TECHNICAL EFFICIENCY AND ITS DETERMINANTS: A CASE STUDY OF FAISALABAD TEXTILE INDUSTRY

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Abstract

The present study investigates the technical efficiency of Faisalabad textile industry. It uses Stochastic Frontier Production function with Translog functional form to analyze firm level cross sectional data for the year 2005-06. The study objective was to find out empirically the technical efficiency score of individual firms and investigate the effects of firm specific factors which include age, size and firm ownership on technical efficiency of firms. Average technical efficiency is observed to be around 81% which shows that textile industry produce 81% on average out of the total potential with given resources. The study concludes that firm age and technical efficiency of firm exhibits inverted u-shaped relationship while there is evidence that size of firm has u shape relation with technical efficiency. However, ownership effects found insignificant for textile industry.

Keywords: Technical Efficiency, Textile Sector, Stochastic Frontier Analysis.

1. Introduction

The textile sector in Pakistan is one of the biggest manufacturing sectors and considered the back bone of country. It has an important impact on economy by contributing 8% to the GDP of the Economy and its share in employment is 40 percent of industrial labor force (Textile policy 2014-19). Textile sectors contribution in total output is approximately 46% and its share in country's exports is 57% (Ministry of textile industry). Pakistan is on 8th number in Asia for exporting of his textile products and this sector provides employment to 38% people of the country. Government of Pakistan in Economic survey (2015) depicts that in the world, Pakistan is 4th biggest producer and 3rd prime consumer of cotton. In the period of highly competitive situation for existence and for meet the global challenges the textile sector needs to upgrade its production level, improve efficiency and productivity.

Faisalabad is hub of textile industry and known as "city of textile" in Pakistan. Faisalabad city is also known as "Manchester of Pakistan" due to rapid development in textile industry. In the paper, 'Technical efficiency and its determinants: A case study of Faisalabad textile industry. The purpose of the paper is to analyses the technical efficiency of Faisalabad textile industry as well as find out the impact of important determinants of technical efficiency. Stochastic frontier model was used. The data was used from secondary sources.

1.1 Importance of Study

One of the important concepts in production economics is Efficiency. For checking the firm's performance on theoretical and empirical grounds it is necessary to measure efficiency score at firm level. It is important to work on firm level analysis to examine the best ways to increase the efficiency of textile industry because economic growth depends on firm's performance. In literature, production function has been used for measuring efficiency of firms. Frontier production function provides maximum potential output by giving inputs. It was impossible to assume same level of production and efficiency of all firms. Taking ideas of (Koopmans, 1951) and (Debreu, 1951), (Farrell, 1957) firstly gave the idea of efficiency and divided it into technical and allocative efficiency.

Allocative efficiency is distinct to choose the best combination of inputs, i.e. at the given price ratio. Technical efficiency is thus to achieve best possible output from any combination of inputs has been chosen. Current study concentrates on technical efficiency, as this has previously been the most difficult component to quantify (Caves & Barton, 1991). In addition, technical inefficiency appears to be an important source of under-performance. This study analyzes the firm's technical efficiency and impact of factors which affect the efficiency score for Faisalabad textile industry. This study tries to analyzing those particular factors which are responsible to create inefficiency among textile firms. The current study will adopt empirical method of stochastic frontier which is generally used in literature for different sectors like Diaz & Sánchez, (2008) highlighted sectors of agriculture, banking, industry and others. The aim of the study is to add a research effort in present work by finding out the efficiency score at firm level as well as to see the relationship between firm's efficiency and some important factors. There are many factors which affect the efficiency of firms but the study in hand will investigate how size, age and ownership pattern (public vs private) of firm will cause a difference in efficiency score among firms.

2. Literature Review

In current period, due to availability of micro level data there are lot of studies worked on measuring technical efficiency of manufacturing industries. An older research work by Pitt & Lee, (1981) used panel data from weaving industry of Indonesia to examine the technical efficiency score. Widely literature used cross sectional data with stochastic frontier function to observe the efficiency of manufacturing industries (Chen & Tang, 1987; Hill & Kalirajan, 1993).

Le & Harvie, (2010) used stochastic production function for evaluating the performance of SME in Vietnam for three different years. Result intimated high average technical efficiency from almost 84% to 92%. Larger size group and older small manufacturing industries were found inefficient while innovation expands efficiency level. An early study selected Taiwan manufacturing industry and investigated influence of research and development and imports of technology on firms producing ability. They used panel data from 1992 – 1995 and 1997- 2003 and fitted translog production function. Both variables found positive and significant impact on firm's performance (Chang & Robin, 2012).

Alao & Kuje, (2010) worked out to confirm the efficiency score of small furniture industry by using Cobb-Douglas form. They discovered TE was 0.52 and important raw material was plywood, timber and labor for production of furniture. The Nail variable found negative impact on output level.

Saputra, (2011) worked on DEA by choosing number of manufacturing industries from Indonesia to find the technical efficiency level from 1990 to 2001. Results showed the difference in efficiency scores during the refer periods. He found five industries were more efficient like Iron, tobacco, transport equipment, industrial chemicals and non-ferrous metal.

Amornkitvikai & Harvie, (2011) selected 178 Thai registered manufacturing industries during period 2002-2008 for measuring their performance level. They used stochastic frontier analysis. The study specified that ownership pattern, size of firm and managerial payment create positive and significant relation with technical efficiency.

3. Methodology

Economic efficiency is further separated into technical and allocative efficiency which is estimate by frontier functions. Technical efficiency is a skill that how firm can best produce output with minimum inputs and given technology. To estimate frontier function different techniques were used in literature. This study will used parametric approach.

3.1 Stochastic Frontier Production Function

Widely use model for efficiency analysis is "stochastic frontier" model, was projected by Aigner D.J., C.A.K. Lovell, & Schmidt, (1977) and Meeusen & Broeck, (1977). Another name of this model is composed error model due to its two random components. Model is written as

$$Y_i = X_i\beta + (v_i - u_i)$$

Or in log form is

$$lnY_i = \beta lnX_i + v_i - u_i$$

It is assumed that mean of this model is a function of independent variables or firm specific factors. Technical inefficiency can be described as in given model form:

$$\mu_i = \delta_i Z_i + w_i$$

The calculation of technical efficiency is observed by dividing the currently output to maximum feasible output from the minimum resources (Taymaz & Saatci, 1997); (Kumbhakar & Lovell, 1998).

$$TE = \frac{f(x_i;\beta)\exp(v_i - u_i)}{f(x_i;\beta)\exp(v_i)} = \exp(-\mu_i)$$

$$0 \leq TE \leq 1$$ [1]

The variables of both models will be calculated simultaneously with maximum likelihood technique.

To observe the technical inefficiency affects, Aigner D.J. et al., (1977) suggested a "log-likelihood function" for above model by supposing "half normal distribution". "Log Likelihood function" is stated as in relation with two parameters of variance as $\sigma_s^2 = \sigma_u^2 + \sigma_v^2$ and $\lambda = \sigma_u/\sigma_v$ $(0 \leq \lambda \leq \infty)$ but the (Battese & Corra, 1977) parameterization will be used by substituting λ with γ.

Where$(0 \leq \gamma \leq 1)$

$$\sigma_s^2 = \sigma_v^2 + \sigma_u^2 \quad \text{And} \quad \gamma = \frac{\sigma_u^2}{\sigma_v^2+\sigma_u^2} = \sigma_u^2/\sigma_s^2$$

$\sigma^2 = 0$ → $u_i = 0$ depicts all firms are full efficient.

$\sigma^2 > 0$ shows all firms are not full efficient.

$\gamma = 1$ shows random errors are cause of deviations from the frontier.

The term "stochastic" having random effects on frontier production which industry cannot be handle. Kumbhakar & Lovell, (1998) observed the main advantage of stochastic frontier model is to calculate the efficiency score and find out the factors of firm's inefficiency jointly. Current study chooses one stage process of stochastic frontier approach built on (Battese & Coelli, 1995) model.

3.2 Factors of Technical Inefficiency

[1] TE ranges between 0 and 1. TE = 0 shows inefficient firm and TE = 1 shows efficient firm.

Technical efficiency can be influenced by many factors. In early years many studies worked to inspect the factors of inefficiency. According to (Lovell, 1993), it is compulsory for the improvement of firm's performance to investigate the factors which create difference in firm's efficiency scores. Caves & Barton, (1991) proposed multiple studies which approach to identify the factors which create inefficiency in production level. It can be illustrated into different sorts:

1) Firm's external factors such as market competition where the firm works.
2) Firm's factors like age, size and kind of firm.
3) Firm's ownership means whether firm belongs to public sector or private sector.

3.3 The Data

Survey data at firm level for the year 2005-06 is use in this study. The source of the data is Punjab bureau of statistics. 75 textile firms are selected from Faisalabad district for empirical estimation.
Translog Production Function is:

$$lnQ_i = \beta_0 + \beta_1 ln(L_i) + \beta_2\, ln(I_i) + \beta_3\, ln(K_i) + \beta_4(lnL_i)^2 + \beta_5(lnI_i)^2 + \beta_6(lnK_i)^2 + \beta_7(lnL_i)(lnK_i) + \beta_8(lnL_i)(lnI_i) + \beta_9(lnK_i)(lnI_i) + v_i - u_i$$

Inefficiency model is defined as:

$$\mu_i = \delta_0 + \delta_1 lnAge_i + \delta_2 lnSize_i + \delta_{11} ln(Age_i)^2 + \delta_{22} ln(Size_i)^2 + \delta_{12} ln(Age)(Size_i) + \delta_{01} D$$

3.4 The Factors of Technical Efficiency

Following review of literature, in this study we find out that the connection exist between technical efficiency and firm's factors like age, size and ownership of firm. Many studies are found in literature which observes the relationship between firm factors and technical efficiency (Pitt & Lee, 1981; Lundvall & Battese, 2000; Bhandari & Maiti, 2007) .

Firm's Age: Number of earlier studies proposed the link between age of firm and technical efficiency and this relationship found unclear. Some studies found positive relationship between these two variables suggesting older firms are efficient due to production experience and it is based on the idea of learning by doing. New firms are inexperienced so not produce output efficiently. While some studies showed the negative relationship between age of firm and technical efficiency by proposing that new firms quickly adopt new innovations and technologies and produce efficiently while older firms have to wait for implementation of new technology which is time taking and costly.

Firm 'size: Another important factor is firm's size which influences the efficiency of firm's output level. It is also ambiguous relationship. Few studies found out positive relationship between these two variables due to the economies of scale in production and investment in new technologies. Some researchers observed negative relationship due to the diseconomies of scale. They found larger firms have problems of supervision and management.

Firm's Ownership; Firm's ownership is one of the significant factors which create efficiency difference among firms. Different ownership classifications were used by different studies to inspect the link between ownership of firm and technical efficiency of firm. This study will use public private ownership used by (Hart, 2003).

3.5 Technical Efficiency Analysis

To select functional form between Cobb Douglas production function and Translog production function a hypothesis test is conduct. Results of hypothesis test on functional form selection and inefficiency model are outline in table1.

Hypothesis Test: For hypothesis test different restrictions are executed on original model. To check the rationality of these restrictions generalized likelihood ratio test is used.

Table 1: Test of Hypothesis for Selection of Functional Form and Inefficiency Model

Null Hypothesis	Log-likelihood under H_0	Test Statistics	Critical Value		Decision
			10%(.10)	5%(.05)	
Cobb Douglass β_4=β_5=β_6=β_7=β_8=β_9=0	-29.085	50.512	10.64	12.59	Reject
No inefficiency effect γ $*$=δ_0=δ_1=δ_2=δ_{11}=δ_{22}=δ_{12}=δ_{01}=0	-19.695	31.732	12.74*	14.85*	Reject
No size effect δ_1=δ_{11}=δ_{12}=0	-8.294	8.93	6.25	7.81	Reject
No age effect δ_2=δ_{22}=δ_{12}=0	-11.339	15.02	6.25	7.81	Reject
No size and age effect δ_1=δ_2=δ_{11}=δ_{22}=δ_{12}=0	-11.974	16.29	9.24	11.07	Reject
No ownership variation δ_{01}=0	-4.262	0.866	2.71	3.84	Accept

*The table value of the γ is given in Table 1 of "(Kodde & Palm, 1986)**"** with 8 degrees of freedom (P.1246)
^In alternate hypothesis, unrestricted model value is -3.8294.

After imposing restriction on original model the results shows, for current study translog production function is better than to Cobb Douglas production function. Similarly by imposing restrictions on inefficiency model the results of null hypothesis shows inefficiency effects are present in sample firm's output level and there is existence of size, age and combine size age effect on efficiency of firms. However ownership variation has no effects on efficiency of firm.

3.6 Estimates of Maximum Likelihood Method

"Frontier 4.1" a computer program by (Coelli, Prasada, & Battese, 1998) have been utilized to estimate the individual parameters of both stochastic frontier model and inefficiency model. The predicted values of variable are highlighted in table 2. T-test is used to check the statistical implication of different parameters and it shows mostly parameters are statistically significant. Based on t-statistics the labor coefficient ($\beta 1$) is significant but negative implying there is no impact of number of workers on firm's output level. According to (Sun, 2006) it is due to the reason that some workers not work properly or efficiently. Predicted values of both parameters of intermediate ($\beta 2$) and capital ($\beta 3$) inputs shows there is positive and significant relationship between these two inputs and output level. It illustrates that intermediate and capital inputs are important for the production of Faisalabad textile industry. The labor ($\beta 4$) has positive relationship to sensitivity of output with respect to labor showing that labor is unresponsive to price for textile industry of Faisalabad. Walujadi, (2010) found similar results for garments firms in Jakarta. (β_5) Depicts intermediate input have positive relationship with sensitivity of output with respect to intermediate input confirms that intermediate input is unresponsive to price and it is very significant. ($\beta 6$) describes capital input have positive relationship with sensitivity of output with respect to capital input, confirms that capital input is unresponsive to price and it is very significant. The joint terms of labor and capital ($\beta 7$) illustrates the sensitivity of output in terms of labor input with capital input. It has negative sign which gives idea that as capital increase, labor is also responsive to it but this relationship is found insignificant. The combine terms of labor and intermediate input ($\beta 8$) describe the sensitivity of output in terms of labor input with intermediate input. It has also negative sign, shows that as raw material increases, labor also increases quickly but this relationship is insignificant. The combine terms of capital and intermediate input ($\beta 9$) describe the sensitivity of output in terms of capital input with intermediate input. It has also negative sign, shows that as capital increases, labor also increases quickly this relationship is significant.

Table 2: Regression Results of Maximum Likelihood Method

ESTIMATED VALUES OF PARAMETERS FOR 2005-06			
Variable	**Parameter**	**Coefficient**	**t-statistics**
Constant	β_0	1.953	1.84*
Log of Labor	β_1	-1.01	-3.25***
Log of Intermediate input	β_2	0.911	4.10***
Log of Capital	β_3	0.729	2.73***
(Log of Labor)^2	β_4	0.073	3.40***
(Log of Intermediate input)^2	β_5	0.063	2.69***
(Log of Capital)^2	β_6	0.052	2.12**
Log of L* Log of k	β_7	-0.025	-0.97^{ns}
Log of L* Log of I	β_8	-0.005	-0.174^{ns}
Log of K* Log of I	β_9	-0.132	-2.90***
INEFFICIENCY MODEL			
Constant	δ_0	- 2.15	-1.28^{ns}
Log of age	δ_1	-4.82	-2.71***
Log of size	δ_2	1.46	2.00**
(Log of age)^2	δ_{11}	1.08	2.78***
(Log of size)^2	δ_{22}	-0.25	-2.26**
Log of age* Log of size	δ_{12}	0.23	2.18**
D_1	δ_{01}	1.72	1.37^{ns}
Sigma-squared	$\sigma_2 = \sigma_u^2 + \sigma_v^2$	0.76	3.07***
Gamma	$\gamma = \sigma_u^2/\sigma^2$	0.972	64.39***
Log likelihood value		-3.829	
Likelihood ratio statistics λ 69.22 with 8 restrictions			
Number of observations 75			
Mean technical efficiency 0.813			

Note**:** *** shows significant at 1%; ** shows significant at 5%; * shows significant at 10%

The inefficiency model' coefficients have exact importance for current study. All coefficients are statistically significant. For predicting joint and u-shaped relationship between age and size variables the square and interaction terms are includes in empirical work.

3.7 Technical Inefficiency Effect Model

The estimated values of coefficients of age and size of firm are given in table 3 and 4 respectively with mean technical efficiency score representing the impact of firm's characteristics on technical efficiency or inefficiency.

3.8 Relationship between Age of Firm and Technical Efficiency

The results of inefficiency model indicate that the coefficient of age is significant but negative suggesting a positive link to technical efficiency and firm age. It depicts as firm age increases technical efficiency also raises means aged or older firms are more efficient then to youngers. Sun, (2006) also originate similar results**.**

Results are also reliable with the conclusions of World Bank and (Fernandes, 2008) empirical work who found an inverse U-shape link to firm age and total factor productivity in their paper. For seeking link between age of firm and technical efficiency score we divide firms as very old, old and young according to the sample size. Table 3 present mean technical efficiencies of different age groups of firm. Older firms are found efficient then to Youngers suggesting positive connection of firm age to technical efficiency. Older firm's mean efficiency score is greater (0.82) then to younger firms (0.80). For u- shaped relationship square term was included in the model. It predicts firms become inefficient after reaching at certain age level. Empirical results shows very old firms are inefficient (0.76) as compare to old firms. It is find out when firms are young they have no experience and not produce efficiently while when firms become very old then it became difficult for them to produce efficiently.

Table 3: **Mean Technical Efficiency by Age Group of firms**

Age Group	No. Of Firms	Age	Mean Technical Efficiency
Young	30	Up to 10 years	0.80
Old	27	11 to 20 years	0.82
Very old	18	21 years to onward	0.76
All Firms	75		0.81

Figure 1: Mean Technical efficiency by age group of firms

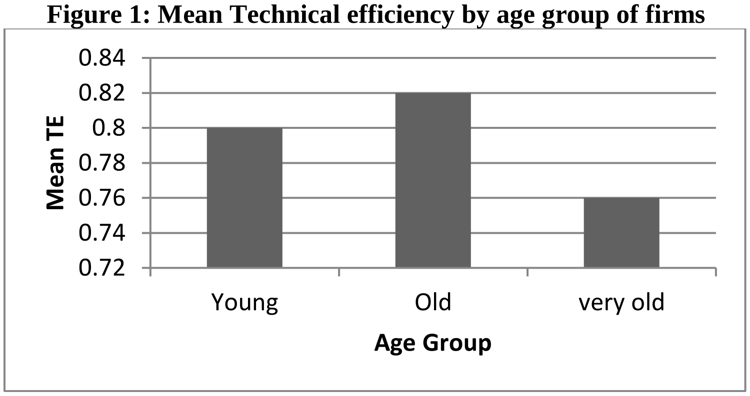
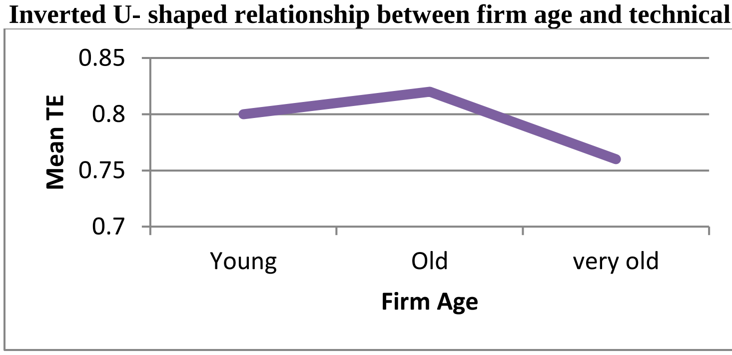


Figure 2: **Inverted U- shaped relationship between firm age and technical efficiency**



11 to 20 years old firms are most productive. Firms that are 10 years old are less in production as compare to old firms and firms which are very old or above 21 years in our sample are less efficient then to old firms making inverted u-shape relationship. It gives the idea when firms are young they are not producing more efficiently due to lack of experience as they get experience they produce efficiently but after reaching at certain age level firms technology and techniques become outdated which again reduce their production.

3.9 Relation between Size of Firm and Technical Efficiency

In inefficiency model, parameter value of firm size depicts positive and significant relationship which expresses the negative effect of firm size on technical efficiency while the square term is significant but negative implying a U-shaped association between technical efficiency and firm size. U shaped relationship shows as firm size increases, technical efficiency decreases but after reaching at certain level efficiency and firm size increases simultaneously. (Aggrey, Eliab, & Joseph, 2010) also found similar results. In current study number of workers is taken to define size of firm by following studies of (Admassie & Matambalya, 2002), (Badunenko, Fritsch, & Stephan, 2008), (Aggrey et al., 2010), (Alvarez & Crespi, 2003) revealed in their studies.

For seeking how firm size and technical efficiency are related to each other we classify firms as small medium and large according to the sample size. Table 4 Present average technical efficiencies of different size groups of firm. Results shows that larger size group is highly efficient in production while the average technical efficiency of middle size firms is less then to small size firms builds u-shaped relationship between technical efficiency and firm size. It explains that technical efficiency decreases as firm size increases but after certain level technical efficiency increases with increase in firm size.

Table 4: Mean Technical Efficiency by size group of firms

Size of Firms	No. Of Firms	No. of Employees	Mean Technical Efficiency
Small	23	Up to 100	0.83
Medium	23	101 to 500	0.72
Large	29	501 to above	0.90
All Firms	75		0.81

Figure 3: Mean technical efficiency by size group of firms

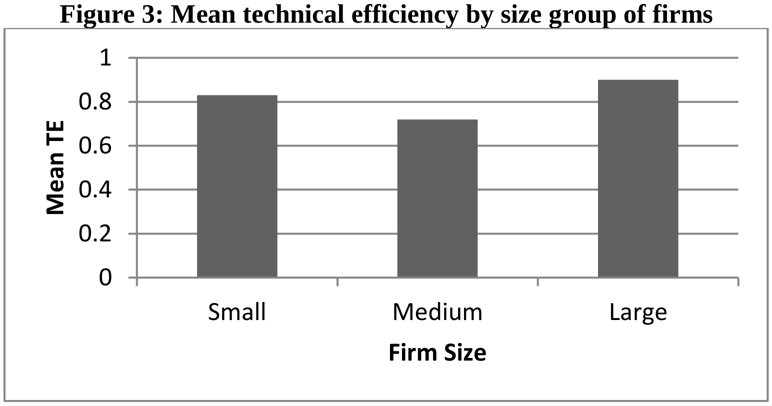
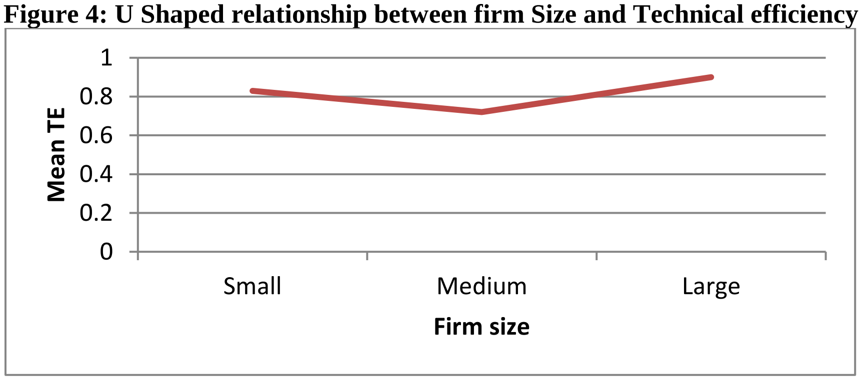


Figure 4: U Shaped relationship between firm Size and Technical efficiency



Dummy variable which is used to investigate the influence of ownership of firm on technical efficiency is positive but insignificant. “No ownership variation” hypothesis is not rejected at 1% level of significance. So this study highlights that ownership variation have no effect on technical efficiency of textile industry. The joint effect of age and size is significant and positive which shows the negative relationship between joint effect of age and size of firm with technical efficiency.

3.10 Parameters of Variance

Frontier parameterizes the log-likelihood in terms of $\boldsymbol{\gamma = \sigma_u^2/\sigma^2}$. The estimates value of gamma which is variance parameter (0.97) is high and significant showing that inefficiency component create highly variation in composite error term and have impact on output level (Coelli et al., 1998). The estimated value of variance parameter is ($\boldsymbol{\sigma^2}$) significant, it defines the presence and absence of inefficiency effects. According to the value of sigma square (0.76) which is greater than zero describes all firms are not complete efficient. The value of likelihood ratio statistics (λ) is (69.22)[2] with 8 restrictions is significant at 5 % level of significance. Estimated value is larger than table value with mixes χ^2 with 8 degrees of freedom. It confirms the idea that firm specific factors are also cause of variation in observed output with random shocks.

3.11 Technical Efficiency in Textile Firms Production

The estimated value of technical efficiencies of individual textile firms is given in table 5. The average anticipated technical efficiency for textile firms are between 0.07 and 0.95 with a mean of 0.81 suggesting that there exist a potential to increase textile production. It is also evident from table that 20 textile firms out of 75 are operating below 80 percent level of technical efficiency while 26 textile firms operating above 90 percent of technical efficiency. This implies that small number of textile firms from the sample is technically inefficient. The results discuss below shows that, in general textile firms have lack of best production techniques and method to produce maximum feasible production from latest technology.

Estimated value of mean technical efficiency of Faisalabad textile industry for the period 2005-06 is almost 81%. This gives the idea that on average, textile firms produce about 81% out of maximum attainable output which they can produce from given resources. In simple words by using efficient techniques in production textile firms can increase output by 19%.

Table 5: Technical Efficiencies of Textile Firms

Firm No.	Technical Efficiency	Firm No.	Technical Efficiency	Firm No.	Technical Efficiency	Firm No.	Technical Efficiency
1	0.928	20	0.901	39	0.733	58	0.868
2	0.884	21	0.872	40	0.869	59	0.945
3	0.905	22	0.892	41	0.823	60	0.905
4	0.778	23	0.874	42	0.402	61	0.823
5	0.901	24	0.899	43	0.945	62	0.820
6	0.895	25	0.709	44	0.842	63	0.860
7	0.775	26	0.747	45	0.918	64	0.768
8	0.829	27	0.904	46	0.925	65	0.816
9	0.928	28	0.806	47	0.905	66	0.940
10	0.889	29	0.898	48	0.903	67	0.073

[2] The description of “likelihood ratio statistic λ” is given as:

“$\lambda = -2 \ln[L(H_0)/L(H_1)] = 2[\ln L(H_1) - \ln L(H_0)]$”

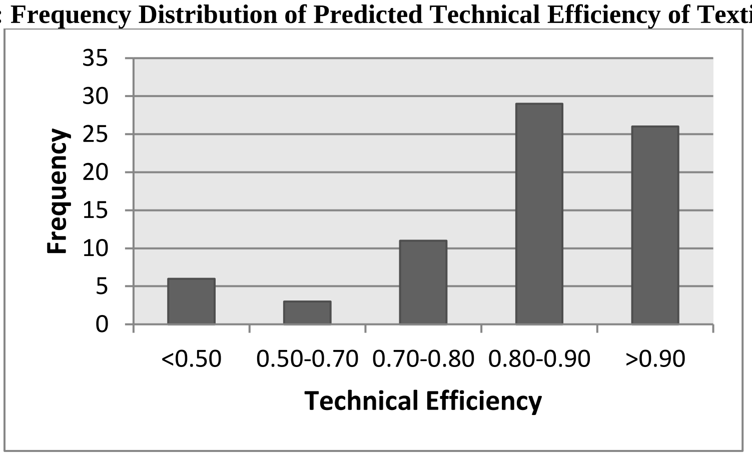
11	0.915	30	0.168	49	0.956	68	0.755
12	0.832	31	0.925	50	0.770	69	0.925
13	0.912	32	0.572	51	0.595	70	0.873
14	0.867	33	0.921	52	0.458	71	0.368
15	0.847	34	0.877	53	0.841	72	0.836
16	0.673	35	0.931	54	0.869	73	0.873
17	0.741	36	0.947	55	0.896	74	0.479
18	0.935	37	0.921	56	0.793	75	0.752
19	0.861	38	0.928	57	0.928		

Mean TE= 0.81

Table 6: Frequency Distribution of Technical Efficiency Estimates for different Textile Firms

Technical efficiency level	Textile firms
<0.50	6
0.50-0.70	3
0.70-0.80	11
0.80-0.90	29
>0.90	26
Mean	0.81
Minimum	0.07
Maximum	0.95

Figure 5: Frequency Distribution of Predicted Technical Efficiency of Textile Firms



4. Conclusion

The current study applied “Stochastic Frontier Analysis’ approach of (Battese & Coelli, 1995) one stage modeling, to estimate level of technical efficiency of 75 firms from Faisalabad textile industry for the period 2005-06 as well as empirically explore the factors of technical efficiency. Empirical results suggest that technical efficiency of firm is relatively great. Average technical efficiency score observe at 81%. This reveals that textile firms produce nearly 81% out of maximum attainable output which they can produce from given resources and production level could be increased by up to 19% by using efficient methods of techniques. Intermediate and capital inputs have more contribution in textile output.

Findings propose that the firm age and size are important cause of the firm’s efficiency. Age of firm and technical efficiency has an inverse U-shape relationship while U shape relation with firm size and efficiency is observed. The Dummy Variable which is used to clear the effect of ownership on technical efficiency is positive but insignificant. So results explain that there is no effect of ownership difference on technical efficiency of Textile firms.

4.1 Policy Suggestions

To encourage textile production an industrial policy should be focus on textile sector growth.

The observe findings clear that textile firms are not operating efficiently due to the less utilization of given resources. Results suggest that 19% more output can be obtained by enhancing technical efficiency.

For improving technical efficiency level at firm level it is clear after empirical analysis that firms should focus on their structure of production and efficient utilization of its present resources.

A study is done to find out the determinants of technical efficiency and it is observe that firm age and size are important factors which cause inefficiency. According to the findings small and medium size firms work inefficiently. So industrial policy should give attention on increasing the economies of scale, managerial skills and best use of current technology.

Lager firms are found more efficient due to the availability of services of technical assistance, institutions and easy access to markets which reduce inefficiency. This suggests that technical assistance and access to markets should be expanded to textile firms.

It is find out that firm age is influential factor for determine efficiency level for firms. Older firm's efficiency reduces with passage of time which ultimately reduces productivity of firms. So it is need of the hour to replace old technology.

To minimize technical inefficiency effects it is necessary to undertake new investment, entering markets, adopt economies of scale. Enhance the awareness to use up-to-date technologies by promoting research program.

To build an atmosphere where small as well as medium sized firms have equivalent approach to those methods which can improve productivity then these firms can operate efficiently. In the same way, development in learning by doing and administrative practices and skills should be improved.

References

Admassie, A., & Matambalya, F. (2002). Technical efficiency of small-and medium-scale enterprises: evidence from a survey of enterprises in Tanzania. *Eastern Africa Social Science*, *18*(2), 1–29.

Aggrey, N., Eliab, L., & Joseph, S. (2010). Firm size and technical efficiency in East African manufacturing firms. *Current Research Journal of Economic*, *2*(2), 69–75.

Aigner D.J., C.A.K. Lovell, & Schmidt, P. (1977). Formulation and estimation of stochastic frontier production functionmodels. *Journal of Econometrics*, *6*, 21–37.

Alao, J., & Kuje, E. (2010). Determination of technical efficiency and production function for small scale furniture industry in lafia metropolis, Nasarawa State, Nigeria. *J. Agric. Soc. Sci*, *6*, 64–66.

Alvarez, R., & Crespi, G. (2003). Determinants of technical efficiency in small firms. *Small Business Economics*, *20*(3), 233–244.

Amornkitvikai, Y., & Harvie, C. (2011). Finance, ownership, executive remuneration, and technical efficiency: a stochastic frontier analysis (SFA) of Thai listed manufacturing enterprises. *Australasian Accounting, Business and*, *5*(1), 35–55.

Badunenko, O., Fritsch, M., & Stephan, A. (2008). What Determines the Technical Efficiency of a Firm? The Importance of Industry, Location, and Size.

Battese, G., & Coelli, T. (1995). A model for technical inefficiency effects in a stochastic frontier production function for panel data. *Empirical Economics*, *20*(3), 325–332.

Battese, G., & Corra, G. (1977). Estimation of a production frontier model: with application to the pastoral zone of Eastern Australia. *Australian Journal of Agricultural and*, *21*(3), 169–179.

Bhandari, A., & Maiti, P. (2007). Efficiency of Indian manufacturing firms: textile industry as a case study. *International Journal of Business and*, *6*(1), 71.

Caves, R., & Barton, D. (1991). Efficiency in US manufacturing industries. *MIT Press*.

Chang, C., & Robin, S. (2012). Knowledge sourcing and firm performance in an industrializing economy: the case of Taiwan (1992–2003). *Empirical Economics*, *42*(3), 947–986.

Chen, T., & Tang, D. (1987). Comparing technical efficiency between import-substitution-oriented and export-oriented foreign firms in a developing economy. *Journal of Development Economics*, *26*(2), 277–289.

Coelli, T., Prasada, D., & Battese, G. (1998). An Introduction to Efficiency and Productivity Analysis. *Kluwer Academic Publishers*.

Debreu, G. (1951). The coefficient of resource utilization. *Econometrica: Journal of the Econometric Society*, *19*(3).

Diaz, M., & Sánchez, R. (2008). Firm size and productivity in Spain: a stochastic frontier analysis. *Small Business Economics*, *30*(3), 315–323.

Farrell, M. (1957). The measurement of productive efficiency. *Journal of the Royal Statistical Society*. *Series A (*, *120*(3), 253–290.

Fernandes, A. (2008). Firm productivity in Bangladesh manufacturing industries. *World Development*, *36*(10), 1725–1744.

Government of Pakistan. (2015). Economic Survey of Pakistan 2014-15. *Ministry of Finance, Islamabad*.

Hart, O. (2003). Incomplete contracts and public ownership: Remarks, and an application to public-private partnerships. *The Economic Journal*, *113*.

Hill, H., & Kalirajan, K. (1993). Small enterprise and firm-level technical efficiency in the Indonesian garment industry. *Applied Economics*, *25*(9), 1137–1144.

Kodde, D., & Palm, F. (1986). Wald criteria for jointly testing equality and inequality restrictions. *Econometrica: Journal of the Econometric Society*, 1243–1248.

Koopmans, T. (1951). *Activity analysis of production and allocation*.

Kumbhakar, S., & Lovell, C. (1998). Stochastic Frontier Analysis. *Cambridge University Press, Cambridge UK*, *14*, 5–22.

Le, V., & Harvie, C. (2010). Firm performance in Vietnam: Evidence from manufacturing small and medium enterprises. *Economics Working Paper*, *04-10, 2010*, 33.

Lovell, C. (1993). Production frontiers and productive efficiency. *The Measurement of Productive Efficiency: Techniques*.

Lundvall, K., & Battese, G. (2000). Firm size, age and efficiency: evidence from Kenyan manufacturing firms. *The Journal of Development Studies*, *36*(3), 146–163.

Meeusen, W., & Broeck, J. van Den. (1977). Efficiency estimation from Cobb-Douglas production functions with composed error. *International Economic Review*, *18*, 435–444.

Pitt, M., & Lee, L. (1981). The measurement and sources of technical inefficiency in the Indonesian weaving industry. *Journal of Development Economics*, *9*(1), 43–64.

Saputra, P. (2011). Analysis of technical efficiency of Indonesian manufacturing industries: An application of DEA. *International Research Journal of Finance and*, *66*(1), 107–116.

Sun, S. (2006). *Technical efficiency and its determinants in Gansu, West China*.

Taymaz, E., & Saatci, G. (1997). Technical change and efficiency in Turkish manufacturing industries. *Journal of Productivity Analysis*, *8*(4), 461–475.

Walujadi, D. (2010). Age, Export Orientation and Technical Efficiency: Evidence from Garment Firms in Dki Jakarta. *Makara Hubs-Asia*, *8*(3).