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ABSTRACT

Indian leather industry has massive potential for generating employment and achieving high export-oriented growth. However, the on-going global economic slowdown and the wide erratic behaviour of the overall weather condition particularly in the Europe pose both threat (of market loss) and opportunity (to gain some unanticipated demand in the market) before it. On the other hand, its economic performance has not been assessed much till date. The present paper attempts to fill in this gap and makes some suggestions regarding the expansion of the industry by examining technical efficiency (TE) of individual leather producing firms for some selected years since the early-1980s. Analysing the industry's firm-level data through the Data Envelopment Analysis the paper observes a significant positive association between a firm's size and its TE, but no such conclusive relation between a firm's age and TE. It also finds significant variation in TE across firms in different groups of states as well as under different organisational structures. Although, non-availability of panel data does not allow one to assess the trend of the performance of the Indian leather firms properly, the average firm-level TE, however, seems to be on an increasing path, except for downswing in some years. On a totality, analysing the relevant supply side factors the paper proposes the policy makers to go forward in expanding the industry particularly keeping India's severe unemployment problem, of both skilled as well as unskilled labour forces, in mind.

Key Words: Leather industry; Data Envelopment Analysis, Technical Efficiency, Scale Efficiency, Returns to Scale.

JEL Classification No: D24, L67, R38.

1. Introduction

The leather industry occupies a place of prominence in the Indian economy in view of its massive potential for employment, growth and exports. In fact, backed by a strong raw-material base and a large reservoir of traditionally skilled and competitive labour force, the Indian leather industry has made significant strides during the past two decades.[1] Not only that, this industry has undergone a dramatic transformation from a mere exporter of raw materials (like tanned hides and skins) in the 1960s to that of value added finished products from the 1970s. Policy initiatives taken by the Government of India (GOI) since 1973 have been quite instrumental to such a transformation.

The structure of the Indian leather industry is quite interesting. It is spread in different segments namely tanning and finishing, footwear and footwear components, leather garments, leather goods including saddlery and harness etc.[2] The industry uses primarily indigenous natural resources with little dependence on imported resources. Hides and skins are the basic raw materials for the leather industry, which originate from the source of livestock. India has a very large share of the world bovine

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1 For instance, export of leather and leather manufacturers (including leather footwear, leather travel goods and leather garments) went up from US $59 million in 1960-61 to US $493 million in 1980-81 and thereafter to US $1449 million in 1990-91 and further to US $2323 million in 2004-05 (Government of India, 2004-05).

2 Detailed discussion on the organisational structure of the industry starting from the stage of collection of raw materials to that of marketing of finished and semi-finished products can also be found in Banerjee and Nihila (1999), Mohapatra and Srivastava (2002) and Singh (2007).

animal population.[3] Further, an overwhelming proportion of the total production of this industry comes from the unorganised sector, i.e., small scale, cottage and artisan sector. The major production centres are spread over selected areas in a few states, e.g., selected places in Tamil Nadu, Kolkata in West Bengal, Kanpur and Agra in Uttar Pradesh, Jalandhar in Punjab and Delhi. And the major export market for Indian leather goods is Germany, with an oftake of about 25 percent of India's domestic production, followed by the USA, the UK, France and Italy. The important export items are leather handbags, footwear and leather garments.

Official policies/programmes undertaken to facilitate the growth of the leather industry include de-reservations of 11 items (particularly semi-finished hides and skins, leather shoes and leather accessories for leather industry) in 2001, abolition of the license system in case of manufacture of most of the leather items. Some items are still reserved for exclusive manufacture by the small-scale sector, but non-small scale units can also obtain approval for the manufacture of these items provided they meet an export obligation of 50 per cent of their annual production.[4]

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3 For instance, India's share in the world bovine animal population in 2005 was the highest (about 19%), followed by Brazil (13%), China (9%) and the USA (6%).

4 In addition, a number of leather development programmes have been initiated in the recent past. A UNDP assisted National Leather Development Programme (NLDP Phase I) was carried out from 1992 to 1998 to upgrade the training systems for design and manufacture of footwear, garments and leather goods and its second phase – called the Small Industries Development and Employment Programme (SIDE - NLDP) – from 1998 to 2002, with a view to promoting poverty alleviation and building linkages between the organised and unorganised sectors. To complement the above mentioned programmes a new plan scheme titled Indian Leather Development Programme (ILDP) started operation in 1992 to bridge critical gaps in infrastructure for integrated development of this industry, to undertake investment/trade development activities and build up an information base for leather industry. Productivity improvement programmes have also been launched for improving the manufacturing processes of footwear in the organised sector. A scheme for tannery modernisation was launched under ILDP in 2000 to provide the much needed financial help to the Indian tanneries for adoption of more efficient and cleaner process technologies for improving their performance in terms of productivity and pollution control.

Governments at both the central as well as state levels are in a way to promote formation of more leather manufacturing clusters in different parts of the country to get reap of the benefits from such clustering in both the cost reducing and quality enhancing dimensions. For instance, the Kerala Industrial Infrastructure Development Corporation (KINFRA) is setting up a footwear park at Vazhakkat, near Ramanattukara, in Malappuram district (*Business Line*, October 7, 2009). The Cabinet Committee on Economic Affairs, Government of India recently gave its nod for development of a leather park under Indian Leather Development Programme (ILDP) and earmarked INR3000 million for it. The aim of the sub-scheme is to provide the industry with infrastructure facilities for setting up leather units across product categories and to attract large domestic joint venture and foreign investments into the Indian leather industry. A leather park set up under this sub-scheme would cover all sectors of leather industry – tannery, all products categories and leather machinery (*Business Line*, October 23, 2009).[5]

Some intrinsic problems affect the leather firms also. Prior to its detailed discussion we can briefly present the nature of the production

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5 Beside these Government initiatives and the Central Leather Research Institute (CLRI), Chennai, a central hub in Indian leather sector with direct roles in education, research, training, testing, designing, forecasting, planning, social empowerment and leading in science and technology relating to leather, some other agencies are stretching their helping hands towards the workers by providing necessary training that a world class modern production unit of the industry needs. For instance, one month (January 1-January 31, 2009) training programme for 26 unemployed workers was conducted by the technical expert of Footwear Design & Development Institute (FDDI), Noida at the Florence Shoe Company Private Limited (with its up to date modern management and technical know-how), Ambur, Chennai under the ‘Workers Training Programme’ of the Department of Industrial Policy & Promotion (DIPP). In this context Mr. Rajeev Lakhara, IRS, Managing Director, FDDI said that the manpower crunch in the Indian leather industry is seen as a major deterrent especially when foreign entities look at India as a region with low production cost. Hence, it’s time to train unemployed workers which will be inducted in the factories and play a vital role in the growth path of the leather sector (FDDI Weekly Newsletter, February 13, 2009).

chain of the industry. The entire production process can be sub-divided into three segments: leather tanning (i.e., raw to semi-finished stage), leather finishing (i.e., semi-finished to finished stage) and making of leather goods/products (i.e., the final stage). Each of these segments has six to eight processes. Tanning is basically converting animal hides (outer covering of cow, buffalo and calf) and skins (outer covering of sheep and goat) into leather. The quality of leather products critically depends on the quality of tanning. However, the activities relating to the processing of leather generate pollution, particularly in the tanning[6] and finishing stages of the production chain and hence, the firms have to bear increasing costs of production for undertaking pollution abating activities and/or relocating their establishments. There are however, some *favourable* factors also. As we have already explored to some extent in footnote 5, major world tanning firms are in the process of shifting their manufacturing base to developing countries due to high wage levels and strict environmental norms in the developed countries. Factors such as sufficient availability of raw leather and cheap skilled labour with their long experience in the technical know-how of production and processing of leather items-all work in India's favour. Further, given that the Indian leather industry is still dominated by household and small-scale sectors, more corporate presence may enhance the possibility of turning out quality leather products at smaller unit cost. All this presents a large scope of expansion before the Indian leather industry.

So, given that there is a large scope of expanding leather production and exporting such products abroad, the question arises whether the present structure of this industry is such as to facilitate such an expansion and, if not, what additional measures are called for. All this needs a thorough examination of its production structure and related

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6 The leather tanning industry has been designated as 'hazardous industry' under the Factories Act, 1948.

features – features focusing on the economic performance of the Indian leather firms. For instance, one may like to know how efficient the different leather firms are technically and/or relative to their scale of operation. Such questions have become important as policy makers are gradually taking necessary steps so as to make the overall productive environment more competitive by removing detrimental policy instruments (introduced earlier to draw private investments in the desired directions) during the process of economic reforms which the economy is going through and which calls for an enhanced efficiency of firms for their growth or even mere survival.

Given the global economic meltdown in the backdrop the present situation, however, creates some hesitation before the policy makers concerning the issue of expansion of the Indian leather industry, at least in the present short run. To be specific, the proposed prospect of the Indian leather industry, as we have already mentioned, largely lies in its export earning potential with West European developed countries and the USA being its major export market. But the on-going global economic crisis affects these countries very badly. Rapidly increasing unemployment in these countries lowers purchasing power of the mass and, as an obvious consequence, overall demand for consumer goods is diminishing with that for leather products is not an exception. According to the industry representatives the Indian leather industry is looking at a 20 per cent drop in output following the slowdown in demand in the international market (*Business Line*, January 29, 2009). The situations even further worsen for Chinese intervention into the European market since China is facing a more intense slowdown because of its focus on the US market and trying to wean away India's European customers (*Business Line*, January 31, 2009). The Government of India already announced a package valued INR3.25 billion for the leather and textile export sectors (*Business Line*, February 27, 2009). Government declared a further 2 per cent incentive for exports of garments and all leather items to the European Union and the US which would be effective from April 1, 2009 and shall remain available till end-September 2009 (*Business Line*, March 1, 2009). Although the quantitative volume of these packages was whether determined by some rigorous estimation or much more induced by the then forthcoming general election of the country is a debatable issue, the need for some support programme is undoubted.

On the other hand, one of the important factors affecting the demand (in a particular time) for leather goods, particularly the leather garments is the prevailing weather condition. Volatility of the overall climatic condition worldwide, as we are experiencing now probably due to global warming, brings some unanticipated blessing to the Indian leather industry in the present crisis-hit unfavourable global market. “The weather god may just be working in favour of the leather goods industry in Europe this year in offsetting recession. The heavy snowfall and cold recorded in most of European countries this year has resulted in a considerable sale of shoes and leather garments, despite recession”, according to Mr. Mario Pucci, International Relations Director, National Association of Italian Manufacturers of Footwear, Leather Goods and Tanning Machinery, ASSOMAC (*Business Line*, February 7, 2009). He said at a seminar in Kolkata on February 6, 2009 that the Indian leather manufacturers may also find a larger market in Italy and other European countries this year as most stores there are already running short of stocks (due to recession).

So, current overall global scenario poses both opportunity and threat before the Indian leather industry. It can be easily understood that these two opposite factors may affect the Indian leather industry from the demand side. The objective of this paper is to examine the supply side factors in this connection and to draw necessary policy conclusion about to which direction the industry should be driven, – expansion or contraction, by the policy makers in the face of the ongoing global economic peculiarities. For that, we have to examine rigorously some selected features of the production behaviours of the Indian leather industry, particularly those related to the firm size – technical efficiency relationship and the region of the production technology where majority of the firms are situated – whether it is the increasing returns to scale (IRS) or the diminishing returns to scale (DRS) segment of the frontier. Age of a firm may also affect its technical efficiency significantly. We also want to examine the overall efficiency level of the Indian leather firms and see whether it is improving over time or not.

Size and age, among others, are two important variables emphasized in the literature those can affect efficiency of a firm. A large firm may have an easier access to cheaper or superior quality of inputs which makes it more productive. Moreover, it may exploit economies of scale, broaden its scope and also find it easier to obtain all the requisite official approvals. These features, by making its operation more effective, allow it to perform better relative to the smaller ones (Penrose, 1959). However, the relation between firm's age and performance may not be so clear cut. One line of argument is that older firms display superior performance as they are more experienced, able to reap the benefits of learning and free from the hazards which newcomers usually face (Stinchcombe, 1965). There are, however, counter arguments as well viz. that the older firms are prone to inertia, lacking adequate flexibility to adapt rapidly to the changing economic circumstances which younger and more agile firms can do much more quickly and efficiently (Marshall, 1920). Also, younger firms may have assets/plants of later generations embodying advanced technology and also younger, more recently educated workers and hence may have higher efficiency (Lall and Rodrigo, 2001).

However, the paper is organised as follows. Section 2 briefly reviews the concerned literature and Section 3 discusses the methodology followed in the paper. Section 4 describes our data set and empirical findings and Section 5 concludes the paper and suggests some policy conclusions. Appendix presents some more results.

2. A Brief Review of Literature

In this connection we may briefly review the literature grown so far, both at the micro and at the aggregative level. It may be noted that we have come across only a few studies in the context of Indian leather industry. So we briefly review studies on technical efficiency (TE) of firms in the context of other industries or the entire industrial sector in India. Some studies use data collected through surveys specifically designed for this purpose (e.g., Little, Mazumdar and Page, 1987; Page, 1984). A number of studies are concerned with estimating and explaining variations in TE in only the *small-scale* industrial units by fitting either a deterministic or a stochastic production frontier (e.g., Bhavani, 1991; Goldar, 1985; Neogi and Ghosh, 1994; Nikaido, 2004; Ramaswamy, 1994). These studies, however, use data relating to pre-reform period. For instance, using the data thrown up by the first Census of Small Scale Industrial Units, 1973, Bhavani (1991) estimates TE's of firms in four metal product groups by fitting a (deterministic) translog production frontier with three inputs, capital, labor and materials and observes a very high level of average efficiency across the four groups. Similarly, on the basis of the data collected under the Second All India Census of Small scale Industrial Units, 1987-88, Nikaido (2004) fits a single stochastic production frontier, considering firms under all of the two-digit industry-groups, using intercept dummies to distinguish different industry groups. He finds little variation in TE across industry groups and a high level of average TE in each industry group. Neogi et al (1994), using industry-level summary data for the years 1974-75 to 1987-88, observes TE's of firms under different industries to be falling over time. The studies by Goldar, Renganathan and Banga (2004), Lall et al (2001) and Mukherjee and Ray (2004), however, relate to the post-reform era. Using the panel data from the Prowess data base of the Centre for Monitoring Indian Economy (CMIE) for 63 firms in the engineering industry for ten years in the 1990's, Goldar et al (2004) fits a translog stochastic production frontier and finds mean TE of foreign firms to be higher than that of domestically owned firms, but no statistically significant variation in mean TE across public and private sector firms among the latter group. At the second stage they attempt to explain variation in TE in terms of some economic variables like export and import intensity, degree of vertical integration etc. Lall et al (2001) fits a translog stochastic frontier to the plant level data for 1994 on each of four product groups, viz., leather product, motor vehicles, machine tools and electronics and computers. For instance, for the leather product group it finds the distribution of plant level efficiency to be highly negatively skewed with the mean value at 0.44 and further that such efficiency is positively related to the plant's energy use, but not much affected by its age or size. Mukherjee et al (2004) analyse the Annual Survey of Industries (ASI) data for the years 1986-87 through 1999-2000 and finds no major change in the efficiency ranking of individual states as well as no convergence in the distribution of TE across states in post-reform period. On the basis of the firm-level ASI data for a number of years Bhandari and Maiti (2007) and Bhandari and Ray (2007) attempt to measure TE of the Indian textiles firms and find considerable room for improving their efficiency. Bhandari and Maiti (2007) fits a translog stochastic frontier to the data for each of the selected years and finds that the firm-level TE, ranging between 68 to 84 per cent over the sample years, varies positively with farm size and negatively with farm age in any given year and that the public sector firms are relatively less efficient than their private sector counterparts. Applying data envelopment analysis method to the same set of data, Bhandari and Ray (2007) computes firm-level TE and arrives at the same set of conclusions except for no strong evidence of effect of a firm's age on its TE. Bhandari (2009) have done some works on Indian leather industry also.

3. Model[7] for Measuring Efficiency: *Data Envelopment Analysis (DEA)*

The non-parametric DEA method introduced by Charnes, Cooper and Rhodes (1978) and further generalised by Banker, Charnes and Cooper (1984) requires no parametric specification of the production frontier. On the basis of a sample of observed input-output data on a given set of producing units, it makes a few assumptions about production technology in order to obtain a production possibility set relevant for the observed units.[8] The corresponding *frontier*, basically a piece-wise linear surface over the data points, is then constructed by the solution of a sequence of linear programming problems – one for each unit in the sample. It then yields, as a by-product, the extent of technical inefficiency of each unit, i.e., the distance between the observed data point corresponding to the unit and the frontier so constructed. For instance, it will show how much proportional increase of the observed output vector of a unit (firm, in our study) were feasible, given the latter's observed use of various inputs. This *proportion* is then used to get a measure of (an *output – oriented*) technical efficiency of the firm. We describe the approach below for the case of single-output firms (say, *N* in number), although the method is a general one applicable to the case of multi-product firms as well.

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7 Two other alternative methods, widely known as the stochastic frontier analysis (SFA) method and method based on the random coefficient regression model may also be applied to this study. However, we do not use the latter while we use SFA only partially in our study.

8 The *assumptions* about the production technology that are made in this method are as follows: (a) All observed input-output bundles are feasible; (b) the production possibility set is convex implying that given a set of *N* feasible input-output bundles, *any* weighted average of these *N* input bundles can produce the same weighted average of the corresponding output bundles and (c) any input or output is *freely* disposable. These assumptions enable one to construct a production possibility frontier on the basis of the observed inputs-output bundles of a given set of firms, following the DEA method.

Let the firm i be observed to produce Y_i quantity of the output by using the input bundle X_i, an *m*-component (column) vector of inputs (the j^{th} element of X_i is taken to be zero, if the i^{th} firm does not use the input). The DEA method seeks to construct a frontier on the basis of the observations on inputs and outputs of all the *N* firms, by solving a set of *N* linear programmes, one for each firm. The problem for the firm *k* is to find a scalar φ and *N* number of λ_{ik}'s which solve the following linear programme.

$$(P_k^O) \qquad \text{Maximise } \varphi$$

subject to (i) $\sum_{i=1}^{N} Y_i \lambda_{ik} \geq \varphi Y_k$, (ii) $\sum_{i=1}^{N} X_i \lambda_{ik} \leq X_k$, (iii) $\sum_{i=1}^{N} \lambda_{ik} = 1$, and

(iv) $\lambda_{ik} \geq 0$ for all $i = 1, \ldots, N$.

Let (P_k^O) has an optimal solution, say $[\varphi_k^*, (\lambda_{1k}^*, \ldots, \lambda_{Nk}^*)]$. The optimal value φ_k^* then gives the maximum possible *proportional increase* in output that could be achieved by the k^{th} firm, with their input quantities being held constant.[9] Thus the technical efficiency of the k^{th} firm relative to the frontier (TE_k^O) is given by $TE_k^O = 1/\varphi_k^*$.[10]

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9 Note that [$\varphi_k = 1$ and $\{\lambda_{kk} = 1$ & $\lambda_{ik} = 0$ for all $i \neq k\}$] is a feasible solution to the above problem. Hence, the optimal value, φ^*_k, will be greater than or equal to one. In case of multi-product firms, Y_i and Y_k in the first inequality will each be a vector (of appropriate dimension), and *not* a *scalar* as is being assumed here. The meaning of the term '*proportional increase* in output' (vector) will be quite clear then.

10 Observe that the DEA programme mentioned here is for the (general) variable returns to scale (VRS) technology. If we are to obtain technical efficiency of a firm under the constant returns to scale (CRS) specification of the technology, we have to solve the same LP problem without the constraint (3) and, therefore, such efficiency under the latter will be no more than that under the earlier technological specification.

Similarly, to obtain technical efficiency of the k^{th} firm in an input-oriented way we have to solve the programme

$$\left(P_k^I\right) \qquad \textit{Minimise} \quad \theta$$

$$\text{subject to} \quad \text{(i)} \sum_{i=1}^{N} Y_i \lambda_{ik} \geq Y_k, \quad \text{(ii)} \sum_{i=1}^{N} X_i \lambda_{ik} \leq \theta X_k,$$

$$\text{(iii)} \sum_{i=1}^{N} \lambda_{ik} = 1, \quad \text{and} \quad \text{(iv)} \ \lambda_{ik} \geq 0 \text{ for all } i = 1, ..., N.$$

and the (input-oriented) technical efficiency of the k^{th} firm relative to the frontier is given by $TE_k^I = \theta_k^*$ where θ_k^* being the optimal solution to the problem P_k^I .

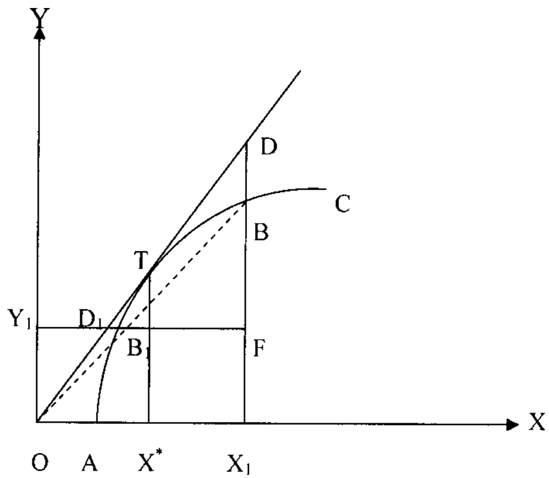

Figure 1

These concepts will be clearer if we discuss with the help of a diagram. Let ATBC (in Figure 1) be the production frontier (exhibiting VRS technology with other usual desirable properties). An (output-oriented) measure of technical efficiency (TE) of firm F, as defined to be the ratio of actually produced amount of output to the frontier level of output for the given level of input used by this firm, is given by

$\frac{FX_1}{BX_1} = \frac{FX_1/OX_1}{BX_1/OX_1}$ which is equal to the ratio of productivity, as defined to be the amount of output per unit of input used, at the point F to that at the point B. Note that TE is identical (and equals to unity) at all points on the frontier, but productivity is not. It is easy to see that productivity is the highest at the point T among all feasible points (i.e., those lie within the production possibility set). Hence, OX^* is the most productive scale size (MPSS) (*a la* Banker, 1984) in the above diagram. Output-oriented scale efficiency of a firm is defined to be the ratio of productivity at its (output-oriented) projection on to the frontier to that at the MPSS. Similarly, input-oriented measure of scale efficiency of a firm is the ratio of productivity at its (input-oriented) projection on to the frontier to that at the MPSS. In other words, scale efficiency is a measure of relative productivity of a firm with respect to productivity at the MPSS, if the firm becomes able to eliminate its technical *inefficiency* in production and, therefore, naturally it lies between 0 and 1.[11] So, scale efficiency of any firm lies on the vertical line BX_1 is, $\frac{BX_1/OX_1}{TX^*/OX^*}$ which is the ratio of productivity at point B to that at point T and scale efficiency of any firm lies on the horizontal line B_1F is the ratio of productivity at the point B_1 to that at point T. But, productivity at point T is equivalent to that of the hypothetical firms lie at point D and D_1. Although, these points are not feasible under the VRS technology, they are on the graph of the CRS technology. Thus,

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11 Note that scale efficiency does not state anything about the actual scale of production relative to the MPSS, in the sense that one cannot say whether the firm actually practicing more or less than the MPSS, by simply observing its scale efficiency score.

$$\frac{BX_1/OX_1}{TX^*/OX^*} = \frac{BX_1/OX_1}{DX_1/OX_1} = \frac{BX_1}{DX_1} = \frac{FX_1/DX_1}{FX_1/BX_1}$$ and similarly we can show that the ratio of productivity at B_1 to that at D_1 is equal to the ratio $\frac{Y_1D_1/Y_1F}{Y_1B_1/Y_1F}$. So, scale efficiency of a firm is the ratio of its TE under the CRS technology to that under the VRS technology.

Note that the frontier shown in the above diagram exhibits all the three types of local returns to scale property along its different segments.[12] Through its AT (TC) segment, increasing (diminishing) returns to scale holds and at the point T local constant returns to scale holds. Clearly, a firm uses less (more) than OX^* amount of inputs have to increase (decrease) its production scale in order to attain MPSS. We say that a firm follows IRS (DRS) technology if its projection on to the frontier touches the frontier in its IRS (DRS) segment. Since, there may be some firms whose output-oriented projection touches the frontier in its DRS segment and its input-oriented projection touches in its IRS segment, finally we take *only* those firms to follow IRS (DRS) technology whose output-oriented (input-oriented) projection is on the IRS (DRS) segment of the frontier.[13]

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12 See Banker (1984), Banker et al (1984) and Färe et al (1985) to obtain extensive discussion on the alternative approaches for identifying the nature of local returns to scale at any given input-output bundle on the frontier of the production possibility set. See also Ray (2004; Chapter 3) for an exposition of the alternative approaches and their equivalence.

13 Note that the nature of returns to scale of the chosen firms in this fashion will not change if we alter the *orientation* of measurement of efficiency since the production function we consider is globally concave.

4. Description of Variables and Data Used

The present study uses the micro-level data, i.e., the data on a number of variables for different individual industrial units collected by the Central Statistical Organisation (CSO), Government of India through its Annual Survey of Industries (ASI) and made available in soft version. Since these data are not panel data and also quite expensive to procure, we have applied DEA method to obtain individual TE and other related features of production behaviour of the firms for *some* selected years – starting from as early as 1980-81 to 2002-03, but keeping one year gap between two selected adjacent years. In other words we consider 1980-81, 1982-83, 1984-85 and so on till 2002-03 (with the exception for the year 1998-99). We have considered the entire organised leather sector, i.e., the part of the industry for which ASI data are published by CSO on a regular basis.

The *six* variables used in our empirical study are defined below along with their corresponding notations (the notation for the i^{th} firm to be indicated by putting a subscript i).

Output (***Y***): the total ex-factory value[14] of products and by-products produced by the firm during the year in question.

Intermediate Inputs (***I***)**:** the value of inputs (both indigenous and imported ones, including power, fuels etc.) used by the firm during the year.

Capital (***FA***)**:** the net value of fixed assets[15] of the firm at the beginning of a year.

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14 The definitions of the various concepts like ex-factory value, fixed asset, manday, wages, salaries etc are as used by the CSO. It would have been very useful if we had the panel data over a number of years. However, the lack of sufficient information did not allow one to construct a panel data set from this source.

15 Ideally one should use Plant and Machinery alone to consider it as an input in a production function. However, we use total value of fixed assets (including value of land and other fixed assets) in view of the observed very high correlation between FA (as we have taken) and value of Plant and Machinery alone. For instance, correlation coefficient between these two variables is as high as 89.85% in the year 2002-03.

Labour **(*L*):** the total number of mandays worked during the year.

Skill Ratio: the ratio of wages and salaries paid to the managerial and supervisory staff to total wages and salaries paid to all workers and employees.[16]

***Age*:** the difference (in years) between the firm's current and initial year of production.

5. Empirical Findings

Using the computer programme DEAP **2.1**, both output-oriented and input-oriented technical efficiency (TE) and scale efficiency (SE) have been calculated, following the DEA methodology, for each individual firm for each sample year relative to the frontier constructed on the basis of the data on all firms in the industry. Subsequently, an (arithmetic) average of these TE and SE values is computed over all firms for each year. These averages are given in the Table 1. The table shows that there is an overall increasing trend in average TE, for both output-oriented and input-oriented measurements. However, there is some downward drift in this trend. From the National Accounts Statistics released by the CSO we also see some temporary downward tendency in the growth rate of GDP of the leather and fur products group started in these years.[17]This may be corroborated with the overall performance

16 We define skill ratio in this manner due to non-availability of data on the suitable variables.

17 For instance growth rate of the GDP of this group from 1981-82 through 2004-05 are given below:

1981-82 22.0	1982-83 10.8	1983-84 21.0	**1984-85** 16.7	1985-86 -19.1	1986-87 -2.5	1987-88 39.9	1988-89 3.7
1989-90 24.9	**1990-91** 17.7	1991-92 1.2	1992-93 27.1	1993-94 50.0	1994-95 -20.6	1995-96 -3.7	1996-97 -10.6
1997-98 34.0	1998-99 6.9	1999-2000 -8.1	2000-01 8.3	2001-02 6.9	**2002-03** -4.2	2003-04 -4.7	2004-05 9.0

Source: National Accounts Statistics, CSO, Ministry of Statistics and Programme Implementation, GOI.

of the Indian leather industry for these years. One additional remarkable feature of such drifts is that for the three consecutive sample years since 1990-91 average TE falls gradually, possibly owing to the structural adjustment to the new economic regime. Since we draw separate frontier for each cross-section and, therefore, the benchmark frontier itself changes from one cross-section to another, the improving trend of overall performance seems show only a partial picture and anyone may think that this may be due to the fact that frontier for these three years shift upward due to relatively weaker norms faced by the potential producing units under the new liberalised economic scenario. H/She may also think that this is also true for the two other years namely 1984-85 and 2002-03. But that is clearly not true if we analyse the results shown in Tables 2a and 2b. These tables show that the ***gap*** between the percentage points showing the firms lies in the IRS segment of the frontier following the input-oriented measurement and at the same time they seem lie in its DRS segment following the output-oriented measurement is ***wider*** in most of these five years as compared to the others. But this can happen only when an overwhelming proportion of the firms are much more deviated from the frontier. Thus, the results imply that that is probably the case here for these years and, therefore, their overall efficiency is relatively less. Again, the combined results (of those shown in Table 2a and 2b) following our consideration discussed in Section 3 is shown in Table 2 which fails to show any clear picture about whether the overwhelming majority of the Indian leather firms are operating with too small or too large scale relative to MPSS. They are too small in fifty percent of the sample years and too large in the rest of the cases. Further, overall level of scale efficiency is as high as around 90% for the Indian leather industry as a whole.

Attempts have also been made to find out some explanation for inter-firm differences in such TE's. For instance, some authors (e.g., Aly et al, 1990; Bhandari and Ray, 2007) adopt a two-stage procedure in this regard and try to find determinants of TE values through regression analyses at the second stage, having estimated these through DEA at the first stage.[18] However, we consider logarithmic value of (output-oriented) TE score (*a la* Banker et al, 2008) of a firm as the dependent variable while treating firm size, its skill ratio, its age and different group dummies defined below as explanatory variables.[19] The dummy variables are used to examine whether these TE's show any variation across firms in different groups of states, ownership pattern and/or internal organisational structure. We have considered three major leather producing states viz. Tamil Nadu, Uttar Pradesh and West Bengal and incorporating a dummy for each state with firms in all other states being considered as the reference group; a dummy variable for the firms under private ownership with those under public ownership being considered as the reference group and a dummy variable for each of the private limited company (PRLC) and public limited company (PULC) type of internal organisational structure with firms under other types of organisation being considered as the reference group. Further, since skill ratio of a firm, as we have defined, can be considered to be an indicator of the proportion of skilled labourer out of its total labour force, one can expect that it will affect a firm's technical efficiency positively. The estimated results are shown in the Table 3. From the results some clear pictures emerge. First of all, size of a firm affects its TE positively with elasticity of technical efficiency with respect to size (shown in the first row) being statistically significant throughout the years. TE of firms varies significantly with its location and internal

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18 Aly et al (1990) used as determinants of efficiency indices variables like degree of urbanisation, firm's size and product diversity etc. for a sample of 322 independent banks in the USA.

19 We have also explained the logarithmic value of the input-oriented TE score of the firms using the same set of explanatory variables for the each sample year and the basic results obtained through it (not shown here) remain the same.

organisational structure. To be specific, firms of Tamil Nadu[20] are relatively less efficient than the firms located elsewhere and those with two specific organisation types namely private limited company and public limited company are performing worse than their counterpart with other organisational structures. Some other features, which are observed to be relatively less prominent, may be stated as well. The variables like skill ratio and age of firm don't affect its TE significantly in most of the cases. However, whenever their impact becomes significant, its sign is positive. Therefore, there exists some evidence of positive impact of firm's age (during the post-liberalised regime) and a similar impact of skill ratio of a firm on its TE. Similarly, trend regarding the overall effect of ownership pattern of a firm on its TE is insignificant. However, the interesting feature is that whenever it becomes significant it is negative prior to the economic liberalisation and positive in later period which is surely an indicator of the relatively friendly government policy towards the private enterprises after implementation of economic liberalisation on a massive scale in 1991.

An important point about the performance of the firms in West Bengal may be noted. The effect of WB dummy is insignificant in most of the cases and is positive whenever it becomes significant (viz. in 1986-87, 1992-93 and 1999-2000). This clearly shows diametrically opposite picture to the general belief that the overall work culture in West Bengal is far backward than that in many other Indian states. An explanation of their (so-called) better performance can, however, be given in this context. The leather firms in West Bengal are historically clustered mainly in the Beliaghata-Taltala-Entaly-Park Circus-Tangra-Dhapa-Topsia region of Central and East Calcutta, which is located right in the middle of some densely populated areas of the city grown around the tanneries, leather warehouses and workers' slums. There are

20 Tamil Nadu is the largest leather producing state with substantial number of firms located therein for each sample year.

few other fringes as well like Dum Dum, Maniktala, Raja Bazar, New Alipore, Tallygunge, Garia etc. Since tanning, as we have already noted, is the most polluting segment of the production chain of the industry and these firms are not any exception in this regard, in view of their relatively close connection with the residential area, in a verdict the Indian Supreme Court orders them to shift their plants to the newly made Bantala Leather Complex. But most of them did not react accordingly and the political parties, both the alliance in power and the oppositions, are surprisingly silent about them, particularly because they don't want to loose cheap popularity at the cost of the long-run benefit of the mass. The authorised enforcement bodies like the State Government, the Calcutta Municipal Corporation, State Pollution Control Authority, and Department of Police – all are equally reluctant to enforce the Court's order. What happens there? As per the record these firms shut down their operation at the area, but like any other *open secret* everyone of the surrounding locality knows that these firms continue their operations in full phase while keeping their main gate closed particularly during night. As a result of the entire story these firms are not effectively facing relatively tighter pollution control norms made for the leather industry and, therefore, can be able to incur less (and effectively negligible) pollution abatement cost. So, they become able to use proportionately more resources than an otherwise identical firm located elsewhere in their production activities which may be a factor in showing them to be performing relatively better.

In this regard we can guess why the firms in Tamil Nadu are shown to be relatively less efficient by our analysis despite their operations in the largest leather cluster of the country with the benefit of usual external economies arises from such a clustering. In its Industrial Development Report 2009, the United Nations Industrial Development Organisation (UNIDO) has identified the leather cluster in Chennai, Tamil Nadu among the ten most dynamic industrial location globally for its better environmental practices for those residing in the cluster among some other factors like its competence in international markets, the extent to which it provides better economic and social benefits in terms of employment, skills, wages etc. For their relatively more concern regarding the environmental norms, in particular and labour welfare, in general, (to implement them) these firms have to incur substantial cost due to pollution abatement and more formal practices regarding the labour laws, which may be an important factor for showing them to be less efficient relative to the firms located elsewhere in the country since, even today, almost none of the other clusters in India is doing so well in these dimensions. But the story was not so shining even until few years back[21] and the Tamil Nadu firms are adjusting themselves relatively faster with the changing overall (sustainable) market conditions than their counterparts elsewhere.

However, as we are unable to construct firm-level panel data from the data set we have and in view of the fact that benchmark frontier, (relative to which individual firms are evaluated), itself changes from one period to another in case of separate cross-sectional analysis for each sample year, our findings of increasing average TE over time may be tentative. However, to overcome this problem, at least to some extent, we construct a representative panel of *average firms*. To be specific, we first arrange the firms in ascending order of their size and club them into ten fractile groups viz. groups containing smallest 10% firms, next 10% firms and so on up to the largest 10% firms and take *only* the average firm (with average value of each variables) from each group. We have done this for each of the sample years. Thus we have a panel of 120 observations with 10 (hypothetical) average firms from each year. Since output, fixed assets and intermediate input variables are measured in

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21 Interested readers may look at Nihila (1999) to get a detailed picture about how poor the overall working environment was at the Tamil Nadu tanning firms until few years back which is qualitatively no different from that prevails at the leather cluster of Dharavi slum, Mumbai during more recent years (Singh, 2007).

(nominal) value terms, we adjust these figures by the suitable price indices. For instance, output is adjusted by the wholesale price index of manufactured products, fixed asset is adjusted by the wholesale price index of machinery and machine tools group and intermediate input is adjusted by the (simple geometric) mean of the wholesale price indices of non-food primary articles and fuel, power, light and lubricants group. We then estimate a time-varying TE model[22] (which is, as we have considered, a panel data stochastic frontier model to estimate a Cobb-Douglas production function with the same three inputs in case of our DEA-based analysis and the same set of explanatory variables (without the dummies) are used to estimate the inefficiency sub-model which we already used in our earlier second-stage regression) with this panel data and obtain individual TE for each hypothetical firm and that for each year. (The detailed results are shown in the Appendix.) The overall level of average TE of these 120 observations is 56% with average level of TE for the individual years 1980-81 through 2002-03 being 46, 49, 53, 52, 59, 55, 56, 62, 59, 56, 57 and 72 percentage points respectively, which clearly shows an increasing trend over time. Therefore, our finding of improving overall performance of the Indian leather manufacturing firms over time is robust in some sense.

6. Concluding Remarks

The leather industry is being considered as one of the most promising industries of India with excellent prospects for growth and export. The government is particularly interested in its promotion in view of its large potential for generating employment and income, with relatively low inputs of capital. A large part of this industry is in the unorganised sector about which very little systemic information is available. To examine some features of the production behavior of this

22 See Cornwell et al (1990), Kumbhakar (1990), Battese and Coelli (1992) for time-varying stochastic frontier models of panel data. An expository discussion of all these models can also be found in Kumbhakar and Lovell (2000; Chapter 3).

industry we have, therefore, no other alternative but to consider the organised part of this industry – the part on which information is available regularly from the Annual Survey of Industries (ASI). In fact, the unit-level data on industrial firms collected and compiled officially under the ASI are quite rich in coverage and content, but have remained largely unexploited till date.

The industry – at least the part covered by the ASI – grew very fast in the last two decades despite some erratic behaviour of its production in the 1990s. To secure a reasonable position in the export market the industry needs to be efficient in production. The purpose of the present study is to examine the extent of technical efficiency (TE) prevailing among the Indian leather firms as well as behaviour of such efficiency across time and across different groups of firms applying the *data envelopment analysis* (DEA). We have considered firm-level data for *twelve* sample years spanning almost equally around the initiation of economic reforms on a large scale in India in the early 1990s. The main results of our study may be summarised as follows.

Size of a firm affects positively its TE with this effect being statistically significant throughout the years. TE of firms varies significantly with its location and internal organisational structures. To be specific, firms of Tamil Nadu are relatively less efficient than the firms located elsewhere and those with two specific organisation types namely private limited company and public limited company are performing worse than their counterparts with other organisational structures. Some other features, which are observed to be relatively less prominent, may be stated as well. The variables like skill ratio and age of firm don't affect its TE significantly in most of the cases. However, whenever their impact becomes significant, its sign is positive. Therefore, there exists some evidence of positive impact of firm's age (during the post-liberalised regime) and a similar impact of skill ratio of a firm on its TE. Similarly, trend regarding the overall effect of ownership pattern of a firm on its TE is insignificant. However, the interesting feature about it is that whenever it becomes significant it is negative prior to the economic liberalisation and positive in later period which is surely an indicator of the relatively more friendly government policy towards the private enterprises after implementation of economic liberalisation on a massive scale in the early 1990s. Again the effect of WB dummy is insignificant in most of the cases and is positive wherever it becomes significant. Further, on a totality, performance of the Indian leather firms is on an improving trend over time (despite few downswings in it) and overall level of scale efficiency is as high as around 90% for the Indian leather industry as a whole.

Finally, we may propose some policy prescriptions on the basis of our results. As we have already discussed, the policy makers face a dilemma from the demand side regarding whether the Indian leather industry is to be expanded at the face of on-going global economic slowdown. On the other hand, analysing supply side factors we may conclude that there should not be any such hesitation in expanding the industry. If it were such that most of the firms are in the diminishing returns path of the production frontier, then the dilemma definitely would arise from the supply side also. In that case, firms are to contract their scale of operation in order to attain most productive scale size. On the other hand, the observed results clearly show that there exists a significant positive association between firm size and its technical efficiency. As an obvious outcome, the result would be in an ambiguity in taking decision in favour of or against the expansion of the industry. But since no clear picture emerges about the scale of operation of the majority of the firms in different years relative to the respective MPSS, the policy makers' objective should be in favour of expanding the industry, with providing specific emphasis on expanding the size of individual production units, in view of the facts that (a) it is a labour intensive industry with relatively less capital, (which is surely a relatively more scarce resource in India), requirement; (b) India have huge volume of traditionally skilled cheap labour; (c) unemployment problem in India cannot be ignored for its relatively large share of total labour force and (d) this problem (of unemployment) becomes more severe nowadays as an obvious outcome of the on-going global economic downturn since a massive proportion of her labour force looses their job which comprises both skilled as well as unskilled labour. Of course, all these points are related to the broad issue of problem of unemployment in India. After all, we are observing some sign in the international market of weakening of the ongoing global downturn. According to Mr. Habib Hussain, Chairman, Council for Leather Exports, India, the Indian leather industry expects to end 2009-10 with a 10% decline in export, slightly better relative to the earlier assessment of a 15% decline. He said that there has been a pick up in demand from the markets in the West with factories getting a healthy order inflow from December, 2009 onwards, which will help bring down the decline in growth. The industry is on the path of recovery from the slowdown of 2008 (*Business Line*, January 31, 2010). In the last quarter (October-December, 2009), the Indian leather industry finally began to see positive growth figures after 12 months of negative performance, Mr. Hussain said (*Business Line*, February 1, 2010). Government may also encourage the preferred organisational structures for the potential new entrant into the industry. Over and above all these Government should help the existing industrial units turning them into modern-day quality leather producers with advanced technology embodied machinery, better managerial skills, technically trained manpower etc to meet the overall demand of the changing markets.

One obvious limitation of our study is that it assesses possible impact of the ongoing global economic slowdown on the Indian leather industry without analysing data pertaining to the recession years since we have analysed data only upto 2002-03. However, we lay our faith on the long-run historical (supply-side) behaviour of the industry in this regard since we have analysed the relevant data for the last two decades.

Again, we use DEA method which is based on the mathematical programming techniques without considering the possible error structures that may affect the analysis. Since each methodology is having its relative advantages as well as disadvantages over any of its possible alternatives, our analysis is not free from its respective limitations.

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Table 1: Average Level of Efficiency of the Indian Leather Firms

	1980-1981	1982-1983	1984-1985	1986-1987	1988-1989	1990-1991	1992-1993	1994-1995	1996-1997	1999-2000	2000-2001	2002-2003
O-O TE	0.64	0.69	0.42	0.54	0.59	0.52	0.43	0.38	0.53	0.55	0.70	0.64
I-O TE	0.65	0.70	0.41	0.54	0.59	0.52	0.45	0.36	0.52	0.56	0.70	0.63
O-O Scale	0.96	0.93	0.84	0.82	0.91	0.93	0.92	0.82	0.89	0.93	0.96	0.93
I-O Scale	0.93	0.90	0.82	0.77	0.89	0.91	0.83	0.83	0.89	0.90	0.95	0.93
Total Firms	362	405	413	468	467	533	567	562	592	321	435	522

O-O: Output-oriented; I-O: Input-oriented; TE: Technical Efficiency; Scale: Scale Efficiency.

Table 2a: Percentage of Firms Lies in Different Return Path along the Frontier (Output-Oriented Measure)

	1980-1981	1982-1983	1984-1985	1986-1987	1988-1989	1990-1991	1992-1993	1994-1995	1996-1997	1999-2000	2000-2001	2002-2003
IRS	49	9	40	27	40	6	57	22	22	54	41	34
Local CRS	17	5	9	10	12	5	15	18	7	18	19	6
DRS	34	86	51	63	49	89	29	60	70	28	40	60

IRS: Increasing Returns to Scale; DRS: Diminishing Returns to Scale and CRS: Constant Returns to Scale. Figures in a column may not add up to 100 due to approximation up to TWO decimal points.

Table 2b: Percentage of Firms Lies in Different Return Path along the Frontier (Input-Oriented Measure)

	1980-1981	1982-1983	1984-1985	1986-1987	1988-1989	1990-1991	1992-1993	1994-1995	1996-1997	1999-2000	2000-2001	2002-2003
IRS	66	18	72	53	60	19	77	59	42	69	50	45
Local CRS	12	4	7	5	9	5	8	15	7	13	18	5
DRS	23	78	21	43	31	76	14	25	50	18	31	50

IRS: Increasing Returns to Scale; DRS: Diminishing Returns to Scale and CRS: Constant Returns to Scale. Figures in a column may not add up to 100 due to approximation up to TWO decimal points.

Table 2: Percentage of Firms Lies in Different Return Path along the Frontier (Combined Results)

	1980-1981	1982-1983	1984-1985	1986-1987	1988-1989	1990-1991	1992-1993	1994-1995	1996-1997	1999-2000	2000-2001	2002-2003
IRS	49	9	40	27	40	6	57	22	22	54	41	34
DRS	23	78	21	43	31	76	14	25	50	18	31	50

IRS: Increasing Returns to Scale; DRS: Diminishing Returns to Scale and CRS: Constant Returns to Scale.

Table 3: Estimated Coefficients of the Explanatory Variables to Explain Logarithmic Value of (Output-Oriented) Technical Efficiency

Explanatory Variable	1980-1981	1982-1983	1984-1985	1986-1987	1988-1989	1990-1991	1992-1993	1994-1995	1996-1997	1999-2000	2000-2001	2002-2003
Size (ln I)	0.06 (2.4)	0.09 (4.3)	0.23 (7.7)	0.30 (9.4)	0.18 (7.6)	0.13 (6.1)	0.25 (5.7)	0.20 (4.7)	0.25 (8.8)	0.10 (4.8)	0.11 (4.8)	0.13 (6.8)
Skill Ratio	0.27 (0.9)	-0.04 (-0.2)	-0.04 (-0.2)	0.71 (2.7)	0.26 (1.3)	-0.08 (-0.3)	-0.02 (-0.1)	-0.44 (-1.8)	0.11 (0.7)	0.30 (1.6)	0.05 (0.3)	0.07 (0.5)
Age	0.00 (1.0)	0.00 (0.7)	0.00 (1.3)	-0.00 (-1.4)	0.00 (1.0)	0.00 (0.8)	-0.00 (-0.5)	-0.00 (-0.2)	0.00 (2.0)	0.00 (0.9)	0.00 (0.8)	0.00 (2.4)
TN Dummy	-0.4 (-3.5)	-0.42 (-4.4)	-0.42 (-3.5)	-0.56 (-4.6)	-0.33 (-3.5)	-0.34 (-4.3)	-0.37 (-3.7)	-0.50 (-5.2)	-0.34 (-4.2)	-0.11 (-1.3)	-0.24 (-2.6)	-0.15 (-2.0)
UP Dummy	-0.04 (-0.4)	-0.15 (-1.5)	-0.17 (-1.7)	-0.15 (-1.3)	0.05 (0.6)	-0.10 (-1.0)	-0.11 (-1.0)	-0.17 (-1.6)	-0.07 (-1.0)	-0.06 (-0.6)	0.01 (0.3)	-0.04 (-0.9)
WB Dummy	-0.19 (-1.1)	-0.24 (-1.6)	0.03 (0.3)	0.30 (2.3)	0.03 (0.3)	-0.03 (-0.3)	0.34 (2.4)	0.16 (1.2)	-0.16 (-1.1)	0.34 (4.2)	0.01 (0.1)	0.05 (1.1)
PRIV. Dummy	0.34 (1.1)	0.13 (0.7)	0.02 (0.2)	-0.26 (-1.7)	-0.11 (-0.9)	-0.22 (-2.8)	-0.22 (-0.8)	-0.69 (-1.7)	-0.14 (-0.4)	0.64 (2.4)	-0.22 (-1.3)	0.18 (1.8)
PRLC. Dummy	-0.05 (-0.4)	-0.20 (-1.4)	-1.0 (-0.8)	-0.24 (-2.0)	-0.16 (-1.8)	-0.05 (-0.6)	-0.34 (-3.8)	-0.45 (-4.8)	-0.21 (-2.6)	-0.29 (-3.8)	-0.20 (-1.8)	-0.09 (-2.0)
PULC. Dummy	0.03 (0.2)	-0.16 (-1.0)	0.05 (0.4)	-0.36 (-2.7)	-0.24 (-1.5)	-0.16 (-1.2)	-0.47 (-3.8)	-0.37 (-3.3)	-0.34 (-3.6)	-0.32 (-2.3)	-0.08 (-1.3)	-0.22 (-1.9)
Constant	-1.83 (-4.3)	-1.74 (-5.6)	-4.47 (-9.7)	-4.96 (-10.3)	-3.46 (-8.5)	-2.60 (-7.7)	-4.63 (-5.7)	-3.52 (-3.8)	-4.83 (-8.6)	-3.12 (-7.2)	-2.08 (-5.0)	-2.87 (-8.8)
$\overline{R}^2$ (%)	3.1	4.2	14.6	22.0	14.3	8.2	17.3	19.4	23.8	10.4	8.2	21.5
No. of Firms	362	405	413	468	467	533	567	562	592	321	435	522

Figure in parenthesis is corresponding (heteroscedasticity-adjusted, a la White) t-ratio.
Since individual standard errors are not too large multicollinearity, if at all, is not contaminating our estimation.
Figures shown as 0.0 and 0.00 are very small and are approximated up to one and two decimal points respectively.

Appendix

Table A.1: Estimated Cobb-Douglas Stochastic Frontier Production Function with Hypothetical (Average) Panel Data

Variable	Parameter	Estimated Value of the Parameter*
Constant	β_0	2.63 (1.93)
$\ln I$	β_1	0.67 (9.40)
$\ln FA$	β_2	0.25 (8.43)
$\ln L$	β_3	- 0.03 (- 0.58)
Constant	δ_0	3.97 (2.96)
$\ln I$	δ_1	- 0.20 (- 2.87)
Age	δ_2	- 0.01 (- 2.07)
Skill Ratio	δ_3	0.17 (0.42)
$\sigma^2 \left(= \sigma_u^2 + \sigma_v^2\right)$		0.02 (6.99)
$\gamma \left(= \sigma_u^2 / \sigma^2\right)$		0.89 (7.73)
Log-Likelihood Value		62.00
No. Of Firms		10
No. of Time Period		12
Total No. of Observation		120
Overall Mean TE (%)		56.24

* *Figure in the parenthesis is corresponding t-ratio.*

Table A.2: Individual TE Score of the Hypothetical (Average) Firms in Different Years

Fractile Group	*Year*											
	1980-81	1982-83	1984-85	1986-87	1988-89	1990-91	1992-93	1994-95	1996-97	1999-2000	2000-01	2002-03
1	0.27	0.29	0.25	0.22	0.33	0.23	0.29	0.46	0.34	0.31	0.27	0.33
2	0.32	0.33	0.40	0.31	0.41	0.32	0.35	0.45	0.51	0.36	0.36	0.52
3	0.32	0.35	0.40	0.38	0.39	0.37	0.36	0.47	0.46	0.47	0.42	0.57
4	0.38	0.38	0.35	0.34	0.47	0.44	0.43	0.41	0.41	0.51	0.43	0.65
5	0.45	0.34	0.59	0.47	0.52	0.50	0.51	0.54	0.58	0.53	0.50	0.70
6	0.39	0.52	0.50	0.51	0.62	0.61	0.56	0.61	0.60	0.44	0.58	0.76
7	0.52	0.55	0.53	0.64	0.62	0.65	0.73	0.74	0.77	0.59	0.67	0.81
8	0.55	0.60	0.66	0.69	0.74	0.70	0.68	0.73	0.68	0.66	0.73	0.93
9	0.57	0.62	0.67	0.69	0.86	0.73	0.75	0.85	0.79	0.82	0.76	0.92
10	0.82	0.90	0.94	0.93	0.96	0.95	0.90	0.92	0.79	0.90	0.96	0.98
Average	***0.46***	***0.49***	***0.53***	***0.52***	***0.59***	***0.55***	***0.56***	***0.62***	***0.59***	***0.56***	***0.57***	***0.72***

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