is the total emolument divided by number of labourers which includes both production and non-production workers[5].

Energy and Price of energy:

Deflated cost of fuel (Appendix-A1) has been taken as measure of energy inputs. Due to unavailability of data regarding periodic price series of energy in India, some approximations become necessary. We have taken weighted aggregative average price index of fuel (considering coal, petroleum and electricity price index, suitably weighted, from statistical abstract) as proxy price of energy. [6]

Capital stock and price of capital:

Deflated gross fixed capital stock at 1981-82 prices is taken as the measure of capital input. The estimates are based on perpetual inventory method. (Appendix-A2) Rental price of capital is assumed to be the price of capital (P_K) which can be estimated following Jorgenson and Griliches (1967):

$$P^t{}_k = r_t + d_t - \dot{P}_k / P_k$$

Where r_t is the rate of return on capital in year t, d_t is the rate of depreciation of capital in the year t and

$\dot{P}_k / P_k$ is the rate of appreciation of capital .Rate of return is taken as the rate of interest on long term government bonds and securities[7] which is collected from RBI bulletin (various issues). The rate of depreciation is estimated from the reported figures on depreciation and fixed capital as available in ASI which Murty (1986) had done earlier. However, we have not tried corrections for the appreciation of value of capital [8] in the estimates of price of capital services.

---

[4] Griliches and Ringstad (1971) have preferred GVA to gross output and reasons for imposing preference have been mentioned in their study.

[5] One serious limitation of this assumption is that this does not take into account variations in quality and the composition of labour force.

6. To compute the price of energy inputs, some studies have aggregated quantities of different energy inputs using some conversion factors (say British Thermal units or coal replacement etc.) and then take the ratio of expenditure on energy to the aggregate quantity of energy. This method is criticized because it assumes different types of energy inputs to be perfect substitutes.

[7] Prime lending rate is generally viewed as an opportunity cost of capital, but problem is that there is no unique lending rate available for use. So, we have used rate of interest on long term government bond and securities as rate of return on capital [as previously used by Jha, Murty and Paul (1991)].Alternatively, one can use the gross yield on preferential industrial shares, if available, as Murty (1986) has done.

[8] As Jorgenson and Griliches note capital gains should be deducted from ($r_t + d_t$) but several studies have not done so and adjustment for capital gains does not seem to make much difference to the result.

The variables are depicted below in table 3 in a nut shell.

[Insert Table 3 here]

4. Analysis of capacity and its utilization:

In this section, analysis of the results regarding measurement and trend in capacity utilization of Sugar industry in India under our consideration has been presented. In order to facilitate comparison of the estimates, we have also subdivided the entire period into 1979-80 to 1991-92 which is termed as pre-reform period and 1991-92 to 2008-09 as post-reform period. Before presenting the result, descriptive statistics showing the differences in the statistics for the variables under consideration for the two time periods are depicted in the following table 4.The descriptive table indicates that mean and standard deviation of all variables have been enhanced significantly during post reform periods.

[Insert Table 4 here]

At initial stage, the result section depicts the results of a multiple regression analysis applied to measure capacity output and the trend in capacity utilization. The variable cost equation shown as equation (4) has been estimated by the ordinary least square methods (OLS). Our model assumes that capacity utilization (CU) is a function of input prices, output and quasi-fixed capital. We find that capacity utilization and input prices have a negative relationship and capacity utilization (CU) and output have a positive one. The derivative of VC (equation 4) with respect to K is negative since capital will substitute labour and energy. In order to test for the concavity of the variable cost function with respect to variable input prices , its Hessian matrix for negative semi-definiteness is evaluated and it is found that concavity condition is fulfilled at all observation points. Therefore, the partial derivative with respect to each of input prices is negative. The partial derivative of VC with respect to output is positive because in our empirical results, $\beta_{KK} > 0$ and $(\alpha_{K} + \beta_{KL}P_L + \beta_{KE}P_E + P_K) < 0$ for all data points. Therefore, positive relation between output and capacity utilization (CU) is an indication that an increase in demand will lead to higher levels of capacity utilization.

The variations in capacity utilization in Indian sugar industry are presented in Table5. The key observations emerged out of the analysis of Table 5 are depicted below.

[Insert Table 5 here]

First, it emerges from the estimated results that CU ratios are less than unity for all observations. There is a prominent diminishing trend in capacity utilization over years because average CU declined from 0.7363 in pre-reform period to 0.6739 in post-reform period implying a decline of 8.47% as well as same declining trend was set in average growth rate of capacity utilization(as is evident from table 5).This implies that actual output fell far short of capacity output of Indian sugar industry which in turn signifies a widening difference between capacity output and actual output. Trend in capacity utilization indicates the presence of idle or excess capacity in the industry for the entire study period. It is a well known fact that the acute shortage of sugarcane-the basic raw materials which accounts for 80 percent weight in intermediate inputs given the self sufficiency of Sugar mills in its energy requirements is the crucial factor responsible for ceasing operation by many sugar mills even in mid of the peak season and thus restrict them to operate at full capacity.

Because of inadequate supply of cane and excessive intervention of the government in fixing the price for both sugar and sugarcane, most of the existing plants and machinery are not being fully utilized in sugar producing states of India. Further, low levels of profitability and low sugar recovery from sugarcane add up the excess capacity in the industry. Besides this, the licensing policy system followed by the government until 1998 did not permit the capacity expansion of the existing mills and thus, restricted them to avail economies of scale. Even after the adoption of deli censing policy of September 1998, the industry is operating with high order of politicization and government control. Consequently, sugar firms are carrying a huge stock of underutilized capital or capacity. Thus, the political control on sugar firms’ operations hinders the techno-economic feasibilities and restricts them to expand their capacity per unit.

Second, if capacity output is taken to be the economic capacity derived from optimization process, the CU ratio could exceed one or it may be less than one. The implication of economic CU less than unity (as our result suggests) is that production is to the left of the minimum point of short-run average total cost curve which further signifies that Indian sugar sector could have reduced its short run generation costs with gradually moving to the tangency point or minimum point of the short run average cost curve.

Third, it is apparent from our study that the economic CU index ranges from about 0.5192 to 0.8509. Capacity expansion varies from 5.55% to 12.29% during these two time frames. Moreover, the correlation between actual output (Q) and capacity output (CQ) is quite high over the entire time period which is nearly 0.9823.

Fourth, a comparison of the average utilization of capacity in the two periods (as shown inTable5) showed a lower average utilization in the post-reform period as compared to pre-reform period. The capacity utilization (CU) trends have also registered a gradual decline since mid-nineties and middle of this decade. Increasing trends have been noticed in the average growth rate of capacity output and actual output during those two periods. During pre-reform period, capacity expansion was not improved rapidly probably due to licensing restriction but relaxation of license rule to some extent since 1993 in case of Indian sugar industry during post-reform period paved the way for drastic expansion of capacity. Although it is true that there is no precise way of distinguishing the various factors that contributed to declining utilization rate, a shift from a restrictive trade regime to a more liberalized trade perhaps decelerates the utilization rate because it might be mainly due to gradually rapid and abrupt expansion of capacity but comparatively slow improvement in the growth rate of actual output as well as actual demand. More precisely, in case of Indian sugar industry, the aforementioned analysis confirms a decline in CU levels in Indian sugar industry over the entire study period and distinct sub-periods. This decline is primarily driven by: i) acute shortage of sugarcane at farm level, which primarily occurred because of mounting sugarcane arrears to be paid to the farmers by the sugar mills. The untimely payments for sugarcane by the sugar firms compel the farmers to diversify and produce even less remunerative crops such as wheat and rice, for which assured marketing is available; and ii) inability of sugar firms to purchase the sugarcane at remunerative price. Nevertheless, the statuary minimum price (SMP) announced by government is always high enough and unconnected with the market oriented price of sugarcane. It adds up the variable cost of production and, thus, sugar firms shut-down their operations even during the mid of the peak seasons.

Trends growth rate of capacity utilization of Indian sugar industry at aggregate level are presented in Table 6 to support the above mentioned result. The semi-log function was finally selected to explain the trend. The semi-log model is log Y = a + bt, where Y = Capacity utilization, a = Constant, t = Time in years, b = Regression coefficient and in this model, the growth rate will be (b x 100) in terms of percentage.

[Insert Table 6 here]

Estimated result in table 6 supports the contention that capacity grows rapidly in post reform period ,simultaneously output grows but at very slow pace. This results in declining growth rate in capacity utilization. It is expected that no single explanation for variations in capacity utilization in this industry group will hold true. Nevertheless, it seems that due to heavy investment in the 1990s, unaccompanied by commensurate expansion of demand, capacity utilization went on worsening in this manufacturing industry.

4.1. Impact of liberalization on Economic CU:

The impact of liberalization on capacity utilization has been judged more precisely, by using a piecewise linear regression equation (popularly known as Spline function) where it is assumed that capacity utilization increases linearly with the passage of time until the threshold time period (t_0)[Here, t_0=1990-91 being last year of pre-reform period after which post-liberalization era begins] after which also it changes linearly with the passage of time but at a much steeper rate. Therefore we have a piecewise linear regression consisting of two linear pieces or segments. The CU function changes it slope at the threshold value (t_0=12). Given the data on CU, time period and the value of threshold level, the technique of dummy variables can be used to estimate the slopes of the two segments of the piece-wise linear regression. The piecewise linear regression equation is as follows:-

$l_n Z_t = \alpha + \beta t + \beta' (t - t_0) D_t$

Result of the regression equation is as follows:-

$l_n Z_t = -0.4067 + 0.0129t - 0.029D_t$

(-6.22) (1.73) (-2.90)

$R^2 = 0.36$

Figures in the parentheses are the absolute values of t statistics and R^2 is the goodness of fit. Here β gives the slope of the regression line in pre-reform period which is positive and significant at 5% level. This implies that growth in CU shows positive trend immediately before liberalization starts.

Co-efficient of the difference between two time period is significant at 5% level and negative (coefficient being -0.029), It can be inferred that liberalization has its significant adverse impact on capacity utilization during post- reforms period.

It is visible from the estimated average growth rate in CU as shown in table 3 that there is a significant decline in average growth rate of CU from 3.25% in pre-reform period to -0.45 % in post -reform period.

A firm's competitive position in the industry is ascertained by its ability of retaining or enhancing market share by any means. The process of deregulation and liberalization has increased the intensity of competition in sugar sector. These changes have led to the restructuring of this industrial sector. The restructuring has affected output growth as well as capacity utilization in negative direction in Indian sugar industry from 1991-92 to 2008-09.Berndt and Fuss (1986) and Morrison (1988) show that there lies a systematic relationship between capital-to-output ratio and CU.This relationship becomes operational through Tobin's q. [9] If $\beta_{KK} > 0$, then a rise in capital-to-output ratio will lower Tobin's q and hence will lower CU rates. Since in our estimates, $\beta_{KK} > 0$ for all data points, industries with high capital-output ratios will have lower level of CU assuming that other things remain the same. This induces us to infer that the sugar industry whose industrial structures depends heavily on traditional manufacturing activities and have higher capital-to-output ratios will generally tend to have lower rates of CU. Furthermore, it is noticed from our results that CU is more sensitive to the extent of capital deepening of the sugar sector. CU is regressed on K_{-1}/Y and Y (GVA) and the relationship was as follows:

$CU = 1.42 - 0.0829\, K_{-1}/Y - 0.00006Y$

(3.58) (-2.34) (-1.76)

$R^2 = 0.21$

Our result suggests a negative and statistically significant association between CU and

K_{-1}/Y which implies that the low CU rate is correlated with high capital-to-output ratio and vice versa and association between CU and Y is found to be statistically insignificant.

5. SWOT Analysis of the Sugar Industry:

SWOT analysis is a strategic planning method used to evaluate the **S**trengths, **W**eaknesses, **O**pportunities, and **T**hreats involved in a project or in a business venture. It involves specifying the objective of the business venture or project and identifying the internal and external factors that are favorable and unfavorable to achieve that objective. It is an important step in planning. The role of

[9] Tobin (1969) defines q as the ratio of the market value to the replacement cost of the firm's capital stock. Berndt and Fuss(1986) have shown that Tobin's q can be written as Z_k/P_k where Z_k is $-\partial VC/\partial K$ and CU and Tobin's q are positively related .Since $\partial^2 VC/\partial K \partial (K/Y)$ is β_{KK}, which is positive, therefore $\partial q/\partial (K/Y)$ is negative. So, industry with high levels of K/Y will have, other things remaining same, low levels of CU.

SWOT analysis is to take information from environment and separates it into internal issues (strengths& weaknesses) and external issues (opportunities and threats).Once this is completed, SWOT analysis determines if the information indicates something, that will assist the firm in accomplishing its objectives or if it indicates an obstacle that must be overcome or minimized to achieve desired results (Ferrel, Lucas and Luck, 1998). The technique is credited to Albert Humphrey, who led a convention at Stanford University in the 1960s and 1970s using data from Fortune 500 companies.

A SWOT analysis must first start with defining a desired end state or objective. A SWOT analysis may be incorporated into the strategic planning model. Strategic Planning has been the subject of much research.

- **S**trengths: characteristics of the business or team that give it an advantage over others in the industry.
- **W**eaknesses: are characteristics that place the firm at a disadvantage relative to others.
- **O**pportunities: *external* chances to make greater sales or profits in the environment.
- **T**hreats: *external* elements in the environment that could cause trouble for the business.

Strengths

• Indian sugar industry is the second largest producer of sugar in the world after Brazil. The sector has a potential to make the country to be self reliant in this highly sensitive essential commodity of mass consumption.

•The current sugar season (2010-11) has been a surplus sugar production year such that the industry is burdened with unprecedented stocks of sugar.

• The sugar industry paid well over Rs. 122.69 billion to the sugarcane growers in the financial year, 2006. In the last sugar season 2009-10, approximately Rs 45,000 crores was paid to farmers as cane price. This year, it is expected to rise to about Rs 51,000 crores.

• Annual tax contribution to exchequer Rs. 17 billion annually.

• Provides direct employment including ancillary activities to near about 0.5 million workers.

• It also supports the down stream industries by providing the raw material.

• Sugarcane farming is more profitable then any other cash crop in India.

• This sector have been the focal point of socioeconomic development of the rural India

• Strong government policies as it comes under essential commodity of mass consumption.

Weaknesses

• Most of the Co-operative sugar industries in India e. g. in Maharashtra find difficult to pay for the sugar cane supplied by the farmers.

• Most of the sugar factories are more then 40 years old and still using the old technology low installed production capacity leads to the decrease in production and losses.

• Lack of professionalism.

Opportunities

• High value of by-products for down stream industries.

• Huge potential to increase the productivity of cane and sugar recovery rate.

• Technology up gradation, new advanced technology available for the byproduct utilization.

Threats

• Sugar sector is vulnerable to political interest.

• Ground water availability for irrigation.

• Quality of soil deteriorates due to overuse of fertilizer and pesticides to increase sugarcane yield.

• Unhealthy competition between members of the society.

5.1.PESTEL analysis of Sugar:

Political factors: The sugar industry in India operates under high political influence. The farmers usually deal through co-operative societies, on which the local parties have a strong influence. To protect the interest of sugar producers, the government came up with FRP pricing. The regulation is facing strong opposition from farmers as well as the state governments, as they want to retain the flexibility of having a higher SAP without bearing any additional cost.

Economic factors: Although there is considerable annual volatility, India’s sugarcane cultivation area constitutes 2.2-2.7% of India’s total cropped area. In financial year, 2009, 0.7% of India’s GDP came from the sugar industry. In addition, the industry usually contributes around Rs. 1,700 crores annually to various state government treasuries by way of excise duties and purchase tax on sugar cane. The contribution of sugar in the value of agriculture output was as high as 6.4% in financial year,2006, though in financial year, 2009, it came down to 4% due to price and production fluctuation in the industry*(Source: The Financial Express).*

Social factors: About 7.5% of the rural population banks on sugarcane farming. The sugar industry directly employs around 2 million workers, and there is also significant indirect employment generation through various ancillary services (*Source: The Financial Express).*

Technological factors: The department of Food and Public Distribution of India is taking initiatives for technological up gradation in sugar mills. Indian sugar mills suffer from lower capacity utilization. Combined with the Department of Science and Technology, Government of India, it works on improvement of plant efficiencies, energy saving and reduction of utilisation of major inputs.

Environmental factors: Ethanol emits less carbon dioxide than crude oil. The use of ethanol not only benefits environment, but also helps the industry to earn carbon credits.

Legal factors: The industry operates under strict legal regulations. Although in some cases it affects the industry and producers, mostly it ensures financial supports and regulations to balance the domestic demand-supply.

6. Summary &Conclusion:

Using time series data of 30 years ranging from 1979-80 to 2008-09, the study tries to assess the economic performance of Indian sugar industry in view of capacity utilization measured econometrically. The major findings of the paper are:

First, the trend in growth rate of capacity utilization follows a decelerating path during the post reform period as there was a sharp decline in average capacity utilization rate in post-reform period as compared to pre-reform period.

Secondly, annual average growth rate of capacity output shows steep upward trend but actual output grows at a much slower rate than capacity output resulting declining growth rate in CU.

Thirdly, the liberalization process is found to have its significant negative impact on capacity utilization since there is a fall in average growth rate of capacity utilization during the post-reform period.

Fourth, the empirical findings suggest that there exist considerable variations in the capacity utilization rates over years within same industry.

Finally, it is noticed from our results that capacity utilization is more sensitive to the extent of capital deepening of the sugar sector.

In order to utilize its capacity fully and run efficiently, the sugar mills within the industry should get uninterrupted supply of raw sugar cane uniformly through out the seasons and the government should ensure the supply of raw inputs. There is a need of coordinated and concerted effort for appreciation and consolidation of the needs of the consumer. farmer, processor and to address to various above issues if India has to attain the glory of self sufficiency and attain the status of net exporter and an important significant player in the international market.

There is an urgent need to improve in productivity both in terms of yield as well as sugar contents and recovery by adopting better harvesting practices and close coordination of sugar mills with farmers. It has been estimated that better farming and harvesting practices could result upto 1.0% improvement in extraction which can lead to 10% increase in production. Therefore, mills and farmers to work together to improve yield and extraction through better harvesting in order to become internationally competitive - i.e. cost effective and quality producer.

References:

Ahluwalia, I.J.(1991), Productivity growth in Indian manufacturing, Oxford University Press, Delhi.

Ajit, D. (1993), "Capacity Utilization in Indian Industries", Reserve Bank of India Occasional Papers, Vol. 14, No.1, pp. 21-46.

Azeez, E.A. (2002), "Economic Reforms and Industrial Performance: An Analysis of Capacity Utilization in Indian Manufacturing", Indian Journal of Economics and Business, Vol. 4, No. 2,pp. 305-320.

[BarIlanS:96], Avner Bar-Ilan and William Strange(1996): Investment Lags, *American Economic Review*, American economic Association, vol.86, no 3,pp610-622.

Berndt, E.R. and Fuss, M.A. (1986), Productivity measurement using capital asset valuation to adjust for variation in utilization *(Paper presented at the Econometric society Summer Meetings, San Diego, C.A.).*

Berndt,E.R and Hesse, D(1986):Measuring and assessing capacity utilization of manufacturing sectors of nine OECD countries, European Economic Review, vol 30,pp961-89

Burange, L.G. (1993), "Implications of Full Capacity Utilization of Manufacturing Sector in Indian Economy", Arthavijnana, Vol.35, No.2, pp. 160-181

Burange, L.G. (1992), "The trends in Capacity Utilization in the Indian Manufacturing Sector:1951-1986", Journal of Indian School of Political Economy, Vol. 4, No. 5, pp. 445-455.

Cassel, J.M. (1937), Excess capacity and monopolistic competition, *Quarterly Journal of Economics*, vol. 51, pp 426-443.

Denny, M, M. Fuss and L Waver man(1981), 'Substitution possibilities for Energy: Evidence from U.S. and Canadian manufacturing Industries in E.R. Berndt and B.C. Field, Modeling and measuring national Resources Substitution (*Cambridge M.A., MIT Press).*

Ferrell, O., Hartline, M., Lucas, G., Luck, D. (1998): Marketing Strategy. Orlando, FL: Dryden Press

Fare. R., S. Grosskopf, and E.. Kokkelenberg. (1989). "Measuring Plant Capacity, Utilization and Technical Change: A Nonparametric Approach,' *International Economic Review*, 30: 655-666.

Färe, R. (1994). "The Existence of Plant Capacity," *International Economic Review*, 25: 209-213.

Friedman. M. (1963), 'More on Archibald versus Chicago', *Review of economic studies*, vol. 30, pp 65-67.

Goldar, B.N and V.S. Renganathan (1992), Capacity utilization in Indian Industries, *The Indian economic Journal*,vol. 39, no2, Oct – Dec,pp 82-92.

Griliches, Z and Y. Ringstad (1971), *Economics of scale and the form of the production function, North Holland, Amsterdam.*

Gulati, K.S. (1959), "Engineering Industry in India- Their Capacity Utilization", The Economic Weekly, Vol.11, No. 19, pp. 635-639.

Gupta, M. and Thavaraj, M.J.K. (1975), "Capacity Utilization and Profitability: A Case Study of Fertilizer Units", Productivity, Vol. 16, No.3, pp.882-892.

Hickman, B.G. (1964), 'On a new method of capacity estimation', Journal of the American Statistical Association, vol.59, pp 529-549.

Indian Sugar Industry,2010, Indian Sugar Industry Research Report,www.research and market.com.

Indian Sugar sector network report,SINET,2010.

Jha, R, Murty, M.N and Satya Paul(1991), Technological change, factor substitution and economies of scale in selected manufacturing industries in India, *Journal of Quantitative Economics*,vol.7,No.1,pp 165-178.

Jorgenson, Dale. W and Zvi Griliches (1967), The explanation of productivity change, *Review of Economic Studies,* vol. 34, pp 249-282.

Johansen, L. (1968) Production Functions and the Concept of Capacity, Namur, Recherches Récentes sur la Fonction de Production (Collection "Economie Mathématique et Econometrie", no. 2) [reprinted in F.R. Førsund (ed.) (1987) *Collected Works of Leif Johansen, Volume 1*, Amsterdam, North Holland,359-382].

Koti, R.K., (1968), Utilization of Industrial Capacity in India, Mimeograph Series 9, Gokhale Institute of Politics and Economics, Poona.

Kendrick,J.W(1973), Post war productivity trends in the United States,NBER.

Klein, L.R (1960), 'Some theoretical issues in the measurement of capacity', *Econometrica*, vol.28, no.2, pp272-286.

Mohandoss, V. M. and Subrahmanyam, K.V. (1981), "Capacity Utilization Concepts and their Relavance to Costs and Returns to Fruits and Vegetable Cold Stores", Indian Journal of Agriculture Economics, Vol.36, No.2, pp. 59-67.

Mathur, P.N. (1969), "Explorations in Making Programme of Full Capacity Utilization", Arthvijnana, Vol. 11, No.2, pp. 320-332.

Morrison, C.J, (1985), 'On the Economic Interpretation and measurement of optimal capacity, *Review of Economic studies* LII, pp295 – 310.

Morrison, C.J, (1988), "Capacity Utilization and productivity measurement", in A.Dogramaci and R.Fare (eds.), Application of Modern Production theory: Efficiency and Productivity (*Boston.M.A: Kluer Academic Publishers, 1988).*

Murty, M.N(1986), Interfuel Substitution and Derived Demands for Inputs in the manufacturing sector of India, *Journal of Quantitative Economics*,vol.2,No.1,pp119-135.

Nelson.R.A (1989), On the measurement of capacity utilization, The Journal of Industrial Economics, vol.XXXVII, March, 1989.

Nayar, N.P. and Kanbur, M.G. (1976), "Measurement of Capacity Utilization in Indian Manufacturing Industries", Indian Journal of Economics, Vol.57, No.225, pp. 221-239.

Nag, S.P. (1961), "Under-Utilization of Installed Capacity in the Cotton Textile Industry in India", Indian Economic Review, Vol. 5, No.3, pp. 274-284.

Paul, S. (1974), 'Growth and utilization of Industrial capacity , *Economic and Political weekly*,vol .9 , no. 49,December 7, pp 2025 -2032.

Pohit, S. and Satish, V. (1995), "Trends in Capacity Utilization in Indian Industries: A Disaggregated Approach", The Indian Economic Journal, Vol. 43, No.2, pp. 20-32.

Ray, S. and Pal, M.K. (2008), "On the Measurement of Capacity Utilization: An Evidence from Indian Chemical Industry", ArthaVijnana, Vol. 50, No.2, pp. 116-128.

Sastry, D.U. (1980), "Capacity Utilization in the Cotton Mill Industry in India", Indian Economic Review, Vol. 15, No.1, pp. 1-21.

Sandesara, J.C. (1969), "Capacity Utilization in Indian Industry: A Study of the Food Manufacturing Industries", Indian Journal of Industrial Relations, Vol. 5, No.1, pp. 28-38.

Segerson, Katherine and Dale Squires.(1990). On the Measurement of Economic Capacity Utilization for Multi-Product Industries, *Journal of Econometrics*, Vol. 44:347-361.

Subba Rao, S.V. (1981), "A Note on Potential Production Index and Capacity Utilization in Industries", Margin, Vol. 13, No. 2, pp. 37-43.

Tobin, James, "A General Equilibrium Approach to Monetary Theory", *Journal of Money Credit and Banking* (1969), pp15-29.

Appendix

Appendix: A-1: Energy Inputs: - Industry level time series data on cost of fuel of Indian sugar sector have been deflated by suitable deflator (base 1981-82 = 100) to get real energy inputs. An input output table provides the purchase made by manufacturing industry from input output sectors. These transactions are used as the basis to construct weight and then weighted average of price index of different sectors is taken. Taking into consideration 115 sector input -output table (98-99) prepared by CSO, the energy deflator is formed as a weighted average of price indices for various input-output sectors which considers the expenses incurred by manufacturing industries on coal, petroleum products and electricity as given in I-O table for 1998-99. The WIP indices (based 1981- 82) of Coal, Petroleum and Electricity have been used for these three categories of energy inputs. The columns in the absorption matrix for 66 sectors belonging to manufacturing (33- 98) have been added together and the sum so obtained is the price of energy made by the manufacturing industries from various sectors. The column for the relevant sector in the absorption matrix provides the weights used.

Appendix: A-2: Capital Stock: - The procedure for the arriving at capital stock series is depicted as follows:

First, an implicit deflator for capital stock is formed on NFCS at current and constant prices given in NAS. The base is shifted to 1981-82 to be consistent with the price of inputs and output.

Second, an estimate of net fixed capital stock (NFCS) for the registered manufacturing sector for 1970-71 (benchmark) is taken from National Accounts Statistics. It is multiplied by a gross-net factor to get an estimate of gross fixed capital stock (GFCS) for the year 1970-71. The rate of gross to net fixed asset available from RBI bulletin was 1.86 in 1970-71 for medium and large public Ltd. companies. Therefore, the NFCS for the registered manufacturing for the benchmark year (1970-71) as reported in NAS is multiplied by 1.86 to get an estimate of GFCS which is deflated by implicit deflator at 1981-82 prices to get it in real figure. In order to obtain benchmark estimate of gross real fixed capital stock made for registered manufacturing, it is distributed among various two digit industries (in our study, sugar industry) in proportion of its fixed capital stock reported in ASI, 1970-71)

Third, from ASI data, gross investment in fixed capital in sugar industries is computed for each year by subtracting the book value of fixed in previous year from that in the current year and adding to that figure the reported depreciation on fixed asset in current year. (Symbolically, $I_t = (\beta_t - \beta_{t-1} + D_t) / Pt$) and subsequently it id deflated by the implicit deflator to get real gross investment.

Fourth, the post benchmark real gross fixed capital stock is arrived at by the following procedure. Real gross fixed capital stock (t) = real gross fixed capital stock (t – 1) + real gross investment (t). The annual rate of discarding of capital stock (D_{st}) is assumed to be zero due to difficulty in obtaining data regarding D_{st}.

Table:1 State-wise Distribution of Co-operative and other sugar mills-2005

	Cooperatives		Others		Total	
State	Number of Factories	Installed Capacity	Number of Factories	Installed Capacity	Number of Factories	Installed Capacity
Andrhra Pradesh	8	192	26	716	34	908
Gujarat	17	1071	0	0	17	1071
Haryana	10	353	3	108	13	551
Karnataka	16	551	21	908	37	1459
Maharashtra	82	6468	20	511	102	6978
Tamilnaru	14	546	20	979	34	1524
Uttar Pradesh	28	784	78	3753	106	4537
Uttaranchal	4	133	6	279	10	412
Punjab	12	405	8	279	20	684
Others	12	182	15	678	27	861
Total	203	10684	197	8302	400	18985

(Source: ICRA sector analysis 2006)

Table:2 Number of Sugar mills, Installed capacity and production of Sugar

SY	2000	2001	2002	2003	2004	2005
Number of factories	**423**	**436**	**434**	**453**	**422**	**400**
Cooperative	251	259	250	269	235	203
Others	172	177	184	184	187	197
Installed Capacity-						
Thousand tonnes	**16181**	**16820**	**17685**	**17498**	**18802**	**18985**
Cooperative	9069	9286	9985	10182	10694	10684
Others	7112	7535	7699	7316	8109	8302
Production-						
Thousand tonnes	**18200**	**18511**	**18528**	**20145**	**13546**	**12691**
Cooperative	10369	10499	9408	10164	6015	4653
Others	7831	8012	9120	9981	7531	8038
Capacity Utilization-(%)	**112.5**	**110.1**	**104.8**	**115.1**	**72.0**	**66.8**
Cooperative	114.3	113.1	94.2	99.8	56.2	43.6
Others	110.1	106.3	118.5	136.4	92.9	96.8

(Source: ICRA sector analysis 2006)

Table-3: Description of variables for calculating Capacity Utilization levels

Variable	Description	Nature in production process
Output:	Deflated real value added	---------
Inputs:		
Labour	Total persons engaged(Production workers+non-production workers)	Variable
Energy	Deflated cost of fuel	Variable
Capital	Real gross fixed capital stock (t) = real gross fixed capital stock (t – 1) + real gross investment (t).	Quasi-fixed

Table-4: Descriptive Statistics

Variables	Pre- reform period				Post-reform period			
	Minimum	Maximum	Mean	Standard deviation	Minimum	Maximum	Mean	Standard deviation
Variable cost(Rs crore)	1107	2358	1585.31	106.33	1869	7605	4948.58	432.78
Output(Rs crore)	1443	3617	2615.23	195.08	3584	15103	8110.67	698.32

Capital(Rs crore)	12939	26197	18118	1110.48	26197	47492	37469.92	2077.08
Energy price(Rs)	0.6853	2.345	1.51	0.1463	2.78	7.41	4.76	0.4345
Labour price(Rs)	0.001286	0.003632	0.002322	0.00022	0.004689	0.015	0.0092	0.00093
Price of capital(Rs)	0.1092	0.2034	0.1547	0.0099	0.1316	0.2105	0.1761	0.00597
Total observations	13				18			

Source: Own estimate.

Table-5: Capacity utilization of Sugar industry in India at aggregate level, 1979-80 to 2008 -09.

Pre-reform period(1979-80 to 1991-92)							Post-reform period(1991-92 to 2008-09)						
Year	Actual output (Cr. Rs)	Capacity output (Cr.Rs)	CU	Output growth	Capacity growth	Growth rate of CU	Year	Actual output	Capacity output	CU	Output growth	Capacity growth	Growth rate of CU
79-80	1443	2371	0.6086	-	-	-	91-92	3584	4212	0.8509	-0.91	-8.55	8.37
80-81	1530	2529	0.6050	6.03	6.66	-0.59	92-93	4029	5557	0.7250	12.42	31.93	-14.80
81-82	1822	2453	0.7428	19.08	-3.01	22.78	93-94	4813	5729	0.8401	19.46	3.10	15.88
82-83	2239	2824	0.7928	22.89	15.12	6.73	94-95	5378	7143	0.7529	11.74	24.68	-10.38
83-84	2319	3142	0.7381	3.57	11.26	-6.90	95-96	6243	11128	0.5610	16.08	55.79	-25.49
84-85	2633	3317	0.7938	13.54	5.57	7.55	96–97	7089	13652	0.5192	13.55	22.68	-7.45
85-86	2397	3321	0.7218	-8.96	0.12	-9.07	97–98	8345	11247	0.7419	17.72	-17.62	42.89
86-87	2687	3639	0.7384	12.10	9.58	2.30	98–99	8266	10761	0.7681	-0.95	-4.32	3.53
87-88	2846	3602	0.7901	5.92	-1.02	7.00	99–00	9246	12074	0.7657	11.86	12.20	-0.31
88-89	2673	3891	0.6870	-6.08	8.02	-13.05	00–01	11137	19338	0.5750	20.45	60.16	-24.91
89-90	3251	4529	0.7178	21.62	16.40	4.48	01–02	10316	14097	0.7317	-7.37	-27.10	27.25
90-91	3617	4606	0.7852	11.26	1.70	9.39	02-03	11023	17341	0.6356	6.85	23.01	-13.13
91-92	3584	4212	0.8509	-0.91	-8.55	8.37	03–04	12735	19524	0.6523	15.53	12.59	2.63
							04-05	13074	20419	0.6403	2.66	4.58	-1.84
							05-06	14243	21598	0.6546	8.94	5.77	2.23
							06-07	14867	23541	0.6315	4.38	9.00	-3.53
							07-08	13492	25981	0.5201	-9.25	10.36	-17.64
							08-09	15103	26749	0.5646	11.94	2.96	8.56
average			0.7363	8.34	5.55	3.25				0.6739	8.62	12.29	-0.45

Source: Own estimate.

Table-6: Trend Growth rate of capacity, output and capacity utilization

Pre- reform period (1979-80 to 1991-92)				Post- reform period (1991-92 to 2008-09)			
Industry/year	Capacity	output	Capacity	Industry/year	Capacity	output	Capacity

			utilization				utilization
Indian Sugar Industry	2.44* (13.69)#	3.11 (10.84)	0.6709 (2.47)	**Indian Sugar Industry**	4.33 (12.06)	3.63 (15.61)	-0.70 (-2.69)
adjusted R^2	0.94	0.91	0.36		0.90	0.93	0.31

Source: Estimated from semi log trend

***trend growth rate,**

 # t values.