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Measuring Efficiency of Textile Firms of Punjab (Pakistan)

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ABSTRACT:

The recognizance about the efficiency level for the textile firms has vital importance mainly for the firms of small scale. This research work measures the efficiency scores of the small-sized textile firms of Punjab, Pakistan. Efficiency scores have been calculated by applying output-oriented Bootstrap DEA under Constant Returns to Scale. Cross-sectional data taken from CMI (Census of Manufacturing Industries) 2010-2011 has been utilized in this research work. Three input variables i-e, number of employees, all the fixed assets and the value of raw materials and one output variable i-e, value-added has been used in this research work. Results showed that not a single small sized textile firm of Punjab is fully efficient under Bootstrap DEA. The highest efficiency score is 0.88, which is considered as benchmark for the other firms. Moreover, mean efficiency score obtained under Bootstrap DEA for the small sized textile firms of Punjab is 0.36, which derives the need to maximize the output of this sector by 64% with the utilization of same quantity of inputs.

KEY WORDS: *Textile Sector, Small-sized Firms, Bootstrap DEA, Efficiency, Maximization of Output*

1. INTRODUCTION

With the increasing constraints in the production process (like energy disaster, low investment in R&D, inability to make optimal use of new technology etc), textile firms are fading away from the path of their technical growth. Especially the firms at small level are facing many challenges regarding these issues. This situation is giving rise to the need to know about their performance so that they can easily know about their rank in the entire market. It is also very crucial to know about their level of efficiency, especially for the small scale firms, for their survival and prosperity. It is one of the important elements of the process of growth (Leibenstein 1996).

The idea of efficiency has been in use since the era of Adam Smith. But the pioneers of an analytical approach to measure the efficiency are Koopsman (1957) and Debreu (1951) and further its empirical application was instigated by Farrell (1957). Basically, there are two techniques to measure the efficiency. First one is Parametric Technique and the other technique is Non- parametric. Parametric technique i.e. Stochastic Frontier Approach (SFA) was firstly initiated by Aigner et al. (1977) and Meeusen and Broeck (1977). Non-parametric technique i.e. linear programming models that are framed on convexity assumptions are known as Data Envelopment Analysis (DEA). It uses mathematical programming to identify the efficiency of the DMU's and categorizes them into two efficient and inefficient DMU's. (Ray, 2004; Sherman and Zhu, 2006; Adler, Friedman and Stern, 2006). The positive point attached with Stochastic Frontier Analysis (SFA) is that it also includes the stochastic variations in the model but its dark side is that, it requires distributional assumption of the error term. Secondly, SFA responds very quickly to the slightest changes in the parametric functional form (Hossain et al., 2012). Further, Mahadevan (2002) pointed out that "Distinctive determinations of the Production function under the parametric approach gives diverse outcomes and this is a genuine methodological issue". If we compare it with DEA then DEA doesn't require these conditions. But there are some deficiencies attached with DEA which are as follow; it suffers from the problem of serial correlation, inability to incorporate Data Generating Process (DGP), exaggeration and underestimation of DEA estimates and underestimation of frontier. That's why; DEA bootstrap approach is introduced. Bootstrap was firstly introduced by Efron (1979). In the bootstrap procedure, we randomly select thousands of "Pseudo samples" (i-e, random sampling with replacement) from the sampling data under consideration. Then each pseudo sample provides the pseudo estimates. From these pseudo estimates, a true distribution is formed and used as approximation for the interest of the estimator (Coelli et al., 2005). Positive points associated with this technique are that it provides us with confidence intervals of the efficiency estimates and consistent inferences for factors that elucidate efficiency.

Textile sector is facing serious challenges and it is one of the major sub-sectors of manufacturing sector. The present status of the textile sector suggests that the efficiency is a key issue to be considered to analyze the status of these firms and the causes of inefficiencies (Memon and Tahir, 2012). It is needful to know the technical efficiency of textile sector because it engages 39% population of the under-utilized workforce and contributes 8.5% of GDP. According to the Ministry of Textile industry[i], Pakistan is the fourth biggest producer of cotton and third biggest consumer of the world and textile sector is considered as a driver towards the development of manufacturing sector.[ii] Keeping in view the significance of textile sector, it is ineluctable to know about its performance because this sector is lagging and also facing declining investment trend over time.

Textile is the overwhelming and export-oriented manufacturing sector of Pakistan, playing crucial role in development of human civilization over several millennia. But it has remained stagnant over the last decade due to various exogenous and indigenous factors, such as subsidies given to cotton farmers and other textile products by several countries which distorted prices, market constraints, global recession and increasingly stringent buyers' conditionality [iii].Thus, here ensues a need to become efficient in order to achieve the targets to survive in business.

This study is aimed at evaluating technical efficiency of small-sized textile firms of Punjab because this sector is the dynamic sector and is regarded as back bone of economy. In this research, three inputs and one output variable is selected to carry the estimation procedure for measuring the efficiency scores of small sized firms of textile sector of Punjab (as prescribed by Coelli et al. 2005). The reason behind selecting the small sized firms is that Pakistan is a developing country which has large number of small sized industries. These small industries are the path for the growth of this sector. According to SMEDA (Small and Medium Enterprises Development Authority), Punjab constitutes the major part of textile sectors having 39,033 small and cottage industrial units. This important province constitutes various pockets of industrial clusters. Textile sector of Punjab has proved to be the major export earner since last four decades. So, this province requires more attention. There is no study in Punjab that has estimated bias-corrected efficiency scores of the small-sized firms of textile sector. This will be the first study to evaluate the efficiency by applying Bootstrap DEA.

2. REVIEW OF LITERATURE:

Many studies have been done for measuring efficiency at international level while the studies at national level are confined and no attention has been paid to explore the efficiency level on the provincial level in Pakistan. Most of the studies have adopted the technique of Data Envelopment Analysis (DEA) of two stages to measure the efficiencies. However Stochastic Frontier Approach has also been adopted by some of the researchers and Malmquist Index has also been used in few studies.

Chandra et al. (1998) estimated the performance of 29 textile firms of Canada for the year of 1994. Estimation techniques used in this study were CCR input model and DEA approach. Annual sales were used as output variable. Inputs were number of employee, average annual investment. A mathematical model was developed in this study to know about the tradeoffs between outputs and inputs. Results of this study showed that most of the textile firms of Canada were found to be inefficient and some of them were concluded as poor performers.

Wadud (2004) evaluated the efficiency of textile and clothing firms of Australia for the period of 1995-98 by using Stochastic Frontier Production Approach. Data was taken by conducting BLS (Business Longitudinal Survey) by the ABS (Australian Bureau of Statistics). Value added of each firm was used as output, while inputs were total annual labor hours of all the workers and non-current assets. Technical efficiencies were expressed as four-digit codes. It was found that mean efficiencies were in range of 43 to 51 percent and 42 to 45 percent in 1995-98 based on the value added frontiers.

Din et al. (2007) conducted a study for Pakistan in which they calculated the technical efficiency of manufacturing firms working in Pakistan. Hence, they incorporated the textile sector in the category of manufacturing sector. They used DEA methodology as well as the stochastic frontier analysis for this purpose. Their findings revealed that technical efficiency is quite disappointing for textile sector in Pakistan. Specifically, technical efficiency of textile sector was found to be 0.30 for the year 2000-2001. In addition, technical efficiency for complete manufacturing sector was estimate to be 0.42 for the same period.

Saricam and Erdmulu (2012) comparatively evaluated the efficiency levels of textile and apparel industry of Turkey using input-oriented Data Envelopment Analysis under variable return to scale assumption. Data of 29 textile companies was selected for the period of 2003 to 2008. Output variables used in this study were net sales and net profits and input variables were number of employees, share holders' equity and net assets. Ten textile industries, three apparel companies and sixteen from both apparel and textile industries got lower average DEA score during this period and thus these were found to be inefficient. The ratio of inefficient industries was also found to be following increasing trend during this period.

Mahmood (2012) analyzed the effect of input composition on the technical efficiencies of textile industries of Pakistan using DEA and TOBIT analysis. Data was taken from the Census of Manufacturing Industries (CMI 2005-06) of 27 industries. Value added was used as the output; labor, all the fixed assets, raw materials, energy and non-industrial cost were used as inputs. It was found that more than eight industries (Cotton Fabrics, Cordage, and Robe etc) were most efficient whereas more than four industries (Carpets and Rugs, Processing of Textile Waste etc) were found least efficient industries. Imported raw material and machinery were found positively related while non-industrial cost was negatively related to the technical efficiencies.

Ahmad & Afzal (2012) examined the technical efficiency of cotton farmers of the Muzaffargarh district of Punjab, Pakistan by using the Stochastic Frontier Production fumction. Primary data was used in this study which was collected through the survey of 100 farmers of the district for the growing season of 2010-11. Inputs used in that research were total area of cotton crop production, quantity of seed per acre, pure nitrogen applied to the unit area, pure phosphorous applied to the unit area, cost of pesticides, number of irrigation per acre, number of family labour, number of cultivation per acre and the output variable was the total production of the farmer. The range of the technical efficiency was found as 0.29 to 0.99 with the mean technical efficiency of 0.72. The study suggested that there is a need to increase the technical efficiency of the cotton farmers.

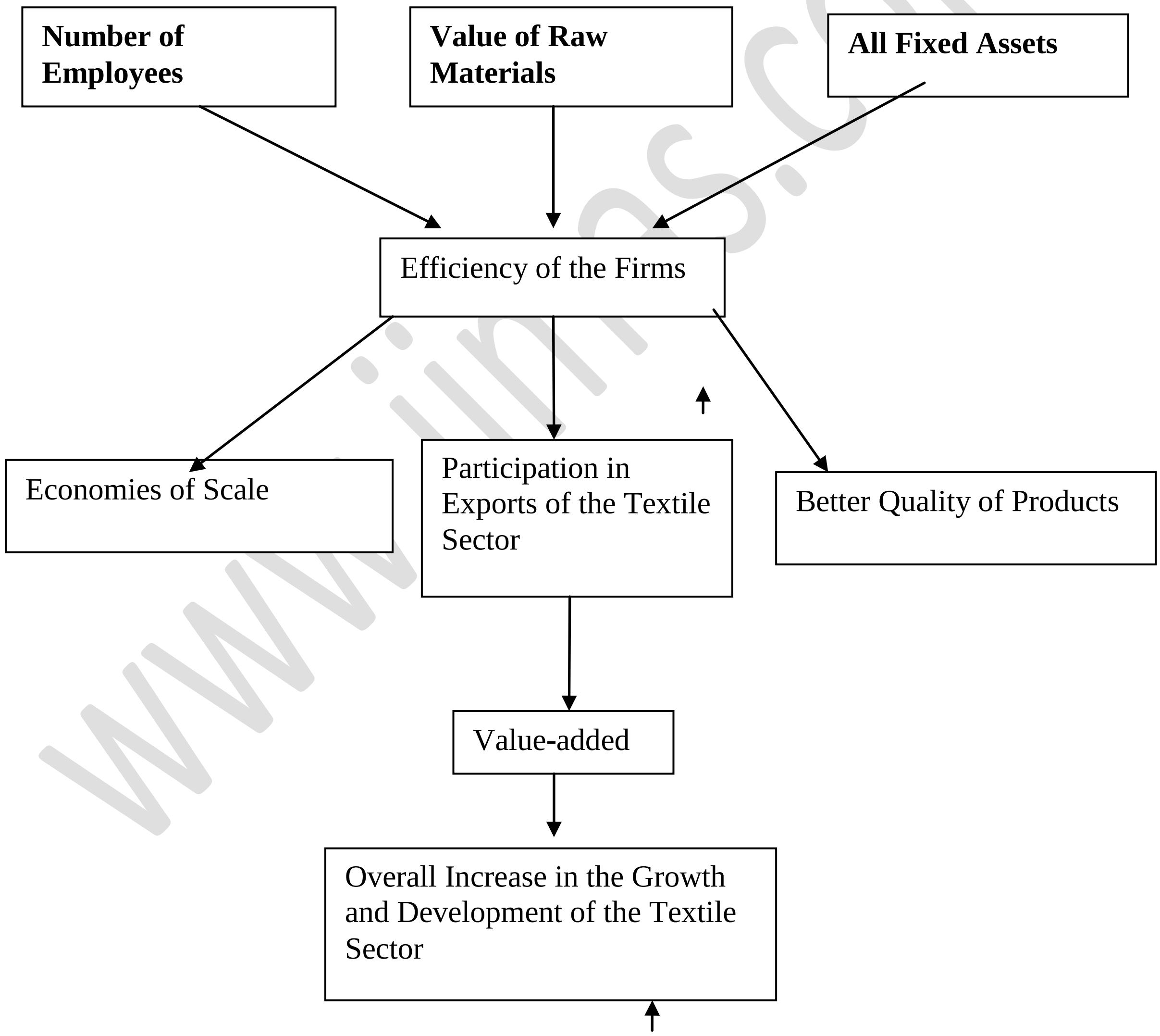
Pandey et al. (2014) calculated the relative scale efficiency of the top ten selected Indian states of textile industry in 2014 by using the input-oriented CRS model of DEA analysis. Data was collected for the period of 2008-09. The results of the study revealed that the Punjab is most efficient state amongst all other states. It was one of the only states that comprised the ability to be called as the efficient state and thus benchmarked for the other states. Gujarat was found to be efficient in some of the areas while Rajasthan, Tamil Nadu and Uttar Pradesh were found to be the most inefficient states.

The review of the literature depicts that DEA technique has been used to measure the efficiencies in most of the studies. But the use of this technique is not appropriate. The errors become serially correlated with the application of this technique.(Ahmad et al., 2015; Alexander, Haug, & Jaforullah, 2010; Bahrini, 2017; Balcombe et al., 2008; Keramidou & Mimis, 2011; Lee, 2012; Simar & Wilson, 1998, 2007, Mujaddad & Ahmad 2016). So, in this study Data Envelopment Analysis (DEA) bootstrap technique is used to acquire the bias-corrected efficiency scores of the textile sector of Punjab. Most of the research that has been conducted on textile sector for the case of Pakistan has focused on national level analysis. Very few studies and limited research has been conducted to estimate the productivity growth for textile and garment sector in the provinces of Pakistan. As major proportion of textile firms are operating in Punjab province, hence it is quite essential to conduct provincial level analysis of textile sector for the case of Punjab. It may help to assess and compare the competitiveness of textile firms working in Punjab. Therefore, this study contributes to the literature in calculating technical efficiencies apropos to the appropriate technique.

3. THEORATICAL UNDERPINNINGS AND METHODOLOGY CONCEPTUAL FRAMEWORK:

A firm is considered as an efficient firm if it is able to utilize its inputs optimally to produce the maximum output. If all the inputs will contribute positively then the firm will move towards efficiency, which may further improve the value added of that firm and hence contribute in the overall growth and development of the sector. In this study, inputs include number of employees, value of raw materials and all the fixed assets of the firms with one output variable that is value-added of the firm. If there is optimal number of employees in the firm then it will help in the minimization of cost and maximization of the profit of the firm. If there is excess number of employees then it will cause an increase in the cost of the firm and affect its efficiency. Even if there are lesser employees in the firm to produce the output then still may be marked as inefficient firm. So the inputs (for example number of employees) should be optimally used to become an efficient firm (Chandra et al. 1998; Din et al. 2007; Erdumlu, 2016; Saricam & Erdumlu, 2012). All the fixed assets of the firm and the value of its raw material help to improve the efficiency of the firm and further development of the sector (Bhandari & Ray, 2007; Erdumlu, 2016; Mahmood, 2012; Yesilyurt & Yesilyurt, 2008). These inputs are directed towards the economies of scale and will boost the exports to other countries. In the small sized firms, efficiency cognizance will assist these firms to be able to participate in the exports of this sector. This participation in exports will further lead this sector towards the growth of their firms.

Figure 4.7



Source: Author's own analysis

Efficiency measurement of the firms is one of the important aspects to reach at the higher peaks of growth and development of the firms. The firm will be considered as efficient if it is at its best. If we consider the definition of OECD, then efficiency can be defined as the extent to which a production process is at its best level. It also has a relative concept of comparing the firms with the best producing firm by benchmarking it. By doing the practice of benchmark, we can compare the quantities of outputs and inputs with the optimal quantities of outputs and inputs. DEA is the technique which is used to measure the efficiency of the DMU's. It is an application of linear programming techniques (Kapelko & Oude Lansink, 2015).

Farrell (1957) was the first who gave the notion of measuring efficiency. Basically, there are two common approaches, which are used to measure the efficiency;

i) parametric technique
ii) nonparametric technique

Parametric technique (includes stochastic frontier analysis (SFA)) was developed by Aigner et al. (1977), and Meeusen and Broeck (1977). Non-parametric technique, which is also distinguished as linear programming models of Charnes et al. (1978) and Fare et al. (1985), based on the convexity assumption is known as data envelopment analysis (DEA). Both techniques have some restrictions; an explicit functional form and distributional assumption of the error term are required by SFA while DEA does not demand these conditions.
Simar and Wilson (1998, 2000) recognized several restrictions with respect to the simple DEA approach i.e.

i) these DEA models do not incorporate the data generating process (DGP) and
ii) the efficiency estimates, which are estimated by DEA, are serially correlated. So, the general DEA estimates are statistically invalid because of these two main flaws.
iii) Presence of uncertainty in the efficiency scores
iv) DEA efficiency estimates are exaggerated and underestimate the frontier.

In case of these severe limitations, Simar and Wilson (1998, 2000) proposed an alternative estimation and statistical inference procedure based on a DEA bootstrap approach which is still a significant approach in case of finding the bias corrected T.E efficiency scores. In this study, the DEA bootstrap has been employed for analysis.

a. Theoretical Underpinnings of Efficiency Measurement:

DEA is a non-parametric way to deal with efficiency measurement of DMU's by utilizing its resources optimally. This technique neither requires any assumption about the functional form of a production function nor any priori information from the outputs and inputs (Ehmcke & Zloczysti, 2009). By the process of optimization, firms can easily attain efficiency. Tjalling C. Koopsman[iv] defines optimization as "best use of scarce resources" and "Mathematical Methods of Organizing and Planning of Production". DEA method of efficiency measurement is divided into two categories:

i) Output-oriented (maximization of output by keeping the inputs fixed)
ii) Input-oriented (minimization of inputs by keeping the output vector constant)

First category indicates the maximization of output by utilizing a limited quantity of inputs available to the firm. This technique is usually adopted if only limited quantity of inputs is available to produce maximum quantity of output. Second category shows the presence of variable quantity of inputs and a specific quantity of output is produced by using minimum inputs. DEA under both cases shows same result under CRS but varies under VRS. In this study, output-oriented DEA under VRS is selected because there are limited resources to produce maximum quantity of output. So, the output-oriented variable returns to scale (VRS) model for getting the efficiency scores is suitable to use. The output-oriented DEA efficiency estimator $\hat{\theta}_{ivrs}$ for any data set (x_i, y_i) for each textile firm can be obtained by solving the following linear programming equation.

$$\hat{\theta}_{ivrsi} = max(\theta > 0|\theta iYi \leq \sum_{i=1}^{n} \Upsilon iYi; Xi \geq \sum_{i=1}^{n} \Upsilon iXi; \sum_{i=1}^{n} \Upsilon i = 1; \Upsilon i \geq 0, i = 1, \ldots .n) \quad (1)$$

In equation (1) X and Y are observed as inputs and outputs and i=1…., n is the specific textile firms. θiYi is the efficient level of outputs, θ is the scalar and Υi is the non-negative vector of constant which explains the optimal weights of inputs to outputs. The obtained value of $\hat{\theta}_{ivrsi}$ is the technical efficiency (T.E) estimate for ith textile firm. In case of output oriented, output should be increased by utilizing the same level of inputs for getting the higher T.E, where $\hat{\theta}_{ivrsi}$=1 means that the textile firm is considered fully efficient while $\hat{\theta}_{ivrsi}$<1 means that the textile firm is inefficient and it needs to increase the output from the given set of inputs for reducing the inefficiencies.

There are two notable points relating to the equation (1). First, in this linear program, VRS is assumed, which is due to our understanding of the market constraints within the Punjab (Pakistan, which may be suitable when it is not possible to assume that all observed units (districts) are operating at an optimal scale (Banker, Charnes, and Cooper 1984) and second, Simar and Wilson (2000) observed that $\hat{\theta}_{vrsi}$ is the downward biased estimator, as specific entity frontier can be underestimated. Due to the limitations of DEA, the smooth bootstrap technique of Simar and Wilson (1998, 2000) have been applied in this study for getting the bias-corrected efficiencies and their confidence intervals accompanied by the DEA with bootstrapping approach.

There are seven steps to perform the DEA bootstrap as described here.

(a) Solve the equation (1) and obtain $\hat{\Theta}_1 \ldots \hat{\Theta}_n$
(b) Produce a sample $\beta_1^{\sim} \ldots ., \beta_n^{\sim}$ from $\hat{\Theta}_1 \ldots \hat{\Theta}_n$
(c) Sample values will be smoothed by using the formula as given:
$\Theta^{\sim}_i{}^* = (\beta_i^{\sim} + h\dot{\varepsilon}_i$ if $\beta_i^{\sim} + h\dot{\varepsilon}i \geq 1$ or $2 - \beta_i^{\sim} - h\dot{\varepsilon}_i$ if $\beta_i^{\sim} + h\dot{\varepsilon}_i < 1)$
Where h is the bandwidth of a standard kernel density and $\dot{\varepsilon}i$ is a random error.
(d) Adjusting the smoothed sample value by utilizing the following formula for getting the value of Θ_i*:
$$\Theta_i^* = \beta^{\sim} * + \frac{\Theta^{\sim}i* - \beta^{\sim}*}{\sqrt{1 + \square^2/\varphi 2\theta}}$$
Where $\beta^{\sim} * = (1/n) \sum_{i=1}^{n} \beta i^{\sim}$ and $\varphi 2\theta$ is the sample variance of $\hat{\Theta}_1 \ldots \hat{\Theta}_n$
(e) Estimate the pseudo data set using by $\theta i/\Theta i*$
(f) By solving the equation (1), calculate the bootstrap estimate $\hat{\Theta}_i$*vrs.

(g) Repeat these 5 steps "b-f" 2500 times to provide a set of estimates.

4. SELECTION OF VARIABLES:

In this study, following variables are selected as outputs and inputs:

a. Output:

Value-added reported in CMI 2010-11 is used as output in this research work.

b. Inputs:

Inputs are selected by a well-known classification of input variables, that is, KLEMS. In this, K stands for capital, L stands for Labor, E stands for Energy, M stands for Material Inputs and S stands for Purchased Services. Last three categories E, M and S are mostly treated in one variable i-e, "other inputs". According to this way, there must be three input variables to measure the efficiency. Here "capital" is measured through the fixed assets of the firms, "labor" is measured through the number of employees and "other inputs" are measured through the raw materials of the firms. According to the Coelli (2005), the fore stated variables truly fall in the categories of KLEMS. Output variable in this study is measured through the Value-added of the firms. Detailed information of the input variables is given below.

i) Labor:

Labor includes the number of employees associated with the textile sector of Punjab. It includes all the people whether serving part time or full time and receive remuneration in cash or any other form. Unpaid family workers, home workers and working proprietors are not included in this category.

ii) Capital:

Capital consists of all the fixed assets like building, land, plant and machinery etc which have expected productive life of more than one year.

iii) Value of Raw Materials:

Raw materials are one of the most crucial inputs in the production process as it becomes the part of output after going through this process. The output produced is very sensitive to the extent of the raw materials. Its quality, quantity and utilization enable the firms to produce optimal output. Hence the value of raw materials is an important component to incorporate, while measuring the efficiency of the firms (Akindipe, 2014).

In the report of CMI 2010-11, Raw materials are physically incorporated in the products and by-products. It includes raw and semi finished materials, assembling parts etc. This source provides the data on the raw materials which are imported and domestically produced.

5. DATA SOURCES

The data for the efficiency analysis is taken from CMI 2010-11 of Punjab. CMI (Census of large scale Manufacturing Industries) constitutes the data of registered establishments under Factories Act, 1934. The main objective of the establishment of CMI is to know about the patterns of the production and the structural changes taking place over time. It was conducted every year before 1990 but now it is conducted after five years. Other statistics in this research has been taken from the Economic Surveys of Pakistan, Punjab Development Statistics (of different years) Ministry of Textile Industry, and from the website of State Bank of Pakistan.

6. ESTIMATION AND INTERPRETATION

DEA bootstrap technique has been applied to the data of the time period 2010-11 to obtain the biased corrected efficiencies of the small sized textile firms of Punjab. In Table A, first column shows the names of the small sized textile firms in the first column, second column shows the original DEA efficiency scores as BE, third column shows the biased-corrected efficiency scores as BC and the last two columns show confidence interval. LB (Lower Bound) shows the lower limit and UB (Upper Bound) shows the upper limit. It helps in determining that either the biased-corrected values are estimated correctly or not. The DEA estimates show the efficiency of small sized textile firms, which contains bias in it. These biased estimates can be easily differentiated by comparing these with the next column, which contains biased-corrected efficiencies. It is noteworthy that the original DEA estimates are overstating the efficiency values and underestimating the frontier. Simar and Wilson (2000) have also described this drawback of DEA in their research. Furthermore, DEA does not provide us confidence interval while bootstrap DEA provides us with it. Thus, it can be easily said that DEA does not provide us with correct efficiency estimates while bootstrap DEA technique provides the confidence interval, which tells that the efficiency scores have been accurately calculated iff they lie within these bounds. So, Bootstrap DEA gives us reliable estimates for the analysis of efficiencies of the firms. The bias-corrected estimates of textile sector of Punjab have been estimated by 2500 simulations. The prime characteristic of these biased-corrected efficiency estimates is that they exist into the upper and lower limits but the original DEA efficiency scores don't provide the upper and lower limits. As it is explained in the previous chapter, output-oriented Bootstrap DEA under VRS is used to estimate the efficiency scores of the small-sized firms of the textile sector of Punjab. The DEA estimates range between 0 and 1. The efficiency score, "0" represents fully technically inefficient firms and "1" represents fully technically efficient firms. For the demonstration of output-oriented case, we employ fixed quantity of inputs to obtain maximum quantity of output. Thus, to minimize the inefficiencies of the firms in this case, output can be maximized by utilizing fixed level of inputs.

Table A indicates the results of the 124 small-sized textile firms of Punjab for the period of 2010-11. It can be concluded that only eighteen textile firms are found to be fully efficient under DEA, namely Mian and Company, Siddique Dyeing Industries, Ali Haider Textile Industries, Muhammad Rafiq Dhulai Works, Matching Thread Works, Talib Mudassar Textile Industries, N.N. Export International (Pvt.) Ltd., Ryozo International (Pvt.) Ltd., Seven Star International-II, Ali Sizing (Leasee of Ali Sizing), Qasim Weaving, Aleem Weaving Industries, R.H Rope Industry, Fine Star Processing Mills (Pvt.) Ltd., New Qadri Dying, Umer Abu Bakkar Silk Factory, Mian Embroidery, and CRI International. 20 out of 124 firms are found to inefficient (in case of DEA approach) with efficiency score of 0.1. It means that these firms can obtain more output by utilizing the same inputs. Their efficiency score of 0.1 indicates that 90% more output can be produced by employing the same quantity of inputs.

But, if we evaluate biased-corrected efficiency scores then it is concluded that no any single firm is found to be fully-efficient under Bootstrap DEA. If we keenly make analysis of the biased-corrected results, then high inefficiencies are found in this sector. The firms with highest biased corrected efficiency scores are Siddique Dying with 0.88 (it means it can produce 12% more output by utilizing same level of inputs), Umer Abu Bakkar Silk Factory with 0.77(it can produce 23% more output by utilizing same level of inputs), Muhammad Rafique Dhulai Works, Matching Thread Works and Aleem Weaving Industries with 0.76 (it can produce 24% more output by utilizing same level of inputs) efficiency score. Firms with lowest biased-corrected efficiency score of the textile sector are Print Gallery and Touseef Silk Factory with 0.02 efficiency score. It reveals that these firms are producing 92% less output by using same level of inputs. The overall situation illustrates that these firms are not producing optimal quantity of output by utilizing fixed quantities of inputs. It also means that maximum output can be produced by utilizing fixed quantity of inputs. Thus the individual results of the firms have shown that the small-sized textile sector of Punjab is unable to produce maximum output within the given set of inputs. After the description of individual efficiency scores of the small-sized textile firms, mean efficiency score of this sector is given at the end of the table 5.1. Mean efficiency score of the textile sector under DEA is 0.46 and under bootstrap DEA is 0.36. This overall situation elucidates that overall small-sized firms of the Textile Sector of Punjab are not producing optimum quantity of outputs with specific quantity of inputs. The mean score of 0.36 indicates that these small sized firms can produce 64% more output with the use of same inputs. Hence the small sized firms of the textile sector of Punjab need to reconsider their output produced by utilizing same level of inputs, during the production process. Though these firms use the industrial waste of the large sized firms but these firms can produce more of their output with the use of these inputs.

It is crucial to take these small-sized textile firms of Punjab along with the large scale firms due to several reasons. First of all, these firms have more potential for the employment of less-educated labors. These small-sized firms also encourage women to participate in the production of textiles (especially traditional textiles to meet the local demand). These small sized firms also control the rural urban migration of the workers. Furthermore, production processes involved in such firms does not include sophisticated technologies; their products are mostly labor-intensive goods. So, it is need of the hour to look on the condition of these small-sized firms. These firms cannot be neglected at any cost, even they also accommodate the overall output of this sector and hence exports of our country may also appreciate by making our country more globalized in the world.

7. CONCLUSION

The aim of this research is to measure the performance of small-sized textile firms, which are indispensible for the growth of the overall textile sector. Performance measurement is one of the foremost goals for the managers of the firms because they want to keep themselves aware of the efficiencies of their firms. They want to optimally utilize their resources to produce a certain quantity of output. Performance analysis helps these firms to know, whether firms are producing output optimally or not, at what rank they are, by how much they can maximize their output by incorporating fixed inputs. This performance can be analyzed by measuring the efficiency scores of each firm. To measure the efficiency scores of the firms, many methods can be adopted. But in this study, most appropriate method i-e, bootstrap DEA has been used. The reason behind adopting this technique instead of DEA is that, DEA provides us biased efficiency scores of the firms, which even do not fall in to the confidence interval and are not close to reality. Bootstrap DEA provides biased-corrected efficiency scores of the firms, so that the DMU's can know correct estimates of their efficiencies. It has also observed in the results of this study that DEA is unable to provide us correct picture of the performances of the firms and stray us towards the misleading decisions. While bootstrap DEA estimates fall into the confidence interval and hence provides us better picture to analyze the performances of the firms.

The main objective of this study is to reveal the performances of the small-sized textile firms of Punjab. As mentioned in the previous chapters, Punjab is one of the highest income provinces of Pakistan, constituting major textile clusters in it. Small-sized firms are selected on the basis of their consequences on the overall textile sector of Punjab. The evidence found from the empirical evaluation of these small sized firms is that, all the firms of textile sector of Punjab are technically in-efficient. This implies that none of the small-sized firms of the textile sector of Punjab is optimally employing its input set to produce output. All of the firms of Punjab are found to be unable to produce maximum output within the given fixed set of inputs. Hence the small sized firms of the textile sector of Punjab need to re-examine their output level acquired in the production process. Though these firms make use of the industrial waste of the large sized firms but these firms are also capable to produce more of their output by using the same inputs. Hence, from the above exploration, it can be aggregated that the small-sized firms of the textile sector of Punjab are not producing their output up to the optimal level by utilizing their same inputs and most of the firms are not properly utilizing the inputs for the production of maximum output. The benchmark firm with the highest efficiency score is Siddique Dying with 0.88 efficiency score.

Given that small-sized firms are imperative for the whole textile sector and is necessary condition for the sustained growth and development of the industrial sector of Punjab, the hindrances and issues facing Punjab's industry need to be addressed. Thus, it is necessary on the part of the managers of the firms, to frame such environment, which assist these small-sized firms especially for the training of the workers, literacy about useful production methods etc.

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APPENDIX

Name	BE	B.C	Confidence Interval at 5% LB	UB
AAY ZED & COMPANY	0.1113	0.087086068	0.074172031	0.107064054
AL UMER DYING	0.052143703	0.043230651	0.038595566	0.049673777
AL-NOOR FABRICS	0.988899602	0.694314743	0.565063694	0.952807447
ALI DOTT BUCKRAM FACTORY	0.225300021	0.193702199	0.175166351	0.213309306
CHAMAN PROCESSING INDUSTRIES (PVT.) LTD.	0.199099988	0.16569429	0.14482318	0.196346502
ELAHI SIZING	0.2997	0.230822089	0.201840462	0.282194593
FAZAL IBRAHIM SILK MILLS (PVT.) LTD.	0.346600027	0.271506874	0.238114401	0.33103704
IZHAR WOOLLEN MILLS	0.184199988	0.144292732	0.123122702	0.175856858
MASTER DYEING INDUSTRIES	0.572499964	0.459068532	0.403843459	0.561446376
MIAN AND COMPANY	1	0.739843064	0.653867857	0.947611309
SAKHI PROCESSING MILLS	0.561099845	0.460897884	0.410678124	0.529898461
TARIQ SPINNING	0.894800137	0.747891693	0.656468214	0.875558606
BAHOO DYING	0.575000144	0.449215311	0.390786657	0.545814585
USWAH WOOLLEN INDUSTRIES	0.45539995	0.321890553	0.26062408	0.439018372
SIDDIQUE DYEING INDUSTRIES	1	0.817410851	0.74406312	0.932533965
HARIS DYES AND CHEMICALS	0.145400002	0.11391447	0.101172938	0.138581584
BADAR DYEING	0.110799997	0.088058765	0.078853222	0.106111311
SHAFQAT SILK FACTORY	0.155400011	0.131421086	0.118815504	0.148891902
AL REHMAN WOOLLEN MILLS	0.209	0.169436846	0.149581426	0.198653803
ALI HAIDER TEXTILE INDUSTRIES	1	0.639656939	0.541803675	0.932314003
GOLDEN INDUSTRIES	0.037587248	0.032016769	0.028467113	0.03630975
KHALID HAMEED & COMPANY	0.617299955	0.469745788	0.405414883	0.582014924
SAEED SPORTS	0.542600074	0.437300127	0.387418657	0.511666246
BEST EMBROIDERY – II	0.332100025	0.264249733	0.235303364	0.31182733
H S EMBROIDERS SIALKOT	0.555199919	0.435937654	0.38964814	0.522643804
LUCKY LABEL EMBROIDERY INDUSTRY	0.479399945	0.394093329	0.352714153	0.454109922
TOP LINK INTRENATIONAL	0.407800074	0.320084092	0.27966904	0.387993164
A U B SILK FACTORY	0.223599996	0.192794387	0.174631188	0.212667723
ASIM SILK FACTORY	0.518400093	0.430467083	0.38705712	0.494066264
CHOHAN SILK FACTORY	0.439299949	0.320909329	0.254760584	0.428068815
FAROOQ SILK MILLS	0.314599955	0.260343648	0.232690394	0.297954424
MEHRAN SILK FACTORY	0.295900009	0.256094275	0.2314473	0.283737527
OSAMA SILK FACTORY	0.505399946	0.41783399	0.378665386	0.478979735
RAHAT SILK FACTORY	0.188800006	0.163991958	0.148238079	0.180644812
ZUBAIR SILK FACTORY	0.390200048	0.320067598	0.285415008	0.372535491
MASOOD COTTON PROCESSING UNIT	0.286200008	0.227638294	0.202621025	0.273386358
FARAN PROCESSING INDUSTRIES (PVT.) LTD.	0.167700006	0.142130612	0.124367854	0.161561355
MUHAMMAD BUKHSH SONS AND COMPANY	0.505800009	0.406488533	0.358844549	0.474312425
ZUFLAH INTERNATIONAL COMPANY	0.147900005	0.119607095	0.105819445	0.139668062

MUHAMMAD RAFIQ DHULAI WORKS	1	0.762140517	0.685844243	0.934273836
SHAKOOR DYING	0.743000011	0.638450149	0.570917356	0.7141995
EJAZ DESIGNING & EMBROIDERY CENTRE	0.671099953	0.54274526	0.483950742	0.631211117
MATCHING THREAD WORKS	1	0.766251231	0.681559189	0.944942009
BISMILLAH SILK FACTORY	0.284999994	0.233600323	0.208752099	0.268809834
G.M INDUSTRIES	0.09424194	0.079701851	0.069039814	0.09328433
RIAZ INDUSTRIES	0.29569999	0.214309395	0.180243899	0.283821762
RUSTAM WEAVING FACTORY	0.135699996	0.115670107	0.103032239	0.129626382
TALIB MUDASSAR TEXTILE INDUSTRIES	1	0.64241672	0.552583272	0.938606676
N.N.EXPORT INTERNATIONAL (PVT.) LTD.	1	0.668064703	0.581425772	0.944602823
RYOZO INTERNATIONAL (PVT.) LTD.	1	0.68468202	0.582672825	0.930989474
FARAN ENTERPRISES	0.173499993	0.151759738	0.137381244	0.167262372
SEVEN STAR INTERNATIONAL - II	1	0.627382879	0.510990381	0.938263218
PRINT GALLERY,	0.024506461	0.021314251	0.01919458	0.023603529
AL-AZIZ WEAVING	0.129400005	0.110579934	0.09889976	0.123105787
BARI SIZING INDUSTRY	0.169799986	0.146973363	0.127084697	0.168268272
AHMED WEAVING FACTORY	0.204699994	0.173151268	0.154652201	0.194642428
ALI SIZING (LEASEE OF ALI SIZING)	1	0.629561567	0.510657681	0.943497697
QASIM WEAVING FACTORY	1	0.628473099	0.511212945	0.932453967
EMPIRE TEXTILE INDUSTRIES	0.408099968	0.333414464	0.300085104	0.385090675
WORLD TEX	0.522200029	0.448996672	0.405681324	0.501208916
GHULAM MUHAMMAD WEAVING FACTORY	0.185400009	0.161837018	0.146802825	0.177729783
AMIN POWER LOOMS	0.863200055	0.720725915	0.644596125	0.818583147
SANA SILK FACTORY	0.407199947	0.345202905	0.313184504	0.383285825
ALEEM WEAVING INDUSTRIES.	1	0.769566419	0.688292354	0.94291854
ASLAM SILK FACTORY	0.258700017	0.221592849	0.200396545	0.244859901
FEROZE DIN TEXTILES	0.519700008	0.422312991	0.382705683	0.491281473
TAUSEEF SILK FACTORY	0.030435018	0.026413841	0.023940993	0.029156768
UMAR INDUSTRY	0.444400004	0.357969511	0.314356274	0.420786694
PARADISE ENTERPRISES	0.043154313	0.032068861	0.028362933	0.040589959
RANA CLASSIC ELASTIC	0.218799996	0.17018655	0.15173229	0.212375187
RANA ELASTIC	0.466600067	0.387324121	0.352279513	0.441175627
REHAN TEX INTERNATIONAL	0.871600214	0.75432587	0.654414286	0.863797305
HASSAN ENTERPRISES - II	0.498399887	0.419742857	0.373214542	0.480240043
ALLIED NAWAR FACTORY	0.483700034	0.397559304	0.354771967	0.454452911
MOON STAR INDUSTRIES	0.197099989	0.167445287	0.150240723	0.189990863
INAM PLASTIC ROPE INDUSTRY	0.703500053	0.488376636	0.409444744	0.661319677
R.H ROPE INDUSTRY	1	0.631779388	0.510798797	0.928556837
KHALIL AKBAR EMBROIDERY	0.430000073	0.348014923	0.310019457	0.413804005
MOON ZARI INDUSTIES	0.427999926	0.316794847	0.273232629	0.405179162
NAEEM TEXTILE INDUSTRIES	0.465200015	0.384117214	0.343090484	0.439562178
NEW PAK SPINNING INDUSTRY	0.236499989	0.189013728	0.167419693	0.222902968
QAMAR COTTON INDUSTRIES	0.871300241	0.75681722	0.674536256	0.849966469
RIAZ CALICO PRINTING WORKS	0.867599915	0.674666411	0.579410531	0.819331638

SHAHID WOOLEN MILL	0.362900007	0.307134363	0.278333285	0.344333171
RAHMANIA TEXTILE MILLS (PVT) LTD.	0.415299984	0.358571894	0.312385003	0.405115966
ZAHOOR EMBROIDERY (PVT.) LTD.	0.604000051	0.469759469	0.411286863	0.576824018
FINE STAR PROCESSING MILLS (PVT.) LTD.	1	0.691986451	0.605930606	0.920913767
HAMEED TRADERS.	0.171200015	0.149838931	0.135883781	0.164791205
NEW HEERA CALLENDER	0.575800045	0.450338677	0.390187715	0.546790504
SADIQ TEXTILE	0.387799968	0.313142627	0.276801667	0.371109015
MASTER DYING	0.351100049	0.30110832	0.272364681	0.334543601
IQBAL DYEING	0.326400052	0.271758405	0.245800498	0.307731129
HAZAFA DYEING	0.290100018	0.233741305	0.209308887	0.273955715
ARSLAN HOSIERY	0.318399951	0.244462437	0.213988881	0.297672469
NEW JALLANDER SIZING INDUSTRIES	0.252699973	0.215080591	0.18617512	0.248210157
INAYAT SIZING INDUSTRY	0.322300036	0.273844983	0.247292151	0.303059691
BAHA R SIZING INDUSTRIES	0.231799992	0.1953051	0.169976506	0.22580525
NOOR SIZZING INDUSTRIES	0.235800006	0.201909132	0.175791691	0.229026917
ANSARI SIZING INDUSTRIES	0.241899979	0.200019242	0.181563663	0.230833545
DILAWAR SIZING INDUSTRIES	0.187600014	0.147313047	0.130428346	0.182291776
SUAK ENTERPRISES (PVT) LTD	0.734699875	0.578864834	0.507263249	0.69452692
SANTA WOHBING WEAVING FACTORY	0.604600039	0.51035771	0.453595996	0.581846618
ABDUL REHMAN TRADERS ;- 175, EAST CANAL ROAD, GULSHEN E HAYAT, FAISALABAD	0.122599998	0.099115542	0.087970763	0.116455785
AL HILAL WASHING PLANT, STREET NO.1, MUJAHID ABAD, FAISALABAD.	0.820999863	0.614269103	0.528700227	0.768848119
NEW QADRI DYING.	1	0.628909854	0.511060891	0.938476309
SAEED BARARGI WORKS INDUSTRY	0.167200007	0.141946596	0.129248679	0.157698112
SALAMAT INDUSTRY	0.771200296	0.627558477	0.566299837	0.730292153
S.A INDISTRY	0.337600035	0.273383368	0.247373022	0.321069031
SALEEM WEAWING FACTORY	0.703400095	0.577282213	0.519335645	0.665484766
M/S CHUDHARY SILK FACTORY	0.652900051	0.529123486	0.474871239	0.619531857
MADINA WEAVING FACTORY	0.382899993	0.316768856	0.280358242	0.371459848
NASRULLAH SIZING INDUSTRY	0.443099981	0.36406119	0.32161797	0.421237444
TAJ SILK FACTORY	0.276900005	0.236692161	0.209270692	0.26512196
UMER ABU BAKKAR SILK FACTORY	1	0.772380298	0.704384583	0.932694873
MIAN EMBROIDERY	1	0.626822093	0.5097648	0.930554573
A.D. TEXTILE INDUSTRIES	0.155100006	0.125609836	0.111233369	0.147542524
AL-ABBAS DYEING ART CO.,	0.651400021	0.477127691	0.414422053	0.612520282
SUBHAN ULLAH PROCESSING IND.	0.101999996	0.084140918	0.075606054	0.096214489
DATA HOSIERY FINISHING &DYEING	0.270800014	0.226503131	0.20353425	0.258810157
NATIONAL DYEING INDUSTRIES.	0.36509995	0.30772611	0.275662071	0.351565645
HAQ BAHOO SIZING INDUSTRIES,	0.269999978	0.229606837	0.201687275	0.259723462

MASHALLAH SIZING INDUSTRY	0.453900091	0.380562105	0.342960345	0.429395008
SONA TEXTILE CORPORATION	0.192400007	0.158703154	0.139909646	0.18344514
CRI INTERNATIONAL	1	0.631156139	0.510035458	0.932675735
Mean Efficiency Score	0.468901364	0.362005087		

[i] Ministry of Textile Industry is established by the Government of Pakistan in 2004 which formulates the policies to boost the textile sector

[2] Year Book 2010-11 and 2011-12 by Government of Pakistan , Ministry of Textile Industry, Islamabad

[iii,4] Pakistan Economic Survey 2014-2015, chapter 3

[iv] Winner of Nobel Prize Economics 1975, "for their contribution to the Theory of Optimum Allocation"