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A Post-Liberalization Period Analysis of Industry Specific Economic Factors Affecting Capacity Utilization in Indian Aluminium Industry

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Abstract:

The present study attempts to analyze the nature of quantitative relationship between different industrial characteristics and capacity utilization using industry- level and company-wise time series data in the context of Indian Aluminium Industry during 1991 – 92 to 2004– 05.Applying a liner multiple regression model with time variable, it is evident that capacity utilization is positively related to demand pressure, Capital Intensity and market concentration variables and time has a very smaller (Significantly different from zero) effect on capacity utilization. But scale of operation variable represented by market share shows confusing and statistically insignificant result which is contrary to our hypothesis.

Key words: Aluminium, industry, liberalization, capacity utilization, India, factors.

1. Introduction:

Study of capacity utilization as a measure of performance of industrial sector in India has received very little attention. Moreover, most of the studies on capacity utilization have used conventional methods, and have paid insufficient attention to the possible theoretical problems. Most of the studies conducted in India followed the conventional engineering (installed capacity) approaches which are basically statistical constructs based on officially published data.The principal problem underlying the interpretation of most of the existing studies is the weak link between the underlying economic theory and the used measures of capacity utilization; therefore a theoretical investigation into the problem is difficult to find. Moreover, it is observed that the earlier studies on capacity utilization has left unaddressed several theoretical problems in determining the factors that affect capacity utilization in Indian manufacturing industry in general and individual industry in particular. Therefore, very little research work has been undertaken so far in assessing the likely economic factors that affect capacity utilization in industries of India. This motivates us to have an inquiry into the determinants of capacity utilization in India's aluminium industry using a more reliable database.

In the context of judging industrial performance, capacity utilization is a crucial factor which explains changes in investment, inflation, long run output growth and level of resource utilization etc. In recent time, analysis of capacity utilization and its likely determinants have been gaining due importance in a 'capital scarce' underdeveloped economy like India. The effective utilization of capacity reflects and ensures balance in growth, quality management, appropriate administrative decision of government in allocation of foreign exchange and licensing of new investment. It is well recognized that utilization of capacity reflects the influences of markets supply and demand conditions, government policies, the degree of monopolization within an industry and the attitude of the managers of the firms in under developed countries (S. Paul 1974). Demand deficit, labour problem, transport bottlenecks, failure in power supply, mechanical/ maintenance trouble, strike etc are major causes responsible for underutilization of industrial capacity in India.

Apart from the above mentioned factors, industry characteristics like demand pressure, capital intensity, market concentration, scale of operation etc and policy variables influence capacity utilization rates of an industry. Paul (1974) found that industry characteristics explaining 40% of inter industry variation in CU rates and policy variables explaining 32% of the inter-industry variation comprise nearly 72% of the total inter-industry variations in CU.

In view of greater openness of Indian economy due to trade liberalization, industrial licensing was abolished since 1991 and private sector can built and expand capacity without any regulation. The policy reforms have the objective to make Indian industry more efficient, technologically up-to date and competitive.

Positive effect of trade liberalization on capacity utilization of different manufacturing industries in India can be explained in several ways -(a) lowering of tariffs will provide to industrial firms cheaper availability of intermediate inputs, which will enable them to improve their capacity growth and utilization performance; (b) reduction in relative cost of imported capital goods will raise capital -labor ratio and embody sophisticated technology, thus enhancing capacity utilization; (c) openness to foreign competition may compel the industries to close their less -efficient firms and make existing firms technically more efficient; (d) increase in competitive pressure on industrial units under trade reforms policies will direct the industries to utilize the resources more efficiently; (e) right of entry to imported inputs and reform in real effective exchange rate along with different trade policies under liberalization help industrial sector to compete in export markets trade policies under liberalization help industrial sector to compete in export markets more effectively through increase in sales and gain in economies of scale which in turn resulted to growth in capacity utilization.

In this backdrop, nearly two decades after these reforms, it is necessary to examine the factors that influence capacity utilization of an industry. In this study, we have attempted to explain the nature of relationship between capacity utilization and different industrial characteristics (excluding other explanatory policy variables like import substitution, effective rate of protection etc. due to unavailability of reliable, comparable data) based on industry level and company -wise time- series data in the context of Aluminium Industry in India.

The object of this paper is to analyze econometrically the effect of demand pressure, capital intensity, market concentration and scale of operation on capacity utilization. It employs multiple regression analysis technique (OLS) considering all explanatory variables in the same equation. Similar attempts were made earlier in the study of S. Paul (1974), Srinivasan (1992) and Goldar and Renganathan (1991).

The methodological nicety of this study lies in the fact that studies attempted earlier on this issue (as mentioned before) incorporate capacity utilization(CU) data from various secondary sources which seems to be mis-reported as well as exaggerated . We have used CU statistics calculated separately by our selves employing minimum capital-output ratio method. Another drawback of earlier studies has been the examining of quantitative relationship of CU and other explanatory variables over a period of time without considering time variable which we have incorporated in our regression model to remove the effect of spurious correlation. Plan of the paper is as follows:-

Section 2 deals with brief overview of India’s Aluminium industry and conceptual study related to capacity, sources of data and scope of the study. Methodology and data base are presented in section 3 Section 4 describes empirical result and summary and conclusion are presented in Section 5.

2. Overview of the Indian aluminium industry and conceptual study related to capacity:

2.1. Brief overview of India’s Aluminium industry:

Till the early 1970s, private entrepreneurs played a leading role in shaping aluminium industry. The Government entered the industry with the setting up of Bharat Aluminium Company, but it gained prominence with the setting up of National Aluminium Company (Nalco). With the introduction of economic reforms in the early 1990s, the industry has adopted and assimilated technologies acquired from leading international players. The assimilation of technology has been sufficient to operate plants at designed efficiency levels but has not led to the accumulation of expertise which can be a source for indigenous technological development.

Among the major aluminium producing countries in the world, India ranks tenth. India produces approximately 500,000 tons of Aluminium representing about 3.5 % of the world aluminium production. At present, Nalco and Hindalco are considered to be amongst the world's lowest cost producers and this has been possible by effective use of capacity and technology, supported by low cost captive power and quality bauxite ore. To retain its competitive edge, in-house R&D has played a significant role in exploiting innovative and creative ideas to ensure a high standard of development despite the bottlenecks of using existing production technologies. Though India's per capita consumption of aluminium stands too low (less than 1 kg) comparing to the per capita consumptions of other countries like the US and Europe (25 to 30 kgs), Japan (15 kgs), Taiwan (10 kgs) and China (3 kgs), in India, the industries that require aluminium mostly include power (44%), consumer durables, transportation (10-12%), construction (17%) and packaging. With one of the world's lowest per capita consumption, the country’s aluminium demand is set to explode. Moreover, local quality raw material, particularly alumina has placed the industry in an advantageous position.

2.2. Concept of Capacity:

The concept of capacity has played an important role in economic analysis. Simply, capacity output is defined as the maximum feasible level of output of the firm. Klein (1960) 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. The definition of installed capacity used by the India government in collecting its statistics is not rigid; rather it comes closer to the engineering definition of capacity. 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. Generally, engineering capacity refers to the maximum potential output per unit of time that a plant can produce under given processes and conditions and when there are no constraints on the flow of variable inputs and no cost consideration. 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. On the other hand, economic capacity is defined as the level of output at which costs are minimized, given fixed capital equipments, the techniques of production, the factor prices and the available quota of inputs in the cases when they are rationed. (Phan-Thuy et.al .1981) 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.

3.Methodology and Data base:

3.1. Source of data:

This paper covers a period of 14 years commencing from 1991-92 to 2004 –05 (specially covering only post-reform period). Researchers face difficulty in conducting studies on capacity utilization because of inadequacy of available official data which are unreliable also. The present study is based on industry level and company wise time series data taken from several issues of Annual Survey of Industries (ASI), National Accounts Statistics(NAS) and Economic Survey, Statistical Abstract (various issues), RBI bulletin etc. CMIE (Market share and Industry analysis) data are also used to arrive at explanatory variables. The study is confined to the aggregate level of aluminium industry of India.

3.2. Dependent and independent variables and hypotheses:-

Dependent variable considered here is capacity utilization. The rate of capacity utilization is merely the ratio of its actual output to the capacity output level. Griliches and Ringstad (1971) have preferred GVA to gross output and reasons for imposing preference have been mentioned in their study. We have considered GVA as actual output following Griliches and Ringstad (1971).

This study estimates the utilization rates on the basis of minimum capital output ratio (Sastry 1984). Fixed capital output ratios are first computed and a bench mark year is then selected on the basis of observed lowest capital output. Considering lowest observed capital – output ratio. The estimate of capacity can be obtained by dividing real fixed capital stock by minimum capital output ratio. The utilization rate is given by actual output as a proportion of capacity output. Hence,

$$\frac{Q}{CO}$$

CU = , CU = Capacity utilization

Q = A Q=Actual output

CQ = Capacity Output

Where CQ = $\frac{C}{C/Q_{min}}$ C is C=Gross Fixed Capital Stock (GFCS)

Independent variables considered in the present study are demand pressure, capital intensity, market concentration and scale of operation. These explanatory variables can be interpreted as under:

Demand Pressure (GO) :

Demand Pressure is measured by growth rate of production over the time period.A positive relationship is expected between demand pressure and capacity utilization on the assumption that high demand pressure will enable the firms within a particular industry to make better utilization of productive capacity.

Capital Intensity (K/L) :

Capital Intensity is expressed as the productive capital used per person engaged. It is obtained by dividing productive capital by no of persons engaged. A positive relationship between capacity utilization and capital intensity is expected because high capital intensive firms of an industry enjoy better economies of scale inducing higher utilization rates.

Market Concentration (CONR) :

Market concentration is defined as the percentage of the sale value accounted for by the top 4 companies in the total sales of the industry. Top 4 companies have been chosen from CMIE data book in accordance with highest sales volume. Greater efficiency of some firms within the industry ensures better market concentration. A few firms capture a larger portion of market share due to their excellent efficiency resulting increase in market concentration. Gradually, inefficient firms are wiped out of competition as a result of generating poor quality and charging high prices of products (due to increase in cost of production). Consequently, efficient firms expand their capacity as well as utilization rates to cope-up with the growing market demand thereby expecting a positive relationship between capacity utilization and market concentration.

Scale of operation (MS):

Scale of operation is defined as the value of its sale as a percentage of the total sales of the manufacturing industry. Capacity utilization can be influenced by the scale of operation of individual firms. As the scale of operation increases, there may be fewer bottlenecks and lumpiness of the individual machine is more easily balanced, thereby increasing the average CU (Lecraw, D.J,). Therefore, one would expect a positive relationship between CU and scale of operation.

Conceptual Model :

In order to examine the effect of various forces (that affect CU) on capacity utilization, we estimate a linear multiple regression equation for all firms taken together using industry level and company wise time series data over a period of 14years. The single equation model with CU as dependent variables and demand pressure (GO), capital intensity (K/L), market concentration (CONR), scale of operation (MC) along with time variable (T) as explanatory variables is depicted as under :-

$U = \alpha + \beta_1 GO + \beta_2 (K/L) + \beta_3 (CONR) + \beta_4 (MS) + \beta_5 T$

Where GO = Growth in production.

K/L = Capital intensity.

CONR = Concentration ratio.

MS = Market share representing scale of operation.

T =Time variable, U = capacity utilization rate.

The regression equation is estimated by ordinary least square (OLS) technique.CU is regressed separately on each independent valuable in different equations and then all explanatory variables are regressed in a single equation.

4. Empirical results:

Table 1 (shown in **Appendix**) presents the estimated regression equations. We find a significant positive relationship between CU and demand pressure variable which supports our hypothesis. The coefficient of demand pressure variable is positive and is statistically significant in all equations at 0.05 level. The major implication of this result is that as the growth rate of production indicating demand pressure increases, pressure is expected to come upon the firms within the industry that have idle capacities to enhance their utilization rates. This suggests that with growing demand for products, aluminium industry has been gradually moving towards fuller utilization of capacity. It is evident that following liberalization in 1991, there was a rapid expansion of output in the industry, which showed up doubling in the rate of growth. This was made possible by significant additions to capacity as investment flowed in to take advantage of a huge market.

The regression coefficient of capital intensity variable is all positive. The regression coefficient is statistically significant at 0.05 level in four equations, one at 0.10 level and another at 0.20 level. It indicates that aluminium sector with relatively more capital intensive units tends to have higher rates of capacity utilization. Capital intensity is generally considered to be the proxy for technology level. With relaxing of import restrictions due to reform process, firms have resorted to more foreign capital-intensive technologies inviting huge opportunity cost of unused capital. The result suggests that capacity utilization rate is more in high capital intensive firms because unless these types of firms operate at higher utilization rate, they cannot recover the higher cost of capital.

The estimated coefficient of market concentration variable indicates a positive relationship between market concentration and CU as coefficient of market concentration in all equations are positive and statistically significant at 0.05 and 0.10 level. The result implies that increase in concentration ratio leads to higher utilization of capacity indicating that capacity utilization tends to be better in more concentrated industry. Marketing styles of aluminium companies, of late, have seen an appreciable shift, moving from the commodity selling approach to one that is more consumer focused, and service –oriented. This has helped greater penetration into the rural and interior markets. Companies are continually widening their marketing networks. They are now far more customer –focused, interacting closely with end users and influencers like architects, civil and structural engineers. This has ushered in a new style of techno-promotion resulting greater market penetration.

This shows that higher seller concentration creates barriers on entry of new firms in the industry which helps assist concentrated firms to utilize its capacity at its fullest possible level thereby ensuring most effective utilization of scare capital resources.

Our regression result reveals that scale of operation variable represented by market share is found to be confusing and statistically insignificant. This reveals that firms with sizable portion of market share do not have significant stimulation regarding utilization of its installed capacity. The result is contrary to our hypothesis.

The explanation for not finding any significant relationship between CU and market share perhaps lies in the fact that over our study period, specially during 90’s (as our data reveals) ,there has not much change in market share of major aluminium sectors despite many players came into operation after economic reforms started since 1991.

Time alone was regressed on CU

$$U = 0.894 - 0.0216T$$

$$(2.98)$$

$$R^2 = 0.37$$

Over the study of 1991-2005, CU decreased by 0.021% per year. This signifies that time had a very smaller impact on CU but was significantly different from zero.

5. Summary and Conclusion:

As discussed earlier, India has undertaken various reform programmes since 1991 in order to make the economy competitive and to meet the global challengers. The objective of this paper is to assess the influence of various explanatory industrial characteristic on capacity utilization in a significant manner during the post reform period. From our regression analysis, it is evident that there exist significant positive relationship between CU and the explanatory of variables such as demand pressure (GO) capital intensity (K/L) and market concentration (CONR). Although scale of operation variable reflected by sizable portion of market share is expected to exhibit a positive relationship, result obtained from our analysis is contradictory as well as unsatisfactory. With regard to the “why’s” of what is revealed from our empirical result, it happens probably due to limitation and inadequacies of data. The present study lends strong support to earlier works conducted by Paul. S (1974)

Goldar and Renganathan (1991), Srinivasan (1992).

In liberalized regime, abolition of licensing rule encouraging new entrants, and at the same time, growing demand inducing existing firms to expand and utilize its capacity to the fullest possible, larger firms having greater access regarding higher capital intensity will contribute towards favorable impact on CU in future. Since aluminium is a core material for infrastructural development, it is directly related to economic growth.

But there are some important lessons that can be learnt from our analysis in that high demand pressure, high capital intensity and high market concentration leading higher CU might have adverse impact on scare resources, employment and distribution system.

In a nut shell, the empirical results presented in this study leave wider scope for further improvement and refinement.

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APPENDIX:

A -1:- 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 price 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, Aluminium industry) in proportion of its fixed capital stock reported in ASI, 1970-71)

Third, from ASI data, gross investment in fixed capital in cement 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 fixed asset in current year. (Symbolically, $I_t = (\beta_t - \beta_{t-1} + D_t) / Pt)$ and subsequently it is 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}.

A -2 :- **Table – 1:**

Regression Result for India's Aluminium Sector relating CU to GO, K/L, CONR, MS and T.

Dependent Variable: Capacity Utilization

Equation	Intercept Term	GO	K/L	CONR	MS	T	R^2
1.	-0.24 (-0.209)*	0.5982 (2.416)	3.954 (1.97)	1.567 (1.92)	0.8041 (0.287)	-0.071 (-2.93)	0.7316
2.	-	0.6346 (3.12)	4.29 (2.17)	1.374 (2.962)	0.44 (0.222)	-0.0671 (-3.11)	0.7278
3.	-0.0091 (-0.0214)	0.5489 (3.26)	4.62 (2.29)	1.41 (2.09)	-	-0.065 (-3.04)	0.7214
4.	1.43 (3.19)	-	-	-	-2.73 (-0.87)	-0.029 (-1.93)	0.3772
5.	0.6894 (5.68)	0.5729 (2.56)	3.721 (1.61)	-	-	-0.0582 (-2.49)	0.6033
6.	0.496 (0.87)	-	1.43 (3.589)	1.497 (2.57)	-2.95 (-0.92)	-0.03 (-1.29)	0.4749
7.	0.72 (1.21)	-	-	1.13 (2.41)	-2.93 (-0.97)	-0.0235 (-1.75)	0.46
8.	0.9421 (5.83)	-	0.843 (1.924)	-	-	-0.0214 (-0.91)	0.3296
9.	0.2956 (0.691)	-	-	1.069 (2.24)	-	-0.0127 (-1.82)	0.4219
10	0.9349 (17.43)	0.36 (1.99)	-	-	-	-0.0264 (-3.34)	0.5342

(Percentage of capacity utilization as calculated by minimum capital output ratio measure is the dependent variable in the above regression equations. Ten alternative equations have been regressed separately.)

For other independent variables, company-wise data published in CMIE(various issue) is the data source for the above regressions.

* t values are given in the parenthesis below.

GO =Growth in output indicating demand pressure.

K/L = Capital intensity.

CONR = Market concentration ratio.

Ms = Market Share representing scale of operation.

T= Time variable.