TRENDS AND DETERMINANTS OF CAPACITY UTILISATION
A Study of Indian Manufacturing under Liberalisation

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I, hereby affirm that the research for this dissertation titled "***Trends and Determinants of Capacity Utilisation: A Study of Indian Manufacturing under Liberalisation***" being submitted to Jawaharlal Nehru University for the award of the Degree of Master of Philosophy in Applied Economics, was carried out entirely by me at the Centre for Development Studies, Thiruvananthapuram.

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Certified that this dissertation is the bonafide work of Mr. Abdul Azeez E, and has not been considered for the award of any other degree by any other university.

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Chapter I

INTRODUCTION

1.1 The Study

The aim of this study is to analyse the trends in and determinants of capacity utilisation (CU) in the manufacturing sector of the Indian economy, in the context of policy changes, following the economic definition of capacity[1]. Realising its significant role in stimulating the rest of the economy[2], industrialisation was assigned a crucial role while adopting the path of planned economic development in India. Starting from the first industrial policy resolution of 1948, the industrial sector has undergone significant changes both in its structure and pattern due to the shifts in policy regimes. The widely held view that the restrictive industrial policy regime, which roughly prevailed between 1950 and 85, created a high cost industrial structure characterised by technological obsolescence, low rates of productivity, capacity utilisation and growth[3] led to a process of re-orientation in planning. This resulted in a shift in the policy starting from the late seventies. The turn around in output growth during the eighties, therefore, was often attributed to the changes in policy regime[4]. However, the shift in the policy paradigm that got further stimulus in 1991 created debates in relation to the impact of the liberal policy regime on Indian industry. Studies that attempted to analyse the trends and pattern of industrial growth noted that changes in the policy regime could influence output growth through variations in total factor

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1 Note that there are two major approaches in defining capacity and utilisation, viz., the engineering and the economic approach, which are discussed in detail in the second chapter.

2 The development models in the economic theory postulate that industrial development is the true vehicle of growth and key element in economic development. Arthur Lewis (1954) illustrates that the movement of labour from agriculture to industry inevitably accompanies economic development. See Fei and Ranis (1961)

3 Srivastava (1996) gives a good review of these arguments.

4 Due to the significant attention given, the sector grew fast during the initial years of planning. It further witnessed a phase of rapid growth in the eighties after the stagnation during the mid sixties and late seventies. However, there are differences of opinion on the timing of the turn around. While the authors like Raj (1984), Alagh (1985) asserted that the turn around had begun just after the mid seventies, drawing attention to the breaking out of the so-called 'Hindu rate of growth', authors like Ahluwalia (1987), Nagraj (1990) identify the same only with the period after 1979-80.

productivity (TFPG), scale economies and capacity utilisation (CU). However, most of the studies done subsequently focused on the analysis of TFPG[5], with very little attention given to the other two important factors. The present study is an attempt to fill this gap by analysing, within the framework of economic theory, the fluctuations in and determinants of capacity utilisation in Indian manufacturing in view of the changes in the policy regime.

The importance of analysing CU in a country like India, where the shortage of capital and abundance of labour, as in many other developing countries characterise the distribution of resources, stems from the fact that capacity utilisation reflects the use of scarce resources as well as the state of demand. Persistent low rate of capacity utilisation appears to be puzzling in view of the fact that firms are expected to optimise through their decisions on capacity creation and utilisation. There seems to be a gap between rationality of firms at the micro level and the sub-optimal macro outcome in the sense that resources have been allocated to create potential, which could have been utilised in some other activity. Increasing capacity utilisation, for obvious reason, would save capital and foreign exchange that are badly needed for industrial development.

The analysis reflecting the extent and determinants of CU is linked with the inter-temporal trends in the growth of output. High utilisation of capacity indicates efficient use of resources, while under utilisation of capacity results in high output costs, since the economy operates at the sub-optimal level. This can lower profitability and retard growth unless the industry is in a position to exercise its market power and raise the prices of its goods to a level ensuring a sufficient surplus. This culminates in welfare losses resulting from higher living costs and/or a fall in the domestic consumption of commodities with a high price elasticity of demand. When the domestic market contracts in this way, the aggravation of under-utilisation of capacity can be countered only thorough an increase in exports. In such a situation the competitiveness of the manufactured goods in the world markets would be undermined by the high average unit cost of production. This assumes importance in an open economy as firms can sustain in the international market only if they

5 For example, Ahluwalia (1985 and 1991), Srivastava (1996), Goldar (1986)

are competitive. Therefore, it is important to analyse the volume and trend of capacity utilisation.

The shift in the industrial policy paradigm in India during the late eighties[6] and early nineties was justified by a number of arguments[7]. The potential gains from increased competition and exploitation of scale economies that could result from a more liberal policy regime[8] provides the base for the micro economic branch of the argument for liberalisation. Then there are the macro economic arguments that link appropriate exchange rate policies with the exploitation of scale economies through increased exports, and with better capacity utilisation. Import liberalisation improves the industrial efficiency by exposing domestic producers to greater competition, internal and external, and by improving access to imported intermediate inputs and capital goods. It is argued that the regulation regime, giving protection to any domestic producer of an import substitute, regardless of cost, efficiency and comparative advantage, clearly created a climate for the existence of excess capacity[9] in the sense that costs could be well above the technological minimum. By reducing the rate of export growth[10], it also affected CU with a low growth of export demand, and the import licensing based on the installed capacity induced firms to expand their capacity in order to get more licenses[11]. Further it allowed firms to maintain their

6 For a discussion of the reforms in 1985 see Khullar (1991), World Bank (1989), Paranjape (1986) etc.

7 See Bhagwati and Desai (1970), Bhagwati and Srinivasan (1975). Also see Ahluwalia (1991), Srivastava (1996) etc. for a review of these arguments.

8 Liberalisation, in broader sense, is defined as any policy action which reduces the restrictiveness or controls-either their complete removal, or the replacement of a more restrictive set of controls with less restrictive ones (Krueger, 1986).

9 The restrictive import policy, if maintained for a number of years the artificially created high levels of profitability could lead to over investment in the industry resulting in a general fall in productivity and capacity utilisation. See Winston(1974)

10 The central idea of the argument that more exports would increase aggregate output, rests on the idea that domestic resources are under utilised. If all resources were fully utilised, any increase in one component of demand would necessarily lead to a fall in another.

11 Bhagwati and Srinivasan (1975) believe that the system of import licensing might have led to the excessive holding of inventories of intermediates and raw materials by Indian firms. Bhagwati and Desai (1970) suggest that since Actual User (AU) licenses were allotted equitably on the basis of existing capacity there were incentives for expanding capacity so as to have access to more imports. Further, the existence of excess capacity did not deter entry as the protected environment offered adequate profit opportunities for those who could obtain a license to enter.

monopoly power and thus making them to operate at high levels of profit even with excess capacity. Thus the limited threat of domestic entry and virtual absence of foreign competition allowed for the existence of excess capacity.

Thus the rationale of the industrial sector reforms in India can be traced to the argument that the regulated regime led to under utilisation of resources and that the unconditional protection provided to the domestic industry fostered a high cost industrial structure which was domestically inefficient in the utilisation of resources and uncompetitive abroad. Moreover, following the striking changes in policy environment the oligopolistic structure of Indian industry has changed over years. In the earlier protected state dominated regime, the sector was experiencing an oligopolistic nature with high barriers to entry and insignificant competitive fringe. However, by the introduction of liberal policy reforms the licensing system was liberalised and thus allowing new firms to enter. The extensive liberalisation in 1991 assigned a significant change in the entire oligopolistic structure.

However, even though it is often argued that a liberal policy atmosphere will enhance competitiveness of industry and will make it more efficient, it is not necessary that a higher rate of utilisation will be observed in a liberalised regime. This is because the direction of change in CU, as a result of a policy change in the direction of more external orientation, is ambiguous, from the theoretical point of view. Rather it is a rational outcome from the firms' part depending on the fluctuations in the market demand, domestic or abroad. Furthermore, in a liberalised regime the domestic market will get more integrated with the international market, and the demand fluctuations in a global context are likely to be more pronounced, which, in turn, would create more fluctuating movements in utilisation. When one argues that the protected policy regime fostered the existence of excess capacity, the question arises as to why a rational firm chooses to keep excess capacity, since by any means it is not a rational action as it is associated with a high cost of production. Apart from any changes in policy there may have some basic rationale from the point of view of a firm to keep certain amount of excess capacity. This motivates us to study the analytical connections between capacity utilisation and various factors shaped by changes in policy regime.

Apart from the general arguments for change in policy paradigm, the impact on CU of the change that happened in the late eighties and early nineties has not been given much attention[12]. Besides, most of the CU studies that are conducted in the case of Indian manufacturing pay less attention to the theoretical underpinnings. In what follows, we examine some of the major studies that are conducted in India in this field of research.

1.1.1 CU in India: A brief Review of Literature

In view of the overriding importance of capacity utilisation in the overall resource-use efficiency of the economy, studies in the Indian context have tried to examine the trends and determinants of capacity utilisation. Since most of them followed the conventional engineering (installed capacity) and Wharton approaches, a theoretical investigation into the problem is hard to find[13].

One of the earliest attempts by Morris and Paul (1961) based on installed capacity figures published by Central Statistical Organisation (CSO) in Monthly Statistics of Production (MSP) for the period 1951-59 revealed an increasing trend in capacity utilisation over the years. Raghavachari (1961) using the same database found a decline in utilisation during 1963-67. NCAER (1966) for the period 1955 to 1964, based on the annual installed capacity and actual production collected from M S P, Directorate General of Technical Development (DGTD) and the Indian Textile Bulletin show a low index of 10 to 15 per

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12 However, in general, the shift in policy created many debates among economists in relation to the impact of liberal policy regime on Indian industry, and it became the keen area of research interest. For example, Ahluwalia (1985, 1991), Joshi and Little (1994), Nayyar (1994), Srivastava (1996).

13 The pioneering works by Berndt and Morrison (1981), Berndt and Hesse (1986), Nelson (1989) etc have clearly pointed out need to follow the economic theory behind CU.

cent under-utilisation in the sector as a whole[14]. Reserve Bank of India (1970)[15], for the years 1961 to 68 based on the methodology developed by Wharton School index of capacity output found that, in most of the industry groups, increase in the potential output had taken place at a faster rate upto 1963, thus lowering the potential utilisation ratio during the period. Jayasree Shah (1977) in line with RBI shows that potential output was not utilised fully and the loss of output was high during 1960-73, giving an average utilisation of 77.5 per cent by all 94 sectors chosen. Sastry (1980) found that Wharton/RBI indices yielded higher levels of utilisation, while installed capacity figures yielded utilisation between 50 to 70 per cent. RBI (1986) found a negligible improvement in capacity utilisation during 1980-85 giving a considerable deterioration of capacity utilisation in basic goods industries and improvement in intermediary and capital goods. The Centre for Monitoring Indian Economy (CMIE-1987) in a study, based on installed capacity figures for the period 1980-86, found that around 35 % industries is terms of their weights in the index of industrial production operate below a capacity utilisation of 60 per cent. Viswanathan and Mukhopadyay (1990) in a study on Indian cement industry using the economic measures of CU show that economic measures of CU are always higher than the conventional engineering measures. Further they indicate the presence of increasing returns to scale in the Industry and insignificant impact of market structure on CU. Burange (1992) show a declining trend in CU after 1965, when analysed in terms of installed capacity.

Most of the studies that tried to examine the determinants of CU in India established that demand plays the vital role in determining the level of utilisation. Paul (1974) found a CU of 50 per cent when adjusted for shifts as against MSP definition based figure of 80 per

14 But this results are unreliable because it constitutes only 140 industries which is just 50 per cent of the total 276 industries covered by the study. More over, the index conceals a considerable disparity in capacity utilisation as between different industries, the rate of under utilisation varies from 10 to 70 percentage across industries.

15 RBI (Divetia and Verma -1970), estimated CU separately for use based groups and input based groups, which were again sub divided as Basic industries, Capital goods, Intermediate goods, Consumer goods, Agro-based industries, Metal based industries and Chemical and coal based industries. They used a modified Wharton index, using monthly level of production index by an industry during the year as a peak output.

cent for 1961-71. The analysis of the determinants demonstrates a positive relation of CU with firm size and demand while a negative relation with the market structure and effective rate of protection. In line with Paul, Goldar and Renganathan (1991)'s econometric analysis also indicates a significant positive relation between CU and demand pressure and also between the latter and market concentration, while a negative relation between the CU and effective rate of protection. Using the data on capacity utilisation relate to 1986, drawn form publications of CMIE, Srinivasan (1992) also found that most of the industries considered are demand constrained. A positive relationship is found between capacity utilisation and capital intensity, scale of operation and market concentration. Ajit (1997) have shown that there has been a declining trend in utilisation in the sector, over the period 1970-90 and strengthened the earlier view that CU is mostly demand determined. ICICI (1994)'s analysis for the private corporate sector, show that capacity utilisation dropped by almost four percentage points during 1991-2 and further by 1.2 percentage points during 1992-3 at the aggregate level and an overall deceleration in 1992-3 over the previous year, according to use based classification of industries. They confirmed the direct and positive relationship between CU and increase in demand. Seth (1998) in a study attributes high utilisation achieved during 1960-65 to the massive amount of public investment in infrastructure, capital and intermediary industries, together with the adoption of import substitution policy.

Thus, a few studies have been undertaken in the past on capacity utilisation in India. These studies found that Indian industrial sector has been facing serious under utilisation of capacity, and this is attributed largely to the deficiency of demand and the restrictive policy followed by India. An examination of this literature reveals, however, that most studies have used conventional measures, and have paid insufficient attention to the possible theoretical problems. As clear from the above discussion the commonly used measures of capacity utilisation in India, are based on the engineering approach in which actual output is compared to the maximum output that may be produced given the stock of capital (or the installed capacity) or the Wharton school measures.

It has long been recognised in the literature that the engineering approach is deficient, in the sense that it is not based on any explicit theoretical foundation. In India these estimates are mainly based on the installed capacity data collected from firms and published by different agencies. The data that many studies used for this purpose are quite unsatisfactory in that they compound inevitable conceptual difficulties with several statistical drawbacks. Principal among these is that the fact that the DGTD, which compiles the data, also regulates Actual User (import license) allocations and therefore, the capacity estimates have tended to lie anywhere within the range defined by entrepreneurs who wish to exaggerate capacity in order to get more AU licenses, and by DGTD officials who will refuse to recognise capacity augmentation because this would increase their apparent obligation to provide AU licenses[16]. Hazari report (1967) also clearly pointed that the licensing policy projected an exaggerated picture of industrial capacity. Further the definition of installed capacity differs from firm to firm, there is no uniform way to define it and it is not clear how these firms respond to the question of their capacity. This creates ambiguity in explaining the results also. Paul (1974) points out that the capacity figures published by the MSP are subject to problems. Many of the firms report capacity based on a single shift operation, which is not the case in practice. CMIE also agrees that there is no standard of units used by companies in the presentation of information regarding installed capacity. As different companies mention capacity in different ways, they warn that it should be taken as indicative only. Most of the companies, as mentioned in the case of MSP data, do not mention the number of shifts assumed in the capacity stated. Moreover, as the economy moved from a system of licensing and strict control on production to a system of capacity increase endorsements and then further to broad-banding and then finally to de-licensing, the importance of the installed capacity figure to the government agencies (such as DGTD) has declined substantially[17].

The Wharton indices were also questioned on many theoretical grounds. In this method one is, first, identifying the major peaks in a seasonally adjusted output series, assuming that the

16 For details on the inadequacies of these data, see Bhagwati and Srinivasan (1975) or Slocum (1970).
17 See PROWESS Manual Vol. II, Centre for Monitoring Indian Economy.

major peaks represent output where resources are utilised full capacity and then, joining the major peaks by linear interpolation potential output is estimated for non peak years. Despite its computational simplicity the measure is criticised on the ground that it is unreasonable to assume that each major peak represents the same intensity of resource utilisation and that potential output grows at a constant arithmetic rate between peaks[18]. In addition, this method didn't take into account, in deriving capacity output, the growth of inputs, which is very important.

Despite the arguments that it was the protected regime that created bottlenecks in utilising the capacity, no serious attempt is made, as evident from the review, to examine how far the new changes helped in stimulating utilisation. Thus the review brings out two major issues; i) the conspicuous absence of a comprehensive analysis of the trend and determinants of capacity utilisation following the economic theory behind it, ii) the little attention given to analyse CU after the reform process. Therefore, there is a need to explore the relationship between capacity utilisation and various factors that presumably influence it, in a theoretically informed way. The present study is motivated from this angle and is trying to analyse trends and determinants of CU in Indian manufacturing.

1.1.2 Choice of Industry

The study is conducted on India's manufacturing sector[19] as a whole and for disaggregated (two-digit level) capital goods sector separately. The choice of the manufacturing sector is convenient because it is characterised by relative homogeneity in inputs and outputs[20] and because it is an important sector of economic activity, which is very much affected by the policy changes over years. The manufacturing sector of the Indian economy contributes 20 per cent to the country's gross domestic product and accounts for 80 percentage of the

18 A detailed review of different measures are given in chapter 2. Also see Christiano (1981).
19 Total Manufacturing is All industries minus Electricity, Gas and Steam and Repair Services.

20 See Artus (1977), O'Reilly and Nolan (1979).

country's total industrial output (NAS, 1996). Further it has been growing at an annual average rate of about 7 per cent for the past ten years, compared with about 6.5 percent average growth rate of GDP at factor cost during the same period (Economic Survey, 1997).

The disaggregated analysis is carried out for avoiding the aggregation bias that may occur when analysed at the aggregate level, and thereby to confirm and authenticate the analysis at the aggregate level. For this purpose, we select the Indian capital goods industry. The rationale of selecting capital goods, for this purpose, stems mainly through the fact that it show a different nature in movement of installed capacity utilisation compared to the whole manufacturing sector, as is evident from the earlier literature. It is found that the fluctuations in CU are more in the case of this sector compared the aggregate manufacturing implying to the possibility of an aggregation bias. If we look at the yearly growth rates of output in this sector, we can see the same kind of differences (see appendix A1.1). Further it is a sector that is very much affected by the policy changes. In the earlier state-dominated policy within the high protective barriers, the sector was promoted by all means. The sector has got further significance in the recent industrial policy regime, particularly regarding import liberalisation. Most of these industries includes in the list of industries for automatic approval of foreign technology agreements and for 51 per cent foreign equity participation, accounting for a significant share in total FDI in the country after 1991[21], which will enable to expand the capacity. In addition the sector has got significant weight in the total industrial production of the country. It increased considerably from 4.7 in 1956 to 18.4 in 1994. Therefore, considering its significant divergence in growth pattern we select the capital goods industry for disaggregated analysis.

21 These industries together constitute nearly 38 % of total FDI inflow, see Subrahmanian et al (1996).

1.1.3 Objectives of the Study

The present study is trying to build on a new series of theoretically consistent and empirically relevant capacity utilisation series and analyse its trends and determinants. The specific objectives of the study are;

- To construct a theoretically consistent series of capacity utilisation for Indian manufacturing for the period 1974-94[22].

- To analyse the trends in capacity utilisation in the Indian manufacturing, both at aggregate level and at the disaggregated capital goods industry for the period 1974-94.

- To study the determinants of capacity utilisation both in aggregate manufacturing and in capital goods industry separately.

- To examine the impact of policy changes on capacity utilisation.

1.1.4 Scheme of the study

The study is organised in six chapters along with the introduction. Chapter 2 reviews the theory behind CU and different methods of measurement that are developed in the literature. In Chapter 3, the specific model used for estimating capacity utilisation and the empirical results are presented. The observed trends in utilisation both at aggregate and disaggregate level are analysed in Chapter 4. In chapter 5 the factors that influenced the observed utilisation levels are examined. The major findings are summed up in Chapter 6.

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22 The selection of this period is largely due to the availability of data. Apart from this it was guided also by the changes in the industrial policy over these period.

Chapter II

CAPACITY UTILISATION: UNDERLYING THEORY AND METHODS OF MEASUREMENT

In economics capacity utilisation is a measure of the intensity with which a national economy or sector or firm makes use of its resources. However, there is a wide range of ambiguity with respect to the meaning of 'capacity' and the definition of 'capacity utilisation'. As the term is associated with a number of different concepts, some of them are discussed in this chapter. The chapter is presented in two sections. The first section deals with the concept of capacity and utilisation. In the second section we discuss the major methods of measurement that are available in the literature.

I

2.1.The concept of capacity

The concept of capacity is widely used in analysing performance of the industrial sector. Though there is no unanimous definition for capacity it is broadly defined as the ability of a firm or industry to obtain maximum possible output from a given set of inputs and technology[1]. And a measure of capacity utilisation gives how much of this capacity is being utilised by the industry, firm or economy. Excess capacity, therefore, is defined as the difference between the output that the production agent in question is capable of producing and the output it actually called on to

1 Klein (1967), Fare et al (1989)

produce[2]. However, in most cases the problem of giving precision to its meaning is rendered extremely difficult by the fact that neither the output attainable nor the output realised is entirely determined by physical constraints or by unrestricted consumption requirements.

Various concepts of capacity utilisation fall roughly into two categories - those that concern the degree of utilisation of capital only (capacity utilisation in "narrow" sense) and those which concern the degree of utilisation of all resources including capital (the "wide sense")[3]. The wider sense definition often considers capacity as an output level where all the inputs are fully employed, or as a full input point on production. However the definition of capacity output is categorised under two approaches i.e. the engineering approach and the economic approach. While the engineering approach belongs to the 'narrow sense' definition of capacity utilisation the economic approach belongs to the wider sense. Let us discuss these approaches in detail.

2.1.1 The Engineering approach

This approach defines capacity as the maximum output that may be produced given the plant and equipment. In other words it considers output per machine year as a measure of annual capacity of a machine[4] and thereby often sets a ceiling on production. In this case one has to fix limits to the use of other inputs that affect production. Then the capacity utilisation can be defined as the ratio of actual output (Y) to this maximum output (Y_0).

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2 It is sometimes used with respect to the fixed factor, while at other times it is used with respect to all the factors involved in the functioning of economic unit. To quote the example given by Cassel (1937), " If because of a pig iron producer is using only half his blast furnace we say that there is one hundred per cent excess capacity in his business it is evident that we can be referring to only the fixed factors in the business. The output of pig iron could be doubled without increasing the number of furnaces, but it could not be doubled without increasing the amounts of coal and iron ore and labours that are used. On the other hand, if we say in a time of depression when production has fallen off to two thirds of its actual level that the community has an excess capacity of fifty percent we must clearly be referring to the whole complex of productive agents taken together".

3 To quote Leeuw (1962) " A stock of plant and equipment 'can produce' a quantity if it is operated 24 hours a day, seven days a week without regard to materials and labour economies; and another quantity if it is operated eight hours a day, five days a week, minus repair time and with the most economical combination of material and labour.

4 See Leeuw (1962) for detailed explanation.

This approach is difficult to interpret economically, because factor prices and quantities of non-capital inputs, which are very crucial in determining the potential or optimal output, are not considered. Since the level of production depends on the relative proportion in which the fixed and variable factors have to be combined to the product economically, non-capital variable inputs derives importance in deciding the potential. Defining capacity by setting a ceiling on production, fixing limits to the use of non-capital inputs is thus largely irrelevant to economists[5]. Because the economic capacity of a given stock of capital will vary with the relative price changes, and alter the optimum combination of capital and other variable inputs, which are totally ignored in engineering definition. Moreover, according to this approach, the point of maximum possible output can go even upto the third phase of production, which is not feasible economically.

2.1.2 The Economic approach

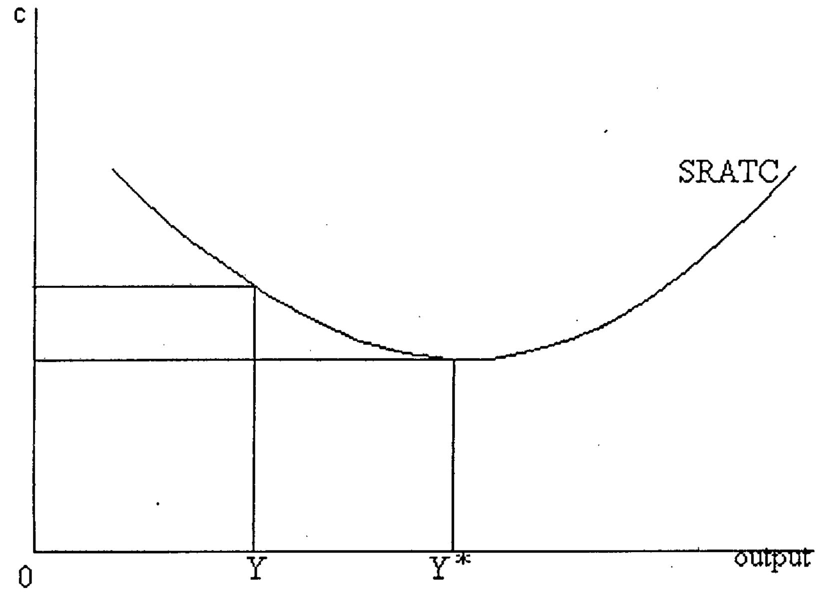
The economic approach, first discussed by Cassel (1937) recognises that;

"Potential output is conditioned in most cases by economic circumstances and must be interpreted as being the optimum output from the economic point of view."

More specifically it recognises that both actual and potential output are capable of wide variations according to the economic circumstances as given by, say, the prices of the products and the costs of the factors of production. Therefore from an economist's point of view capacity is purely a cost concept. Two different definitions of potential output for the economic approach have been put forth. The first suggested by Cassel (1937) and Hickman (1964) corresponds to the output (Y*) at which the short run average total cost curve reaches its minimum. The second, advocated by Klein (1960) and Friedman (1963), corresponds to the output (Y**) at which the long run and short run average costs curves are tangent to each other. Consider the following figures.

5 See Kennedy (1998)

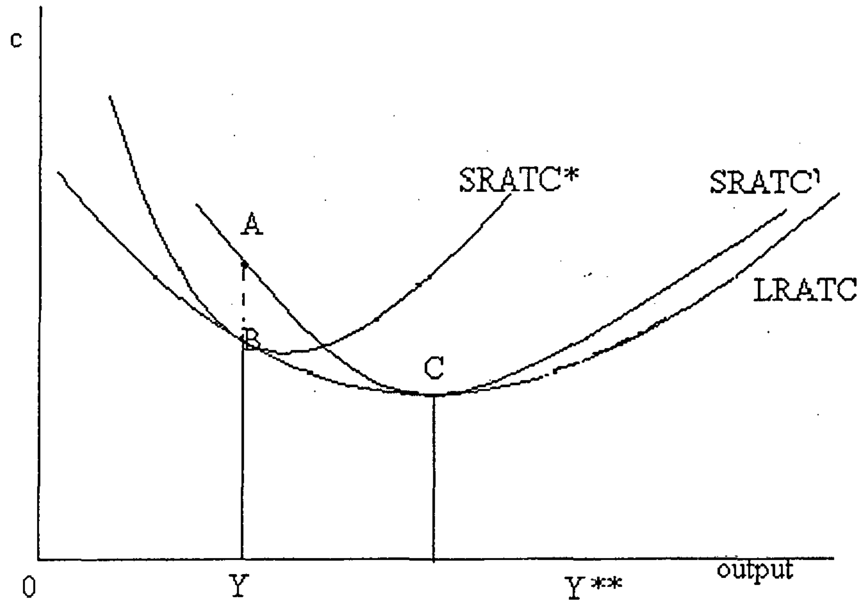
Figure 2.1



According to the first definition, potential output will be Y* where the industry's short run average total costs are minimised (Figure 2.1). If the industry is producing an output smaller than Y*, say Y in the figure, then there exists excess capacity, which is equal to the difference between Y* and Y, and the capacity utilisation will then be (Y/Y*). Unit costs of production will be higher than the minimum if the actual output either exceeds or falls short of Y*[6].

6 That means the average total cost function is assumed to be U-shaped, though not necessarily symmetrically so, and capacity utilisation may exceed or fall short of 100 percent as output varies to either side of the point of minimum average cost. See Hickman (1964).

Figure 2.2



To come to the second definition, assume that the industry is currently at point A (Figure 2.2), producing Y units of output along SRATC'. The industry is not in long run equilibrium at A, as SRATC' > LRATC. It would be in equilibrium at either point B or C, as both represent the points of tangency between the LRATC and SRATC curves. Points B and C differ in that B is on a new short run cost curve, SRATC*, while C lies along the original cost curve, SRATC'. Point C represents the potential output relevant for capacity utilisation, i.e. Y** and thus capacity utilisation is given by the ratio (Y/Y**).

The relation between the two economic measures of capacity utilisation depends upon the degree of returns to scale. In the case of constant returns to scale, two definitions are equivalent; in the case of increasing returns to scale Y* > Y** implying that CU* < CU** while under decreasing returns to scale Y** > Y* implying that CU** < CU*.

Thus from the above discussion it can be seen how divergent the definition of capacity and utilisation could be. However, the demand for capacity utilisation figures having been brisk, and following these different- broadly the narrow and wider - definitions, a number of measures has been also appeared in the economic and statistical literature. Major ones are discussed, in detail, in the next section.

II

2.2 Capacity Utilisation: Methods of Measurement

This section discusses several methods that have been developed in the literature to measure capacity utilisation. As we already discussed, in simple words, capacity utilisation can be defined as the ratio of actual output to some measure of potential output. This can be with respect to firms, industries or the macro economy as a whole and gives a measure of the amount of total capacity that is being used. Therefore, any measure of capacity utilisation hinges on the definition of capacity output or potential output. The two basic approaches used in estimating CU are the statistical or data based methods and the survey method. These measures generally include (i) those using exclusively output series in the estimation of capacity, (ii) those which use both output and physical capacity data as given by the measures of output per machine based on engineering information, (iii) those which use fixed capital figures along with output series, and (iv) those based on estimation of production function and cost function. A brief review of some of the important measures is given in the proceeding paragraphs.

DATA BASED METHODS

2.2.1 Trend through peaks

This measure was developed by Klein (1960) at Wharton Econometric and Forecasting Associates (WEFA). Being a wider sense approach, it attempts to measure the degree of utilisation of all inputs[7]. The method applied to a sector such as manufacturing is as follows. First, seasonally

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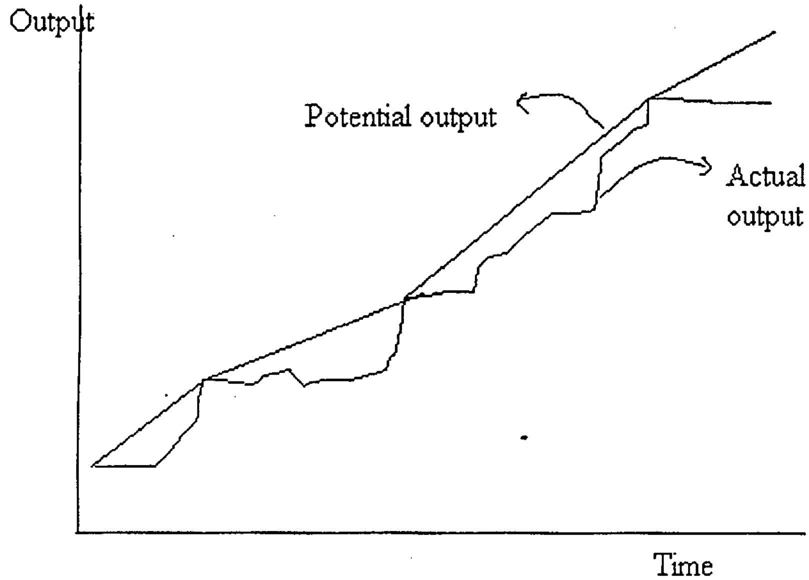
7 It doesn't consider inputs directly in measuring capacity utilisation, but since it consider the attained output, it is argued that the effect of inputs are captured.

adjusted figures for each of several manufacturing industries are plotted. It is assumed that the major peaks[8] in the series represent output where resources in the economy are utilised full capacity and then, joining the major peaks by linear interpolation one gets potential output for non peak years. The line drawn is taken to be capacity output and capacity utilisation is the ratio of actual output to contemporaneous points on the line drawn (see the Figure 2.3).

Figure 2.3



The measure is attractive in that it is easy to compute from published data. In addition, it has the advantage of defining potential output as an attainable level of production. However the method is criticised on the ground that it is unreasonable to assume that each major peak represents the same intensity of resource utilisation. If, for example, the economy fails to surpass what is perceived as a major peak, not because it has reached its productive potential but because of a decline in demand, calculated utilisation rates in neighbourhood of the peak would be biased upward.

Again it is unreasonable to assume that potential output grows at a constant arithmetic rate between peaks. This growth is expected to be somewhat uneven, similar in pattern to investment activity,

8 Deciding whether a peak is 'major' or not is merely a matter of value judgement.

which is procyclical. In addition, this method didn't take into account the growth of inputs, in deriving capacity output. The WEFA measure of capacity utilisation never exceeds 100 percent.

2.2.2 Modified trend through peaks

This method was developed by Dhrymes (1976) in order to make improvement over WEFA assumptions. He constructs the non-peak potential output series by using information on developments in employment in addition to information on the capital stock. The method is as follows. First, one constructs an employment series that is adjusted for cyclical variations in output[9]. Next, the peak levels in output are identified (as is done for WEFA). Then a Cobb-Douglas production function is fitted to these points by using the factor shares approach. Let the set D be the subset of indices; t = 1,2...T that correspond to peak output. The production function is

$$Y_t = Ae^{\Gamma t} K_t^{(1-\alpha)} L_t^{\alpha} e^{ut} \quad t \in D \qquad (1)$$

Where observed K_t and L_t are assumed to be fully utilised for $t \in D$. The estimate of a α ($\hat{\alpha}$) is taken as the geometric average of labour's share for $t \in D$.

$$\hat{\alpha} = \text{Exp}\,(1/T')\,[\sum_{t \in D} \log\,(W_t L_t / Y_t)] \qquad (2)$$

Where Wt is the wage rate, T' is the number of peak output points (e.g., the number of elements in D), and the exp $x \equiv e^x$. Next, setting $Z_t = \log Y_t - (1-\hat{\alpha})\,Kt - \hat{\alpha} L_t$, $t \in D$, one chooses $\hat{C}$, $\hat{\Gamma}$ and $\hat{u}_t$, for $t \in D$ in

$$\hat{Z}_t = \hat{C} + \hat{\Gamma}_t + \hat{u}_t \qquad (3)$$

9 The adjustment procedure assumes that percentage changes in manufacturing employment are proportional to percentage point changes in the economy wide unemployment rate. See Artus-1977 for a detailed explanation of the reasoning behind this.

so that $\sum_{t \in D} \hat{u}_t^2$ is minimised. Capacity output Y^c_t is then defined as

$$Y^c_t = (\exp C)\, e^{\hat{r}t}\, Kt^{(1-\hat{\alpha})}\, L^p_t{}^{\hat{\alpha}}, \quad t = 1...T \qquad (4)$$

Where L^p_t, (t = 1...T) is the L_t series adjusted for cyclical variation[10]. Thus, peak values in Y_t, assumed to represent capacity output, are joined by a curve that takes into account developments in both labour and the capital stock within the context of the estimated historical relation between these and output. This is much more attractive method than simple trend through peak method in that it is benchmarked using the assumption that observed peaks represent points of full resource utilisation, making use of available information regarding what happens to potential output between peaks.

2.2.3 Output/Capital ratio

This measure lies on the existence of a stable proportional relation between the stock of capital and potential output. The method assumes that fluctuations in the observed output/capital ratio are due largely to deviations in output from its potential. It overcomes some of the difficulties of the trend through peak method by relating growth and fluctuations in capacity to investment activity.

The method is as follows, first, construct an actual output/capital ratio series (Y_t/K_t), t=1,....,T, where Y_t and K_t are output and the capital stock, respectively, at time t. Next, construct a capacity output/capital series by fitting a linear trend[11] to the actual output/capital series, as follows:

$$(Y_t/K_t) = a_0 + a_{1t} + u_{1t}, \quad t = 1,......,T \qquad (5)$$

10 See Artus (1977), for the adjustment process.

11 There is, generally, a declining trend in output/ capital ratio, in most of the industrialised countries. This may be due to decreasing productivity of capital resulting from an increase in capital intensity, or it may be due to other factors.

Where a_o, a_1, and u_1 are fitted by least squares. The capacity output/capital ratio is taken to be the points on a line with time derivative a1, raised just enough so that it touches only one of the observed (Y_t/K_t) series. The adjusted trend Y/K ratio-call it $(Y_t/K_t)^c$ is assumed capacity output/capital ratio. As stated previously, the method assumes that actual and capacity output/capital ratios differ because of deviations of output from its potential. That is, it is assumed that,

$$(Y_t/K_t)^c = (Y^c_t/K_t) = (100/CU_t)*(Y_t/K_t)^{12} \quad (6)$$

$$\text{Where } CUt = (Y_t/Y^ct)*100 \quad (7)$$

$= [(Y_t/K_t)/(Y_t/K_t)^c] * 100$ is defined as the capacity utilisation rate.

Another variant of this method is the minimum capital output ratio, developed by National Conference Board of US, under which, on the basis of the lowest capital output ratio, a benchmark year is selected, where the capacity is assumed to be utilised fully. Applying this benchmark capital output ratio, one estimates the potential series for other years.

This method is similar to the WEFA method in that it is simple to carry out and is based on published data[13], and also has got an advantage over it in that it takes into account the effect of changes in the rate of investment on potential output between production peaks. But, since this approach considers the capital input only in measuring capacity output, it belongs to the narrow approach in defining capacity utilisation. In addition, it is the capital productivity that is considered here rather than the utilisation. It is possible to argue that the high productivity of capital achieved in a particular year, representing the highest output capital ratio or the lowest capital output ratio,

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12 We know C U = $(Yt/Y^ct) * 100$, then $Y^ct = (Yt/CU)*100$, and $(Y^ct/Kt) = (Yt/CU)*(100/Kt) = (100/CU)*(Yt/Kt)$.

13 Note that difficulties associated with computing consistent capital stock series from published data are existing in the case of any estimation where capital input is considered.

may be due to the intensive use of other factors which are not considered in measuring the potential. Therefore, the assumption that the same level of productivity is not achieved in every year because of the deviation of actual from potential, is not weighty valid. It should be noted that there are enough empirical evidence to prove the tendency to overstate/understate partial productivities depending on how intensively other factors are employed[14].

2.2.4 Investment function

Bert.G.Hickman (1964)'s formulation of the investment functions implies a precise relationship between capital stock and capacity. The method is based on certain assumptions. First is that the real net investments (changes in real net capital stock) in any year is proportional to the difference between actual and desired capital stock where the latter is defined as that stock which would be desired in the long term equilibrium under the condition existing at time t. In symbols,

$$K_t - K_{t-1} = b\,(K_t^* - K_{t-1});\ 0 < b \leq 1 \qquad (8)$$

Where, K_t and K_t^* are respectively actual and desired stock at the end of the year t[15].

Secondly it is assumed that desired stock is a function of the expected long term or 'normal' level of output (Y^*) and relative prices (P^*)[16] in the year (t), plus a time trend, i.e.,

$$K_t^* = a_1 + a_2 Y_t^* + a_3 P_t^* + a_4 T \qquad (9)$$

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14 For example Ahluwalia (1991) show that the increasing labour productivity in Indian manufacturing is an overestimation resulted from the increased capital intensity.
15 If b = 1, the entire gap between desired and actual stock will be diminished within year t, but if b is less than one, only a fraction of adjustment will be completed during the year. See Bert G. Hick man for more detailed discussion.
16 Hickman tried two forms of relative price variables. One was the real price of capital defined as the ratio of price of capital and the price of product, and the other was the ratio of the money wages and the money price of capital.

Combining (8) and (9) yields,

$K_t - K_{t-1} = b\, a_1 + (ba_2) Y_t^* + (ba_3)\, P_t^* + (ba_4)\, T - bK_{t-1}$; and if the variables in this equation are written in log form,

$$\mathrm{Log}K_t - \log K_{t-1} = (b) \log a_1 + (ba_2) \log Y_t^* + (ba_3) \log P_t^* + (ba_4)\, T - b \log K_{t-1} \qquad (10)$$

Allowing certain modification to the model such that it preserves the assumption of a constant annual speed of adjustment of desired to actual stock, but which makes expected long-term or normal output (and prices) a weighted average of current and recent outputs (and prices). This can be done by trying lagged as well as current outputs (and prices) in regressions of the general form of (10). Suppose that the best regression for a particular industry include output and price term for the current and preceding year[17],

$$\log K_t - \log K_{t-1} = b \log a_1 + (ba_{21}) \log Y_t + (ba_{22}) \log Y_{t-1} + (ba_{31}) \log P_t + (ba_{32}) \log P_{t-1} + (ba_4)\, T - b \log K_{t-1} \qquad (11)$$

where $(ba_{21}) \log Y_t + (ba_{22}) \log Y_{t-1} = (a_2) \log Y_t^*$.

$$(12)$$

And $(ba_{31}) \log P_t + (ba_{32}) \log P_{t-1} = (a_3) \log P_t^*$

Basic investment regression was actually fitted in this form. Thus the expected long-term or normal output Y_t^* and relative price P_t^* are derived as weighted average of the output and price terms, with weights determined by the (a) coefficients. Then it is possible to write the equation for desired stock as a function of normal output and prices as in (9). Now, substituting actual stock for desired stock in (9) and solving the equation for output the capacity output is obtained.

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17 Alternative regressions can be tried including, one, two or more than two output (and price) terms and the equation which yield the best over results for each industry as judged by goodness of fit, significance of coefficients etc. can be selected.

In formulising this method, Hickman realises that capacity is purely a reflection of firm's short-run cost conditions. However, his implicit assumption that the effects of non capital input prices are captured by equation (11) seems to be shadowy[18]. Moreover, it doesn't consider the optimisation behaviour of firms in terms of utilising their capacity.

2.2.5 Production Function approach

The production function approach to estimating potential output has been used by many studies, based on the Cobb Douglas production function. This concept attempts to measure statistically the normal relation between inputs and output, taking account of the fact that inputs are sometimes under-utilised.

Consider a production function[19],

$$Y = f(K, L) \qquad (13)$$

Where, Y = actual output,

K = capital input and,

L = labour input,

Then, for estimating capacity output series the actual variables K and L are substituted by their full employment level. There are several views in selecting a full employment input level, and

18 According to him the effect of input prices are captured by equation (11) in that it is the optimum capital stock Kt * to use in combination with the labour input implied by optimal output Y*, given the input prices.

19 See Artus (1977), Reilly and Nolan (1979) for different production functions.

none of them are free from theoretical limitations. One of the widely used approach is to fit a trend regression as,

$$\bar{L} = \alpha + \beta t + u_L, \text{ and}$$
$$\bar{K} = \alpha + \beta t + u_K, \tag{14}$$

Then this trend line is shifted up in such a way that it passes through the higher than average value of utilisation by the addition to the trend of a selected "high though not maximum" positive residual[20]. Then these estimated values of inputs are substituted in the original equation and the resulting output will be the potential output. Capacity utilisation then is measured as the ratio of actual to this potential output. The problem with this measure is that the selection of full employment level of labour and capital are subject to criticisms. There is no uniform criterion to select such a level of inputs.

Another variant of this method which is much more statistically conducive, is the recently developed varying coefficient frontier production function, used by Kalirajan and Salim (1998). In this method instead of substituting full employment level of inputs, one is considering the maximum coefficient among the estimated actual response coefficients, assuming these coefficients corresponds to the efficient use of the inputs. Then, using these frontier coefficients one estimates the potential output. For example, assuming a Cobb Douglas technology, and allowing the parameters to be random, the stochastic varying coefficient frontier production function can be written as,

$$\ln Yt = \beta_{0t} + \sum_{k=1}^{K} \beta_{kt} \ln X_{kt} \; ; \; t = 1,2,\ldots\ldots,T \tag{15}$$

20 The interpretation of this upward shift was given as an actual higher than average value of the input of the factor to get potential output or more efficient utilisation of the existing factor inputs, leading to a greater output or a combination of the two. See Reilly and Nolan (1979).

Where Y_t is the output at time t, X_{kt} is the level of k^{th} input at time t, β_{0t} is the intercept term at time t and β_{kt} is the actual response of the output to the method of application of the k^{th} input in the period t. Since it is a random coefficient model, each individual parameter vector, β_k varies from the mean vector $\bar{\beta}$, by a random error vt. More specifically, since the intercept and slope coefficients are varying acrosss years we can write,

$$\beta_{0t} = \bar{\beta}_0 + v_{0t}$$

$$\beta_{kt} = \bar{\beta}_k + v_{kt} \qquad (16)$$

Considering equation (15) and (16) together, the varying coefficient frontier production function can be written as:

$$\ln Yt = \bar{\beta}_0 + \sum_{k=1}^{K} \bar{\beta}_k \ln X_{kt} + (v_{0t} + \Sigma \ln X_{kt} v_{kt} k_t); \quad t = 1,2,\ldots\ldots,T \qquad (17)$$

Once these coefficients are estimated, let β^*_0, β^*_1, β^*_2,........, β^*_k be the estimates of parameters of the frontier production function yielding the maximum possible output. These are obtained from among the individual response coefficients, which vary across years as,

$$\beta^*_j = \text{Maxt}\{\beta_{jt}\} \qquad t= 1,2,3,\ldots\ldots,T$$
$$j= 0,1,2,,\ldots\ldots,K$$

Then the maximum possible output or the potential output for the t-th year can be estimated as:

$$\ln Y^*_t = \beta^*o + \Sigma\beta^*k \ln X_{kt} \qquad (18)$$

Where X_{kt} refers to the actual levels of inputs used in t^{th} year.

The production function method has the advantage that it takes directly into account the available production resources in the industry in estimating potential output. A relationship between actual output and inputs is estimated, and this relationship is then used to estimate the level of output corresponding to full utilisation of inputs.

2.2.6 Cost function approach

This approach to measure potential output is more of theoretical in nature compared to all other methods, realising that potential output and capacity utilisation are short run notions, conditional on the industry's stock of quasi-fixed inputs[21]. Consider a firm with a production function.

$$Y = f(V, X) \qquad (19)$$

Where Y is the level of output, V is an $n \times 1$ vector of variable inputs, and X is a $j \times 1$ vector of service flows from quasi fixed inputs. Then the firm faces the problem of maximising variable profits, i.e revenue minus variable costs, conditional on output price P, prices of the variable inputs P_v and X. Berndt and Morrison (1981), puts forth another alternative framework using the duality theory. In their formulation the optimisation problem facing the firm is that of minimising variable cost, conditional on Y, P_v and X. Thus, following the duality theory there exists a dual variable cost function,

$$VC = g(Y, P_v, X) \qquad (20)$$

where VC is the average variable cost. Now let P_x be the vector of prices for the quasi-fixed inputs, and define average total cost C as

$$C = VC + C_x \qquad (21)$$

where C_x is the average fixed cost; $C_x = P_x X$

21 Inputs fixed in the short run, but available at increasing marginal costs in the long run.

Now if we follow the economic definition of potential output (Y*), advocated by Cassel, Hickman, Klein etc. i.e. the output for which C is minimised,

$$Y^* = h\ (P_v, X, P_x) \qquad (22)$$

When there are long run constant returns to scale, Y* also represents a tangency between the long run and the short run average total cost curves.

SURVEY-BASED METHODS

Another way of compiling estimates of capacity utilisation is to survey the firms. There are two kinds of surveys, which are discussed below.

2.2.7 Type #1 surveys

Surveys of this kind collect information used to calculate utilisation rates. Here they ask the following kind of questions "at what percentage of manufacturing capacity did your company operate in (month and year)?"

Aside from the problem that the response rate might suffer if capacity were defined too precisely or made too complicated, respondents may not be able to interpret or answer the question[22]. In any event, any attempt to define capacity with complete precision is not really possible and soon encounters increasingly troublesome ambiguities.

2.2.8 Type # 2 surveys

Another type of survey yields estimates on the percentage of firms that are operating at full capacity. Usually they ask for a "yes" or "no" answer to the question like, " is your present level of output below capacity (i.e. are you working below a satisfactorily full rate of operation?)"

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22 For example, capacity defined in the least-average cost sense might require more information than a business actually records.

It has already been indicated that it is not always clear how businesses choose to define capacity when responding to survey questionnaires. Since the definition is often left to the respondent, it may be interpreted in the narrow, capital utilisation sense, or in the wider sense, that is, the extent to which all resources are utilised. More over, even when the questionnaire defines which of the two meanings is intended, the time horizon that businesses have in mind in evaluating their capacity also introduces uncertainty for interpretation. Since surveys cover only a sub sample of the population their estimates are subject to sampling errors too.

Concluding Remarks

In the above discussion we have examined different approaches behind defining and measuring capacity and utilisation. The two basic definitions put forward in the literature are the engineering definition which is defined in terms of a ceiling on production and the economic definition which gives enough space for the role of non-capital inputs and their prices in deciding potential. However, the review clearly indicates the inadequacy of engineering notion of capacity in analysing the economic behaviour of industries. In addition to all the ambiguities, the important conclusion we could derive is that capacity is only one short run restraint on output- namely, the restraint imposed by mainly the existing capital stock and further by the availability of non capital inputs. At the conceptual level each of these restraints is defined independently of the other; but in practice the various restraints may combine and interact in complicated ways. In measuring CU, full capacity has been variously defined as a minimum point on cost function, a full input point on aggregate production function and a ceiling on machine's production. Among the available measures, the production function method has the advantage that it takes directly into account the available production resources in the industry in estimating potential output. A relationship between actual output and inputs is estimated, and this relationship is then used to estimate the level of output corresponding to full utilisation of inputs. However, the principal problem, underlying the interpretation of most of the measures is that the crucial ink between underlying economic theory and these measures of CU is weak. All the measures except cost function fails in satisfying the economic theory behind CU, in terms of firms' optimising behaviour, while cost function estimates realises capacity at any time- an output variable- depends on the size of capital stock and level of input prices of productive resources. Keeping these theoretical and measurement issues in mind, let us move on to the measurement of capacity utilisation in Indian manufacturing in the next chapter.

Chapter III

ESTIMATING CAPACITY UTILISATION FOR INDIAN MANUFACTURING

This chapter deals with the estimation of the models, discussed in chapter two, in measuring capacity utilisation. More specifically, we estimate capacity utilisation based on (i) neo-classical cost function, (ii) Wharton index, (iii) minimum capital output ratio and (iv) installed capacity. The estimation is done at the aggregate and disaggregate level in order to understand the aggregation bias, if any.

The outline of the chapter is as follows. In the first section we explain the data and variables used. Section two explains the methodology used in the study. The results of empirical investigation is presented in the third section. In the final section a comparison of CU based on different measures is presented which is followed by conclusion.

I

3.1. DATA AND VARIABLES

The main sources of data for the study are the Annual Survey of Industries (ASI) and Chandhok (1990). The data on output, capital, labour, fuel and materials, required for the analysis are taken from different issues of ASI on 'Summary results for factory sector'[1]. The major attraction of the ASI source, collected by NSSO and processed by CSO, is that it provides consistent and detailed data set for many industrial characteristics at the disaggregate level in the manufacturing. However, the coverage is restricted to the

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1 A detailed account of ASI definitions is given in Appendix A3.1.

organised or registered sector only; therefore we are limiting the study to the registered sector of manufacturing. The common problems of any survey data relating to variations in response and therefore in coverage[2] are not corrected for our purpose by any means. In addition, the criterion for the classification of a factory in ASI is the value of its principal products. Sometimes, this results in shifts of factories from one industrial class to another in subsequent surveys and tends to affect the comparability of data over time. The selection of the period of analysis, viz. 1974-94, is largely due to the availability of data and is further guided by the significant policy changes that the industrial sector faced over this period.

The required price indices are collected from various issues on "Revised index number of whole sale prices in India" and "India: Database" complied by Chandhok (1990). A brief description of the variables used is given below.

Output: The output variable is obtained by deflating the gross value of output given in ASI by the whole sale price index (1981-2=100) of manufactured products. The same procedure is applied for the disaggregated analysis also. The choice of gross output measure overcomes the controversies on the method of calculation and the validity of separability assumptions[3] for the use of value added. But there is a trade-off between seperability assumption and double counting of the intermediate inputs in an aggregate analysis, which is unknown.

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2 For example there are significant differences in the data published by ASI and NAS, both for registered manufacturing sector. Ahluwalia (1985) gives some correction factors for adjusting these differences.

3 When we are taking Value added as a measure of output, we have to assume that material input is separable from primary inputs. See Balakrishnan and Pushpangadan (B-P, 1994, 1998), Pradhan and Barik (1998) for details.

Capital: Despite its crucial place in economic theory as an essential input in the production process, capital is the most difficult concept to deal with both in theory and measurement[4]. The commonly used and widely accepted method of measuring this composite commodity is the perpetual inventory method. In the case of Indian manufacturing, there are a number of studies where perpetual inventory method is adopted for capital measurement[5]. The merit of this method is that it is the addition to capital stock that is deflated, rather than the stock itself[6].

We, for the purpose of the present study, make use of the approach followed by Hashim and Dadi (1973, hereafter H-D). In this method we require an estimate of the capital stock for benchmark year and estimates of investment in constant prices in the subsequent years. While constructing an estimate of capital stock, one has to consider the fact that capital embodied in a particular asset goes on declining physically over time due to depreciation. However, in the context of Indian manufacturing, there are several issues in correcting the capital series for depreciation as pointed out by Goldar (1986). One problem is that the figures on depreciation given in the data sources do not adequately represent the actual capital consumption (Banerji, 1975). Apart from this measurement problem, there is a theoretical justification for the use of gross capital, especially in developing countries. Capital stock in less developed countries is often used at approximately constant level of

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4 Many researchers have discussed the problems facing in constructing a consistent series of capital stock, see for example, Robinson (1971), Kuh (1971), Harcourt and Laing (1971), Hashim and Dadi (1973), Goldar (1986), Jorgenson (1993) etc. To quote Robinson "...capital is not what capital is called, it is what its name is called. The capital goods in existence at a moment of time are all the goods in existence at that moment. It is not all the things in existence. It includes neither a rubbish heap nor Mont Blac. The characteristic by which 'goods' are specified is that they have value; that is, purchasing power over each other... The list of goods is quite specific. It is so many actual particular objects; called blast furnaces, over coats, etc. etc. Goods grouped under the same name differ from each other in details of their physical specification and there must not be overlooked. Differences in their ages are also important.... to express it as a quantity of goods we have to evaluate the item of which it is composed....."

5 For example, Hashim and Dadi (1973), Banerji (1975), Goldar (1986), B-P (1994).

6 Note that, in measuring capital input some of the Indian studies used published data directly without making any price corrections. See Goldar (1986) for a review.

efficiency for a period far beyond the accounting life measured by normal depreciation until it is eventually discarded or sold for scrap. In this connection, business firms incur a large amount of expenditure on repair and maintenance so as to keep the assets in good working condition. H-D argue similarly that, such expenditure should be treated as reinvestment since the main objective of such expenditures is to keep the productive capacity of capital assets more or less intact. As a result, they argue that there is no need to subtract depreciation from gross capital stock so as to correct for capital consumption. The present study estimates only gross capital. The procedure of estimation is explained below in detail.

ASI provides information about fixed capital of manufacturing by different categories, i.e., (i) land, (ii) building, (iii) improvements on land, (iv) plant and machinery (v) transport equipment (vi) other fixed assets and (vii) intangible assets. We have clubbed these groups into four major groups as (i) land and improvements on land, (ii) buildings and construction (iii) plant and machinery and (iv) other assets. In order to obtain the "gross" or "purchase value" of the written down value (depreciated book value, as reported in ASI) an appreciation of the reported figures is required. H-D, using about 1000 balance sheets of the firms covered by ASI and published by RBI, have estimated the ratio of purchase value to the book value, gross net ratio (GNR), for buildings and construction, plant and machinery and other assets separately. The book values of assets are then converted into gross value for the year 1960, using these ratios for the above said three groups[7] and assuming GNR for land as unity[8]. Thus the gross value of i^{th} category assets in a particular industry for 1960 is obtained as;

$$G_i^{60} = B_i^{60}(GNR_i)$$

7 For those industries where GNR is not given in H-D, we have considered the mere average of the nearest industries, nearest in the sense of product and process, and in some cases twice the book value, See B-P (1994).
8 See B-P (1994).

i = buildings & construction, plant & machinery and other assts.

G = gross value of fixed assets, and

B = depreciated book value of fixed assets.

For estimating the capital stock at the bench mark year, 1960, H-D provide the gross value of capital purchased during the period 1902-1945 and in each remaining years until 1960. This proportion is applied to the gross value of fixed capital in 1960 to obtain the year wise value of fixed capital bought in the past. To adjust for age structure, the estimate for each year is then inflated using the current to purchase price ratio given in H-D to obtain gross value of the fixed capital at replacement cost in 1960 prices. Converting this to 1981-2 prices and then adding investment (in 1981-2 prices) for subsequent years we get the series of capital stock for the succeeding years in 1981-2 prices. Following Banerji (1975), a perpetual inventory component is added to this benchmark estimate as shown below;

$$Kt = K_0 + \sum_{t=1}^{T} I_t ,$$

Where K_t is the capital stock in year t, K_0 is the benchmark year capital stock, and It is the gross investment in year t.

Gross investment is worked out as[9],

$$I_t = (B_t - B_{t-1} + D_t) / P_t$$

Where, B is the book value of fixed capital, D is the depreciation and P is the appropriate deflator[10] for capital assets.

---

9 See Banerji (1975)

10 Whole sale price index of machinery and machine tools with base 1981-2=100 is used

Capital cost: Capital costs are defined as the gross operating surplus after adjusting for emoluments and profits[11]. Specifically,

$$C_k = NVA + D - E - R$$

Where C_k denotes the capital cost, NVA denotes net value added (as given in ASI) , D denotes amount of depreciation, E denotes total emoluments and R denotes the profits.

Labour cost and wage rate: We need data on both labour cost and wage rate. Therefore, we take the value of total emoluments as the labour cost and the total emoluments divided by number of employees as the wage rate.

Price and total cost of fuel: The value of total fuel consumed is used. In order to derive the price variable for fuel, we construct a price index by combining price indices of different components of total fuel consumed by each of the selected industries using appropriate weights. The weights assigned[12] are taken from the Input Output Transaction Matrix, 1989-90.

Price and total cost of material: The value of total purchase of materials is used. For constructing the price variable we follow the same procedure as followed in the case of fuel.

11 See Berndt and wood (1975), Varshist (1984), Berndt and Hesse (1986)
12 These weights are given in appendix.

II

3.2 Methodology

3.2.1 The Cost Function Approach

When Klein originally advanced his explicitly short run notion of capacity utilisation, he expressed some reservations on practical difficulties in empirically estimating parameters of short run average cost curves. But his scepticism of measurement is to be evaluated from the point of view that at that time (1960) the modern theory of duality had not yet become widespread, nor had short run specification of firms temporary equilibrium been developed. Recently, along with the empirical cost and production function studies based on the modern theory of duality, researchers have begun to incorporate short run fixities of certain inputs, such as capital. In the present study we exploit this recent development in the specification of short run equilibrium, and employ the translog short run cost function or variable cost function, following Christenson and Greene (1976), Berndt and Hesse (1986) and Nelson (1989).

Assume the industry possess a smooth, well behaved production function,

$$Y = f(K, L, F, M) \qquad (1)$$

Where Y is the gross output, K is capital input, L is labour input, F is the fuel input and M is the material input. Allowing the stock of capital available to the industry to be a quasi fixed input, so that the industry attempts to minimise cost conditional to a given size of plant. Assuming that the industry minimises the variable cost of producing a given output, subject to a fixed stock of capital, K, then there exists a total variable cost function,

$$VC = f(P_i, Y, K) \qquad (2)$$

where P = input price, i =1,..,n

This cost function represents the minimum variable cost of producing a given output, conditional on a given set of input prices, P_i and plant size or capital stock, K.

The treatment of capital as a fixed input distinguishes short run cost function from long-run function in that while in the short run cost function the stock of capital appears on the right hand side of the equation, the price of capital appears as an explanatory variable in the long-run cost function. Moreover, the dependent variable in short run function is total variable cost while in long run function it is total cost.

Assuming a translog function, the approximation to the short run total variable cost function in (2) is

$$\ln VC = \alpha_o + \sum_{i=1}^{n} \alpha_i \ln P_i + 0.5 \sum_{i=1}^{n} \sum_{j=1}^{n} \alpha_{ij} \ln P_i \ln P_j + \beta_Y \ln Y + 0.5\, \beta_{YY} (\ln Y)^2 + \sum_{i=1}^{n} \beta_{Yi} \ln Y \ln P_i$$

$$+ \gamma_K \ln K + .5\, \gamma_{KK} (\ln K)^2 + \sum_{i=1}^{n} \gamma_{Ki} \ln K \ln P_i + \gamma_{KY} \ln K \ln Y \qquad (3)$$

Any well-behaved variable cost function must be homogenous of degree one in prices, for the translog this requires the parameter restrictions:

a) $\Sigma\alpha_i = 1$

b) $\Sigma\alpha_{ij} = \Sigma\alpha_{ji} = 0$

c) $\Sigma\beta_{Yi} = 0$ (4)

d) $\Sigma\gamma K_i = 0$

For the empirical implementation it is useful to employ additional equalities that reflect economic optimising behaviour. Using Shephard's lemma, the variable cost share equation is obtained by logarithmically differentiating (3) with respect to the exogenous variable, input price P_i, given K and Y[13].

$$\frac{\partial \ln VC}{\partial \ln P_i} = \alpha_i + \sum_{j=1}^{n} \alpha_{ij} \ln P_j + \beta_{Yi} \ln Y + \gamma_{Ki} \ln K = M_i \; ; i = 1,\dots,n \qquad (5)$$

Where M_i is the cost share of i^{th} input.

The above cost minimising share equation for variable inputs are exactly analogous to those obtained when one employs the traditional translog cost function under the assumption that all inputs are instantaneously adjustable, except that here the quantity of capital appears as a regressor instead of price of capital.

The economic measure of capacity output (Y*) and utilisation (CU ≡ Y/Y*) is defined in terms of short run average total cost (SRTC), not the total variable cost (VC). It is to be noted that the average total cost includes both average total variable cost and average total fixed cost, where the total fixed costs are defined as the expenditures on the fixed input, capital, i.e.

$$SRTC = VC + C_k \qquad (6)$$

where C_k is the cost of capital, subsequently

$$SRATC = (VC/Y) + (C_k /Y) \qquad (7)$$

---

13 Following Shephard's lemma, $\partial C/\partial P_i = X_i$; $\partial \ln C/\partial \ln P_i = P_i i X_i/C = M_i$, where Pi is the price of i-th input (X_i) and M_i is its cost share.

Now if the potential output Y = Y* is defined at the point where SRATC is minimised, then (∂ SRATC/∂ Y*) = 0, which in terms of (7) implies that

$$(1/Y^*)(\partial VC/\partial Y^*) - (VC/Y^{*2}) - (C_k/Y^{*2}) = 0 \quad (8)$$

Since $\partial \ln VC/\partial \ln Y^* = (\partial VC/\partial Y^*)(Y^*/VC)$, the required estimate of $\partial VC/\partial Y^*$ is $(\partial \ln VC/\partial \ln Y^*)(VC/Y^*)$, where

$$\frac{\partial \ln VC}{\partial \ln Y^*} = \beta_Y + \beta_{YY} \ln Y^* + \sum_{i=1}^{n} \beta_{Yi} \ln P_i + \gamma_{KY} \ln K = M_y \quad (9)$$

Then[14]

$$\frac{\partial VC}{\partial Y^*} = VC\ (My-1) - Ck = 0 \quad (10)$$

Where M_y and VC are functions of both ln Y* and Y*. Therefore, it is not possible to obtain an analytical or closed model solution for Y* in (10). Instead, numerical or iterative computational procedure must be employed. Then the estimate of CU will be the ratio of Y to Y*.

The above model gives a system of equations, i.e. n+1 equations, one variable cost function and 'n' share equations, providing a seemingly unrelated regression model that can be used to estimate the parameters. To make the model operational, we must impose the restrictions (4) and solve the problem of singularity of disturbance covariance matrix of the

14 Following (9), $(\partial VC)/(\partial Y^*) = My\ (VC/Y^*)$, substituting in (8) we obtain
$(1/Y^*)My(VC/Y^*) - (VC/Y^{*2}) - (Ck/Y^{*2}) = 0$
$= My(VC/Y^{*2}) - (VC/Y^{*2}) - (Ck/Y^{*2}) = 0$
$= (VC/Y^{*2})[My-1] - (Ck/Y^{*2}) = 0$
$= VC(My-1) - Ck = 0$

Table 3.1 SURE ESTIMATES OF TRANSLOG COST FUNCTION
AGGREGATE MANUFACTURING

Parameters	**Estimates**	
α_0	-0.068656	(-2.59)
α_F	0.072439	(29.16)
α_M	0.80762	(21.57)
α_{FF}	0.035448	(2.92)
α_{MM}	0.026041	(3.36)
α_{FM}	-0.004948	(-0.552)
β_Y	-2.7594	(-7.872)
β_{YY}	26.692	(7.488)
β_{YF}	0.019688	(0.927)
β_{YM}	-0.006727	(0.472)
γ_K	2.1214	(6.284)
γ_{KK}	23.838	(6.875)
γ_{KF}	0.011939	(0.574)
γ_{KM}	0.001742	(0.128)
γ_{KY}	-25.085	(-7.163)
Chi-square	120.6306	
DW (Variable Cost)	1.731	
DW (Share of Fuel)	1.932	
DW (Share of Materials)	1.6074	

Note: Asymptotic t-ratios are given in parentheses
DW = Durbin Watson statistic

A cost function is well behaved if it is concave in input prices and if its input share functions are positive. The translog function doesn't satisfy these restrictions globally[17], we have to confirm it at each observation. It is found that the estimated variable cost shares are positive at all observations, thereby satisfying the first order condition (or postitivity) globally. The second order condition is satisfied if the Hessian matrix based on the parameter estimates is negative semidefinite; we find that the concavity condition is also

17 A Cobb Douglas function may satisfy these conditions globally, however since the second order approximation is possible in a translog function, which is quadratic in log terms, we consider this function

satisfied at 90.48 per cent of the observations. Hence we may conclude that the estimated cost function represents well-behaved production structure.

Table 3.2
SURE ESTIMATES OF TRANSLOG COST FUNCTION: CAPITAL GOODS SECTOR

Coefficient	Parameter estimates		
	Non-electrical.	Electrical Mach.	Transport equip.
α_0	-0.1092 (-4.58)	-0.0390 (-2.98)	-0.0821 (-5.02)
α_F	0.0017 (1.098)	0.0326 (31.70)	0.0445 (33.16)
α_M	0.8145 (46.92)	0.8015 (254.8)	0.7626 (179.1)
α_{FF}	0.2869 (5.020)	0.0059 (1.723)	0.0078 (1.250)
α_{MM}	0.2874 (3.675)	0.0938 (5.005)	0.1209 (4.551)
α_{FM}	-0.2727 (-4.51)	-0.0147 (-2.41)	-0.0163 (-1.64)
β_Y	0.2092 (0.506)	0.5746 (6.077)	3.8723 (20.52)
β_{YY}	5.1192 (1.354)	-5.9405 (-8.66)	16.776 (14.06)
β_{YF}	-0.1786 (-1.74)	-0.0068 (-1.28)	-0.0224 (-3.38)
β_{YM}	0.1275 (1.256)	0.0528 (2.719)	0.1802 (8.396)
γ_K	-0.4982 (-1.16)	-1.1522 (-10.4)	-3.5419 (-19.1)
γ_{KK}	4.9703 (1.521)	-6.7952 (-8.33)	16.656 (14.38)
γ_{KF}	0.1371 (1.462)	0.00005 (1.009)	0.0212 (3.361)
γ_{KM}	-0.0436 (-2.47)	0.01045 (0.494)	-0.1498 (-7.43)
γ_{KY}	-5.0642 (13.05)	6.64890 (0.897)	-17.062 (-14.6)
Chi-square	54.6125	210.39	232.88
DW (VC)	1.86	1.94	1.48
DW (S F)	1.91	1.37	2.41
DW (SM)	1.77	2.19	1.56
R-Square (VC)	0.90	0.87	0.78
R-Square (SF)	0.84	0.43	0.84
R-Square (SM)	0.63	0.84	0.81

Note : VC= Variable Cost function, SF = Share of Fuel, SM= Share of Materials, DW= Durbin Watson Statistic.

In the case of capital goods sector also the high value of R-square, Chi-square and insignificant autocorrelation (as evident from the DW statistic) fits the model well. The first order conditions are satisfied in all industries at all observations while the second order is satisfied at 100 percent in non-electrical machinery, at 85.7 per cent in electrical machinery and 95.2 per cent in transport equipment.

As the estimated coefficients are significant and the function satisfies the conditions for a well behaved cost structure, we measure the output where the short run average total cost is minimised using the equation (11). As we already mentioned, since a closed form solution is not feasible, we used the iteration procedure for solving the equation for potential output. Then comparing this estimated optimal output with the actual output we get the economic capacity utilisation figures. The estimated CU figures together with the figures based on conventional measures, which are discussed in detail below, are given in table 3.3 and 3.4.

3.2.2 The Wharton Approach

Despite its theoretical limitations we estimate CU based on Wharton index also. For this purpose, first we have identified the major peaks over 1974-94 for each of the eighteen two digit industry groups which constitutes the aggregate manufacturing sector. Then using linear interpolation method we draw a line joining these major peaks and the points in this line which are corresponding to the actual production points are considered as the potential output. Using this estimated potential output series we estimate the time series of capacity utilisation figures for each of the individual industry. For the aggregate sector, a weighted average of these estimates are considered weights being the share of each industry in total output. Since the peaks may vary from industry to industry, at the aggregate level it is not necessary to get a 100 per cent utilisation level. The estimated CU figures are given in tables 3.3 and 3.4 for aggregate level and disaggregated level.

3.2.3 The Minimum Capital/Output ratio Approach

Among the two available measures in this approach, we use the one suggested by National Conference Board of US. For this purpose first we have worked out the capital output ratio in each of the two digit industry groups and then considered the year in which the ratio is minimum as the year where the utilisation is 100 per cent in each industry. Using this ratio we estimate CU for each industries separately as,

$CU = (Y/Y^c)$

$Y^c = (K)/\min.(C)$

Where $\min.(C) = \min.(K/Y)$

Then, a measure of aggregate CU is obtained by taking a output weighted average of each of these individual industries. The results so obtained are presented in tables 3.3 and 3.4, both for aggregate sector and disaggregated capital good sector respectively.

3.2.4 Installed Capacity Utilisation

The installed capacity figures were drawn from Burange (1990) which are based on Monthly Statistics of Production (MSP) data. These figures are available only upto 1986-7which are presented along with the other measures in tables 3.3 and 3.4.

III

3.3 COMPARISON OF DIFFERENT ESTIMATES

a) Aggregate Analysis

The results based on different measures for aggregate manufacturing are given in table 3.3. The table gives very interesting issues that warrant discussion. First, in almost all years capacity utilisation estimates using the cost function exceed the traditional engineering approach (or installed capacity)[18], pointing that the engineering measures of capacity

18 See Nelson (1989).

utilisation significantly understate the more relevant economic capacity utilisation. This difference may mainly be due to the inclusion of input prices. As different from engineering notion, in economics, when we consider input prices along with capital, the volume, intensity and cost of these inputs affect the "capacity". Even if an engineer views that a machine can produce a certain amount of output, the price of other inputs, depending on the substitutability/complementarily, may restrict its production ability by affecting unit cost of production.

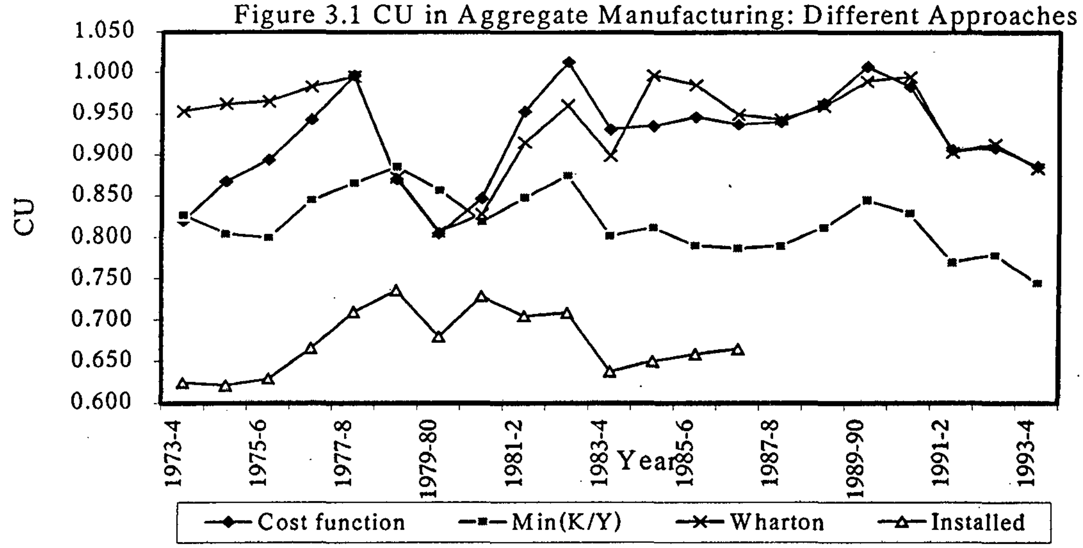
Table 3.3 CAPACITY UTILISATION IN AGGREGATE MANUFACTURING 1974-94: DIFFERENT APPROACHES

Year	Cost function	Min K/Y ratio*	Installed capacity+	Wharton *
1973-4	0.821	0.828	0.624	0.954
1974-5	0.868	0.805	0.621	0.962
1975-6	0.894	0.801	0.629	0.965
1976-7	0.943	0.846	0.665	0.983
1977-8	0.997	0.866	0.710	0.996
1978-9	0.871	0.886	0.736	0.873
1979-80	0.806	0.857	0.680	0.807
1980-1	0.847	0.820	0.729	0.829
1981-2	0.954	0.848	0.705	0.916
1982-3	1.014	0.875	0.709	0.961
1983-4	0.932	0.803	0.638	0.900
1984-5	0.936	0.812	0.651	0.997
1985-6	0.947	0.791	0.658	0.985
1986-7	0.938	0.788	0.665	0.950
1987-8	0.941	0.791		0.944
1988-9	0.963	0.812		0.960
1989-90	1.008	0.845		0.990
1990-1	0.984	0.830		0.995
1991-2	0.906	0.771		0.904
1992-3	0.909	0.779		0.914
1993-4	0.886	0.745		0.884

Note: * These are the output weighted average for 2-digit industries

Source: + Burange (1990) and others estimated as described in the text.

Figure 3.1 CU in Aggregate Manufacturing: Different Approaches



It is obvious from the Figure 3.1 that there exists wide gap between different measures. The simple correlation between the economic measure and other measures are; 0.683 with Wharton indices, 0.17 with capital output ratio measure and 0.106 with installed capacity utilisation respectively. The least correlation of installed capacity utilisation and minimum capital output ratio is not amazing. The potential output in the economic definition is largely affected by the changes in input prices which is not the case with the engineering definition, where we consider only the capital input. It is to be noted that in both engineering and economic measures we are comparing the same actual production with different levels of potential output and therefore apart from the differences in levels of utilisation there will be differences in the movements also. However, CU in 1979-80 was particularly low, irrespective of the methodology used; all the estimates show a turn around after 1980. While all the traditional measures of CU give an utilisation ratio of less than or equal to unity, the economic measures of CU are closer to unity and span both sides of unity[19]. Another interesting observation is that all the measures give a high level of utilisation compared to the installed capacity utilisation. This strengthens the argument, discussed in the initial chapter, that the installed capacity figures in India give highly exaggerated picture of actual capacity, mainly due to the reporting errors regarding single/multiple shift operation and the definition of capacity that differ from firm to firm.

b) Disaggregate Analysis: Capital Goods

From the figure 3.2 it is obvious that in most years, disregarding the systematic differences in the level, the direction of movement of all the measures was more or less the same in the case of capital goods except in the case of installed capacity figures which show an entirely different movement. The simple correlation between economic measure and conventional measure are respectively, 0.635 with Wharton index, 0.911 with capital output ratio, and -0.236 with installed capacity utilisation. However, when we consider the individual industries in separate, the picture is different. There are wide differences among these measures from industry to industry (see table 3.4 and 3.5). While capital output ratio measure show high correlation with economic measure in all the three industries, installed CU and Wharton show the same only in non-electrical machinery.

19 Capacity utilisation defined in terms of optimal output or cost minimising output can be greater than, equal to or less than unity. This contrast with all of other CU measures, which are typically less than or equal to one.

Table: 3.4 CAPACITY UTILISATION IN CAPITAL GOODS INDUSTRY

	Non-electrical machinery				Electrical Machinery			
Year	Cost	Min.K/Y	Installed	Wharton	cost	Min.K/Y	Installed	Wharton
1973-4	0.834	0.865	0.442	0.953	1.004	0.866	0.587	1.000
1974-5	0.875	0.915	0.496	1.000	0.772	0.695	0.579	0.833
1975-6	0.823	0.859	0.535	0.921	0.833	0.748	0.599	0.856
1976-7	0.925	0.965	0.576	1.000	0.943	0.843	0.657	0.928
1977-8	0.933	0.972	0.729	1.000	0.952	0.856	0.636	0.910
1978-9	0.962	1.000	0.710	1.000	0.957	0.866	0.754	0.883
1979-80	0.925	0.962	0.750	0.971	0.962	0.879	0.726	0.881
1980-1	0.951	0.993	0.808	0.983	1.045	0.955	0.594	0.930
1981-2	0.936	0.979	0.835	0.983	1.003	0.925	0.581	0.865
1982-3	0.937	0.982	0.835	0.996	1.079	1.000	0.594	1.000
1983-4	0.896	0.938	0.6972	1.000	0.939	0.886	0.5378	0.870
1984-5	0.880	0.938	0.7022	0.993	0.961	0.914	0.6087	0.882
1985-6	0.854	0.887	0.569	1.000	0.936	0.900	0.6162	0.839
1986-7	0.839	0.876	0.612	0.923	0.920	0.892	0.618	0.803
1987-8	0.895	0.940		0.998	0.982	0.960		0.899
1988-9	0.844	0.881		0.954	0.936	0.938		0.905
1989-90	0.911	0.945		1.000	0.991	0.995		0.935
1990-1	0.897	0.929		0.998	0.952	0.972		1.000
1991-2	0.811	0.842		0.906	0.857	0.890		0.947
1992-3	0.755	0.781		0.900	0.847	0.894		1.000
1993-4	0.771	0.801		0.887	0.741	0.798		0.918

Contd..

Table 3.4 concld...

	Transport equipment				Capital goods			
Year	Cost	Min.K/Y	Installed	Wharton	Cost	Min.K/Y	Installed	Wharton
1973-4	1.090	1.000	0.581	1.000	0.980	0.912	0.480	0.985
1974-5	0.977	0.906	0.570	0.894	0.874	0.840	0.503	0.911
1975-6	0.908	0.848	0.527	0.809	0.852	0.817	0.521	0.865
1976-7	0.995	0.923	0.592	0.877	0.952	0.911	0.562	0.939
1977-8	0.968	0.900	0.769	0.831	0.950	0.911	0.702	0.921
1978-9	0.810	0.771	0.767	0.891	0.914	0.885	0.727	0.927
1979-80	0.810	0.770	0.733	0.883	0.901	0.872	0.739	0.912
1980-1	0.824	0.783	0.848	0.874	0.942	0.913	0.781	0.930
1981-2	0.865	0.819	0.847	0.907	0.933	0.908	0.788	0.920
1982-3	0.879	0.833	0.802	0.918	0.965	0.938	0.792	0.971
1983-4	0.855	0.814	0.785	0.883	0.896	0.881	0.690	0.920
1984-5	0.850	0.812	0.796	1.000	0.896	0.888	0.711	0.960
1985-6	0.795	0.764	0.640	0.902	0.861	0.851	0.596	0.916
1986-7	0.851	0.813	0.637	0.930	0.869	0.859	0.623	0.886
1987-8	0.848	0.813		0.908	0.910	0.905		0.934
1988-9	0.945	0.896		0.974	0.911	0.907		0.943
1989-90	0.970	0.920		0.954	0.959	0.954		0.962
1990-1	1.017	0.962		1.000	0.957	0.955		0.999
1991-2	0.835	0.806		0.839	0.835	0.849		0.900
1992-3	0.926	0.885		0.934	0.845	0.856		0.948
1993-4	0.967	0.921		0.965	0.828	0.842		0.925

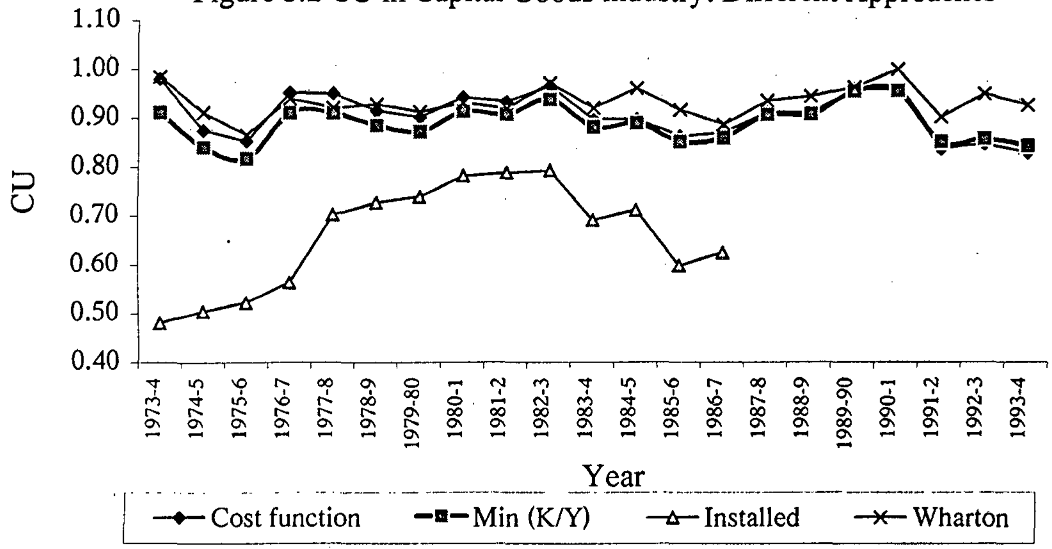
Table 3.5

SIMPLE CORRELATION OF CONVENTIONAL MEASURES WITH ECONOMIC MEASURE OF CU

	All Mfg.	Non Elect	Elect. Mach	Transport	Capital goods
Min(K/Y) ratio	0.170	0.995*	0.769*	0.987*	0.911*
Installed CU	0.106	0.663*	0.831*	0.460	-0.236
Wharton Indices	0.683*	0.840*	0.261	0.392	0.635*

Note: * Significant

Figure 3.2 CU in Capital Goods industry: Different Approaches



If we consider these results at aggregate and disaggregate level together it is seen that the high correlation between capital output ratio measure and economic capacity utilisation that existed in the case of capital goods industry is not found in case of aggregate manufacturing. At the same time the correlation between the latter and Wharton indices maintained even at the disaggregated level when the capital goods sector is taken as a whole. Since the Wharton measure is a frontier in the sense that it is the trend line drawn through the attained peaks, it might have resemblance with the cost function estimates which is the minimum point on the variable cost. However it is also subject to wide difference when examined at each of the three components of capital goods sector (table 3.5), showing the sensitivity of the measure. Apart from the linear correlation we have worked out correlation of log series as well as de-trended series. These results also show the same trend without much differences ruling out the possibility of spurious correlation. These results are reported in appendix 3.2. In short, while the correlation between economic measures and capital output ratio are very high in case of capital goods sector as a whole and each of the components, it is very small in case of aggregate manufacturing and while the correlation between the former and Wharton index is very high in case of aggregate sector and capital goods sector as a whole it is very low in both electrical machinery and transport equipment. Therefore the choice of any particular measure of CU may have serious influences on the conclusions to be drawn from these figures.

The movement of capital utilisation and economic CU can be related theoretically. When the unit cost of production, influenced by variable input prices, is very high the firms fails to achieve its potential, at the same time as a result of the reduction in the use of non capital inputs that are required for utilisation of capital, reduction in capital utilisation also occur[20].

Summing Up

In this chapter we have presented the estimated coefficients of translog cost function and the capacity utilisation figures based both on economic and conventional measures. A comparison of economic CU with that of Wharton, minimum capital output ratio and installed capacity utilisation figures show that even if there are some resemblance in the movements of some of the conventional measures with that of economic measure at the aggregate (disaggregate) level it doesn't show the same pattern at disaggregate (aggregate) level. This implies that the measures are highly sensitive, suggesting that one must be careful in deriving conclusions out of these measures. And this also hints that there is an aggregation bias in these measures which is to be dealt cautiously. This significant divergence of conventional measures from economic measures creates ambiguity in relying on a particular measure on CU. However, the power of economic measure in indicating the

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20 Note that the physical plant can be utilised fully only if the variable inputs are sufficiently employed, which may be affected, largely, by the input prices. Capital alone can't produce.

optimal output movements is justified in the sense that it reflects the effect of capital, along with the price movements of non-capital inputs. Therefore, considering the relative lack of theoretical support to the conventional measures we rely on the economic measures. Thus, for theoretical and empirical relevance we are trying to analyse the trends in economic CU and its major determinants at the aggregate level. As the differences in the movements of CU at aggregate and disaggregate level strengthen the importance of the analysis of CU at more disaggregated level we are analysing them at disaggregate level also in the next chapter.

Chapter IV

CAPACITY UTILISATION: ANALYSING THE TRENDS

This chapter analyses the trends in capacity utilisation, defined in terms of firm's short run cost minimising behaviour, for the aggregate manufacturing sector as well as the disaggregated capital goods sector during the period 1974-94. The chapter is organised in three sections. In the first section, we analyse the trends in CU both at aggregate and disaggregate level separately. In the second section the relationship between CU and the growth of output is examined. The third section sums up the findings.

I

4.1 TRENDS IN CAPACITY UTILISATION

4.1.1 Aggregate Manufacturing

In this section we examine the trends in economic capacity utilisation in the aggregate manufacturing sector. From Figure 4.1, we observe three distinct phases in the movements of CU. Phase one, from 1973-4 to 1983-4 , is characterised by relatively high fluctuations. In phase two, covering the period from 1983-4 to 1989-90, CU is stable with very little fluctuations. And, phase three, 1990-1 to 1993-4, witnessed a steady decline in the CU. However, the variations over the years are in accordance with the ups and downs in the growth of the economy. It is seen that the variation in the growth of gross domestic expenditure and the level of investment in the manufacturing sector are also relatively high during the first phase (Table 4.2). From the Table 4.1 it is seen that CU is the highest in the sub period 1985-90, which is characterised by a partially liberalised regime. This high performance may primarily due to the rise in real income of the middle income categories in the organised work force, creating more demand, which was a direct result of government's fiscal and industrial policies[1]. At the same time, the full liberalisation period

1 See Kelker and Kumar (1990).

1991-94, shows a reduction in utilisation compared to the earlier periods, indicating that liberalised regime did not bring about a higher level of utilisation. Let us examine the fluctuations over the years in detail.

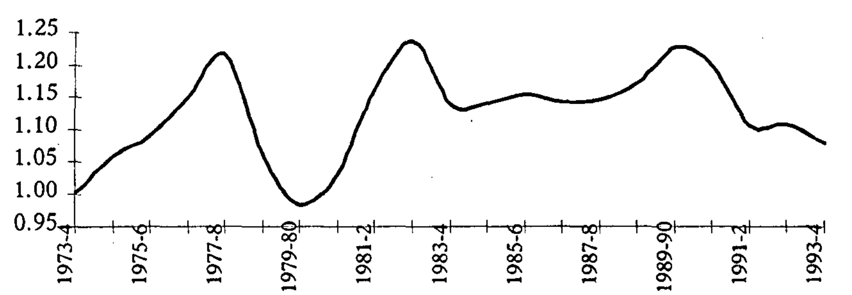
Table 4.1
AVERAGE UTILISATION OF ECONOMIC CAPACITY:
AGGREGATE MANUFACTURING, 1974-94

Period	Average Utilisation	C. V	Average % Growth rates	C.V
1974-94	0.922			
1974-84	0.904	7.6	1.57	512.02
1985-90	0.955	2.8	1.33	147.13
1991-94	0.921	5.7	-1.56	-292.17

Note: CV denotes coefficient of variation.
Source: Table 3.3

During the entire period, the CU peaks were attained in the years 1977-8, 1982-3 and 1989-90, while it was particularly low in the years 1973-4, and 1979-80 (Figure 4.1). The low rate of utilisation in 1973-4 can largely be attributed to the first energy price shock; the whole sale price index of petrol has shown an increase of more than 45 per cent during this period (i.e. from 121.6 in 1972-3 to 178.6 in 1973-4).

Figure 4.1 Indices of Capacity Utilisation in Aggregate Manufacturing :1973-4=100



However, CU showed an increasing trend from 1973-4 to 1977-8, following a considerable increase in the domestic demand Firms have to produce more with the given level of fixed input in order to meet the market demand, which, in turn, stimulated CU. The gross domestic expenditure during this period registered an average growth rate of 4.8 per cent per annum. The potential output grew at a constant rate of about 6 per cent during this period, which was lower than the growth of output. The significant increase in the growth of demand in 1977-8 induced firms to utilise more of their capacity, resulting in an over utilisation. In addition, the rate of growth of capacity remained stagnant in 1976-7 and 1977-8 resulting from the decline in investment in 1976-7 by 30 per cent.

Table 4.2 GROWTH OF GFCF AN GDE (1980-1 PRICES)
PERCENT INCREASE OVER PREVIOUS YEAR

Year	GFCF	GDE
1973-4	-5.74	3.0
1974-5	18.8	1.2
1975-6	60.8	9.2
1976-7	-30.1	1.8
1977-8	9.16	7.2
1978-9	32.9	5.8
1979-80	-23.3	-5.2
1980-1	6.7	6.6
1981-2	25.9	6.5
1982-3	-3.1	3.8
1983-4	27.1	7.4
1984-5	2.2	3.7
1985-6	5.4	5.5
1986-7	-6.7	4.9
1987-8	23.8	4.8
1988-9	-1.6	9.9
1989-90	9.7	6.6
1990-1	20.7	5.6
1991-2	6.48	0.4
1992-3	13.3	5.4
1993-4	16.3	4.8
Averages		
1974-84	10.8 (242.0)	4.3 (93.7)
1985-90	5.4 (194.1)	5.9 (36.9)
1991-94	14.2 (42.01)	4.05 (60.1)

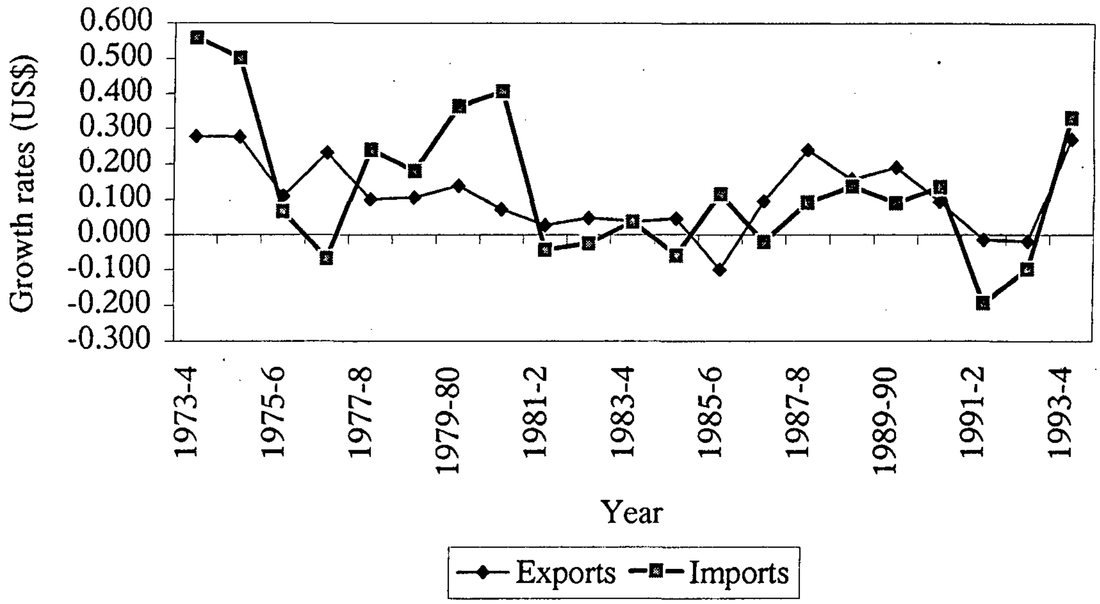
Note: GFCF = Gross Fixed Capital Formation in registered manufacturing
GDE = Gross Domestic Expenditure
Figures in brackets are coefficient of variation
Source: National Accounts Statistics.

After the peak growth of CU in 1977-8, it shows a declining trend in 1978-9 and 1979-80. The expansion of investment in 1978-9 by 33 per cent resulted in an expansion of capacity. However, due to the decline in demand, firms could not utilise it. The high demand and high utilisation in 1977-8 might have induced firms to expand their capacity, as reflected in the hike in investment in 1978-9, suggesting that firms failed to anticipate future demand. This together with the impact of second and third oil shocks and attendant reduction in aggregate demand resulted in a drop in utilisation. The Wholesale Price Index of fuel increased by 16 per cent in 1979-80 and further by 14 per cent in 1980-1 following the increase in the price of petrol and natural gas by about 71 per cent in 1979-80 and by 47 per cent in 1980-1. Gross domestic expenditure declined by 5 per cent 1979-80, reflecting a shortage of aggregate demand. Following the decline in utilisation in 1978-9 investment declined considerably by 23 per cent in 1979-80 and registered a negligible growth rate in 1980-1, resulting in a reduction in the growth of potential. However due to the stagnation in domestic demand and exports, together with a hike in the growth of imports, firms failed to utilise their capacity. Increased exports affect CU favourably in that it creates more demand and, thereby, allows firms to utilise more of their capacity; whereas import of manufactured products may hinder utilisation because it reduces the domestic demand for domestically produced goods[1]. It should be noted, however, that since the export/import intensity of Indian industry is negligible compared to that of domestic demand these factors have very little impact on utilisation. However, it may have significant impact on utilisation in years when there are considerable changes in these factors to alter aggregate demand. During the same period material price indices also show a dramatic increase accompanied by the increase in oil price; it increased by about 33 per cent over the same period. The input prices affected CU in that it resulted in an increase in the output prices and thereby affected demand[2]. The stagnant infrastructural investment during 1978-80 might have also affected CU. Investment in infrastructure will increase the marginal productivity of investments in other projects, thereby stimulating better utilisation. The decline in agricultural real wages[3] during this period, which is identified as a period of stagnant demand

1 Note, however, there are arguments that increased imports can affect utilisation positively also in the sense that it will provide better inputs and technology.
2 Output price increased by 17 per cent in 1980 and further by 13 per cent in 81.
3 See Anadraj (1996).

for manufactured products[4], accompanied by a reduction in the agricultural GDP by 14 per cent in 1980[5] also might have contributed to the drop in CU by reducing the demand for

Figure 4.2 Growth of Total Exports and Imports



industrial products from the agricultural sector.

The period 1980-83 has clearly marked by a significant acceleration in utilisation, even the sector has over utilised its capacity in 1982-3 suggesting a current deficiency of capacity. This was the period in which the mostly debated turn around in Indian industry occurred. During this period the gross domestic expenditure maintained somehow a stable growth rate, registering an average of 5.6 per cent per annum, with an increase in agricultural production by 16 per cent in 1980-1 and by 6 per cent in 1981-2, infrastructural investment by 13 per cent in 1980-1, by 25 per cent in 1981-2 and 1982-3. The increase in the agricultural production stimulated utilisation through its linkage to the industrial sector. The high linkage of agricultural sector to the industrial sector in India is well documented: the linkage works through many ways - important ones are the creation of demand for industrial products and the provision of wage good. Specifically, as Anandraj (1996) clearly pointed the cyclicality in the agricultural growth can, through consequential changes in the

4 See Krishnaji (1984).
5 In 1980-1 prices, National Accounts Statistics, CSO.

pattern of effective demand, cause cyclicality in industrial growth. In addition, the policy reforms during this period that intended to regularise the excess plant capacity installed over and above the licensed capacity, also helped improving CU. All these might have resulted in conducive supply side and demand side factors that helped to raise the level of utilisation and, thereby, to achieve high output growth.

After a decline by about 8 per cent in 1983-4, CU maintained a stable level up to 1989-90, registering a high utilisation. During this period, domestic demand registered an average growth rate of 6.1 per cent with slight increase in export and considerable decline in import accompanied by a continuos increase in the growth of infrastructural investment. It is to be noted that in 1984-5, the process of liberalisation only moderately started and the industrial licensing was further liberalised in 1987-8. At the same time, to encourage production and to provide flexibility to manufactures to adjust their product mix to market demand, the concept of broad banding was introduced. However, showing an insignificant response to these changes, CU remained stable largely because of the stable demand in the economy.

In the third phase, i.e. in the nineties, the CU figures show a small declining trend. Nineties is the period when the sector experiences serious structural changes. Despite the argument that an open atmosphere would stimulate better utilisation, the response of the sector was much unsatisfactory. The reduction in utilisation during this period was a result of mixed factors. The new policy environment of the 1990's was expected to bring new dimensions to the oligopolistic structure of the industrial sector. As the market structure gradually move towards competition, industries were expected to experience entry of new firms. The overall industrial capacity expanded registering an average rate of growth of 8 per cent, resulting from the significant hike in investment after the nineties.

Table 4.3 OVERALL LEVELS OF CONCENTRATION: AGGREGATE MANUFACTURING

Year	Average level of concentration	Average	
1987-8	67.54		
1989-90	68.09		
1990-1	70.04	1987-91	68.56
1991-2	69.59		
1992-3	70.59		
1993-4	68.71	1992-94	69.30

Source: Mani (1998)

However, it is shown that though the entry barriers were lowered through liberalisation of the licensing system, majority of the manufacturing firms were remained concentrated as ever before [7]. It is found that there was no indication of a decline in concentration levels, rather it registered a marginal increase from 68.5 to 69.3 (Table 4.3). Thus, these stable levels of market share may imply that the degree of competition does not necessarily increase with liberal policy[8].

The recent theoretical works[9] in industrial organisation allude to the possibility that excess capacity may be used as a strategy for deterring entry[10]. As the policy envisaged free entry, the existing firms might have expanded their capacity in order to threaten new entry, as well as to give a signal to a new entrant that there is deficiency of demand in the market. The lack of increase in competition hints to the possibility that firms might have kept unutilised capacity to deter entry in the new liberalised regime.

Table: 4.4 ACTUAL FDI INFLOW TO INDIA, 1992-94

Year	Actual gross inflow	Outflows	Actual Net inflow
1991-2	147	18	129
1992-3	345	30	315
1993-4	651	65	586

Note: in million US dollars
Source: Mani (1998)

Moreover, the increased inflow of FDI to the country, resulting in an expansion of total capacity, without considerable improvement in the growth of domestic demand as well as in growth of exports (exports registered a negative growth rate in 1991-2 and 1992-3) resulted in keeping part of capacity idle. The actual FDI inflow to the country increased by about 350 per cent during 1992-94.

7 Mani (1998).

8 However, as entry restrictions eased, the possibility of emerging new modes of entry such as; consolidation of units through mergers and amalgamations especially of the horozontal type couldn't be undermined. Depite the fact that there are no official source on mergers and take-overs, it is found that there have been 121 mergers and take-overs during the period 1988-92. See Parikh, et al. (1997).

9 Dixit (1980), Liberman (1987).

10 Though, it was argued that in India the existence of excess capacity did not deter entry as the protected environment offered adequate profit opportunities for those who could obtain a license to enter (Bagwati and Srinivasan-1975), this may hold true in the new changing policy environment.

Table 4.5
AVERAGE GROWTH RATES OF OUTPUT AND CAPACITY

Year	Actual Output	Potential Output
74-94	7.2	6.8
74-84	7.2	6.4
85-90	8.3	7.2
91-94	5.6	7.8

Note: Potential is estimated using the cost function as explained in chapter 3.

These changes, together with firms' anticipatory expectations in the liberalised atmosphere on future export demand, resulted in an expansion of capacity, which is not utilised fully. Evidently the growth of potential output or capacity output is rapid after 1989-90 compared to the growth of actual output, which ultimately resulted in a decline in utilisation (see Table 4.5). All these factors together with a stagnant investment in infrastructure and the general recession in the economy resulted in a lower level of utilisation. This indicates that firms might have created/expanded capacity for strategic reasons/anticipatory expectations[11]. This confirms our hypothesis that a liberalised regime need not necessarily be associated with a high level of utilisation, rather CU is a rational outcome of the firms' strategic movements and expectations on future demand, depending on the market fluctuations.

4.1.2 Trends in CU in Capital Goods Sector

In the case of capital goods, we see wide fluctuations over years (Figure 4.3). However, there are differences in the movements of CU compared to that of aggregate manufacturing. The sector registered the least utilisation in 1993-4, while in 1973-4 it was the highest. The average utilisation in the sector was higher during 1974-84, while it was during 1985-90 in the case of aggregate manufacturing. It came down marginally by 2 per cent during 1985-90 and further by 4 per cent during 1991-94. Both non-electrical machinery and electrical machinery sectors followed the same pattern while transport equipment sector exhibits the higher rate of utilisation during 1991-94.

11 Therefore, it needs further detailed analysis giving consideration to firm specific strategic behaviour, oligopolistic changes in the sector and anticipatory expectations on demand and prices, which is beyond the scope of our study. See Morrison (1985).

Table: 4.6 AVERAGE UTILISATION OF ECONOMIC CAPACITY :CAPITAL GOODS INDUSTRY

Industry ⇒ Period ⇓	Non Electrical Machinery	Electrical Machinery	Transport Equipment	Capital Goods *
1974-94	0.879	0.934	0.904	0.906
1974-84	0.909 (5.10)	0.954 (9.21)	0.907 (9.92)	0.923 (4.30)
1985-90	0.870 (3.38)	0.954 (2.96)	0.877 (7.57)	0.901 (3.91)
1991-94	0.808 (8.64)	0.849 (11.15)	0.936 (7.26)	0.866 (7.58)

Note: * denotes output weighted average for capital goods.
Figures in parentheses are coefficients of variation
Estimated using the figures given in table 3.4

Following the liberal policy reforms since 1985, the duties on project imports were reduced from 65 to 45 per cent. Even though, considering its adverse effect on domestic manufactures, it was raised by 10 per cent in 1986, given the aggressive strategy adopted by foreign manufactures of capital goods it was proved in adequate. The foreign manufactures of capital goods, which were saddled with excess capacity as a result of the international recession, resorted to selling their equipment by providing liberal credit facilities[12]. The impact was adverse for domestic producers who could not provide these attractive schemes and thereby forced to cut down production resulting in a decline in utilisation after 1984-5. This also resulted in an increase in the share of imported equipment purchased by domestic producers that affected domestic production adversely. The import of capital goods as a percentage of net availability increased from 14.7 per cent in 1984-5 to 22 per cent in 1993-4 (Table 4.7).

Table: 4.7 SHARE OF IMPORTS IN NET AVILABILITY OF CAPITAL GOODS

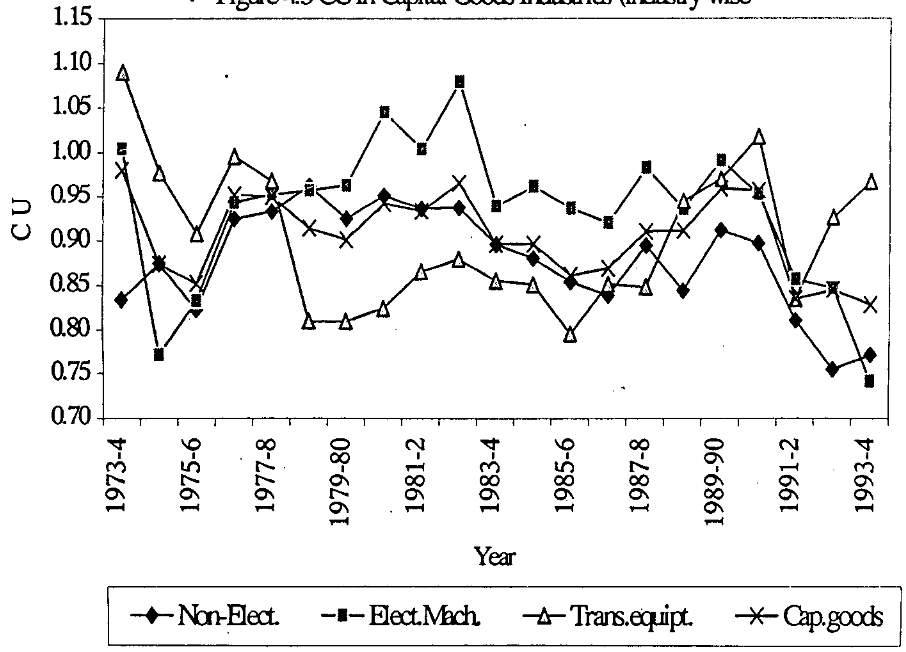
Year	Imports(M)	Exports(X)	Net availability(N)	M as a % of N
1973-4	652	118	3851	16.93
1979-80	1368	449	9712	14.10
1986-7	6279	836	29934	20.97
1993-4	18575	4940	82310	22.56

Note: Net availability is calculated as, Domestic Production of capital goods plus Imports minus exports

Source: RBI, Report on currency and finance, vol. II, various issues.

12.See Chandrashekhar (1992)

Figure 4.3 CU in Capital Goods Industries (industry wise



In 1990, the government further allowed importing of 30 per cent of plant and machinery required, and foreign investment upto 40 per cent of equity on automatic basis, which also created stagnation in demand for domestically produced capital goods. Further, in 1991 industrial licensing was more or less fully abolished for all industries, except those for strategic and social reasons, and automatic clearance for import of capital goods was provided. Moreover, the average growth rate of exports in capital goods declined during 1991-94 as compared to that of earlier periods, implying that the openness of the economy did not help much in improving export and thereby affecting aggregate demand for capital goods and capacity utilisation. This together with a decline in domestic demand for capital goods, as evident from the net fixed capital formation (NFCF)[13], in 1991-2 and further

13 Here we assume that the demand for capital goods comes mainly from the investment in the economy. In other words the variations in the net capital formation in the economy reflects the variations in the demand for capital goods.

decline in the growth in 1993-4 accompanied by an increase in the average rate of growth of imports during 1991-94. All these contributed to the marginal drop in CU in capital goods sector.

Table: 4.8
AVERAGE GROWTH RATES OF EXPORTS AND IMPORTS

Period	Exports	Imports
1974-94	14.7	11.3
1974-84	17.0	14.9
1985-90	15.4	7.7
1991-94	7.5	6.5

Note: Simple average growth rates
Source: RBI Report on currency and finance, vol. II, various issues

Interestingly after liberalisation, as it is observed in the case of aggregate manufacturing, the average level of concentration in capital goods industry also does not show any significant divergence from that of earlier periods. Contradictory to the argument that liberalisation will bring forth more domestic competition, concentration ratio has shown a marginal increase, implying absence of any improvements in competition[14].

Table: 4.9 AVERAGE THREE FIRM CONCENTRATION: CAPITAL GOODS

Year	Concentration ratio
1988	74.72
1990	76.11
1991	79.27
1992	79.06
1993	80.54
1994	79.92

Source: Mani (1998)

After having an overall idea of the movements of CU in the aggregate capital goods sector, let us examine separately each of the three components of the sector, viz. non-electrical machinery, electrical machinery and transport equipment.

14 The argument is that CU will be more in a more competitive environment as they are operating at a competitive price; P=MC=AC=MR. However, it is countered by the entry deterrence arguments, see for example, Liberaman (1987).

4.1.2.1 Non-electrical machinery

The non-electrical machinery sector had the highest utilisation in 1978-9 and the least in 1992-3. The sector shows the least average utilisation during 1991-94, while it was the highest during 1974-84. During the period 1974-79, the trend was to increase capacity utilisation; except for the slight decline in 1975-6 by about 5 per cent. This phenomenon of CU in 1975-6 can be gauged through the performance of exports and imports. Export of the sector has registered a decline in growth rate by more than fifty per cent while import has increased by 30 per cent. This together with a stable domestic demand resulted in a drop in CU in 1975-6. Besides this, it is seen that throughout the period exports have been increasing, resulting in a hike in the utilisation during 1974-79. Moreover, the domestic demand increased considerably over the years, which resulted in an increase in CU over time (see Table 4.10). The highest utilisation in 1978-9 is accompanied by the high growth of export in this sector together with considerable increase in net fixed capital formation in the country. In this year exports of non-electrical machinery increased by 38 per cent over the previous year. The decline in the growth of potential output along with the maintenance of the same growth rate of output as that of previous year in order to meet the increased demand-domestic and external-also helped in raising utilisation. While the potential has grown only by 3.5 per cent compared to 6.6 per cent in the previous year, output remained at 7 per cent, as in the previous year (See appendix Table A 4.1).

CU has dropped by 4 per cent in 1979-80, with a decline in the NFCF by 19 per cent. Further, the reduction in public investment during eighties[15], also might have contributed to reduction in demand and thereby CU. The infrastructural investment in the economy that declined by 3 per cent in 1978-9 continued to be stagnant in 1979-80 (see Table 4.10). Apart from boosting the efficiency of investment in other projects, investment in infrastructure by its very nature creates direct demand

15 See Ahluwalia (1985)

for capital goods, and public sector being the major player during this period, the changes in its activities should have immediate impact on the sector as a whole.

Table:4.10 GROWTH OF INVESTMENT IN THE ECONOMY: 1974-94

Year	NFCF	Investment in infrastructure			
		Railway	Electricity	Mining	Total
1973-4	43.9	-3.8	-34.7	34.7	-21.5
1974-5	-17.7	-7.6	0.3	-5.3	-2.7
1975-6	1.7	2.6	44.6	73.1	38.0
1976-7	12.8	4.9	13.5	64.2	21.5
1977-8	11.4	-10.3	13.2	4.2	6.9
1978-9	30.2	0.5	7.3	-28.4	-2.6
1979-80	-18.9	6.7	-0.3	8.5	2.3
1980-1	10.8	21.6	9.5	20.9	13.5
1981-2	-4.3	10.9	23.8	42.4	25.6
1982-3	-8.2	1.6	8.9	80.8	24.8
1983-4	2.3	4.3	-2.3	-13.5	-5.4
1984-5	-7.9	4.0	-0.5	-6.5	-1.8
1985-6	30.4	-0.1	13.8	24.6	15.1
1986-7	-6.6	39.1	28.1	2.9	21.3
1987-8	28.2	-23.1	1.9	10.7	-4.8
1988-9	24.9	13.3	2.0	3.0	3.5
1989-90	5.1	-12.3	-2.0	18.8	2.1
1990-1	25.9	10.5	9.3	-0.9	6.4
1991-2	-28.7	-2.7	12.4	-17.5	2.3
1992-3	11.7	34.8	-5.1	-6.6	-1.4
1993-4	5.9	-0.5	9.1	11.6	8.3

Note: all are percentage increase over previous year.
Source: National Accounts Statistics, various issues.

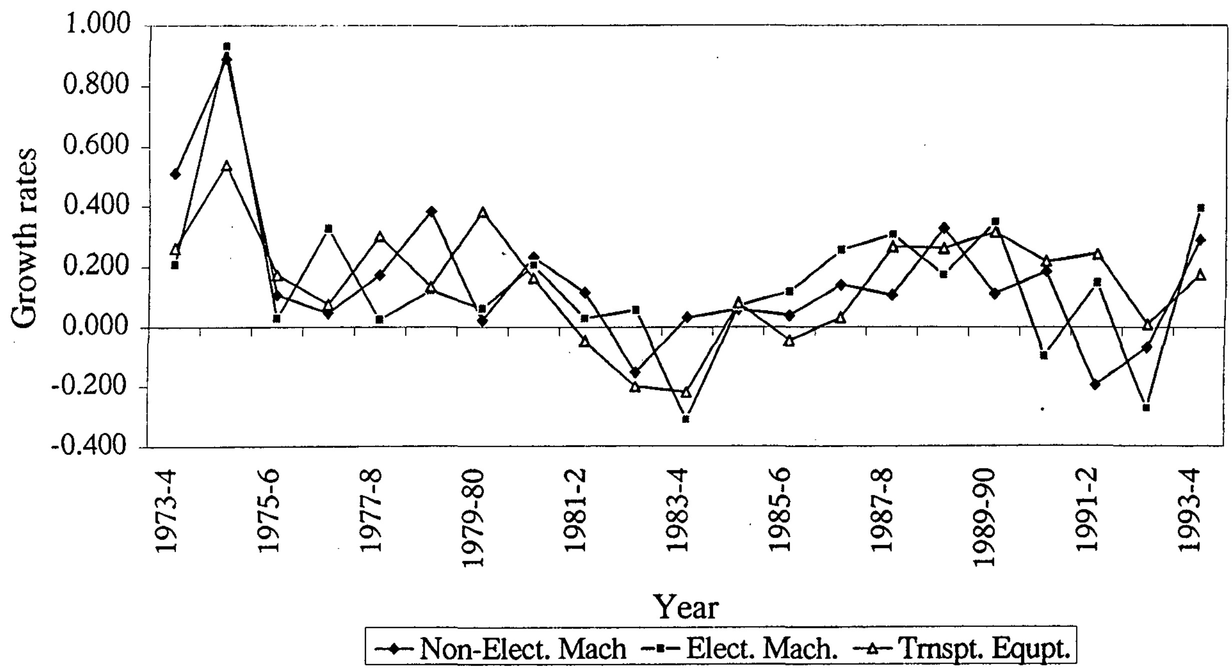
Now coming on to the 1980s, it is seen that the sector is maintaining a stable, but slightly declining trend in CU upto 1988-9, except a slight increase in 1987-8. The stable movement of demand again follows it. Following a decline in 1979-80, NFCF has maintained a more or less stable level with very small fluctuation upto 1986-7 and in 1987-8 it increased. This together with the government policy allowing expansion of capacity in 1980, has resulted in a marginal drop in CU. However, the drop was not severe due to the maintenance of a stable demand and exports.

In the nineties immediately after the policy reforms were initiated, the sector showed a continuous decline in utilisation level as is seen in the case of aggregate manufacturing. As clear from NFCF figures the aggregate demand for capital goods did not improve during this period. In fact, it declined from Rs. 40222 crores in 1989-90 to Rs. 33914 crores in 19934. However, the export demand during this period showed wide fluctuations, registering high growth rate in 1990-1, 1993-4 and negative growth rates in 1991-2 and 1992-3. Except for 1991-2 imports also registered an impressive growth rate. This implies that the drop in utilisation during the nineties was a result of the drop in domestic demand, and increased imports affecting the domestic demand.

4.1.2.2 Electrical Machinery

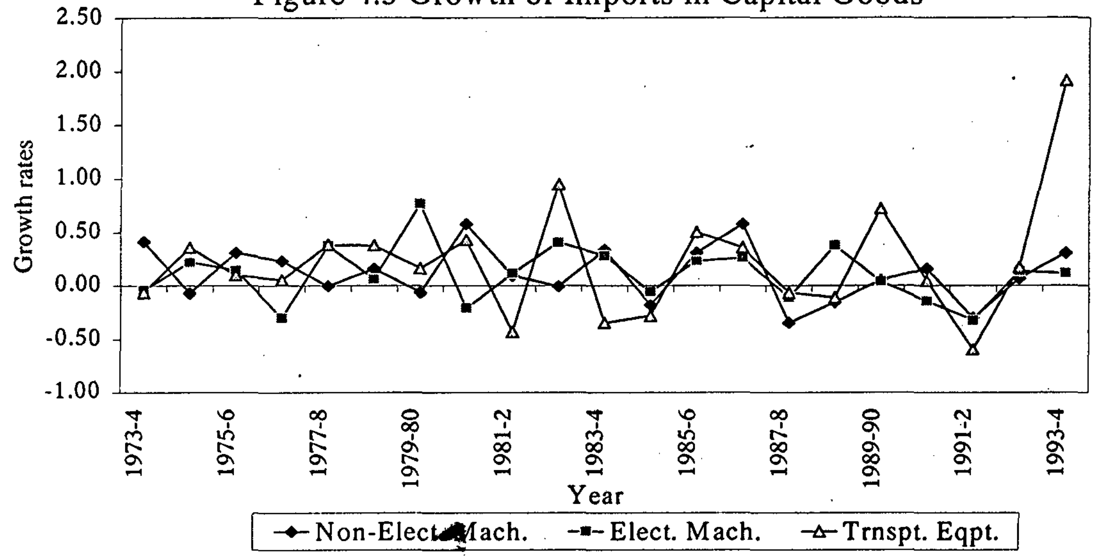
This sector experienced over utilisation in the years 1973-4, 1980-1, 1981-2 and 1982-3

Figure 4.4 Growth of Exports in Capital Goods



following increase in demand. While the sector maintained the same level of average utilisation during the sub periods 1974-84 and 1985-90, it declined substantially during 1991-94. After a sharp decline in 1974-5 utilisation moved up in 1975-6 and 1976-7. It maintained a stable level of utilisation, hovering around 95 per cent during 1977-80 and increased considerably in 1980-1.

Figure 4.5 Growth of Imports in Capital Goods



The acceleration in eighties is accompanied by the maintenance of a stable demand and the increase in private consumption expenditure on electrical appliances (by more than 25 per cent)[16]. Moreover, infrastructural investment in 1980-1, 1981-2 and 1982-3 increased considerably. However, in 1981-2 the sector showed a decline in both domestic demand and growth of export accompanied by a sharp increase in import thereby resulting in a marginal drop in CU.

Following the highest increase in export (by about 20 per cent) and considerable improvement in domestic demand (increased by 10 per cent) in 1980-1, firms might have induced to invest in their capacity. In the subsequent year, capacity could not be utilised due to the decline in net fixed capital formation by 4 per cent and a rise in imports by 11 per cent. Since 1982-3, the sector experienced a continuous negative growth rate in CU except for the years 1987-88 and 1989-90. However, after 1984-5 the movements of electrical machinery is same as that of non-electrical machinery.

16 National Accounts Statistics (1982)

4.1.2.3 Transport equipment

As different from the other two industries and aggregate manufacturing, transport equipment sector shows a higher average utilisation during 1991-94. In the case of this sector we can see three distinct phases; first is 1973-4 to 1978-9 in which CU fluctuates slightly. It has declined considerably from 1973-4 to 1974-5, which we attribute largely to the hike in the price of fuel. As the fuel price increased in 1973-4 the private expenditure on transport equipment declined by 0.4 per cent accompanied by a decline in NFCF by about 18 per cent in 1974-5 thereby CU has come down. Further the decline in infrastructural investment in the economy, particularly in railways also affected utilisation. The CU then slightly improved and attained a peak in 1976-7, where both NFCF and private expenditure on transport equipment increased significantly (see Tables 4.10 and 4.11). Then again came down in 1977-8 and further in 1978-9 following a decline in investment in railways.

During the phase 1980-88, the industry maintained a stable level of utilisation. From 1987-8 onwards it started moving up registering an over utilisation in 1990-1 following the colossal increase in the NFCF (by 26 per cent) along with the increase in investment in infrastructure and private expenditure on transport equipment.

Table: 4.11
GROWTH OF PRIVATE EXPENDITURE ON TRANSPORT EQUIPMENT

Year	% increase	Year	% increase
1973-4	29.7	1984-5	9.6
1974-5	-0.4	1985-6	9.4
1975-6	44.3	1986-7	10.2
1976-7	23.2	1987-8	-7.5
1977-8	5.6	1988-9	10.8
1978-9	3.9	1989-90	-3.4
1979-80	10.0	1990-1	11.2
1980-1	110.8	1991-2	-5.4
1981-2	6.2	1992-3	1.6
1982-3	10.3	1993-4	26.7
1983-4	78.2		

Note: percentage increase over previous year
Source: National Accounts Statistics, various issues.

In 1991-2 it declined with a decrease in the private expenditure on transport equipment, NFCF, and investment in railways. However, in 1992-3 it recovered with the hike in the NFCF (growth rate increased from -28.7 to 11.7) and investment in railways by 35 per cent. At the same time import had also increased considerably (by 16 percent). The growth of imports continued in 1993-4 when it increased by more than 100 per cent. The rise in CU of this industry in the face of growing imports suggests that this sector might have depended on imported parts and equipment. Interestingly, this is the only industry within capital goods sector that has shown an improvement in the 1990s while all other industries and aggregate manufacturing have shown a declining trend.

The common feature that can be traced from the movements in these three industries is that all the sectors have shown a hike in utilisation in 1976-7, 1980-1, 1982-3 and 1991-2. Both in electrical machinery and non-electrical machinery industry, CU has declined in the 1990s, whereas in transport equipment industry, CU has improved. While both electrical machinery and non-electrical machinery show the high average utilisation during 1974-84 the transport equipment registered the same during 1991-94. Recall the fact that, at the same time, the aggregate manufacturing registered the high average utilisation during 1985-90. However, the above analysis at the disaggregate level strengthen our finding regarding the impact of policy changes on CU at aggregate level. It is evident that though the specific policy regarding the expansion of investment etc. can have impact on utilisation, the macro policies of late eighties and early nineties have made no considerable influences.

II

4.2 CU AND OUTPUT GROWTH

The cyclicality of output growth is always associated with the cyclical fluctuations in utilisation. As firms utilise their existing optimal capacity more, output will also increase. The movements in the growth rates of CU and output are pictured in Figures 4.5, 4.6, 4.7 and 4.8. It is obvious from the figures that, the growth of output is very much explained by the growth of CU in almost all years and in all industries.

Over the period, the production of aggregate manufacturing sector grew at an annual average rate of 7.2 per cent, while the capacity (in terms of potential output) grew at an average rate of 6.8 per cent per annum. Thus the pace of expansion of production was higher than the pace of expansion of capacity. Both CU and output have a similar trend throughout the period though the growth of output is higher than that of CU. It indicates the influences of factors like productivity and scale economies. When analysed in detail, it is found that CU has increased by 20 per cent from 1973-4 to 1977-8 resulting in an increase in output by 11 per cent. However, the rate of growth was stagnant (see Figure 4.6).

Table 4.12

GROWTH OF CU AND ACTUAL PRODUCTION, AGGREGATE MANUFACTURING

Period	Capacity utilisation	Actual output
1974-5 to 1977-8	4.90	11.17
1978-9 to 1979-80	-10.06	-3.03
1980-1 to 1982-3	8.00	14.12
1983-4 to 1984-5	-3.80	3.86
1985-6 to 1989-90	1.51	8.58
1990-1 to 1993-4	-3.12	5.61

Note: Simple average growth rates.

The decline in the output in 1978-9 and 1979-80 (growth rate were -5.7 and -0.3 respectively) is clearly explained by the reduction in CU. During these years, CU has dropped significantly by about 12 per cent and 7 per cent respectively. This is one of the three phases of stagnant growth of per capita consumption of manufactured products as identified by Krishnaji (1984)[17]. The acceleration in CU after 1979-80 contributed to the turn around in output growth. Output has increased by about 48 per cent from 1979-80 to 1982-3 while CU has increased by about 26 per cent.

In 1983-4 following a decline in CU, the growth rate of output has declined from 12 per cent in 1982-3 to 0.9 per cent in 1983-4 and then maintained a growth rate hovering around 7 per cent per annum in the subsequent years. To illustrate, CU grew at a rate of 1.51 per cent between 1985-6 and 1989-90 which declined to –3.12 per cent in the subsequent period from 1990-1 to 1993-4. The growth of output had declined simultaneously from 8.58 per cent to 5.61 per cent. It should be noted that during this period, the sector faced a general recession, which is further followed by a stagnation in exports.

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17 Krishnaji (1984) identifies three stagnant phases of growth of per capita expenditure on manufacturing, viz. 1964-68, 1971-75 and 1977-81.

Fig.- 4.6 CU and Output Growth in Aggregate Manufacturing

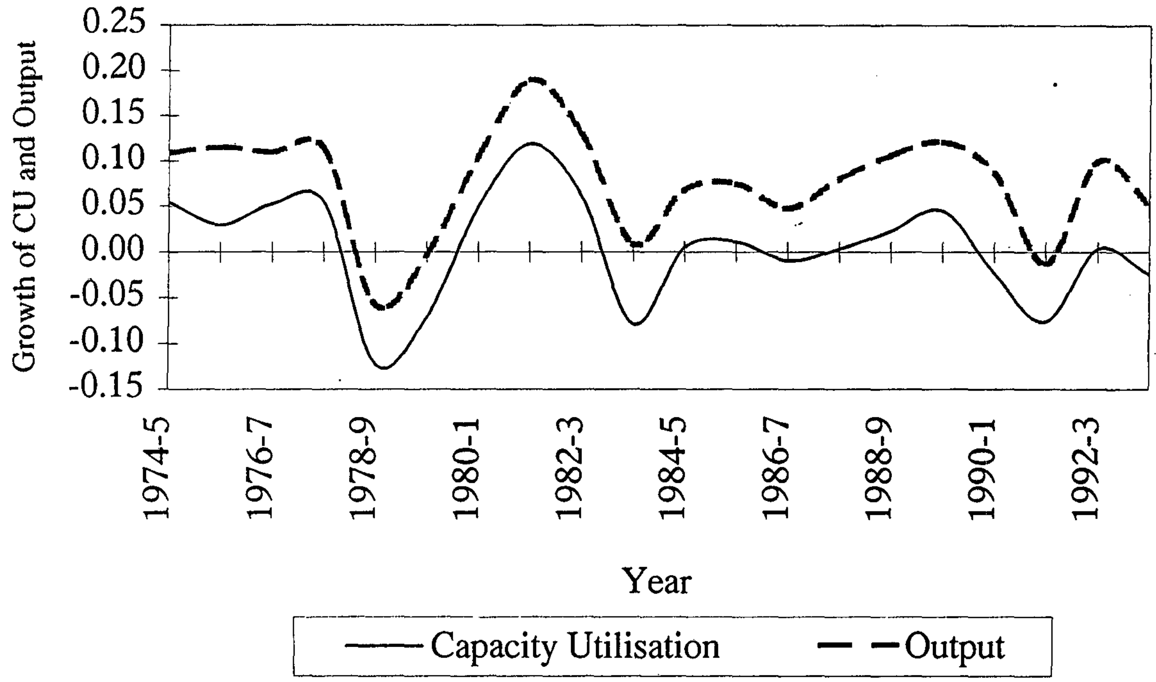


Fig 4.7 CU and Output Growth in Non-electrical Machinery

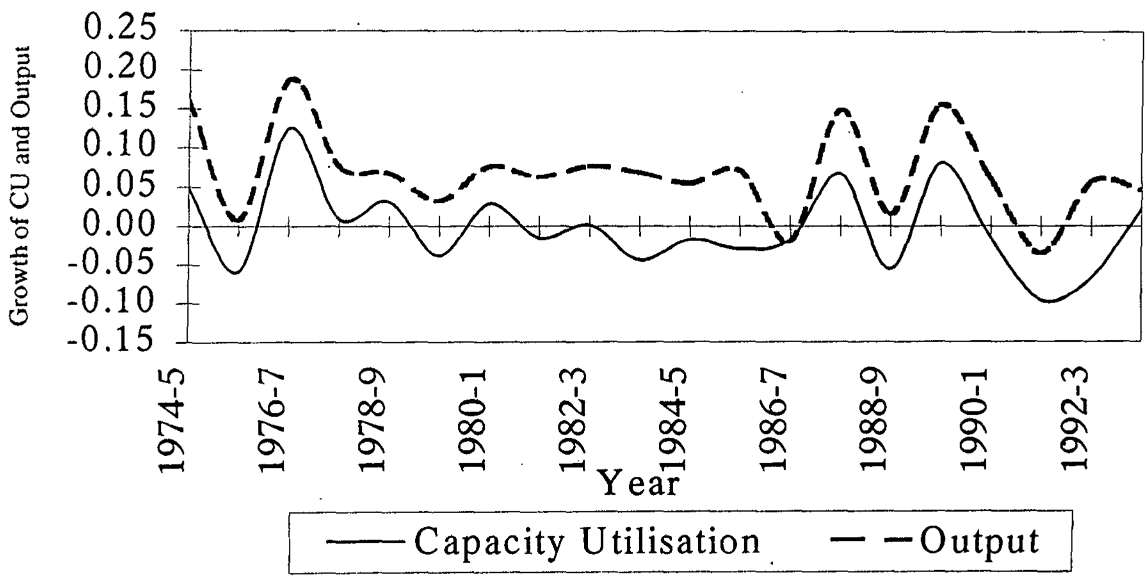


Fig - 4.8 CU and Output Growth in Electrical Machinery

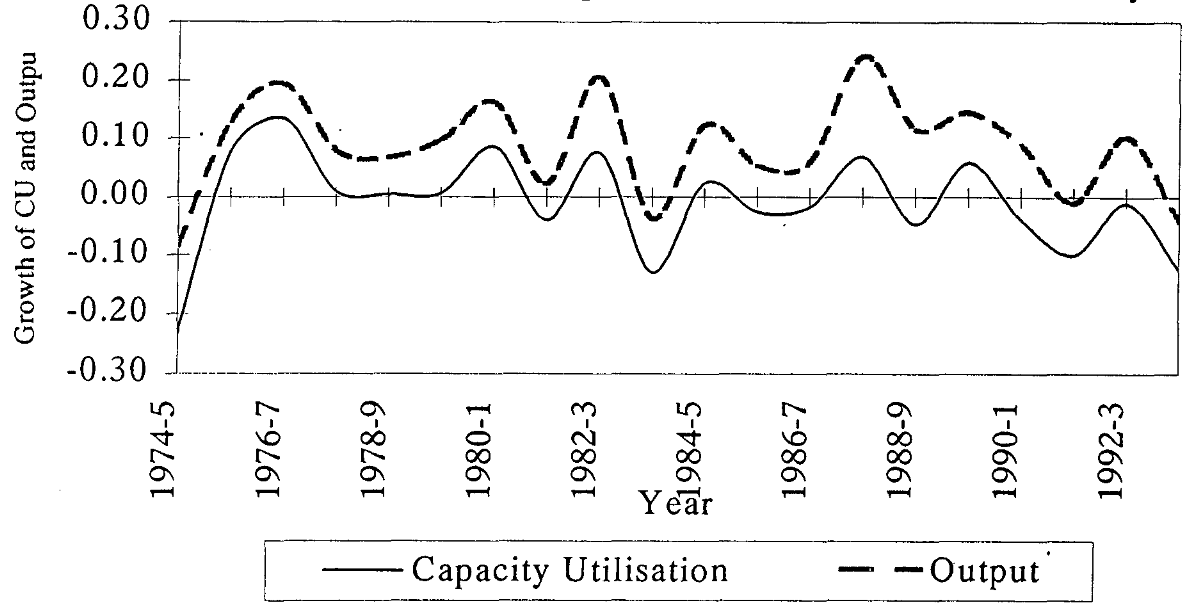
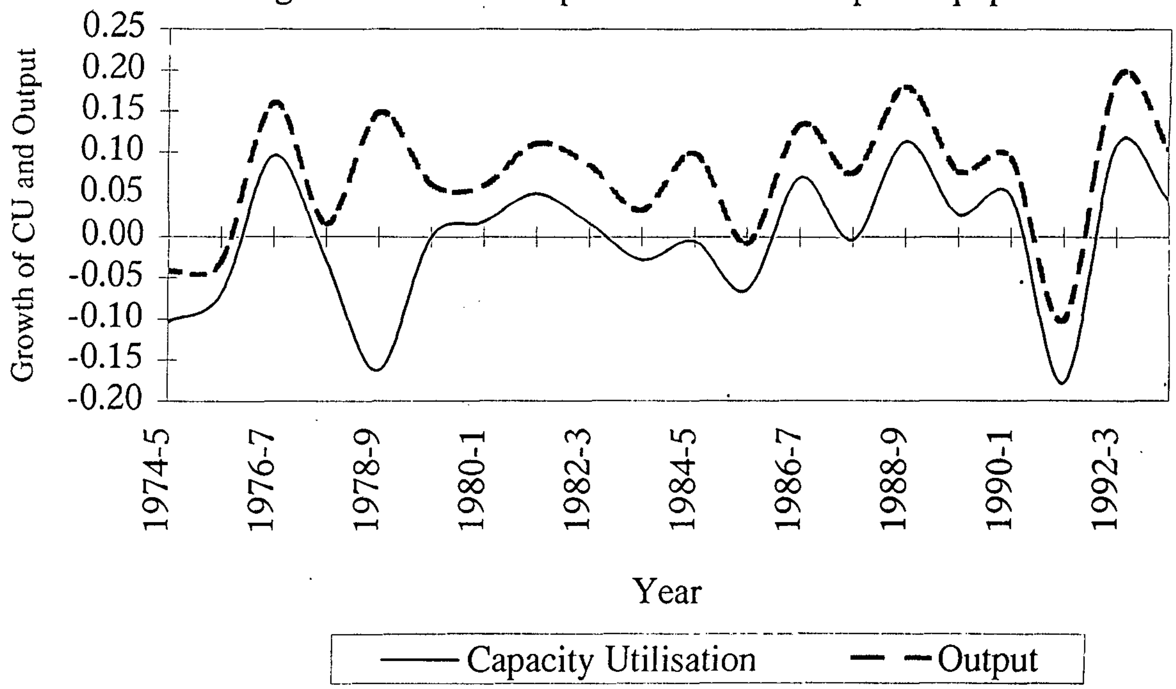


Fig - 4.9 CU and Output Growth in Transport Equipment



In the case of capital goods sector, a similar relationship between CU and output growth is discernible. The peak growth of CU in non-electrical machinery in 1976-7 is followed by a peak growth in output also. The same is the trend in other industries too. However, in transport equipment, only in 1978-9, the growth rates show an opposite trend. In the case of this sector, it is the investment activities in the economy that determines, mainly, the utilisation level, which again ultimately depends on the aggregate demand in the economy. It is, thus, obvious that the cyclical fluctuations in CU is very much reflected in cycles of output growth.

III

4.3 Summing up

To sum up, the analysis of trends in CU of manufacturing sector and capital goods sector revealed that the former experienced an utilisation rate of 92 per cent and the latter a rate of 90 per cent between 1973-4 and 1993-4. Three distinct phases are identified with regard to CU of aggregate manufacturing sector. Phase one, 1974-84, was characterised by high fluctuations, phase two, 1985-90, had a stable level of utilisation, and phase three, 1991-94, experienced a declining utilisation. While phase one is covers the policy regime, phase two and three are characterised by partial and full liberalisation policies. The fact that CU has not improved when liberalisation measures were ushered in, suggests a little impact of changes in policy on CU. Evidences were, however, found to support a relationship between CU and specific policy measures affecting investment and capacity expansion. It was also observed that CU was a major source of output growth in the Indian manufacturing. The same is true in the case of capital goods and its three constituents. It is, though, observed that movements in CU coincide with that of certain economic variables as expected, a more rigorous empirical investigation is carried out in the next chapter.

Chapter V

DETERMINANTS OF CAPACITY UTILISATION

In the previous chapter, we have observed that the fluctuations in the utilisation level are largely depends on the macro economic variables. This chapter examines the factors influencing utilisation of optimal capacity in a multiple regression framework. The chapter is organised in two sections. In the first section we discuss the logical basis for the selection of the factors that have impact on utilisation. The second section elucidates empirically the relationship.

I

5.1 FACTORS AFFECTING CU

In the second chapter, we observed how divergent the definitions of capacity and utilisation could be. Similar kinds of difference exist in respect of the relationship between some economic characteristics and CU. Let us examine the major factors that are expected to have influence on CU, in this section.

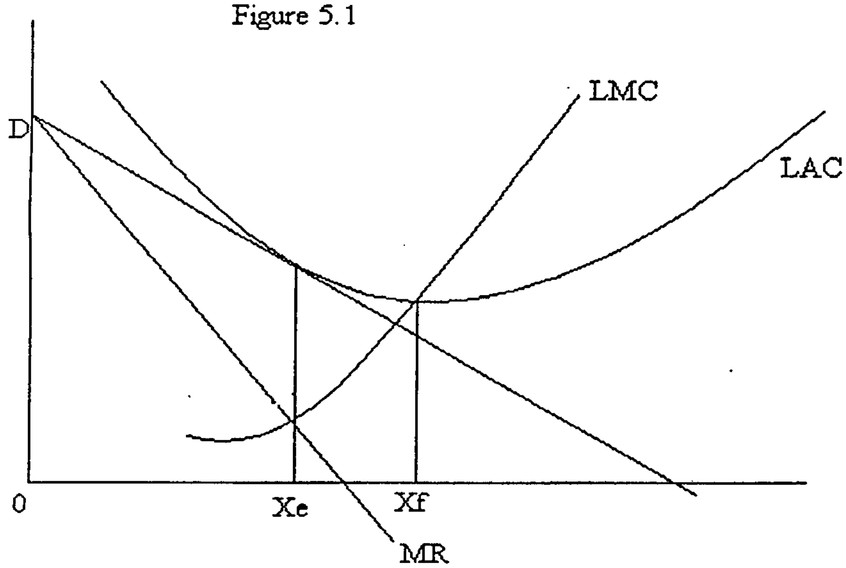
5.1.1 *Size of the firm*: The importance of the technological constraints imposed by the production function on capacity utilisation is worthy of mention. For example, the existence of economies of scale generally implies a level of CU which falls short the long-run optimum, since it could make it more profitable in the long run to have larger capacity and utilising only a part of it in the initial phase[1]. The advantages arising from economies of

1 See Betancourt and Claugh (1977), and Winston (1974). To quote Winston " In the long run, a producer may decide to overbuild plant capacity, 'because economies of scale mean that the cost of a little idleness now will be more than compensated by fuller utilisation and higher profits later".

scale sometimes outweigh the disadvantages of capacity under utilisation. In other words, the profit rate in many small firms working at full capacity may be lower than the corresponding rate in a larger enterprise even when the latter works at less than full capacity (Manne 1967).

5.1.2 ***Market Structure:*** Market structure is one of the important factors, which is potentially important in influencing CU. The appearance of Chamberlin's monopolistic competition initiated a long debate regarding the existence of excess capacity and the effect of market structure on excess capacity. In monopolistic competition, due to the fact that tangency of AC and demand curve occurs necessarily at the falling part of LAC, i.e., at point where LAC has

Figure 5.1



not reached at its minimum level, each firm will produce an output less than the optimal, i.e., at a cost higher than minimum (excess capacity, then, will be the difference between xf and xe in the Figure 5.1).

In perfect competition, equilibrium condition being MC = AC = MR = P, it is argued that excess capacity doesn't exist. However, it is argued that excess capacity can be kept as a barrier to entry in a competitive atmosphere[2]. The basic entry deterrence argument is that excess capacity enables incumbents to threaten to expand output and cut prices following entry thereby making entry unprofitable[3]. In the case of a monopolist, maximisation of profit does not necessarily imply that he chooses to operate at the minimum of the average cost curve, nor does it imply that he will necessarily maintain excess capacity. Utilisation of capacity in the case of a monopolist, like firms in other market structures, largely depends on fluctuations in demand and related strategic aspects like entry deterrence.

In the case of oligopoly, i.e., high seller concentration, high barriers to entry and insignificant competitive fringe, the probability of collective action is very high. Uncertainty assumes some importance in this case since the demand for each firm's products depends on the uncertain behaviour of its rival[4]. He may create excess capacity to retain his own customers and service his rival's customers unexpected needs in case an anticipated future increase in demand occur (Dusenberry-1958).

5.1.3 ***Demand Pressure:*** Characteristics of product demand that affect CU fall into two categories, depending on whether the resulting idleness is unanticipated or planned. If the producer anticipates a secular growth in demand, he may find it more profitable to install a large plant, leaving the capital stock idle part of the time, but avoiding the higher costs associated with capital expansion over time. Unanticipated capacity under utilisation, on the other hand, arises if there is a decline in demand because of changes in taste, income, etc, forcing a cut back in production. Therefore, ceteris paribus, growth in market demand should be an incentive for increased supply of output resulting in better utilisation.

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2 See Liberman (1987).

3 Profit maximising firms hold non-strategic excess capacity in markets where demand is cyclical or stochastic, or where plants are inherently lumpy or subject to economies of scale. Strategic excess capacity may be built either to deter new entry or to pre-empt existing rivals.

4 As Morris (1964) pointed, an oligopolistic firm, faced with uncertain demand, may optimally decide on some degree of reserve capacity which could be drawn upon in times of high demand, if other factor services are forth coming.

5.1.4 ***Input Prices***: The relation between factor prices and capacity utilisation is very complex, but important. The influence of input prices comes through its relation with the potential output depending on whether the input is a substitute / complement to capital. Specifically, if variable input(s) and fixed input(s) are Hicks-Allen substitutes (complements), then an increase in the price of variable input decreases (increases) the potential output (Y*); if however, they are independent inputs, the variation in variable input prices do not affect potential. Intuitively, if for example, the variable input, say labour, and fixed input, say capital, are substitutable inputs, with an increase in the wage rate, the firm's long run optimal capital output ratio (K/Y*) would increase from, say, K_0/Y^* to K_1/Y^*. This implies that in the short run, the given level of capital, K_0 corresponds with a smaller Y*. Alternatively, if they are complementary inputs, an increase in wage rate would imply a lower long-run optimal K/Y*; in the short run the firm's given level of capital K_0 would then be associated with a large Y*.

5.1.5 ***Exports and Imports:*** Exporting may enlarge a firm's market and ease demand bottlenecks, while importing may envisage speedy availability of critical inputs and technology, contributing to increased capacity utilisation. Even if domestic demand is not adequate enough, CU can be high if there is enough exports. On the other hand, export market may be less stable and predictable because of imperfect knowledge about competing producers and consumers, which may have adverse impacts on level of utilisation.

5.1.6 ***Policies:*** It is not very much clear how a change in policy will affect the utilisation level. However, economic policies have direct and indirect effects on industrial CU. Even the technological parameters of the production function affecting cost structure of the industry, can be influenced by national policies. They can promote the adaptation of imported technologies and the local development of appropriate technologies and thus expand the set of feasible technologies. Moreover, input supply, relative input prices etc also can be affected by government policies. On the demand side, the effectiveness of stabilisation policies determines in part the severity of unanticipated idle capacity resulting from changes in the aggregate demand.

Thus the above discussion show the different views on the impact that can be made by different factors on utilisation. In the next section, let us examine how some of these factors behave in the Indian context in terms of their impact on utilisation.

II

5.2 Determinants of CU in Indian Manufacturing

In this section we examine the influence of some of the above discussed factors on utilisation level in Indian manufacturing, within the data constraints we have. Since the study is conducted at the aggregate level, an examination of the impact made by market structure will be a complicated exercise. In the same way, it is difficult to capture size of the firms, however, we consider the capital intensity, as is done by many studies. Therefore, accepting the data limitations at an aggregate level analysis, we estimate a multiple regression equation considering some of the industrial characteristics and policy changes that are expected to have impact on CU. The variables that we employed are i) demand pressure - represented by the gross domestic expenditure at market prices over the period 1974-94 in the case of aggregate manufacturing. This entails the assumption that the ups and downs in the movements of gross expenditure in the domestic market affects in the same way the expenditure on industrial output also. In capital goods industry, the demand is proxied by the level of investment in the economy, under the assumption that the demand for capital goods is mainly from investment activities. Apart from this, in the case of transport equipment we have added the private expenditure on transport equipment as given in NAS. ii) Capital intensity, represented by the ratio of total capital stock to total number of employees; iii) Exports; iv) Imports; v) Input prices [Price of labour, Price of capital, Price of fuel and price of material]; vi) a time trend T and vii) Government policies, proxied by two dummy variables, first taking the value zero for pre 1985 and one for post 1985 and the second, taking zero for pre 1990 and one for post 1990. This division is to capture the impact of the policy changes that occurred during late eighties and early nineties.

The estimated regression coefficients with t ratios, DW statistic and R-squared value are given in Table 5.1. We estimated three functional forms, viz., linear, double log and semi-log, and we selected the double log function, which is reported. The R-squared values are significantly high and the Durbin Watson statistic indicates absence of autocorrelation problem.

Table: 5.1 ESTIMATED COEFFICIENTS: DETERMINANTS OF CAPACITY UTILISATION

Variables	Estimates			
	All Manufacturing	Non-elect. Mach	Elect. Machinery	Transport Equpt.
Intercept	-0.1157(-2.274)**	-0.1776(-4.17)*	- 0.0657 (-6.871)*	0.1201 (2.952)**
Demand	2.2170 (3.319)*	0.0026 (2.72)**	0.8350 (3.961)*	0.1151 (4.982)*
Dummy 1	0.0638 (0.838)	-0.0528 (-0.945)	-0.0197 (-0.203)	0.0039 (2.032)
Dummy 2	-0.0451 (-1.367)	0.0281 (0.606)	-0.0778(-2.768)**	0.0707 (0.628)
Export	0.0003 (0.008)	0.0258 (3.987)*	0.1353 (1.636)	0.0439 (0.255)
Import	-0.0786 (-1.736)	-0.0241 (-0.365)	-0.0124 (-0.096)	0.0994 (2.996)**
Capital Intensity	-0.8387 (-1.054)	-0.4402 (-1.205)	-1.0312(-2.702)**	-0.8155 (-0.074)
Labour Price	-0.1312 (-1.806)	0.4589 (2.824)**	0.4481 (0.759)	1.6018 (2.871)**
Capital Price	-0.7364(-2.935)**	-0.6815 (-3.728)*	0.0766 (2.053)	0.5456 (0.518)
Fuel Price	0.4035 (3.866)*	-0.0097 (-0.107)	-0.3326(-2.865)**	-0.4533 (-5.236)*
Material Price	0.8613 (1.007)	0.1105 (-0.639)	-0.4879 (-3.265)*	-1.1996 (-1.147)
Time trend	-0.0787(-0.31)**	0.0041 (1.125)	0.0163 (0.265)	-0.0468 (-0.595)
R^2	0.894	0.867	0.839	0.871
Durbin Watson	2.107	2.457	1.786	2.411
Deg.of freedom	9	9	9	9

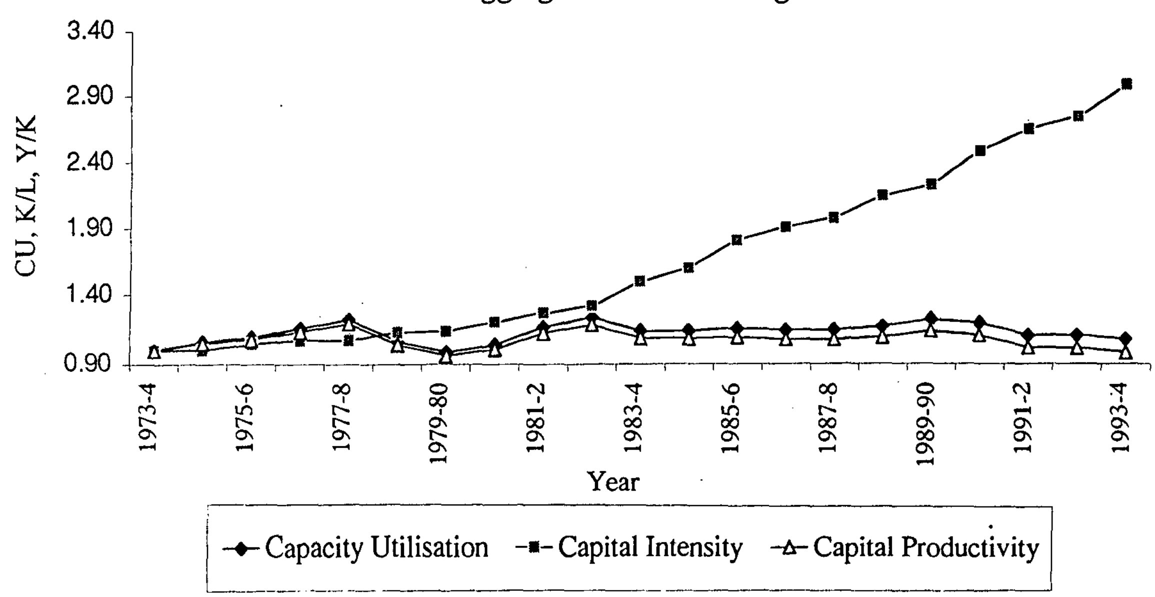
Note: All in log. form except dummy and trend. Figures in parentheses are t-ratios.
* Significant at 1 per cent level of significance.
* * Significant at 5 per cent level of significance.

As expected the market demand showed a positive effect on CU in aggregate manufacturing. The highly significant coefficient with high magnitude in absolute value insinuate to the pivotal power of demand in explaining the movements in CU, making us to conclude that the sector has adjusted most flexibly to market demand shocks. In the case of capital goods sector also demand got highly significant coefficients both in electrical machinery and transport equipment, implying that it is the major determinant of capacity utilisation, while its level of significance is low in the case of non-electrical machinery. This phenomenon of CU moving with fluctuations in demand makes our hypothesis that CU is not a random outcome, but it is a result of firms' rational behaviour depending on the fluctuations in demand. Firms opt to keep a part of their capacity idle mainly in order to utilise it at a time of high demand. This is clear from the over utilisation of capacity in some years where demand moved significantly up. However, it may also suggest that firms failed to forecast their future demand and thereby adjust their capacity.

As is observed while analysing the fluctuations in CU, the policy changes doesn't made any significant impact on CU, both at aggregate and disaggregate level, which is confirmed in the regression results too. Both dummy variables yielded insignificant coefficients. Recall that, as we mentioned in the introduction chapter, one of the arguments for liberalisation in India was that an open economy framework will provide stage for utilising optimum capacity more. Our results invalidates these arguments. Rather as the economy opened fully, abolishing all barriers to entry the possibility to keep excess capacity for different reasons are high and thereby hindering the hike in utilisation. Since the markets are more integrated with global market, the demand fluctuations and the corresponding expectations will be more uncertain which will make the firm to keep part of capacity idle in order to utilise at a time when demand moves up. Thus our view that a liberalised regime need not necessarily accompanied by a higher utilisation is confirmed by the regression results. Beyond any changes in policy regime, it is the fluctuations in market demand for the industrial products that induces firm to utilise its capacity, and therefore, if the demand can be altered by policy changes that may reflect in utilisation levels too.

In the case of the impact made by the external sector of the economy; export have yielded a positive and significant coefficient only for non-electrical machinery. In all other industries and in aggregate manufacturing the impact is negligible. This, implies that the non-electrical machinery sector adjusted to both its export market and domestic demand. This may also imply that if the volume of exports were high enough to make significant impact on aggregate demand, CU might also be high. Because if we examine the export intensity (export as a percentage of output) of these industries, it is seen that it is very high in the case of non-electrical machinery, where we got a significant positive coefficient, compared to other two industries. The positive and insignificant coefficient of exports in other industries, therefore, suggests that its impact is favourable but negligible. While the export intensity of Indian industry has increased by 36 per cent over 1974-94 import intensity has increased by 67 per cent. Import has yielded a negative but insignificant coefficient in all industries except

Figure 5.2: Indices of CU, Capital intensity and Capital Productivity: Aggregate Manufacturing

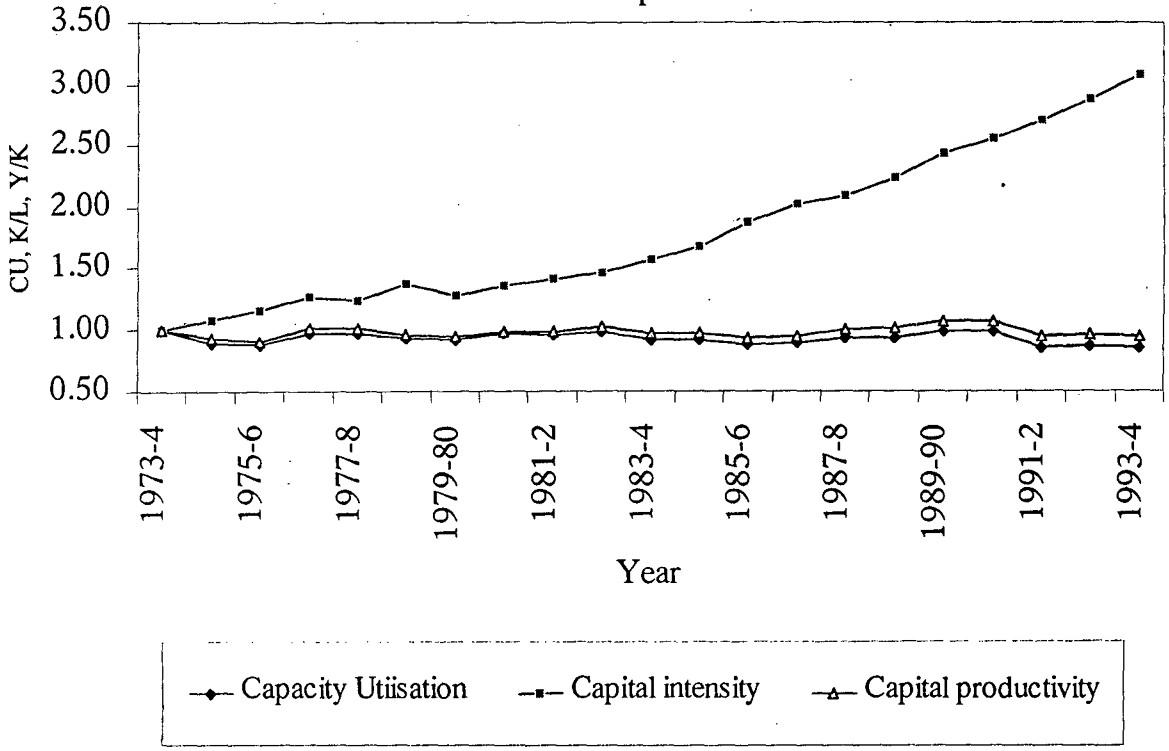


transport equipment where it is positive and significant. This may due to the high dependence of import for critical spares and parts in transport equipment sector which is needed to utilise its capacity. At the same time in other industries and in the aggregate sector the increased import might have affected domestic demand and thereby utilisation. The major finding emerges from this is that again it is the fluctuations in demand-domestic or export- that is more important in utilising capacity.

Capital intensity shows a negative and insignificant impact on utilisation in the aggregate manufacturing and in all the three sub groups of capital goods. It implies that the intensive use of capital doesn't made any significant impact on utilising the optimal capacity. This finding is contradictory to the earlier Indian studies[5]. Studies argued that a more capital intensive process is believed to provide a greater incentive to economise on the larger capital cost through high utilisation. In other words, firms with higher capital intensity are likely to operate at higher utilisation rates in that they can't afford the rental cost of unused capital. Invalidating these arguments our finding goes in par with the pure theoretical view in this regard. From the purely theoretical point of view one can't attribute a clear cut relationship between capital intensity and utilisation. A firm may opt for a capital intensive production because of the relative cheap availability of capital. In such a context, it is not necessary for the firm to utilise its capacity. Instead it may keep part of its capital idle in order to avoid the cost of capacity expansion in the future. The relation is further examined with the help of Figures 5.2 and 5.3, which show the trends in capital intensity, capital productivity and capacity utilisation.

[5] For example, Paul (1974), Srinivasan (1992)

Figure 5.3 Indices of CU, Capital intensity and Capital Productivity: Capital Goods



From the figure the phenomena of increase in CU during 1974-78 in aggregate manufacturing can be gauged through the pattern of growth of the capital productivity and capital intensity. As the sector experienced a fragile increase in capital productivity during this period (i.e. from 100 in 1973-4 to 118 in 1977-8) and capital intensity remained more or less stable, capacity utilisation moved up. From 1980 onwards both capital productivity and capital intensity started increasing considerably. During the period 1980-83, one notable feature is that the increase in capital intensity was not accompanied by a decline in capital productivity. This strengthen the argument that gradual increase in capital deepening over years made no considerable impact on improving CU, rather it is the productivity of capital that contributes to the utilisation. After 1983 it can be seen that the capital intensity is increasing significantly with a stable level of capital productivity without making any influence on utilisation.

The capital goods sector doesn't show any divergence from this phenomenon. Capital intensity is increasing over years without making much impact on CU (Figure 5.3). At the same time capital productivity show close association with CU. It should be noted, however, that since the capital productivity is estimated as the ratio of output per unit of capital, there may be an under estimation due to the increasing capital intensity.

The positive association between capital productivity and capacity utilisation is not surprising since our estimates are based on cost function, which is a mirror image of production function. It is to be noted that we have a U-shaped short run average total cost curve only because of the existence of the quasi-fixed input, capital, and due to short run fixity of capital it is the productivity that is more important. The major conclusion derives out of the above discussion is that it is not necessary to have a higher level of utilisation even if a firm goes for the use of more and more capital.

The movements in our CU measure might be attributed to the fact that economic CU measures explicitly depend on input prices; while the traditional measures do not. While a positive and significant relation is found between fuel price and CU in the aggregate manufacturing sector, a significant negative relation is found between the same variables in electrical machinery and transport equipment. A negative and significant influence is made by the price of capital on CU in aggregate manufacturing and non-electrical machinery. A positive influence is made by price of labour in non-electrical machinery and transport equipment. Material price is found to be insignificant in all the industries except in electrical machinery where it is negative and significant. Though it seems to be contradictory to have different impact on CU by different input prices, at a glance, it is not surprising to have different impacts on different industries by different input prices. Because, ultimately the impact of input prices comes through its relationship with the potential output[6], which depends on the substitutability/complementarily of variable inputs to fixed input. Specifically, for example, if labour and capital are substitutes (complements), then the predominant effect of an increase in wage rate will be to reduce (increase) the capacity of the firm. Therefore, in order to capture the impact of input prices

6 See Berndt and Morrison (1981).

on optimal output, we estimated another regression in which dependent variable is the estimated potential output and independent variables are the input prices. The estimated coefficients are given in Table 5.2.

Table 5.2 ESTIMATED REGRESSION COEFFICIENTS: POTENTIAL OUTPUT & PRICES

Variable	Coefficients: All Manufacturing	Non-electrical Machinery	Electrical Machinery	Transport Equipment
Intercept	0.381 (8.92)*	0.550 (8.14)*	-0.168 (-2.52)**	0.425 (3.41)*
Price of Labour	0.195 (3.63)*	0.075 (0.95)	0.698 (5.32)*	0.006 (0.05)
Price of Capital	-0.020 (-0.16)	-0.379 (-2.16)**	0.531 (1.65)	-0.761 (-2.97)*
Price of Fuel	-0.012 (-0.30)	0.052 (0.96)	-0.216 (-2.16)**	0.043 (0.40)
Price of Material	0.467 (2.43)**	0.741 (3.56)*	0.067 (0.15)	1.434 (4.12)*
R^2	0.996	0.997	0.988	0.998
Degrees of freedom	16	16	16	16

* Significant at 1 per cent level of significance
** Significant at 5 per cent level of significance.

It is evident from the table that while the price of labour affected the potential output positively both at aggregate level and in electrical machinery, it is not significant in other two industries. The price of capital on the other hand, show a negative and significant influence on potential in non-electrical machinery and transport equipment while it is not significant in aggregate manufacturing and in electrical machinery. Price of fuel is significant only in the electrical machinery sector, where it has a negative impact. Material price have a positive impact in all the industry groups and aggregate manufacturing, though it is not significant in the case of electrical machinery.

Figure 5.4: Indices of CU and Relative input Prices, Aggregate Manufacturing

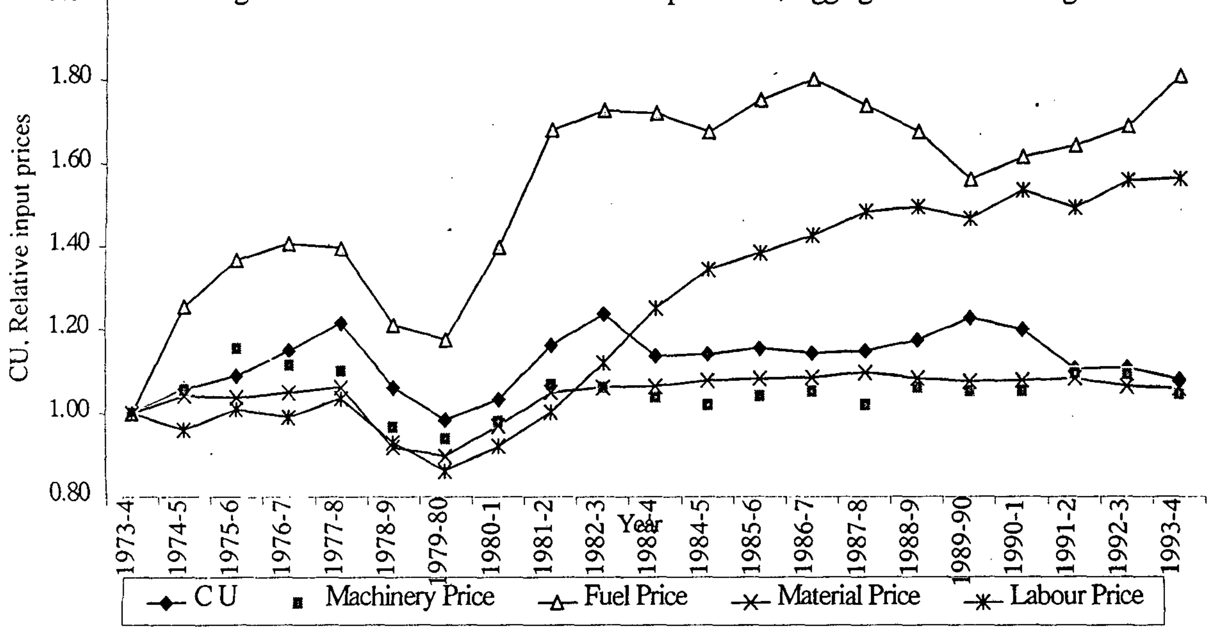


Table: 5.3. INPUT SHARES IN THE TOTAL VARIABLE COST-AGGREGATE MANUFACTURING SECTOR

Year	Labour		Fuel		Materials	
	Actual	Estimated	Actual	Estimated	Actual	Estimated
1973-4	0.130	0.127	0.079	0.072	0.791	0.801
1983-4	0.109	0.089	0.088	0.081	0.802	0.831
1989-90	0.088	0.076	0.089	0.084	0.823	0.840
1993-4	0.081	0.064	0.085	0.085	0.834	0.851

Note: Actual shares are computed from the ASI figures, while estimated shares are computed using Shapard's lemma in estimated cost function.

The above observations hints to the possibility of the complementarily between labour and capital in the case of electrical machinery and the aggregate sector and between material and capital in all industries except in electrical machinery. At the same time a substitution possibility between fuel and capital is seen in the case of electrical machinery. However, in order to make a firm conclusion on the substitution/complementarily of these inputs one has to work out the elasticity of substitution, which is not tried.

Table: 5.4 INPUT SHARES IN TOTAL VARIABLE COST
CAPITAL GOODS

Year	Labour	Fuel	Material
	Non-electrical Machinery		
1974	0.178	0.046	0.776
1980	0.176	0.041	0.783
1985	0.169	0.039	0.791
1990	0.146	0.036	0.818
1994	0.137	0.038	0.825
	Electrical Machinery		
1974	0.151	0.028	0.821
1980	0.154	0.029	0.817
1985	0.150	0.036	0.815
1990	0.112	0.026	0.861
1994	0.108	0.029	0.863
	Transport Equipment		
1974	0.189	0.045	0.765
1980	0.217	0.053	0.729
1985	0.194	0.045	0.761
1990	0.142	0.039	0.819
1994	0.120	0.037	0.843

Note: Estimated using ASI figures.

These possibilities, however, if we decipher with the negative impact of fuel price on CU in electrical machinery, may imply that the changes in fuel prices affected negatively both potential as well as actual production in this industry. Similarly the positive impact made by the material price on both potential and utilisation suggests that output growth is dominated over the capacity growth followed by the hike in material price. The finding of high effect of material price on potential output is strengthened if we look at the share of this input in the total variable cost. In the total variable cost labour and fuel absorb, in 1993-4, only 8 per cent and 8.5 per cent respectively, in the case of aggregate manufacturing, while material alone constitutes the rest, i.e. 83 per cent (see Table 5.3). It is clear from the

Table that the share of labour in the total variable cost is declining over the period, while that of materials is increasing over years[7]. The share of labour has declined from 13 per cent in 1973-4 to 8 per cent in 1993-4. Thus the highest share of materials, evidently imply that the increase in material prices have much larger impacts on potential output than do proportional increase in wage rate and fuel prices. A similar trend can be seen from the capital goods sector also. The share of non-material inputs in the total variable cost declined over years both in non-electrical machinery and transport while the share of fuel maintained in the case of electrical machinery (Table 5.4).

Apart from all these relationships input prices may affect CU, depending on how far the change in input prices are transformed to the changes in output price. If for an example an increase in the price of fuel is transformed to an increase in the price of output, from the firms' point of view, there is no reason to reduce the production, provided the market demand is not altered. An examination of the relative price movements (price of inputs in relation to the price of output) at the aggregate level show that while the relative price of material and capital remained more or less constant over years, suggesting an immediate transformation of input prices to output prices, both price of fuel and labour increased more than proportionately of output prices over years. The proportionate movement of material and capital price, together with positive impact of material price and negative impact of capital price on utilisation, however, suggest that even if it is transformed to output price, it can affect CU, if demand is affected by the changes in output prices. The movement of relative prices in capital goods sector is also found to be more or less in the same line and is, therefore, not repeated again[8]. The overall conclusion emerges out of this observations on input prices and its impact on economic CU is that though the price changes can affect the potential output depending on the substitutability/complementarily of inputs, given the

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7 Note that Pradhan and Barik (1998) show that material inputs are the major contributing input to output growth in Indian manufacturing.

8 The figures showing the movements in relative prices in disaggregated capital goods sector are given in appendix A5.

firms' market power to alter the output price, it is mostly the demand that is more important in deciding the level of utilisation.

The significant negative coefficient of time trend in the manufacturing sector as a whole suggests that over years, the sector faced a deterioration in the utilisation. However it is not significant in all the three industries suggesting that these sectors failed to achieve considerable improvement in capacity utilisation over years.

III

5.3 Summing up

In this chapter, we examined the determinants of capacity utilisation in the Indian manufacturing. The analysis highlights the significant influence of demand fluctuations on utilisation level. The negligible impact of imports and exports, strengthen that it is the domestic demand that determines CU largely. However the non-electrical machinery sector show good response to the export market. CU has, thus, adjusted more flexibly to the movements in demand, and therefore the prevalence of excess capacity may largely due to the failure of firms in anticipating the future demand. As evident from the relation of price with CU, we gather that the supply factors, in case of some inputs, through increase in prices affected the utilisation levels, by affecting the expansion of capacity.

Despite these widely accepted and expected relationships the important observation we could make out from the above analysis is the little and insignificant role of macro economic policies on utilisation. This confirms our hypothesis that CU is a rational outcome of the firm rather than a random variable that can be influenced by any policy changes. This invalidates the arguments for liberalisation in India based on the view that a liberalised regime will stimulate CU. Another foremost conclusion emerges is the insignificant role of capital intensity, which is in contrast with the earlier findings, however, in accordance with the theoretical logic.

Chapter VI

SUMMARY AND CONCLUSIONS

The present study aimed to analyse the trends and determinants of capacity utilisation in Indian manufacturing for the period from 1973-4 to 1993-4. The study draws its relevance from the conspicuous absence of a theoretical investigation into the capacity utilisation analysis in India, particularly in the changed policy atmosphere as evident from the review of earlier studies. The analysis is carried out for aggregate manufacturing sector and capital goods sector. The latter is studied at a more disaggregated level, namely, non-electrical machinery, electrical machinery and transport equipment. For this purpose we used the ASI data. However, estimation of inputs such as capital, cost of capital and material price needs further improvements.

As a forerunner to the analysis of CU, we reviewed the different theoretical views associated with the definition of capacity and measurement issues. It is found that two approaches are followed for defining capacity. They are the engineering approach and the economic approach. The problems connected with measurement of CU spawns from the approaches followed to define CU. However, the measurement methods belong to two broad categories, viz. the narrow sense and the wider sense. While the narrow sense approach considers only the utilisation capital input into account, the wider sense definition considers all the inputs. The engineering approach belongs to the former while the economic approach belongs to the latter. The engineering approach, that considers only the machinery capacity, thus, is found to have a limited application in explaining economic behaviour of firms. Similarly there are measures that belong to wider sense category, which include Wharton index, minimum capital output ratio and cost function. Except cost function approach the other measurement methods lack sound theoretical basis. Therefore, the study employs cost function to measure economic capacity utilisation. As a prelude an exercise was carried out, however, to understand the sensitivity of cost function vis-à-vis other measures. To this end, results obtained using cost function were correlated with those of other measures. The finding suggested that there is no unique relationship between cost function and other measures, though some variations are observed in the case of some industries. This in turn suggests a high sensitivity of the measures and, therefore, can not be considered as a good indicator of economic capacity utilisation. Empirically, it was thus-shown that cost function approach measures the true economic capacity utilisation.

The analysis of trends in CU, both at aggregate and disaggregate level shows wide variations over the period 1973-4 to1993-4. While the aggregate sector registered the higher rate of utilisation during 1984-90 period, the capital goods sector showed the same during 1974-84. However, it is evident that both the aggregate and disaggregate sectors adjusted most flexibly to the changes in the demand, suggesting that the firms behaved rationally in the sense that they operated profitably keeping part of capacity idle, which seems to be less costlier than producing surplus output. Export and import does not have major role in determining the level of utilisation at an over all level, due to their negligible share in total production. They, however, made impact in some years when the intensity of these variables are very high. The movements of CU show its little response to the macro policy changes also.

The empirical evaluation of major determinants of capacity utilisation confirms the role of demand, particularly domestic demand, in determining the level of utilisation. It also clearly brings out the negligible impact of policy changes during eighties and nineties. The absence of commendable impact on utilisation by liberal policy measures confirms our hypothesis that an open economy atmosphere need not necessarily accompanied by a higher level of utilisation. Rather it fosters the firms' willingness to keep more excess capacity due to the increased uncertainty in the market. Apart from the influence by the specific policies relating to the investment behaviour of firms, macro policies made no significant influence on utilisation.

As contradictory to most of the earlier studies, our study found an insignificant influence on utilisation by capital intensity, which is, however, in accordance with the theoretical logic. This invalidates the arguments that a high capital intensity will provide room for higher levels of utilisation.

Over the period, the growth of output is largely explained by the increase in utilisation levels. Due to the changes in domestic demand, exports, imports and infrastructural development, whenever utilisation moved up, output also moved up. However, we hold the view that an increased output is not feasible if there is no adequate demand for it. This may be the reason for firms keeping capacity idle, as it is a rational course of action from their point of view. Therefore the concern should be to boost the demand–both domestic and export–for domestically made products, which in turn may lead to higher levels of utilisation and output growth.

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Appendix 1

Figure A1.1a: Output Growth in Aggregate Manufacturing and Capital goods, 1974-94

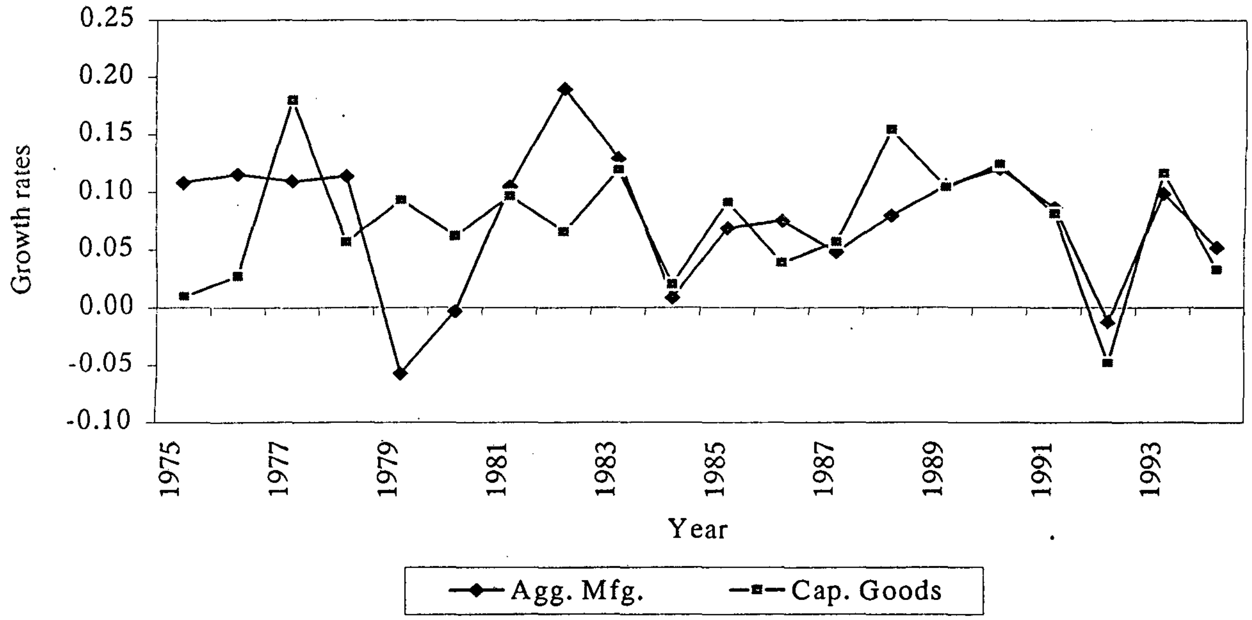

Figure A1.ab: Utilisation of Installed Capacity, Aggregate Manufacturing and Capital Goods, 1951-87.

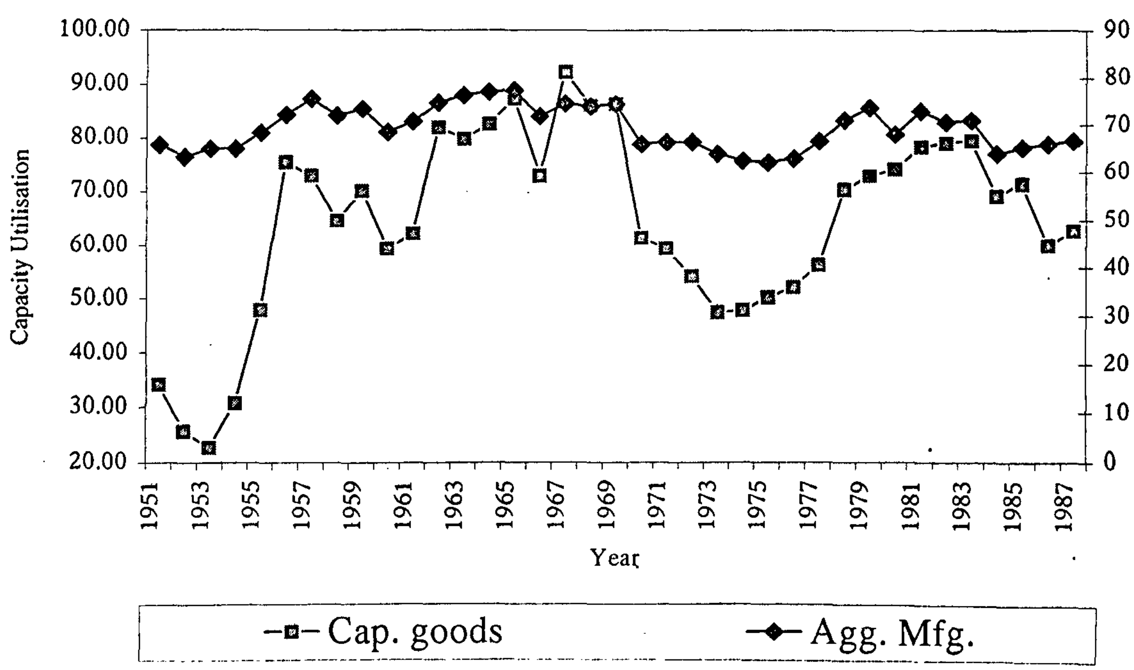

Table A1.1 GROWTH OF INPUTS AND OUTPUT IN AGGREGATE MANUFACTURING 1974-94

Aggregate Manufacturing								
Year	Output	Capital	Labour	Fuel	Materia l	K/L	Y/K	Y/L
74-94	7.22	7.28	4.12	7.47	7:14	5.96	-.067	5.89
74-84	7.19	6.49	5.13	7.94	7.26	3.86	0.697	4.56
85-94	7.23	7.87	3.36	7.11	7.05	7.53	-.641	6.89
Non Electrical Machinery								
74-94	8.98	8.32	5.28	7.02	8.10	5.56	.668	6.23
74-84	9.17	6.66	5.28	7.02	8.1	3.31	2.51	5.81
84-94	8.85	9.56	5.03	7.24	8.91	7.26	-.071	6.54
Electrical Machinery								
74-94	6.26	6.8	4.61	5.66	6.22	5.31	-.536	4.76
74-84	7.38	6.28	6.14	7.64	6.91	3.17	1.08	4.26
84-94	5.43	7.18	3.46	4.18	6.40	6.89	-1.75	5.14
Transport Equipment								
74-94	7.25	7.27	4.66	6.51	7.99	5.64	-.013	5.63
74-84	6.66	8.69	7.29	6.67	6.84	4.75	-2.02	2.72
84-94	7.71	6.21	2.69	6.39	8.86	6.31	1.49	7.80

Note: Overall growth rates are calculated using an exponential fit, ln $Y=\alpha + \beta t + \varepsilon t$
K/L =Capital intensity, Y/K and Y/L are partial productivities of capital and labour

Table A1.2 SHARE OF CAPITALGOODS IN TOTAL MANUFACTURING 1974-94

Characteristics	Non Elect		Elect Mach		Transport		Capital Goods	
	1974	1994	1974	1994	1974	1994	1974	1994
Output	5.7	5.4	6.1	6.3	6.1	6.2	17.9	17.9
Fixed capital	5.9	3.9	5.2	4.4	5.7	5.0	16.8	13.3
Emoluments	7.7	8.3	6.9	8.0	9.9	9.6	24.5	25.9
Employees	6.3	6.1	4.9	5.5	7.6	6.7	18.8	18.3
Net Value Added	7.4	6.5	7.6	7.3	7.7	6.5	22.7	20.3

Table A1.3
RELATIVE SHARES OF SUB SECTORS IN CAPITAL GOODS

	1974	1980	1984	1990	1994
Output					
Cap.goods	100	100	100	100	100
Non-Ele	31.7	34.0	35.5	31.3	30.3
Ele. Mach.	34.0	34.2	31.2	35.6	35.0
Trns.Equipt	34.3	31.8	33.2	33.2	34.7
Fixed Capital					
Cap.goods	100	100	100	100	100
Non-Ele	35.1	27.8	32.7	28.6	29.5
Ele. Mach.	31.2	23.0	26.0	32.2	32.7
Trns.Equipt	33.7	49.2	41.3	39.1	37.8

Appendix 3

A3.1 A note on ASI data

Annual Survey of Industries gives a detailed report on the performance of the industrial sector of India brought out every year by Central Statistical Organisation. It replaced both the Census of Manufacturing Industries and the Sample Survey of Manufacturing Industries with effect from the year 1959. The survey is conducted for registered sector only. The present study considered both aggregate Manufacturing Sector and the disaggregated two digit capital goods sector in India. The aggregate manufacturing consists of 19 (20 to38) two-digit industries, while the capital goods sector consists of three industries (36, 37, 38), as per ASI classification. This classification is based on the National Industrial Classification (NIC), while ASI follows NIC 1970 upto 1988-89, it follows NIC 1987 after that. We follow the earlier classification in which electrical machinery and non-electrical machinery are classified separately. For post 1989-90 period, we therefore collected the three digit level data and is aggregated for two digit level, for these two industries. A brief description ASI definitions of variables are given below.

3.1.1 ASI Definitions of Variables

Fixed Capital represents the depreciated value of fixed assets owned by the factor as on the closing day of the accounting year. Fixed assets are those which have a normal productive life of more than one year. It covers all types of assets, new or used or own constructed, deployed for production, transportation, living or recreational facilities, hospitals, schools etc. for factory personnel.

Depreciation is consumption of fixed capital due to wear and tear and obsolescence during the accounting year and is taken as provided by the factory owner or is estimated on the basis of cost of installation and working life of fixed assets.

Total Employees include all workers and persons receiving wages and holding supervisory or managerial positions engaged in administrative office, store keeping section and welfare sections, sales department as also those engaged in purchase of raw materials etc or production of fixed assets for the factory and watch and ward staff.

Total Emoluments are defined to include all remuneration capable of being expressed in monetary terms and also payable more or less regularly in each pay period to total employees plus imputed value of benefits in kind.

Fuels consumed represent total purchase value of all items of fuels, lubricants, electricity, water etc. consumed by the factory during the accounting year including gasoline and other fuels for vehicles except those that directly enter into products as materials consumed.

Materials consumed represent the total delivered value of all items of raw materials, components, chemicals, packing materials and stores which actually entered into the production process of the factory during the accounting year. Also include the cost of material used in the production of fixed assets including construction work for factory's own use.

Gross Output is defined to include the ex-factory value of products and by-products manufactured during the accounting year. It also includes the receipt for non-industrial services rendered to others, the receipt for work done for others on material supplied by them.

Table A3.1 Ratio of estimated capital stock to fixed capital, 1974-94

Year	Agg. Mfg.	Non-elect.	Elect. Mach	Trns. equpt.
1973-4	3.5062	3.2151	2.4891	4.0068
1974-5	4.1804	3.5899	2.7301	4.6735
1975-6	3.9046	3.6343	3.0196	5.0120
1976-7	3.6501	3.4891	2.9439	4.3791
1977-8	3.4946	3.3473	2.9365	4.2930
1978-9	3.3988	3.5931	3.0696	2.6467
1979-80	3.5414	3.7826	3.2772	3.0010
1980-1	3.6892	4.1016	3.3837	3.3266
1981-2	3.7027	4.0032	3.5812	3.5168
1982-3	3.5054	3.8001	3.1812	3.4244
1983-4	3.2415	3.3869	3.1055	3.4914
1984-5	3.2805	3.7332	3.0800	3.2669
1985-6	3.3885	3.3145	3.2279	3.4345
1986-7	3.4074	3.9534	3.2771	3.3831
1987-8	3.3359	3.9130	2.9433	3.3211
1988-9	3.4612	3.9944	2.8893	3.5397
1989-90	3.5517	3.9989	3.0960	3.8442
1990-1	3.2681	3.9241	3.0427	4.0840
1991-2	3.5122	4.2114	3.3386	4.2365
1992-3	3.3709	3.5747	3.2965	4.0116
1993-4	3.1305	3.8698	3.2324	3.8480

Note: Estimated as estimated capital stock/fixed capital (using constant price figures).

Table A 3.2a Weights assigned for constructing fuel price index in selected industries

Industry ⇒ Commodity ⇓	Non-elect Machinery	Electrical Machinery	Transport Equipment	All Manufacturing
Coal and lignite	5.84	1.43	3.05	14.86
Petroleum, natural gas	3.27	4.25	0.00	38.80
Electricity	90.89	94.32	96.95	46.34
Total	100.00	100.00	100.00	100.00

Table A 3.2b Weights assigned for constructing material price index in selected industries

Industry ⇒ Commodity ⇓	Non-elect Machinery	Electrical Machinery	Transport Equipment	All Manufacturing
Food Articles	0.000	0.002	0.000	4.860
Non food articles	0.223	0.071	0.387	17.294
Metallic minerals	0.001	0.000	0.000	0.622
Non-metallic minerals	0.027	0.001	0.000	2.383
Food products	0.000	0.000	0.000	1.553
Beverages, tobacco	0.000	0.000	0.000	0.192
Cotton	0.124	0.187	0.044	4.813
Wool	0.001	0.000	0.002	3.691
Jute, hemp, mesta textiles	0.053	0.008	0.034	1.092
Textiles	0.263	0.063	0.567	1.559
Wood	1.750	1.777	1.600	0.656
Paper	0.819	3.256	1.707	4.392
Leather	0.071	0.020	0.088	0.868
Rubber, plastic products etc	6.241	4.994	16.025	5.502
Chemicals	3.953	16.048	12.962	18.495
Non metallic mineral products	0.556	2.301	0.614	1.164
Basic metals	69.619	57.530	47.163	23.462
Metal products	15.514	10.496	15.602	6.069
Others	0.784	3.248	3.206	1.333
Total	100	100	100	100

Source: Input Output transaction matrix, 1989-90.

Table A 3.3 ESTIMATED CORRELATION BETWEEN DIFFERENT MEASURES OF CU

Aggregate manufacturing

Linear					**Logarithmic**					**Detrended**				
	Cost	K/Y	Instlled	Wharton		Cost	K/Y	Instlled	Wharton		Cost	K/Y	Instll	Whart
Cost	1.00				Cost	1.00				Cost	1.00			
K/Y	0.17	1.00			K/Y	0.15	1.00			K/Y	-0.15	1.00		
Instlled	0.11	-0.07	1.00		Instlled	0.03	-0.53	1.00		Instlled	-0.23	0.41	1.00	
Wharton	0.68	0.03	-0.20	1.00	Wharton	0.69	0.02	-0.14	1.00	Wharton	0.67	-0.36	-0.10	1.00

Contd..

Capital Goods Industry

Non Electrical Machinery

Linear	Cost	K/Y	Wharton	Logarithmic	Cost	K/Y	Wharton	Detrended	Cost	K/Y	Wharton
Cost	1			Cost	1			Cost	1		
K/Y	0.9956	1		K/Y	0.9959	1		K/Y	0.9965	1	
Wharton	0.8409	0.847	1	Wharton	0.852	0.8572	1	Wharton	0.8412	0.8638	1
	Cost	**Installed**			**Cost**	**Installed**			**Cost**	**Installed**	
Cost	1			Cost	1			Cost	1		
Installed	0.6632	1		Installed	0.6828	1		Installed	0.7824	1	

Electrical Machinery

Linear	Cost	K/Y	Wharton	Logarithmic	Cost	K/Y	Wharton	Detrended	Cost	K/Y	Wharton
Cost	1			Cost	1			Cost	1		
K/Y	0.7691	1		K/Y	0.7713	1		K/Y	0.6729	1	
Wharton	0.2673	0.4262	1	Wharton	0.2539	0.4245	1	Wharton	-0.111	0.2851	1
	Cost	**Installed**			**Cost**	**Installed**			**Cost**	**Installed**	
Cost	1			Cost	1			Cost	1		
Installed	0.8319	1		Installed	0.8358	1		Installed	0.9835	1	

Transport Equipment

Linear	Cost	K/Y	Wharton	Logarithmic	Cost	K/Y	Wharton	Detrended	Cost	K/Y	Wharton
Cost	1			Cost	1			Cost	1		
K/Y	0.9929	1		K/Y	0.9935	1		K/Y	0.9879	1	
Wharton	0.3991	0.4529	1	Wharton	0.3772	0.43	1	Wharton	-0.033	0.09	1
	Cost	**Installed**			**Cost**	**Installed**			**Cost**	**Installed**	
Cost	1			Cost	1			Cost	1		
Installed	0.4697	1		Installed	0.4059	1		Installed	0.6759	1	

Capital Goods

Linear	Cost	K/Y	Wharton	Logarithmic	Cost	K/Y	Wharton	Detrended	Cost	K/Y	Wharton
Cost	1			Cost	1			Cost	1		
K/Y	0.8998	1		K/Y	0.9004	1		K/Y	0.8032	1	
Wharton	0.6521	0.7723	1	Wharton	0.6452	0.773	1	Wharton	0.3675	0.7611	1
	Cost	**Installed**			**Cost**	**Installed**			**Cost**	**Installed**	
Cost	1			Cost	1			Cost	1		
Installed	-0.230	1		Installed	-0.183	1		Installed	-0.299	1	

Appendix 4

Table A4.1 GROWTH OF OUTPUT, CAPACITY AND UTILISATION IN INDIAN MANUFACTURING, 1974-94

Year	Output				Potential Output				Capacity Utilisation			
	Agg. Mfg	Non.Elect. Mach	Elect.Machinery.	Trnspt. eqpt.	Agg. Mfg	Non.Elect. Mach	Elect.Machinery.	Trnspt. eqpt.	Agg. Mfg	Non.Elect. Mach	Elect.Machinery.	Trnspt. eqpt.
1974-5	10.8	15.8	-8.4	-4.2	4.82	10.44	19.23	6.86	5.7	4.9	-23.1	-10.4
1975-6	11.5	0.7	13.0	-3.1	8.23	7.06	4.78	4.32	3.0	-5.9	7.9	-7.1
1976-7	10.9	18.7	19.3	16.0	5.16	5.66	5.32	5.87	5.5	12.4	13.3	9.6
1977-8	11.4	7.6	7.9	1.5	5.39	6.58	6.87	4.42	5.7	0.9	0.9	-2.8
1978-9	-5.7	6.7	6.7	14.8	7.97	3.51	6.21	37.23	-12.7	3.1	0.5	-16.3
1979-80	-0.3	3.2	9.7	6.2	7.69	7.33	9.09	6.23	-7.5	-3.9	0.6	0.0
1980-1	10.5	7.5	16.2	6.0	5.07	4.58	7.03	4.15	5.2	2.8	8.6	1.8
1981-2	18.9	6.2	2.2	11.1	5.69	7.91	6.47	5.75	12.5	-1.6	-4.0	5.0
1982-3	12.9	7.6	20.5	8.4	6.22	7.47	12.07	6.72	6.3	0.1	7.5	1.6
1983-4	0.9	6.8	-3.7	3.1	9.74	11.68	10.68	6.04	-8.1	-4.4	-13.0	-2.8
1984-5	6.9	5.5	12.3	9.9	6.39	7.34	9.72	10.50	0.4	-1.8	2.4	-0.5
1985-6	7.5	7.0	5.4	-0.8	6.23	10.32	8.16	6.09	1.2	-3.0	-2.6	-6.5
1986-7	4.8	-2.0	6.0	13.4	5.79	-0.21	7.88	5.99	-1.0	-1.8	-1.8	7.0
1987-8	8.0	14.9	24.1	7.5	7.64	7.68	16.19	7.86	0.3	6.7	6.8	-0.4
1988-9	10.6	1.6	11.5	18.0	8.06	7.67	17.04	5.95	2.3	-5.7	-4.7	11.4
1989-90	12.1	15.5	14.4	7.8	7.08	6.95	8.08	4.97	4.7	8.0	5.8	2.7
1990-1	8.7	6.0	8.8	9.3	11.30	7.69	13.23	4.22	-2.4	-1.6	-3.9	4.9
1991-2	-1.3	-3.6	-1.1	-10.2	7.14	6.71	9.93	9.41	-7.9	-9.6	-10.0	-17.9
1992-3	9.9	5.6	10.2	19.2	9.57	13.36	11.53	7.54	0.3	-6.9	-1.2	10.9
1993-4	5.2	4.6	-4.1	10.5	7.92	2.43	9.53	5.89	-2.6	2.2	-12.5	4.4

Appendix 5

Figure A 5.1 CU and Relative Prices- Non electrical Machinery

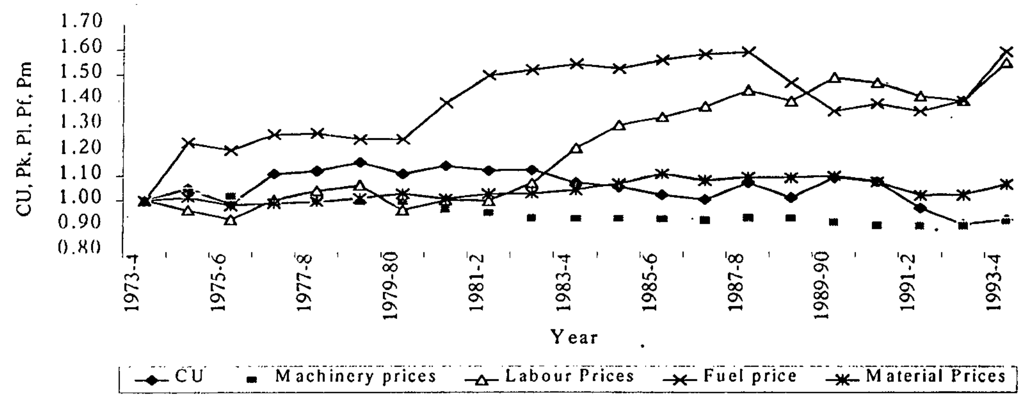

Figure A5.2 CU and Relative Prices: Electrical Machinery

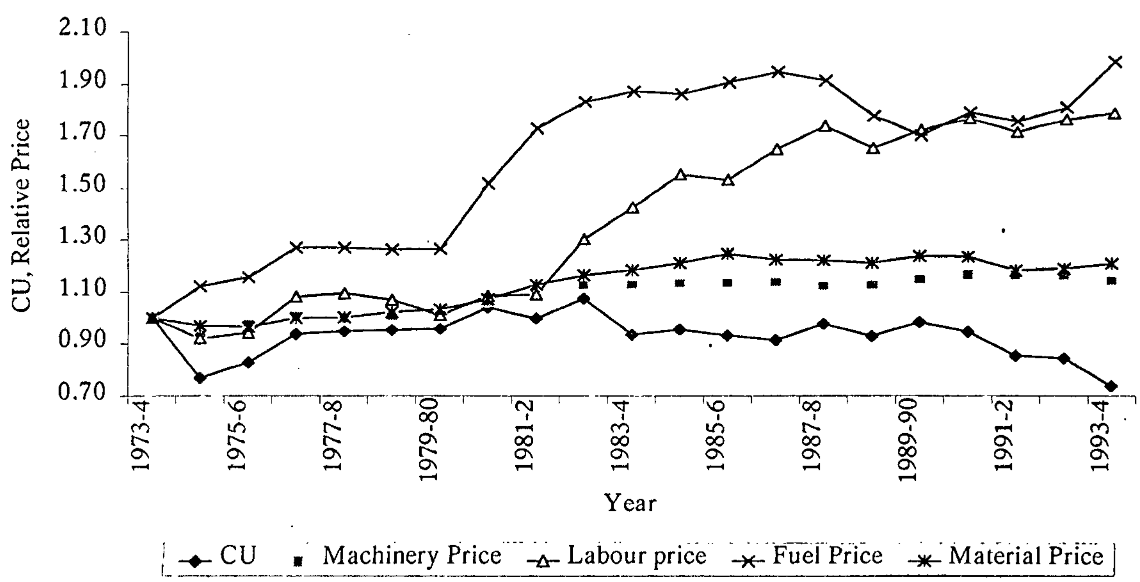

Figure A5.3 CU and Relative Prices-Transport equipments