ISSN 2454-5597

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Working Paper-26
http://iire.in/ojs/index.php
Issue-August 2016

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Abstract

Although, the Indian industries have experienced more than two decades of reforms; they are unable to have a steady growth rate over the years. There could be various causes behind this. However, inefficiencies among Indian manufacturing industries is felt, could be a major cause of this unsteady and inconsistent growth. These inefficiencies could be due to the influence of various factors as discussed in Leibenstein's theory of X-efficiency. Leibenstein measures X-inefficiency as the difference between the actual output and the maximum output attributable to the input that is not used effectively. The study aims at measuring this X-inefficiency in a set of Indian industries using DEA and compares them over two different periods, *i.e.*, 2003-04 and 2008-09 using ASI data. The study concentrates on six manufacturing industries located in sixteen states of India. A Tobit regression is also carried out to identify the factors influencing these inefficiencies. Tobit results show strong influence of localisation and urbanisation economies on technical, scale and allocative inefficiency to be prevalent in 2003-04 while management labour productivity is shown to influence technical inefficiency. In 2008-09, it was found that impact of liquidity on inefficiency prevailed to a large extent while all others were not significant. The high allocative inefficiency and the influence of inflation indicate the possibility of over investment in inventories in these industries.

Keywords: X-Inefficiency, Leibenstein's Theory, Indian Manufacturing.

JEL Codes: L6, D21, D22

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1. INTRODUCTION:

The liberalization process in India began in the mid-1980s, but the effect of these, were seen almost a decade later, *i.e.*, in the mid and somewhat late 1990s when industries grew rapidly to reach an all-time high of 11.77 per cent in 1996-97 (GOI, 1997). However, this high growth did not remain consistent and it came down to 6.1 per cent and remained steady at this during the decades 1985-86 to 1994-95 and 1994-95 to 2003-04 (Chandrashekhar and Ghosh, 2004). Recent trends indicate that growth in this sector is volatile (GOI, 2012) and the current position is that India is worst off on industrial growth (Livemint, 2013). Thus, it is seen that although the Indian industries have experienced more than two decades of reforms, they are unable to have a steady growth rate. There could be various reasons for this situation, however, the inefficiencies among Indian manufacturing industries is felt, could be a major cause for this unsteady and inconsistent growth. These inefficiencies could be due to the influence of various factors as discussed in Leibenstein's theory of X-efficiency. In the basic proposition of X- efficiency theory, he identified non-maximizing behaviour as a key to the idea of X-efficiency (Leibenstein, 1978). According to him, it is a result of nexus of pressures an individual decision maker faces from external environment and the responsibility consequences that apply to him. With lower intensity of environmental pressures on the decision maker his concern over the constraints operating on the organization is less and thus his effort expanded is also less. This reduced effort according to Leibenstein, leads to higher costs and the basic proposition then is that more loose is the effort- responsibility consequences, greater the degree of X-inefficiency. In other words, it is the excess of actual over minimum cost, or the difference between maximal effectiveness of utilization and actual utilization. Thus he says that the degree of X-inefficiency is measured as the difference between the actual output and the maximum output attributable to the input that is not used effectively. A study in this direction would possibly help in analysing the unsteady and inconsistent growth in Indian manufacturing industries.

There have been both theoretical and empirical works on X-inefficiency. While, theoretical works have concentrated on X-inefficiency and its relation with competition and market relation (Bertoletti and Poletti 1997), X-inefficiency in efficient wages (Ellingsen 1997) *etc*., the empirical work in X-inefficiency relate to comparison of X-inefficiency between Canadian and US firms (Foote and Ashegian, 1985),comparison of X-inefficiency between grain marketing and farm supply co-operatives (Ariyaratne *et al.,* 2000), review on X-inefficiency of state owned enterprises in market competition (Zhuang *et al*., 2010), measuring X-inefficiency of hockey team in production of “offences” during 1989-90 season (Leibenstein & Maital 1992), and comparison of Pakistani and US firms for X-inefficiency (White 1976). These clearly show that such a study in the Indian context seems to be unheard of and therefore, the paper aims at measuring the X-inefficiency in a set of Indian industries using DEA and comparing those over two different periods, *i.e.*, 2003-04 and 2008-09 using ASI[1] data. The study concentrates on six[2] manufacturing industries located in sixteen[3] states of India. A tobit regression is also carried out to identify the factors influencing these inefficiencies.

The results show that industries are allocatively most inefficient followed by scale and technical inefficiency. Tobit results show strong influence of localisation and urbanisation economies on technical, scale and allocative inefficiency to be prevalent in 2003-04 while management labour productivity is shown to influence technical inefficiency. In 2008-09, it was found that impact of liquidity on inefficiency prevailed to a large extent while all others were not significant. The high allocative inefficiency and the influence of inflation indicate the possibility of over investment in inventories in these industries.

Thus, the next section deals with the review of literature followed by approach used in this study such as in section 3. Section 4 describes the methodology followed by discussion on the data used and adjustments made to make data workable in section 5. While, section 6 deals with analysis of empirical results, section 7 brings out policy implication and section 8 concludes the paper.

2. REVIEW OF LITERATURE:

Dealing with theoretical and empirical works of inefficiency it is found that White (1976) talks about the monopoly firm which will be less efficient than a competitive industry. The study presents the views of Wells (1973) and Ranis (1975) who argue that in less developed countries this inefficiency is likely to take the form of excessive use of capital-intensive equipment and methods. Capital-intensive technologies he says involve large quantities of shiny new equipment, which convey the aura of being up-to-date and yield high prestige, *i.e*., capital-intensive equipment in less developed countries is felt to embody a fair amount of non-pecuniary benefits. The entrepreneur enjoying a monopoly or market power position (protected by tariffs or licenses or other barriers to new entry by potential rivals) according to White (1976), is likely to trade off some potential profits for equipment that is more capital-intensive than cost minimization would dictate. The entrepreneur in a more competitive environment is said to find his choices are under tighter constraints, and he is likely to choose more labour-intensive methods. White (1976) hypothised that entrepreneurs in Pakistan had a fairly extreme preference for non-pecuniary benefits; if given a completely free choice, they would prefer to use the same technology as that found in developed countries in the same industry, for the reasons given by Wells (1973) and Ranis (1975). Specifically, the entrepreneurs would prefer to use the same capital-labour ratio as that found in developed countries. The presence or absence of a competitive environment, though, will influence th0e freedom of that choice; more competition will tend to force them to use more labour-intensive technologies. This proposition was tested by White (1976) using Pakistani and U.S. cross-section data for a sample of 31 Industries for 1967-1968 and it was assumed that the U.S. capital-labour ratios are those that the Pakistani entrepreneurs are interested in emulating. The results found that there were major similarities in the kinds of technologies used in Pakistani and an American industry however these similarities were not absolute. There was room for some flexibility, and in a competitive environment, whether created from internal or external sources, does appear to encourage this flexibility in socially worthwhile directions in Pakistan and likely in other LDCs as well, *i.e.,* in labour-intensive directions. This especially appears to be true for labour involved in activities away from the production floor. The conclusion that followed from the quantitative study in this paper, was that the potential for technological flexibility didn't appear to be present and that therefore policies that affect incentives and that can potentially affect entrepreneurial behaviour was indeed important. These included policies affecting relative prices and general competitive environment.

Stevenson (1982) considered whether differences in competitive pressure are systematically associated with differences in relative efficiencies. He used electric utility industry for an empirical analysis of the competitive pressure hypothesis because tests for the effects of competitive pressure on X-inefficiency are best conducted on a sample that exhibits variations in the degree of competition but not in the availability of production technologies and the electric utility industry provided a useful sample for this analysis. He assumed that the utilities are profit-oriented entities with an objective function of cost minimization following Christensen and Greene (1976). He used sample which comprised of the generation activity of 79 electric utilities and 25 of which are combinations. The data were derived from various issues of the Federal Power Commission's (FPC) Statistics of Privately Owned Electric Utilities in the United States, the FPC's Performance Profiles: 1963-70, and the National Association of Regulatory Utility Commissioners. The result showed that the competitive entry into established markets can lead to the enforcement of higher levels of efficiency on the work force. Evidence from the electric utility industry suggested that competitive pressure does affect both the static and dynamic efficiency. Though the future potential for competition between electric and natural gas distributors may be limited due to a declining supply of natural gas, the results showed the significant importance for policy development in the regulated sector.

Foote and Ashegian (1985) measure relative X-inefficiency of Canadian owned firms and U.S. owned firms operating in Canada. Canadian government policies aimed at subsidization of domestic firms in hope that it will improve the efficiency of domestic firms over their foreign counterparts in Canada. The paper thus compares the X-inefficiency of Canadian owned firms with their U.S. owned counterparts operating in Canada, so as to analyse the implications of X- inefficiency within the production process of the two. The paper used cross sectional annual balance sheet data from 198 manufacturing firms in Canada over the period 1971 to 1980 from the Canadian Compustat Tape. The data included 172 Canadian owned firms and 26 U.S. owned firms operating in the manufacturing sector of the Canadian economy. They found that U.S. owned firms exhibit lower X-inefficiency than Canadian owned firms and the Canadian owned firms have higher returns to scale, but lower elasticity of substitution. Although capital and labour contributes real value added of Canadian owned firms than to U.S. owned firms, it was found that managers of Canadian owned firms was not able to substitute one factor for another like the managers of U.S. owned firm.

Leibenstein, and Maital (1992) argue that DEA allows for measuring and partitioning X-inefficiency, in the context of what Leibenstein (1979) has termed the missing branch of economics, or "micro-micro" *(i.e.*, analysis of the internal workings of organizations and the groups that comprise them). This is illustrated by finding the X-inefficiency of 19 members of the Boston Bruins hockey team in the production of "offense" during the 1989-1990 seasons. The paper shows that although DEA is a model built explicitly on maximization, since X-efficiency is based on max/non-max postulate which allows for but does not preclude maximising behaviour. DEA provides a useful set of scalar measures that enables positive quantities for comparison of inefficient agents with efficient ones. This is done by assuming that at least some decision making units are successfully practising maximizing behaviour. The paper concludes that to establish the usefulness and validity of DEA as an X-inefficiency methodology could include a retrospective study of previous empirical X-inefficiency studies, using DEA to re-evaluate their conclusions.

Ellingsen (1997) in his paper argues that the distributional conflict between agents is a prime source of organizational inefficiency. The author assumes that agents have limited liability under an optimum multitask incentive scheme. Wage level is shown to increase with agent's discretion and organizational profits. But with multiple agents it is felt that the production would not be fully optimal for the principle to fully eliminate distributional conflicts within an organization. Thus the analysis brings out the relation between competition and inflation of costs pointing out the role of the organizations production technology.

Bertoletti and Poletti (1997) question the traditional thinking of whether the competition forces firms toward efficient behaviour. The author considers a duopoly firms run by managers and affected by adverse selection on costs. The paper points out that, to have a genuine effect on firm X-inefficiency, competition must change managerial incentives. It introduced the availability of some signal on the rivals' behaviour and showed that, if costs are correlated, the contractual use of that signal can render private managerial information uninfluential. In the quoted literature, competition is said to have no genuine effects on X-inefficiency because it does not change the cost of inducing the manager to make a given level of effort. The model of oligopolistic interactions was used among firms affected by adverse selection on (ex post observable) costs, and investigated the effect of increasing the number of competitors. The authors used settings where marginal cost is endogenous and depends negatively on managerial effort. They considered imperfectly competitive market with firms facing an internal agency problem. This is done by modelling a Cournot duopoly where firms' costs depend on a firm-specific parameter and on managerial effort.

Frantz, (2007) has discussed Leibenstein's idea on X-inefficiency by analysing many of his works. In the introductory chapter, discussing his X-efficiency theory, Frantz points out that the 'Development of X-Efficiency Theory' offered a new view of neoclassical economics one which brought out the implications of non-fully rational behaviour. This according to him implied that firms are not just profit maximizing or cost minimizing but still beyond. This is based on six postulates which are-imperfect markets, incomplete labour contracts/ production function, discretionary effort, rationality as a continuum and inert areas. Effect of imperfection is said to include obstacles to buying and selling inputs and final products and obstacles to transacting otherwise mutually advantageous trade. In labour contracts he says the labourer is free to perform in his best possible way because labour contract define hours of work, wages to be paid and besides this even if firms may have performance standards and expectations, there is nothing about labourer's behaviour in connection with production of output. This also according to him implies that workers have effort discretion. Production functions again he says are also not strictly the conversion of inputs into outputs as per engineering blueprints. Individuals according to him do not always behave fully rational. This behaviour of not fully rational could also be the possibility for decision makers. The concept of inert area is also said to be talked about by Leibenstein. This is defined as a range of effort within which the individual is mobile in the sense that it is habitual, routine *etc*. The individual leaves the inert area due to pressure from management, peers *etc*. when such pressures are such that the cost of remaining in the inert area is greater than the benefit.

Thus, the review apart from various theoretical and empirical works clearly spells out the different angles in which Leibenstein has analysed X-inefficiency.

3. APPROACH TO THE STUDY:

The review of literature shows that the studies have used non-parametric programming and Data Envelopment Analysis (DEA) pioneered by Farrell (1957), for measuring X-inefficiency, however there are others like Foote and Ashegian (1985), who have used a log-likelihood ratio to discriminate between Cobb-Douglas, CES and trans logarithmic production function describing the Canadian manufacturing sector. The production relationships here have been estimated cross-sectionally over time. In this paper, inefficiency is calculated by first measuring relative efficiencies of firms in an industry spread over number of states and then deducting this efficiency from one. The relative efficiency is measured using DEA.

Though, theoretically studies have concentrated on X-inefficiency and its relation with competition and market relation (Bertoletti and Poletti 1997), X-inefficiency in efficient wages (Ellingsen 1997) *etc*., empirically working on such issues need accurate data of individual firms which are not that easy in vast economy like India. However, the issue of principal agent problem discussed by Leibenstein could be taken up by interpreting the work pressures and decisions of agents. Peel (1974), indirectly points out that it is the decreases in efforts and effectiveness of managers that lead to X-inefficiency, which is also confirmed by Button and Weyman Jones (1992). They also point out that Leibenstein (1978) identified non-maximizing behaviour as a key to the idea of X-efficiency and this according to it is as a result of nexus of pressures an individual decision maker faces from external environment and the responsibility consequences that apply to individual decision maker. With lower intensity of environmental pressures on the decision maker, his concern over the constraints operating on the organization is less and thus his effort expended is also less. This reduced effort according to Leibenstein, leads to higher costs and the basic proposition then is that more loose is the effort- responsibility consequences, greater the degree of X-inefficiency. In other words, it is the excess of actual over minimum cost, or the difference between maximal effectiveness of utilization and actual utilization. Thus he says that the degree of X-inefficiency is measured as the difference between the actual output and the maximum output attributable to the input that is not used effectively. Therefore, it is felt that manager's role in the functioning of the production process plays an important role in a firm's development. Indices related to these could be considered for the econometric model.

Besides, the factors influencing efficiency could also be considered for they would be inversely influencing inefficiency. Considering these factors, it could be said that though, Scitovsky (1955) discusses concentration measurements of industry under different economic conditions, regional economic theory links benefits of firms to scale economies, localisation economies and urbanisation economies. Within the firm, scale economies result due to increase in production level and these are enhanced when firms are located in places where other firms of the same industry are located (Bannister *et al*; 1995). At the industry level firms get the benefit of scale economies because of the size of the industry in a particular location (Lall *et al*; 2004). These benefits refer to the localisation economies and they relate to the sharing of specialized labour or information on techniques, production *etc.* related to the industry. Added to these, when large number of firms belonging to different industries are located at close proximity to one another in a particular location, firms get the benefit of physical and financial infrastructure, larger pools of labour with general skills, entrepreneurial talents *etc*. These benefits which are outside the industry are referred to as agglomeration/urbanisation economies. Though these benefits help the firms in reducing cost, one cannot forget the diseconomies like higher wage bills, rising land values, traffic congestion *etc.*, which are associated with concentration of firms in a location. Surely, firms that are able to see that economies of regional concentration outweigh these diseconomies, would be able to produce more efficiently (Bannister *et al.,* 1995). However, if economies of regional concentration is unable to outweigh the diseconomies or if diseconomies are stronger than the economies inefficiency is the result.

Thus, this study tries to find the extent to which inefficiency of firms in different industries in different regions is influenced by the liquidity in industry[4], the management labour productivity, localisation and urbanisation factors by using an econometric model. As liquidity in industry and management labour productivity relates to manger's decisions in a firm the paper uses these two indices. The two are represented as LIQ- Liquidity in industry and PRO- management labour productivity. While LIQ is a measure of short term financial strength and the adequacy of cash flows to meet near obligations, PRO represents the income generated per manager by lowering cost per unit.

Using the negative relationship between inefficiency and the urbanization and localization factors, the paper uses five indicators relating to them. These indicators are represented by LQO – Location Quotient for Output, LQF – Location Quotient for number of factories in operation in each industry, LQS – Location Quotient for average scale of industry, LQU - Location Quotient for urbanisation and AGG/ DIV – Agglomeration or Diversity. While LQO is an average measure of size of the industry using output in comparison to that at the national level, LQF, is a measure of average size of the industry using factories in operation in comparison to that at the national level. Again while LQS is a measure of average scale of regional industry in relation to the average scale at the national level, LQU is a measure of the effects of urbanisation economies enjoyed by all the firms in the region.

The first three of these four indicators (LQO, LQF, LQS) represent localisation and the last one (LQU) refers to urbanisation. Agglomeration (AGG/DIV) is measured as one minus Herfindahl-Hirschman index[5]. Since diversity could be used to capture effects of inter-industry agglomeration, the study measures it by (1-(Herfindahl-Hirschman index)) which is measure of specialization and concentration.

4. METHODOLOGY:

As DEA is used to measure inefficiencies in industries in different states in this section the study initially explains the DEA model. Further, as factors affecting inefficiencies in these industries are captured through an econometric (Tobit) model, the same is also explained.

4.1 DEA model:

Inter-state variations in industrial efficiency are measured using number of approaches. The common among them are the econometric approach which uses

Cobb-Douglas and CES production functions and the modified econometric approach called the Stochastic Frontier Analysis (Kumbhakar and Lovell, 2000). Though Stochastic Frontier Analysis comes under parametric approach, recent trend shows the use of DEA- non-parametric approach in great use. The technique is identified as one, which uses least number of assumptions as compared to other parametric approaches (Balk *et al*., 2001).

Performance of an industry is best studied by recognizing the divergence of both inputs and output. DEA is a methodology (Ramanathan, 2003 and Ray, 2004) in which linear programming is interestingly applied, resulting in comparative efficiency. Generally, DEA is used for assessing relative performance of a set of firms called a Decision Making Unit (DMU). These units make use of identical inputs so as to produce a variety of identical outputs. Similarly, this study considers the firms belonging to an industry using identical inputs and producing identical outputs across states. The DEA which uses linear programming in an interesting way helps in bringing out the comparative efficiency, the wastage of resources & the optimal output related to these firms in an industry in the different states they operate. These are then converted to inefficiency by deducting the efficiency figures from one. As such, the study initially looks into the inter-state variations in industrial inefficiency.

Discussing the working process under DEA, the study considers six industries in 16 states of India. Here, the industrial output considered relates to one single output for each industry in a state. Besides, these industries in the 16 different states are considered to use four inputs to produce a single output. The efficiency of conversion here is measured for a particular state by a fractional program. This program maximizes the ratio of weighted outputs to weighted inputs for the state considered, subject to the condition that the similar ratios for all states be less than or equal to one. Weights here are considered as non-negatives. (See Appendix-1 for the mathematical formulation of the DEA model)

4.2 Econometric model:

Since the study focuses on principal agent problem the interpretation of which have been shown to consider liquidity in the industry and management labour productivity as factors influencing inefficiency the econometric problem would make use of the following two indices. The LIQ-liquidity in the industry is calculated as current ratio of the firm which is given by the ratio of current assets[6] to current liabilities[7] which acts as a key measure of short term financial strength and the adequacy of cash flow to meet near obligation (Ariyaratne *et al*., 2000). This liquidity measure helps the firm to spend with ease. Considering relationship with inefficiencies it could be said that liquidity and inefficiency are positively related.

An efficient management of a firm is said to generate more income per employee and would have lower per unit cost. Taking gross income per management employee as a proxy to management labour productivity it could be said that the relationship between inefficiency and management labour productivity is negative. Thus, PRO is calculated as the ratio of gross income to management labour wages.

As the paper further aims at analysing the extent to which other factors such as concentration indices also influence the inefficiency of industries in each state, these factors have also been incorporated in the econometric model. Since it is hypothesized that inefficiencies of industry in each state are said to be influenced by localisation and urbanisation economies as well as principal agent problems, inefficiencies of different states under each industry are considered as dependent variables and the seven indicators relating to localisation, urbanisation, agglomeration, liquidity and managerial productivity are used as independent variables. Moreover, since the use of OLS for a dependent variable ranging from zero to one would give biased results (Wooldridge, 2011), the study uses maximum likelihood estimation. Thus, a two limit Tobit model is used to analyse the econometric model. These models have been used for five different inefficiencies: the first related to technical, second related to scale third related to allocative, fourth related to economic and fifth related to overall. The above model is defined as follows,

$$INEFF_{ij} = f\,(LQO_{ij}, LQF_{ij}, LQS_{ij}, LQU_{ij}, AGG/\,DIV, LIQ, PRO, D1 \text{ to } D5) \qquad \ldots.\ (1)$$

Here, the $INEFF_{ij}$ represents technical, scale, allocative, economic and overall inefficiency for industry *i* in state *j*.

The independent variables have been classified into four groups. The first is a set of variables LQO, LQF, and LQS explained in section 2 which are the location quotients capturing localisation economies, the second group made up of one variable (LQU) captures urban economies, the third group is made up of one variable (AGG/DIV) which consists of agglomeration economies while the fourth group is made up of principal agent problem represented by LIQ and PRO. These are technically defined as follows: -

$$LQO_{ij}= (O_{ij}/\sum O_{ij})/ (NO_i/\sum NO_i) \quad \ldots\ldots\ldots\ldots (1.1)$$

where, O_{ij} is the total output in industry *i* and state *j* while NO_i is the national output in industry *i* for all states.

$$LQF_{ij}= (F_{ij}/\sum F_{ij})/ (NF_i/\sum NF_i) \quad \ldots\ldots\ldots\ldots (1.2)$$

where,F_{ij} is the number of factories in operation of industry *i* in state *j* while $NF_i$is the number of factories in operation of industry *i* in all states.

$$LQS_{ij}= (LE_{ij}/\sum LE_{ij})/ (F_{ij}/\sum F_{ij}) \quad \ldots\ldots\ldots\ldots (1.3)$$

where, LE_{ij} is the labour employed by industry *i* and state *j* while F_{ij} is the factories in operation of industry *i* in state *j*.

$$LQU_{ij}= (U_j/P_j)/ (NU/NP) \quad \ldots\ldots\ldots\ldots (1.4)$$

where, U_j is the urban population in state *j* while P_j is the total population of state *j*. NU is the national urban population while NP is the total national population.

Besides these localisation and urbanisation indicators, the indicator representing agglomeration economies *i.e.* AGG/DIV is given by

$$AGG/DIV = (1 – (\text{Herfindal-Hirschman index})) \quad \ldots\ldots\ldots\ldots (1.5)$$

$$LIQ_{ij} = WC_{ij}/OL_{ij} \quad \ldots\ldots\ldots\ldots (1.6)$$

where WC_{ij} is the working capital and OL_{ij} is the outstanding loans in industry i and state j.

$$PRO_{ij} = GI_{ij}/MLW_{ij} \quad \text{..(1.7)}$$

where, GI_{ij} is the gross income of industry i in state j and $MLW_{ij}$is the salary of mangers in industry i and state j.

In order to abide by the Tobit model, one industry is considered as a benchmark and other industries have been compared with this benchmark industry. As such, dummy variables (D1 to D5) are used to represent different industries to suit the Tobit model.

5. DATA BASE AND ADJUSTMENTS:

The study uses disaggregated state wise data on industries from Volume I of ASI data for the years 2003-04 and 2008-09. These two years in particular are considered as it is after 2003-04 the volatility in industrial growth is obviously seen and a five-year gap would be most appropriate for comparison. A set[8] of sub-industries have been clubbed together to form six industries in all 16 states. Under each industry in the sixteen states it uses data on number of factories in operation, invested capital, interest paid, working capital, outstanding loans, total output, fuels consumed, materials consumed, depreciation, gross income all available in Table 2 of the ASI volume I. Workers employed, employees other than workers and wage and salaries available in Table 4 and Electricity purchased available in Table 6 both in the same volume are used for the six industries in the sixteen states considered in this study. Data have been converted into constant price by using price deflator to see sound comparison of results. In order to capture the efficiency of a typical firm all outputs and inputs are divided by the number of factories in operation in each industry under each state.

Other than that, national and state wise urban and total population figures are collected from the Census 2001[9] and Census 2011[10] to calculate the urbanisation ratios for the year 2003-04 and 2008-09 respectively.

6. EMPIRICAL RESULTS AND ANALYSIS:

The results in this study are measured by using two different methodologies and these two methodologies have been solved by using different statistical software which have been mentioned below.

6.1 Results on Inefficiency:

The DEAP[11] package is initially used to solve the model on DEA. Comparative efficiencies have been calculated for all the sixteen states in each of the six industries. These efficiencies are split up into four, *i.e*., technical efficiency (TE), cost efficiency (CE), allocative efficiency (AE) and scale efficiency (SE). SE is the ratio of constant returns to scale technical efficiency (CRSTE) to variable returns to scale technical efficiency (VRSTE). AE is the ratio of cost efficiency to technical efficiency. While TE and SE is calculated using one output and four inputs like capital, workers (which also includes employees other than workers), electricity consumed and materials consumed in DEAP, CE and AE are calculated by considering one output and four inputs capital, labour, electricity consumed and employees other than workers and their respective prices[12]. Economic efficiency (EE) is calculated as product of TE and AE. Overall efficiency is the product of TE, AE and SE. The inefficiency in each is calculated by deducting these efficiencies, *i.e*., TE, CE, AE, SE, EE and OE from one. Then these six inefficiencies, *i.e*., technical inefficiency (TI), cost inefficiency (CI), allocative inefficiency (AI), scale inefficiency (SI), economic inefficiency (EI) and over all inefficiency (OI) have been taken separately to form six different econometric models, as shown in model I. Since managers' decision are said to play a role on the X-efficiency/X-inefficiency, surely these could be in all direction whether it is the use of technology/input or prices purchased at /share of inputs or expansion. Thus the paper considers technical, cost, allocative, scale and their different product to analyse X-inefficiency in Indian manufacturing industries.

Results on inefficiency show that industries in states are technically least inefficient which is followed by scale and allocative inefficiency. Observing Table 1A and 1B in Appendix-2 for technical inefficiency for the year 2003-04 and 2008-09 respectively, it is seen that for the period 2003-04 of study, 15 out of 16 states show at least 33 per cent of industries in these states to be technically inefficient. Of these while 2 states show 83 per cent of its industries technically inefficient, four states each show 66 per cent and 50 per cent of its respective industries technically inefficient. However, during the year 2008-09 there is an improvement as only 13 out of 16 states had at least 33 per cent of industries in these states to be technically inefficient. In other words, while four states show 83 per cent industries technically inefficient, one state had 66 per cent industries technically inefficient, three states had 50 per cent industries technically inefficient. Three states had only 17 per cent industries technically inefficient. While no state has less than 33 per cent inefficiency in 2003-04, in 2008-09 three states showed only 17 per cent inefficiency. However, states showing 83 per cent of industry inefficient were only two in 2003-04 but this increase to four in 2008-09. Thus, while there is improvement on one side there is deterioration on the other.

Observing Table 2A and 2B in Appendix-2 for allocative inefficiency for the year 2003-04 and 2008-09 respectively, it is seen that for the period 2003-04 of study, all the states under study show at least 50 per cent of industries in these states to be allocatively inefficient. Of these while two states show all six of its industries allocative inefficient, nine states had 83 per cent industries allocative inefficient and three states had 83 per cent industries allocative inefficient. However, during the year 2008-09 there is an improvement because all states had only 33 per cent of its industries allocatively inefficient. While four states had 100 per cent industries allocative inefficient, five states had 83 per cent industries allocative inefficient, four states had 66 per cent industries allocative inefficient, two states had 50 per cent industries allocative inefficient. Improvement is no doubt seen in all states that showed 50 per cent inefficiency in 2003-04 because this has been reduced to 33 per cent inefficiency in 2008-09. However, there were only two states showing 100 per cent inefficiency in 2003-04, this increased to four in 2008-09. Here again there is a mixed picture of improvement and deterioration.

Observing Table 3A and 3B in Appendix-2 for scale inefficiency for the year 2003-04 and 2008-09 respectively, it is seen that, 14 out of 16 states show at least 50 per cent of their industries scale inefficient during the year 2003-04. Of these while two states had all its industries under study scale inefficient, three states had 83 per cent of industries scale inefficient, another three states had 66 per cent of industries scale inefficient and six states had 50 per cent industries scale inefficient. Only two states had 33 per cent industries scale inefficient. However, during 2008-09, 12 out of 16 states had 50 per cent of its industries scale inefficient. Of these while one state had all its industries under study scale inefficient, three states had 83 per cent industries states scale inefficient, another five states had 66 per cent states scale inefficient and three states had 50 per cent industries scale inefficient. While one state had 33 per cent industries scale inefficient, two states had 17 per cent industries scale inefficient and one state had none of its industries as scale inefficient. Across states scale inefficiency is seen to have reduced over the two years of the study.

Overall it could be said that over the two years of the study scale inefficiency seems to have reduced in a better manner than technical and allocative inefficiencies. Between technical and allocative inefficiencies, technical inefficiency seems to have reduced more as compared to allocative inefficiency. This is because while technical inefficiencies are for a maximum of five industries in a state unlike the allocative which are there in all six industries in the states where it exists.

Coming to the industry part it is also observed from the above Tables 1A, 1B, 2A, 2B, 3A and 3B, Basic Metal and Alloys was technically inefficient in 11 states, scale inefficient in fifteen states and allocative inefficient in fourteen states for the period 2003-04 though the same reduced to four, eight and twelve respectively for the year 2008-09. The Manufacturing of Electrical Machinery (which to a greater extent are under the small scale industries) is found to be technically inefficient in eight states, scale inefficient in eleven states and allocative inefficient in eleven states in 2003-04. But in 2008-09 the same industry showed technical, scale and allocative inefficiency in ten, eight and twelve states respectively. Here, technical and allocative inefficiencies have increased from eight and eleven to ten and twelve respectively. Whereas, scale inefficiency decreased from eleven to eight states. While large scale manufacturing units using heavy machinery like the Paper and Paper products, showed eight, eight and thirteen states inefficient technically, scale and allocative in 2003-04 the same reduced marginally to twelve states for allocative inefficiency but increased to ten and eleven states respectively for technical and scale inefficiency in 2008-09. The Basic Chemicals which are found to be technically, scale and allocative inefficient in nine, eight and thirteen states respectively in the year 2003-04 showed a different picture in 2008-09. While technical and allocative inefficiency respectively remained same at nine and thirteen states, scale inefficiency increased from eight to ten states for the year 2008-09. In the case of Metal Products and Parts, while the allocative inefficiency remained the same at twelve for both the years of the study, scale inefficiency decreased from nine to eight states and technical inefficiency increased from seven to nine. In the case of Textiles while scale inefficiency and allocative inefficiency remained the same at ten and twelve respectively for both the years of the study, technical inefficiency decreased from seven to four respectively during the period of the study.

Over all it could be said that industries are allocatively most inefficient, followed by scale inefficiency and technically inefficiency for both the years under study. These indicate improper use of resources by industries or over investment of inventories which could be due to bad management or even the prevalence of inflation in the economy. The industry on Textiles, an industry dominant in the small scale sector is found to be least inefficient under all the three heads of technical, scale and allocative. This clearly shows the benefits of reforms accrued to this sector. These indicate the betterment of technology and achievement of optimal scale in industries in states.

Observing Tables 4, 5, 6, 7, 8 and 9 in Appendix-2 it is seen that the deterioration in (increase in inefficiency as compared to the first period) different inefficiencies in the different industries under study over the two periods are varying from industry to industry. Besides, while technical and scale inefficiency deterioration are equal at a total[13] of 35 over the 6 industries, allocative inefficiency deterioration was still higher at 47 over the 6 industries. The technical and allocative inefficiency deterioration was lowest in the Basic Metal and Alloys industry and highest in Metal Products and Parts industry. However, scale inefficiency deterioration continued to be lowest in the Basic Metal and Alloys industry but highest in Paper and Paper Products industry.

Industry wise, while Basic Chemicals and Manufacture of Electric Machinery have each 6 technical inefficiency deterioration, Paper and Paper Products and

Textiles have respectively 9 and 3 technical inefficiency deterioration each. Similarly, Basic Chemicals, Manufacture of Electric Machinery, Metal Products and Parts and Textiles have 5, 4, 8 and 6 respectively scale inefficiency deterioration each. In the case of allocative inefficiency deterioration, Basic Chemicals, Manufacture of Electric Machinery, Paper and Paper Products and Textiles have respectively 8, 9, 8 and 7 each. Overall looking into these details it is seen that both technical and scale inefficiencies have reduced much more as compared to allocative inefficiency.

Observing the deterioration over the two periods state wise for these different industries, it is seen that while Chhattisgarh and Jharkhand are the two states with least deterioration in inefficiencies (three) or maximum improvement in efficiency, Maharashtra, Uttar Pradesh and Punjab have high deterioration in inefficiencies to the extent of 14, 11 and 10 respectively. The deterioration in inefficiencies in other states are 9 each for Haryana, Rajasthan and Uttarakhand, 8 each for Tamil Nadu and West Bengal, 7 and 6 each for Andhra Pradesh and Madhya Pradesh respectively, 5 each for Kerala and Odisha and finally four each for Gujarat and Karnataka. Overall while Chhattisgarh and Jharkhand are the better performing states, Maharashtra is the worst performing states *i.e*. inefficiencies have increased the most in Maharashtra.

With the Permit Quota Raj[14], having siphoned off from the Indian economy due to liberalization and the reform process, industrialist have been able to adopt their choice of products and the production system. This has made them technically less inefficient as well as less inefficient in scale. However, with allocative in-efficiency being higher than the first two, it is clear that the macro problems of inflation or a supply chain mismanagement resulting in poor industrial linkages could possibly have forced the firms to over invest in inventories. This could possibly be a reason for higher allocative inefficiency and a proof of over investment in inventories prevailing in Indian industries under study. Recent study by Swaminathan *et al.*, 2013, supports the above conclusion. Added to this, the liquidity in hands of industry and the prevalence of inflation could also have forced managers to stock inventories in anticipation of higher prices, clearly indicating the X-inefficiency in Indian manufacturing industries.

Besides, while the new states could absorb the benefits of the industrial reform process easily, the industrially established states had their difficulties absorbing these benefits. Also, the new states have a benefit of experience gained by being a part of the bigger state. Added is also the enthusiasm involving in governing new states. The problem of governance, time lag involved in processing and implementing projects was a common feature of established states. As such, states like Maharashtra is found to be functioning highly inefficiently, whereas newly formed states of Chhattisgarh and Jharkhand is seen to be least inefficient.

6.2 Results of the Tobit model:

Next, the econometric model is solved using 'R'[15]. 60 regressions with 80 observations each have been run by keeping each industry as a benchmark for 2003-04 and 2008-09. Since the study considers 6 industries, therefore 6 runs for each one of the six inefficiencies (TI, AI, SI, CI, EI and OI) have been made for 2003-04 and 2008-09 respectively. The results of only Basic Metals and Alloys industry as benchmark is tabulated. This is because this industry was found to be having the least inefficiency in 2003-04 and also had the maximum significant results in the Tobit run. This is presented in Table 10 and 11 in Appendix-2.

The pre-regression data analysis of 2003-04 shows high correlation between AI and EI as compared with TI and EI for all industries. The correlation between TI and AI for all the industries is low. This shows that EI is influenced by AI to a greater extent and by TI to a lesser extent.AI shows again a high correlation with respect to OI. The correlation between TI and OI is higher than correlation between SI and OI for all the industries except for Paper and Paper Product which shows opposite results. Thus, OI is again more influenced by AI as compared with TI and SI. Similar results were obtained in 2008-09 for correlation between TI, AI and EI. For correlation between TI, AI, SI and OI, it was found that OI was more influenced by AI as compared to TI and SI. Here, the correlation between TI and OI is higher than correlation between SI and OI for all the industries.

6.2.1 Tobit Results using industry as bench mark for 2003-04 and 2008-09.:

Considering Basic Metal and Alloy industry as a benchmark in Tobit analysis for 2003-04, it is found that in the case of all the three inefficiencies- TI, SI, and OI, presented in Table 10, Textile industry is the most inefficient industry with estimated coefficient of -0.3731, -0.4807 and -0.5559 respectively below the benchmark industry. For AI, and EI, Manufacturing of Electrical Machinery industry is most inefficient with an estimated coefficient of -0.3712, and -0.4694 respectively below the benchmark industry. On the other hand, Paper and Paper Products industry is found to be the least inefficient with estimated coefficient of -0.0885, -0.2016 and-0.3815 respectively below the benchmark industry, under the three inefficiencies- TI, EI and OI. Manufacturing of Electrical Machinery is found to be least inefficient with estimated coefficient of -0.4190 respectively below the benchmark industry for SI. For AI, Basic Chemicals is found to be least inefficient with estimated coefficient of about -0.2010 below the benchmark industry Here, it is found that nearly five industries under the Tobit run on TI have statistically significant results (the degree of significance is different) below the benchmark industry. For SI, AI, EI and OI all industries under each Tobit runs show statistically significant results below the benchmark industry.

For 2008-09 keeping Basic Metal and Alloy industry as a bench mark, it is found that in the case of the three inefficiencies: AI, EI and OI presented in Table 11, Textiles is the most inefficient industry with estimated coefficient of -0.3256, -0.3368 and -0.2627 respectively below the benchmark industry. On the other hand, in the case of TI and SI Manufacture of Electrical Machinery and Metal Products and Parts respectively are found to be the least inefficient industry, with an estimated coefficient of 0.2228, and -0.0321 above and below the benchmark industry. Basic Chemicals is found to be the least inefficient industry with an estimated coefficient -0.0256, -0.0243 and -0.0289 below the benchmark for AI, EI and OI respectively. In the case of TI and SI Textile industry is found to be the least inefficient industry, with an estimated coefficient of 0.1120 and 0.0035 above the bench mark industry. Here, the Tobit run on TI and AI have 3 industries respectively, above and below the benchmark industry as statistically significant and for Tobit run on OI there was only one industry below the benchmark as statistically significant.

6.2.2 *General Results of Tobit Analysis:*

Observing Table 10 in 2003-04, LQO is found to be positive and statistically significant at 5 per cent, for TI indicating a direct relationship between average measure of size of industry and TI. This is against the hypothesis and as such rejected. However, the average measure of size of industry is negative and significant at 1 per cent and 5 per cent respectively for SI and AI indicating an indirect relationship between average measure of size of industry and SI and AI. This clearly indicates a strong influence of average measure of size of industry on Scale and Allocative inefficiency because we have hypothised an indirect relationship between the two and results also favour it. Thus the hypothesis is accepted at 1 per cent and 5 per cent level. LQS is found to be positive and statistically significant at 5 per cent, for SI indicating a direct relationship between average scale of regional industry and SI. This again is against the hypothesis and as such rejected. UA, *i.e*., diversity or effect of inter-industry agglomeration were found to be negative and statistically significant at 10 per cent for TI and SI and at 5 per cent for AI, indicating an indirect relationship between effect of inter-industry agglomeration and TI, SI and AI. This again indicates a strong influence of agglomeration effects on Technical, Scale and Allocative inefficiency because we have hypothised an indirect relationship between the two and results also favour it. Thus the hypothesis is accepted at 10 per cent and 5 per cent level. These imply that most of the localization economies and urbanization economies have strong role to play in the scale inefficiencies and allocative inefficiencies of the industries. PRO, *i.e*., management labour productivity is found to be negative and statistically significant at 10 per cent level for TI indicating a favourable relationship as hypothised by the study. Thus it is observed that both the localisation economies and urbanization economies and management labour productivity strongly influence the different inefficiencies of the industries

Observing Table 11 in 2008-09, LIQ, *i.e*., short term financial strength was found to be positive and statistically significant at 10 per cent and 1 per cent for TI and AI indicating the strong role played by liquid money in technical, scale and allocative inefficiencies. This possibility might be due to the inflation facet. However, no other factors considered were found to be influencing the different inefficiencies.

Overall it could be said that the localization and urbanization economies which were strongly influencing technical, scale and allocative inefficiencies in 2003-04, do not influence any of the inefficiencies in industries during 2008-09. However, LIQ is found to be strongly influencing technical and allocative inefficiencies of industries. This indicates the influence of inflation which has been high in 2008-09 as compared to 2003-04. Allocative inefficiencies indicate over investment in inventories and the cause is seen to be inflation in 2008-09.

As there have been arguments in favour of OLS (Mcdonald John, 2009), the study has 36 OLS runs with 80 observations each, by keeping each industry as a benchmark, *i.e.,* as already mentioned, since the study considers 6 industries, there were six runs for each one of the six inefficiencies (TI, AI, SI, EI, CI and OI). It has been observed that the OLS and Tobit results are not identical.

7. POLICY IMPLICATIONS:

With technical and scale inefficiencies for the six industries selected in the study being lesser than allocative inefficiency, the data and results affirm the positive effects of liberalisation in upgrading technology in Indian industries and the betterment of foreign direct investment. The higher allocative inefficiency in the industries under study call for improvement in management of raw materials finished goods, cash in hand or liquidity *etc*. This implies that the country needs to speed up the reforms relating to efficient use of resources and supply chain management which could see that over investment in inventories are reduced. Besides, the prevalence of a supply chain mismanagement calls for strengthening the existing reforms on industrial linkages or introducing new reforms to see a high degree of coordination between sectors such that interdependencies between sectors are solved in the best manner possible. Added to this inflation is also a strong factor influencing higher cash in hand or liquidity. Therefore, efforts to reduce inflation through monetary and fiscal policies is also the need of the hour. India, which is already in its second stage of reforms, is focussing on such aspects discussed above. Therefore, if the reforms persist, it could be expected in future that allocative inefficiency in Indian industries is reduced considerably like the technical and scale inefficiencies.

8. CONCLUSION:

The study of six industries across sixteen state for year 2003-04 and 2008-09 show that inefficiency in relation to technical and scale seems to have decreased considerably over the period, however so far as allocative inefficiency is concerned it seems to prevail highly in both the years and have decreased less as compared to the other two inefficiencies. The cause for this could be over investment in inventories and greater liquid cash available with the firms in the industries, which ultimately could be because of prevalence of inflation in the economy. The regression results support this argument. The government measures in controlling inflation could possibly help in overcoming such X-inefficiency.

End Notes:

1. Annual Survey of Industry (ASI) Volume I deals with industries data published by Central Statistics Office, Government of India. This volume, consist of mainly three tables related to state wise data. The first table provides state wise and industry wise factories in operation, working capital, outstanding loans, invested capital, interest paid, total output, fuel consumed, materials consumed, total inputs, gross value added, addition in stocks of material consumed, fuel, semi-finished goods, finished goods, gross capital formation, income, profit *etc*. The second table deals with number of persons engaged, *i.e*., workers, employees other than workers, unpaid family members/proprietor, total man days employed and wages and salary including employer's contribution. The third table deals with type of fuel.
2. The study deals with six industries and these relate to the Basic Chemicals, Basic Metal and Alloys, Manufacture of Electrical Machinery, Metal Products and Parts, Paper and Paper products and Textiles for they cover more than 90 per cent of industrial output and are prevalent in all the 16 states considered. Each one of these have been formed by summing up related industries for *e.g*., Basic Chemicals (*e.g*., Basic Chemicals comprises of Manufacture of Basic Chemical and Manufacture of other Chemical Product.). In order to reduce the bulk of the paper the other sets could be given to interested readers on request.
3. The sixteen states considered for the study are as follows: Gujarat, Maharashtra, West Bengal, Orissa, Jharkhand, Haryana, Punjab, Rajasthan, Uttar Pradesh, Uttarakhand, Andhra Pradesh, Chhattisgarh, Karnataka, Kerala, Madhya Pradesh and Tamil Nadu.
4. Since the data is aggregate data for an industry the representation is shown as an industry but the data used is so framed that we consider an average firm for each industry.
5. We measure the concentration of industries as well as specialization and diversity of region using Herfindahl-Hirschman index. The Herfindahl-Hirschman index is given by,

   $H_j^c = \sum_{i=1}^{n} (g_{ij}^c)^2$ and $H_j^s = \sum_{i=1}^{m} (g_{ij}^s)^2$

   where: $g_{ij}^c = X_{ij}/X_j$ and $g_{ij}^s = X_{ij}/X_i$

i : region (1 to 17), *j* : industry (1 to 9), *X* : Total output, *Xij*: Total output in industry *j* in region *i*, *Xj*: Total output of industry *j*, *Xi*: Total output in region *i*, H_j^s: The Herfindahl-Hirschman index for specialization, H_j^c: The Herfindahl-Hirschman index for concentration., g_{ij}^c : the share of industry *i* in the total national output of region *j*, g_{ij}^s: the share of region *j* in the total national output of industry *i*.

6. Current assets: The data on current assets is arrived at by using working capital. (Working capital as per concept is defined as sum of physical working capital plus cash deposit in hand and at bank and the net balance receivable over amounts payable at the end of the accounting year.)
7. Current liabilities: Total current liabilities related to sundry debtors, overdraft, cash credit, other short term loan from banks and other financial institutions and other current liabilities. Some of the other accounting details are available with outstanding loans which is defined as all loans whether short term or long term, whether interest bearing or not, outstanding according to the books of the factory as on the closing day of the accounting year. Thus, the data on current liabilities is arrived at by using outstanding loans as a proxy to the above definition of current liabilities.
8. Refer to end note 2 and 3.
9. Census 2001 is the latest census data available and close to 2003-04.
10. Census 2011 is the latest census data available and close to 2008-09.
11. DEAP stands for Data Envelopment Analysis (Computer) Programme which is used to conduct Data Envelopment Analysis for the purpose of calculating efficiencies in production. It is designed by Tim Coelli, Centre for Efficiency and Productivity Analysis, Department of Econometrics, University of New England, Armidale, NSW, Australia. Data Envelopment Analysis uses non-parametric linear programming method to calculate efficiencies.
12. Average wage per industry per state has been considered as the price of labour which is calculated by dividing wages by labour. Though, real interest rate plays an important role in calculating price of capital we have used the simplest form of interest and depreciation as a cost of capital and its corresponding price is calculated as interest plus depreciation per unit of capital *i.e.*, interest plus depreciation is divided by invested capital. Besides

though, all capital need not be borrowed, we understand that the owned capital has an opportunity cost as such we use the invested capital as the denominator in the calculation of price of capital. In the case of price of fuel consumed we make use of factory sector data on fuel consumed given in Table 6 of ASI volume I and use the electricity purchased as a proxy for all fuel consumed. This is selected because electricity purchased is available in both quantity and volume and forms the largest share in the total of all fuels having both quantity and volume. Materials consumed invariably involved the use of large number of items, so we assume its price to be equal to one across all states.

13. When inefficiency between two years of study is looked into we have 16 states with 6 industries, *i.e.*, 96 possibilities.

14. ‘Permit Quota Raj’ refers to the period between post-independence and pre-liberalisation or pre-reforms in India. India for a long time, followed the mixed economy process where investment decisions for a large number of manufacturing sectors were taken up by the private sector. It is a well-known fact that private sector investment is motivated by profitability and the allocation of resources could be different from social optimal allocation. Thus in order to regulate private sector investments, the Indian government used permits or licences and quotas as a weapon during the pre-liberalisation period.

15. R is an open source programming language used for statistical and computational data analysis.

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APPENDIX-1

$$MaxE_m = \frac{\sum_{j=1}^{1} v_{jm} y_{jm}}{\sum_{i=1}^{6} u_{im} x_{im}} \quad \text{……………………………..…….. (A1)}$$

Subject to

$$0 \leq \frac{\sum_{j=1}^{1} v_{jm} y_{jn}}{\sum_{i=1}^{6} u_{im} x_{in}} \leq 1 \quad \text{………....…………………….. (A2)}$$

n = 1, ..., m, ... 16, $v_{jm}, u_{jm} \geq 0$ i = 1 . . . 6, j = 1

The variables v_{jm}, u_{jm} are the weights to be determined by the above mathematical program. Though the weights are considered non-negative, in some DEA programs it would be shown as $v_{jm}, u_{jm} \geq \varepsilon$, where ε is an arbitrary small positive number. This is just done to ensure that all inputs and outputs have positive weights. The m^{th} state is the base state in the above model. The optimal value of the objective function is said to be the DEA efficiency score of the m^{th} state. If this is equal to one then the m^{th} state satisfies the necessary condition to be DEA efficient, if not it is DEA inefficient. Surely, this efficiency is relative to the performance of other 15 states considered here.

Since it is not easy to solve such a fractional objective function, this could be converted into a linear problem by either converting the numerator or denominator to unity. By setting the denominator to unity in the above model, the output maximization linear programming problem can be obtained. On the other hand, by setting the numerator to unity the input maximization problem can also be obtained, *i.e.*,

$$MaxE_m = \sum_{j=1}^{1} v_{jm} y_{jm} \qquad \text{……………………………………….. (A3)}$$

Subject to

$$\sum_{i=1}^{6} u_{im} x_{im} = 1 \qquad \text{……………………………………. (A4)}$$

$$\sum_{j=1}^{1} v_{jm} y_{jn} - \sum_{i=1}^{6} u_{im} x_{in} \leq 0 \qquad \text{……………………………………. (A5)}$$

n = 1, ...m.., 16, $v_{jm}, u_{jm} \geq 0$ i = 1 . . . 6, j = 1

A complete DEA model involves solutions of n such programs, each for a base state *i.e.*, 16 in this study. This gives 16 different sets of weights in each program. Though, the constraints remain the same, the ratio to be maximized changes. Generally, the dual of the above model is used for the computation of the efficiency score, which is

$$Min\ \vartheta_m \qquad \text{…………………………………………….…. (A6)}$$

Subject to

$$\sum_{n=1}^{16} y_{jn} \lambda_n - S_j = y_{jm} \qquad \text{……………………………………….. (A7)}$$

$$\vartheta_m x_{im} - \sum x_{in} \lambda_n - S_i = 0 \qquad \text{…………………………………….. (A8)}$$

$\lambda n, S_j, S_i \geq 0$ i = 1 . . . 6, j = 1

This dual rates a particular state *i.e.*, the m^{th} state. This state is relatively efficient if and only if the optimal values of its efficiency ratio, θ_m, equals unity and the optimal values of all the slack variables S_i and S_j are zero for all i and j. This model assumes constant returns to scale. But, by appending the constraint

$$\sum_{n=1}^{16} \lambda_n = 1 \qquad \text{……………………………………………. (A9)}$$

Variable returns have been incorporated in the model.

APPENDIX-2

Table 1A- Technical Inefficiency (2003-04)

STATE	FREQUENCY	BC	BMA	MEM	MPP	PPP	TEX
A.P	5	0.4540	0.6290	0.0000	0.1290	0.3310	0.2790
Chhattisgarh	4	0.0000	0.7740	0.0000	0.1140	0.0980	0.3730
Gujarat	2	0.0000	0.0000	0.1010	0.0000	0.0000	0.0550
Haryana	2	0.0000	0.0000	0.0690	0.0390	0.0000	0.0000
Jharkhand	3	0.3100	0.8710	0.0000	0.1810	0.0000	0.0000
Kerala	3	0.3140	0.3590	0.3630	0.0000	0.0000	0.0000
Karnataka	4	0.2220	0.5820	0.0000	0.1900	0.0480	0.0000
M.P	2	0.1890	0.1780	0.0000	0.0000	0.0000	0.0000
Maharashtra	3	0.0760	0.4550	0.0000	0.0000	0.0000	0.0940
Odisha	4	0.4800	0.8630	0.0000	0.0000	0.5390	0.0340
Punjab	3	0.0000	0.0000	0.5980	0.0000	0.1620	0.1150
Rajasthan	2	0.0000	0.0260	0.1980	0.0000	0.0000	0.0000
Tamil Nadu	4	0.1770	0.0000	0.2610	0.2250	0.2400	0.1170
U.P	2	0.0000	0.5610	0.0000	0.0000	0.0230	0.0000
Uttarakhand	1	0.0000	0.0000	0.2760	0.0000	0.0000	0.0000
West-Bengal	5	0.1120	0.6900	0.4940	0.0350	0.0840	0.0000
FREQUENCY		9	11	8	7	8	7

Note: - Frequency (FRE) shows number of non-zeros. Industries presented are BC-Basic Chemical, BMA- Basic Metal and Alloys, MEM-Manufacture of Electrical Machinery MPP-Metal Products and Parts PPP-Paper and Paper products, TEX- Textiles.

Table 2A- Allocative Inefficiency (2003-04)

STATE	FREQUENCY	BC	BMA	MEM	MPP	PPP	TEX
A.P	5	0.6210	0.4380	0.0000	0.1450	0.2440	0.3540
Chhattisgarh	5	0.0000	0.4430	0.4850	0.4570	0.6010	0.4470
Gujarat	5	0.0000	0.0920	0.0020	0.0140	0.3430	0.1190
Haryana	4	0.0500	0.0000	0.0600	0.0310	0.0000	0.2350
Jharkhand	5	0.6340	0.0740	0.0000	0.5060	0.0490	0.5260
Kerala	6	0.6150	0.6470	0.4200	0.2120	0.6650	0.1730
Karnataka	5	0.3390	0.5510	0.1020	0.0790	0.3250	0.0000
M.P	3	0.0710	0.3100	0.0000	0.0000	0.4400	0.0000
Maharashtra	4	0.1990	0.5880	0.0000	0.0000	0.4410	0.1840
Odisha	5	0.2050	0.4450	0.0000	0.1590	0.0840	0.3210
Punjab	5	0.3990	0.5540	0.3900	0.0000	0.5250	0.2270
Rajasthan	4	0.0410	0.4640	0.0160	0.3610	0.0000	0.0000
Tamil Nadu	5	0.4270	0.0000	0.1210	0.2840	0.2440	0.2290
U.P	5	0.0000	0.8770	0.0280	0.1240	0.0540	0.0990
Uttarakhand	3	0.4850	0.7000	0.0350	0.0000	0.0000	0.0000
West-Bengal	6	0.1900	0.5090	0.3030	0.0170	0.3030	0.6760
FREQUENCY		13	14	11	12	13	12

Note: - Frequency (FRE) shows number of non-zeros. Industries presented are BC-Basic Chemical, BMA- Basic Metal and Alloys, MEM-Manufacture of Electrical Machinery MPP-Metal Products and Parts PPP-Paper and Paper products, TEX- Textiles.

Table 3A- Scale Inefficiency (2003-04)

STATE	FREQUENCY	BC	BMA	MEM	MPP	PPP	TEX
A.P	6	0.0060	0.5210	0.1190	0.1330	0.0020	0.0830
Chhattisgarh	6	0.0650	0.3530	0.2220	0.0480	0.0050	0.0070
Gujarat	3	0.0000	0.5470	0.0000	0.0000	0.0480	0.0030
Haryana	4	0.0000	0.3080	0.1760	0.0310	0.0000	0.0430
Jharkhand	3	0.1060	0.0330	0.0000	0.0150	0.0000	0.0000
Kerala	5	0.0130	0.6920	0.3670	0.1550	0.0000	0.2670
Karnataka	5	0.0120	0.3000	0.0260	0.0680	0.0070	0.0000
M.P	3	0.0000	0.7450	0.4480	0.0000	0.0020	0.0000
Maharashtra	2	0.0000	0.5060	0.0000	0.0000	0.0000	0.0180
Odisha	4	0.0210	0.3340	0.0000	0.0000	0.0210	0.4340
Punjab	3	0.0000	0.2670	0.0100	0.0000	0.0010	0.0000
Rajasthan	3	0.0000	0.6850	0.0010	0.1880	0.0000	0.0000
Tamil Nadu	5	0.1870	0.0000	0.0280	0.0120	0.0650	0.1030
U.P	2	0.0000	0.6130	0.0440	0.0000	0.0000	0.0000
Uttarakhand	3	0.8190	0.5180	0.0000	0.0000	0.0000	0.0090
West-Bengal	4	0.0000	0.6360	0.0760	0.0230	0.0000	0.0830
FREQUENCY		8	15	11	9	8	10

Note: - Frequency (FRE) shows number of non-zeros. Industries presented are BC-Basic Chemical, BMA- Basic Metal and Alloys, MEM-Manufacture of Electrical Machinery MPP-Metal Products and Parts PPP-Paper and Paper products, TEX- Textiles.

Table 1B- Technical Inefficiency (2008-09)

STATE	FREQUENCY	BC	BMA	MEM	MPP	PPP	TEX
A.P	5	0.0960	0.2820	0.4720	0.0000	0.2120	0.4170
Chhattisgarh	1	0.0000	0.0000	0.0000	0.0000	0.0000	0.3140
Gujarat	2	0.0880	0.0000	0.1870	0.0000	0.0000	0.0000
Haryana	5	0.1440	0.0000	0.3120	0.0510	0.4170	0.1180
Jharkhand	2	0.0370	0.0000	0.0000	0.0000	0.0010	0.0000
Kerala	3	0.0790	0.0000	0.0320	0.0000	0.1020	0.0000
Karnataka	1	0.0000	0.0000	0.0000	0.0000	0.3200	0.0000
M.P	2	0.0000	0.0000	0.0000	0.1990	0.0910	0.0000
Maharashtra	5	0.1520	0.5270	0.1740	0.2690	0.1230	0.0000
Odisha	2	0.0000	0.3950	0.0000	0.1450	0.0000	0.0000
Punjab	4	0.3740	0.0000	0.3140	0.0000	0.2180	0.0910
Rajasthan	2	0.0000	0.0000	0.3110	0.1240	0.0000	0.0000
Tamil Nadu	1	0.0000	0.0000	0.0000	0.2890	0.0000	0.0000
U.P	5	0.0930	0.1340	0.2130	0.0050	0.1250	0.0000
Uttarakhand	3	0.1380	0.0000	0.3040	0.3340	0.0000	0.0000
West-Bengal	3	0.0000	0.0000	0.3650	0.0880	0.2230	0.0000
FREQUENCY		9	4	10	9	10	4

Note: - Frequency (FRE) shows number of non-zeros. Industries presented are BC-Basic Chemical, BMA- Basic Metal and Alloys, MEM-Manufacture of Electrical Machinery MPP-Metal Products and Parts PPP-Paper and Paper products, TEX- Textiles.

Table 2B- Allocative Inefficiency (2008-09)

STATE	FREQUENCY	BC	BMA	MEM	MPP	PPP	TEX
A.P	5	0.3950	0.3190	0.4490	0.0000	0.3360	0.4140
Chhattisgarh	4	0.1190	0.6390	0.0000	0.3170	0.0000	0.3710
Gujarat	2	0.1920	0.0000	0.0630	0.0000	0.0000	0.0000
Haryana	6	0.4520	0.2740	0.4720	0.0510	0.5050	0.0690
Jharkhand	4	0.6190	0.0000	0.4860	0.0000	0.2210	0.4200
Kerala	6	0.8020	0.6880	0.2790	0.1240	0.6540	0.0970
Karnataka	3	0.0000	0.0000	0.0000	0.1030	0.0320	0.4330
M.P	4	0.8640	0.1140	0.0000	0.0750	0.0510	0.0000
Maharashtra	6	0.2550	0.4330	0.0820	0.2350	0.3460	0.2600
Odisha	3	0.0000	0.5630	0.0000	0.2020	0.0000	0.1900
Punjab	5	0.7830	0.3300	0.0890	0.0000	0.5840	0.3720
Rajasthan	5	0.1680	0.2320	0.0560	0.3970	0.0000	0.2650
Tamil Nadu	4	0.0000	0.0000	0.2830	0.0150	0.2740	0.3000
U.P	5	0.3210	0.8710	0.0820	0.1360	0.1340	0.0000
Uttarakhand	5	0.4550	0.6340	0.1040	0.2390	0.4840	0.0000
West-Bengal	6	0.6530	0.7150	0.1270	0.2010	0.3980	0.5930
FREQUENCY		13	12	12	12	12	12

Note: - Frequency (FRE) shows number of non-zeros. Industries presented are BC-Basic Chemical, BMA- Basic Metal and Alloys, MEM-Manufacture of Electrical Machinery MPP-Metal Products and Parts PPP-Paper and Paper products, TEX- Textiles.

Table 3B-Scale Inefficiency (2008-09)

STATE	FREQUENCY	BC	BMA	MEM	MPP	PPP	TEX
A.P	4	0.0810	0.0020	0.0000	0.0000	0.0173	0.0480
Chhattisgarh	2	0.0000	0.1360	0.0000	0.0000	0.0000	0.0260
Gujarat	0	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Haryana	5	0.1150	0.0000	0.0960	0.0950	0.0080	0.0120
Jharkhand	1	0.0380	0.0000	0.0000	0.0000	0.0000	0.0000
Kerala	6	0.0060	0.1190	0.1000	0.1800	0.0340	0.4000
Karnataka	1	0.0000	0.0000	0.0000	0.0000	0.0090	0.0000
M.P	3	0.0640	0.0000	0.1280	0.0340	0.0000	0.0000
Maharashtra	5	0.0650	0.6610	0.0310	0.0820	0.1250	0.0000
Odisha	4	0.0000	0.0010	0.0000	0.0430	0.1710	0.3320
Punjab	5	0.0310	0.0000	0.0110	0.2260	0.1340	0.0890
Rajasthan	3	0.0000	0.0120	0.0170	0.0000	0.0000	0.0790
Tamil Nadu	4	0.3420	0.1070	0.0000	0.0000	0.2370	0.1220
U.P	4	0.1230	0.0000	0.1340	0.0650	0.0510	0.0000
Uttarakhand	3	0.1090	0.0000	0.0000	0.0500	0.1280	0.0140
West-Bengal	4	0.0000	0.0670	0.0210	0.0000	0.0500	0.1830
FREQUENCY		10	8	8	8	11	10

Note: - Frequency (FRE) shows number of non-zeros. Industries presented are BC-Basic Chemical, BMA- Basic Metal and Alloys, MEM-Manufacture of Electrical Machinery MPP-Metal Products and Parts PPP-Paper and Paper products, TEX- Textiles.

Table 4- State wise Inefficiency in Basic Chemical Industry

States	2003-04	2008-09	2003-04	2008-09	2003-04	2008-09
	TI	TI	SI	SI	AI	AI
A.P	0.4540	0.0960	0.0060	0.0810	0.6210	0.3950
Chhattisgarh	0.0000	0.0000	0.0650	0.0000	0.0000	0.1190
Gujarat	0.0000	0.0880	0.0000	0.0000	0.0000	0.1920
Haryana	0.0000	0.1440	0.0000	0.1150	0.0500	0.4520
Jharkhand	0.3100	0.0370	0.1060	0.0380	0.6340	0.6190
Kerala	0.3140	0.0790	0.0130	0.0060	0.6150	0.8020
Karnataka	0.2220	0.0000	0.0120	0.0000	0.3390	0.0000
M.P	0.1890	0.0000	0.0000	0.0640	0.0710	0.8640
Maharashtra	0.0760	0.1520	0.0000	0.0650	0.1990	0.2550
Odisha	0.4800	0.0000	0.0210	0.0000	0.2050	0.0000
Punjab	0.0000	0.3740	0.0000	0.0310	0.3990	0.7830
Rajasthan	0.0000	0.0000	0.0000	0.0000	0.0000	0.1680
Tamil Nadu	0.1770	0.0000	0.1870	0.3420	0.4270	0.0000
U.P	0.0000	0.0930	0.0000	0.1230	0.0000	0.3210
Uttarakhand	0.0000	0.1380	0.8990	0.1090	0.4850	0.4550
West-Bengal	0.1120	0.0000	0.0000	0.0000	0.1900	0.6530

NB: TI- Technical Inefficiency, SI- Scale Inefficiency, AI- Allocative Inefficiency

Table 5- State wise Inefficiency in Basic Metal and Alloys Industry

States	**2003-04**	**2008-09**	**2003-04**	**2008-09**	**2003-04**	**2008-09**
	TI	TI	SI	SI	AI	AI
A.P	0.6290	0.2820	0.5210	0.0020	0.4380	0.3190
Chhattisgarh	0.7740	0.0000	0.3530	0.1360	0.4430	0.6390
Gujarat	0.0000	0.0000	0.5470	0.0000	0.0920	0.0000
Haryana	0.0000	0.0000	0.3080	0.0000	0.0000	0.2740
Jharkhand	0.8710	0.0000	0.0330	0.0000	0.0740	0.0000
Kerala	0.3590	0.0000	0.6920	0.1190	0.4470	0.6880
Karnataka	0.5820	0.0000	0.3000	0.0000	0.5510	0.0000
M.P	0.1780	0.0000	0.7450	0.0000	0.3100	0.1140
Maharashtra	0.4550	0.5270	0.5060	0.6610	0.5880	0.4330
Odisha	0.8630	0.3950	0.3340	0.0010	0.4450	0.5630
Punjab	0.0000	0.0000	0.2670	0.0000	0.5540	0.3300
Rajasthan	0.0260	0.0000	0.6850	0.0120	0.0120	0.2320
Tamil Nadu	0.0000	0.0000	0.0000	0.1070	0.0000	0.0000
U.P	0.5610	0.1340	0.6130	0.0000	0.8770	0.8710
Uttarakhand	0.0000	0.0000	0.5180	0.0000	0.7000	0.6340
West-Bengal	0.6900	0.0000	0.6360	0.0670	0.5090	0.7150

NB: TI- Technical Inefficiency, SI- Scale Inefficiency, AI- Allocative Inefficiency

Table 6- State wise Inefficiency in Manufacture of Electrical Machinery Industry

States	2003-04	2008-09	2003-04	2008-09	2003-04	2008-09
	TI	TI	SI	SI	AI	AI
A.P	0.0000	0.2820	0.1190	0.0020	0.0000	0.3190
Chhattisgarh	0.0000	0.0000	0.2220	0.0000	0.4850	0.0000
Gujarat	0.1010	0.1870	0.0000	0.0000	0.0020	0.0630
Haryana	0.6900	0.3120	0.1760	0.0960	0.0600	0.4720
Jharkhand	0.0000	0.0000	0.0000	0.0000	0.0000	0.4860
Kerala	0.3630	0.0320	0.6700	0.1000	0.4200	0.2790
Karnataka	0.0000	0.0000	0.0260	0.0000	0.1020	0.0000
M.P	0.0000	0.0000	0.4480	0.1280	0.0000	0.0000
Maharashtra	0.0000	0.1740	0.0000	0.0310	0.0000	0.0820
Odisha	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Punjab	0.5980	0.3140	0.0100	0.0110	0.3900	0.0890
Rajasthan	0.1980	0.3110	0.0010	0.0170	0.0170	0.0560
Tamil Nadu	0.2610	0.0000	0.0280	0.0000	0.1210	0.2830
U.P	0.0000	0.2130	0.0440	0.1340	0.0280	0.0820
Uttarakhand	0.2760	0.3040	0.0000	0.0000	0.0350	0.1040
West-Bengal	0.4940	0.3650	0.1076	0.0210	0.3030	0.1270

NB: TI- Technical Inefficiency, SI- Scale Inefficiency, AI- Allocative Inefficiency

Table 7- State wise Inefficiency in Metal Products and Parts Industry

States	2003-04	2008-09	2003-04	2008-09	2003-04	2008-09
	TI	TI	SI	SI	AI	AI
A.P	0.1290	0.0000	0.1330	0.0000	0.1450	0.0000
Chhattisgarh	0.1140	0.0000	0.0480	0.0000	0.4570	0.3170
Gujarat	0.0000	0.0000	0.0000	0.0000	0.0140	0.0000
Haryana	0.0390	0.0510	0.0310	0.0950	0.0310	0.0510
Jharkhand	0.1810	0.0000	0.1500	0.0000	0.5060	0.0000
Kerala	0.0000	0.0000	0.1550	0.1800	0.2120	0.1240
Karnataka	0.1900	0.0000	0.0680	0.0000	0.0790	0.1030
M.P	0.0000	0.1990	0.0000	0.0340	0.0000	0.0750
Maharashtra	0.0000	0.2690	0.0000	0.0820	0.0000	0.2350
Odisha	0.0000	0.1450	0.0000	0.0430	0.1590	0.2020
Punjab	0.0000	0.0000	0.0000	0.2230	0.0000	0.0000
Rajasthan	0.0000	0.1240	0.1880	0.0000	0.0000	0.3970
Tamil Nadu	0.2250	0.2890	0.0120	0.0000	0.2840	0.0150
U.P	0.0000	0.0050	0.0000	0.0650	0.1240	0.1360
Uttarakhand	0.0000	0.3340	0.0000	0.0505	0.0000	0.2390
West-Bengal	0.0350	0.0880	0.0230	0.0000	0.0170	0.2010

NB: TI- Technical Inefficiency, SI- Scale Inefficiency, AI- Allocative Inefficiency

Table 8- State wise Inefficiency in Paper and Paper Products Industry

States	2003-04	2008-09	2003-04	2008-09	2003-04	2008-09
	TI	TI	SI	SI	AI	AI
A.P	0.3310	0.2120	0.0020	0.0173	0.2440	0.3360
Chhattisgarh	0.0980	0.0000	0.0050	0.0000	0.6010	0.0000
Gujarat	0.0000	0.0000	0.0480	0.0000	0.3430	0.0000
Haryana	0.0000	0.4170	0.0000	0.0080	0.0000	0.5050
Jharkhand	0.0000	0.0010	0.0000	0.0000	0.0490	0.2100
Kerala	0.0000	0.1020	0.0000	0.0340	0.6650	0.6540
Karnataka	0.0480	0.3200	0.0070	0.0090	0.3250	0.0320
M.P	0.0000	0.0910	0.0020	0.0000	0.4400	0.0510
Maharashtra	0.0000	0.1230	0.0000	0.1250	0.4410	0.3460
Odisha	0.5390	0.0000	0.0210	0.1710	0.0840	0.0000
Punjab	0.1620	0.2180	0.0010	0.1340	0.5250	0.5840
Rajasthan	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Tamil Nadu	0.2400	0.0000	0.0650	0.2370	0.2440	0.2740
U.P	0.0230	0.1250	0.0000	0.0510	0.0540	0.1340
Uttarakhand	0.0000	0.0000	0.0000	0.1280	0.0000	0.4840
West-Bengal	0.0840	0.2230	0.0000	0.0500	0.3030	0.3980

NB: TI- Technical Inefficiency, SI- Scale Inefficiency, AI- Allocative Inefficiency

Table 9- State wise Inefficiency in Textiles Industry

States	2003-04	2008-09	2003-04	2008-09	2003-04	2008-09
	TI	TI	SI	SI	AI	AI
A.P	0.2790	0.4170	0.0830	0.0480	0.3540	0.4140
Chhattisgarh	0.3730	0.3140	0.0070	0.0260	0.4470	0.3710
Gujarat	0.0550	0.0000	0.0030	0.0000	0.1190	0.0000
Haryana	0.0000	0.1180	0.0430	0.0120	0.2350	0.0690
Jharkhand	0.0000	0.0000	0.0000	0.0000	0.5250	0.4200
Kerala	0.0000	0.0000	0.2670	0.4000	0.1730	0.0970
Karnataka	0.0000	0.0000	0.0000	0.0000	0.0000	0.4330
M.P	0.0000	0.0000	0.0000	0.0000	0.0000	0.0000
Maharashtra	0.0940	0.0000	0.0180	0.0000	0.1840	0.2600
Odisha	0.0340	0.0000	0.4340	0.3320	0.3210	0.1900
Punjab	0.1150	0.0910	0.0000	0.0890	0.2270	0.3720
Rajasthan	0.0000	0.0000	0.0000	0.0790	0.0790	0.2650
Tamil Nadu	0.1170	0.0000	0.1030	0.1220	0.2290	0.3000
U.P	0.0000	0.0000	0.0000	0.0000	0.0990	0.0000
Uttarakhand	0.0000	0.0000	0.0090	0.0140	0.0000	0.0000
West-Bengal	0.0000	0.0000	0.0830	0.1830	0.6760	0.5930

NB: TI- Technical Inefficiency, SI- Scale Inefficiency, AI- Allocative Inefficiency

Table 10-Tobit Results (2003-04)

Coefficients	TI	SI	AI	EI	OI
Intercept	0.0708	0.5289.	0.4605.	0.5025***	0.7132.
LQO	0.0910**	-0.0816***	-0.0719**	-0.0137	-0.0544
LQU	0.1618	0.0071	0.1056	0.1334	0.1145
LQS	0.0387	0.0355**	0.0128	0.0686**	0.0857***
LQF	-0.5491	-0.0680	0.3684	-0.6986	-0.6591
UA	-6.1106*	-4.3810*	-6.6675**	-7.2149**	-7.7325**
LIQ	0.0120	-0.0094	-0.0458**	0.0037	-0.0002
PRO	-0.0289*	0.0115	-0.0047	-0.0192	-0.0100
D1	-0.3426***	-0.5220.	-0.2010**	-0.2959***	-0.4437.
D2	-0.0885	-0.5432.	-0.2082**	-0.2016*	-0.3815.
D3	-0.3308***	-0.4792.	-0.3397.	-0.4068.	-0.5424.
D4	-0.2787**	-0.4190.	-0.3712.	-0.4694.	-0.5478***
D5	-0.3731***	-0.4807.	-0.2492***	-0.4245.	-0.5559.

Significance codes: '***' 0.01, '**' 0.05, '*' 0.10, '.' 0.001 The variables are as described in the text and the D's refer to the dummies representing different industries like Textiles Industry, Basic Chemical Industry, Paper and Paper Products, Metal Products and Metal Products, Manufacture of Electrical Machinery Industry and Basic Metal and Alloys Industry. NB: TI- Technical Inefficiency, SI- Scale Inefficiency, AI- Allocative Inefficiency

Table 11-Tobit Results (2008-09)

Coefficients	**TI**	**SI**	**AI**	**EI**	**OI**
Intercept	-0.3565*	-0.0875	0.1693	0.1184	0.1429
LQO	0.0585	-0.0422	-0.0644	-0.0435	-0.0224
LQU	0.1540	0.1009	0.0227	0.0877	0.1323
LQS	0.0610	0.0239	0.0632	0.6755	0.0689
LQF	-0.6260	0.7004	0.8014	0.5714	0.4203
UA	-0.4479	-3.4722	-2.2686	-2.3758	-3.2466
LIQ	0.0251*	-0.0062	0.0430***	0.0477***	0.0396***
PRO	-0.0027	-0.0044	-0.0017	-0.0019	-0.0034
D1	0.2062*	0.0343	-0.0256	-0.0243	0.0289
D2	0.1513	0.0328	0.0981	0.1069	0.1233
D3	0.1959*	-0.0321	-0.2001***	-0.1387	-0.1236
D4	0.2228**	-0.0163	-0.1940***	-0.0922	-0.0929
D5	0.1120	0.0035	-0.3256**	-0.3368	-0.2627***

Significance codes: '***' 0.01, '**' 0.05, '*' 0.10, '.' 0.001 The variables are as described in the text and the D's refer to the dummies representing different industries like Textiles Industry, Basic Chemical Industry, Paper and Paper Products, Metal Products and Metal Products, Manufacture of Electrical Machinery Industry and Basic Metal and Alloys Industry. NB: TI- Technical Inefficiency, SI- Scale Inefficiency, AI- Allocative Inefficiency

Published by:

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