Technical Efficiency of Selected Textile and Garment Companies in Ethiopia

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Abstract
This study is about the level and determinants of technical efficiency of selected textile and garment companies in Ethiopia. Company level data of 38 companies for the period of 20006-07 to 2014-15 was taken from revenue authority of Ethiopia and Ethiopian textile industry development institute. Stochastic Frontier Analysis was used to estimate technical efficiency using a trans log production function with inefficiency effects model. In addition, in order to test the existence of significance difference in technical efficiency, analysis of variance was conducted for these companies grouped by size, participation in export and ownership type.The average technical efficiency of these companies was found to be 86.85%. In addition, size of a company, participation in export market, ownership type and type of sub-sector showed a statistically significant association with technical efficiency. However, age of a company, location of a company and year of observation did not show statistically significant association with technical efficiency.

Keywords: *Technical Efficiency, Stochastic Frontier Analysis, Panel Data, Textile and Garment, Ethiopia.*

1. INTRODUCTION

Technical efficiency is a principal element in economic profitability and affects the competitive position of a firm. Debreu (1951) and Farrell (1957) introduced a measure of technical efficiency. Their measure is defined as one minus the maximum proportionate reduction in all inputs that still allow continuous production of given outputs. A firm is said to be technically efficient if it is producing the maximum output from the minimum quantity of inputs (Farrell, 1957). The study of productive efficiency is an interest of economics and management professions as it can assist in public policy and managerial decision making (Belhassen and Womack, 2000).

Textile and garment industry is one of the oldest, largest and most global industries in the world. It is the typical 'starter' industry for countries engaged in export-orientated industrialisation, (Gereffi, 2002). The technological features of the textile and garment industry have made it suitable as the first step on the 'industrialisation ladder' in poor countries. Some of these poor countries such as Bangladesh, Sri Lanka, Vietnam and Mauritius have experienced a very high output growth rate in the sector, (Keane and Velde, 2008). Textile factories had been relocated to different parts of the world over the years in search of low production costs. Foreign textile companies are starting investing in Ethiopia due to cheap labour costs, availability of raw material and social and environmental favourable issues anticipating better profits to their owners, (Al Derin, 2014).

The few studies conducted in Ethiopian reported the existence of some problems and challenges for the growth and performance of manufacturing companies in general and textile and garment companies in particular. Some of the problems of textile and garment companies in Ethiopia include weak supply chain performance (Admaw, 2010), poor performance measurement practice, poor product quality, poor logistics handling, poor customer and supply relation (Rahel,2010), poor and fragile industry, unsatisfactory local demand, poor firm's strategy and structures (Hiwotie,2010),low emphasis on marketing strategy and resources (Aschale,2017), low productivity and quality, unrest related to land issues, government bureaucracy (Hann and Thews, 2017), technical inefficiencies (Jemal ,2008) and cotton market imperfections (Bosena et. al.,2011).

Moreover, Admasu (2006) reported the existence of survival problem for manufacturing companies. Melaku (2013) has also found inefficiency in the production system of manufacturing companies. He got an average technical efficiency of 86% for these companies and reported that most of the industrial groups had time invariant efficiencies. Taye (1998) reported that bigger and older manufacturing companies in Ethiopia were more efficient. He found that that advantageous location, entrepreneur human capital, owner access to business network and owner ethnicity had a significant efficiency. Yared (2010) had reported that cost and trade openness had a significant positive impact while cotton export and exchange rate had a negative impact on export performance of manufacturing companies in Ethiopia.

In 2002, the Federal Democratic Republic of Ethiopia formulated a national industrial policy that emphasizes on the national importance of the manufacturing industry to play a key role in the economic sector and chose textile and garment as one of the important sectors to boost its export and import substitution program of the industrialization plan (TIDI, 2014). The government has given special offers such as income tax holidays, duty free import of machinery, exemptions of stamp duty on export of manufactured products, and working loan for these companies. In addition, there is abundant trainable and cheap labour, high raw material production potential and cheap power supply in the country which creates opportunities to the growth and development of this sector, (ETIDI, 2014).

In contrast to the above facts, the value of textile and garment export for this sector is almost none when compared to the world market. The share of total Ethiopian textile and garment export was only 0.01% of total exports to the world market in 2015. In addition, the total value of textile and garment imports was only 0.07% of total imports from the world market in 2015 (WTO, 2016).Hence, this study tries to estimate technical efficiency and assess the association between some company specific characteristics and technical efficiency of selected medium and large scale textile and garment companies in Ethiopia during 2006-2007 to 2014-2015.

2. LITERATURE REVIEW

Technical efficiency is a principal element in economic profitability and what drives companies to be superior in their performance is an important issue among different researchers in the area of strategic management. There are two common theoretical explanations given by scholars regarding the factors that affect the source of competitive advantage of companies. The structure conduct and performance approach dictates that the industry and market has much influence on the performance of a company while the resource based view says that the internal resources and capabilities of the company matters most of its success (Porter 1981 and Barney, 1991). Barney (1991) defined resources and capabilities as all assets, capabilities, organizational processes, firm attributes, information, knowledge etc., controlled by a firm that enable it to conceive of and implement strategies which improves its efficiency and effectiveness.In this section, we will see some theoretical explanations and empirical researches conducted under the resource based approach in order to understand relationship between firm specific factors and manufacturing company performance which is measured by technical efficiency.

2.1. Size and Technical Efficiency

Different theoretical explanation is given regarding the relationship between size and performance of companies and inconclusive empirical results are reported by different researchers. Gibrat's law states that growth rate of a firm are not a function of its size (Gibrat, 1931,cited in Relander, 2011, Garvea et. al., 2011).In contrast to Gibrate, the structural inertia theory explains the relationship between company size and profitability to be weak and negative (Lachaal et. al., 2004; Aggy, 2010). This negative relationship may be due to organizational inefficiencies, higher bureaucratization, and inefficient decision making process and agency problems associated with bigger management layers for larger companies (Ramasamy et al., 2005). Another possible argument to justify the possibility of a negative firm size-profitability relationship can be due to a general managerial or technological inefficiency in larger firms which cause higher production costs which end up in reductions in profits (Ramasamy et. al., 2005).

On the other hand, the liability of smallness theory says that expectations of success are brighter for large organizations and that on the average, small firms have a higher likelihood of failure as result of limited access to capital, problem is attracting and retaining skilled workers and higher administrative costs, (Aldrich and Anster, 1986).

2.2. Age and Technical Efficiency

Age of a company refers to the length of time during which a company has existed since its existence. The relationship between age of a company and performance are explained by two competing hypothesizes-the learning by doing and development of bureaucratic problems on old ages.The learning by doing hypothesis assumes a positive relationship between age of a company and company performance.Older firms are more experienced, have enjoyed the benefits of learning, are not prone to the liabilities of newness, and can therefore enjoy superior performance. Older firms may also benefit from reputation effects, which allow them to earn a higher margin on sales (Ilaboya and Ohiokha, 2016). Taye Mengistae (1998) and Onder (2003) have found a positive association between age of a company and technical efficiency.

On the other hand, development of bureaucratic problems on old ages assumes a negative relationship between age and performance of companies.Older firms are prone to inertia, and the bureaucratic problems that go along with age; they might have developed routines, which are out of touch with changes in market conditions, in which case an inverse relationship between age and profitability or growth could be observed. Some researchers (Lachaal et. al., 2004; Zhou, 2014; Çalmaşur, 2016 and Fareed et. al., 2016) have got a negative relationship between age of a company and its technical efficiency.Still, there are also some researchers (Margono et.al.·, 2004) who did not find a significant relationship between age of a company and technical efficiency.

2.3. Ownership and Technical Efficiency

According to the Agency theory, there may be inefficiencies in public ownerships as managers of state-owned enterprises may pursue objectives that differ from the interest of the owners. In other words, private ownership has advantages over public ownership in terms of being inherently more efficient and profitable. In this regard, there are some empirical researches which found a positive impact of private and foreign owned companies with technical efficiencies (Taymaz and Saata, 1997; Onder, 2003 and Sinani et. al., 2007). However, there are some studies that did not get a significant association between ownership types and efficiency, (Margo et. al., 2004 and Liaquat et. al., 2017).

2.4. Export Orientation and Technical Efficiency

Participation in export activity may help companies to have a huge market access which leads to economies of scale due to massive production. In addition, companies may face a tough challenge to be efficient in their operation in order to compete with world market leading companies. Accordingly, some researchers (Graner &Isaksson, 2007; Zhou, 2014) found that exporting companies are more efficient than non-exporting companies.

On the contrary, Mok (2010) argue that those companies that focus on either the domestic or international markets are more efficient than those who serve both markets. On the other hand, Brand et. al. (1997) found non-significant association between exporting activity and technical efficiency.

2.5. Location and Technical Efficiency

There are some indications regarding the importance of company location for technical efficiency. Onder (2003) found that companies in operating metropolitan cities are more efficient than others. Margo et al. (2004) also found that location is important for technical efficiency.

3. Methodology

3.1. Sources of Data

Financial statement data of medium and large scale manufacturing companies for 2006-07 to 2014/2015 was taken from the Ethiopian Customs and Revenue Authority. Textile and Garment company data was extracted from these data based on tax reporting identification number assigned by the authority and only those companies that had a complete record and survived during the study period was identified. This results in 38 textile and garment companies having a balanced 9 years data with 342 observations. This data comprises of balance sheet, profit and loss statement, and form of ownership, location and type of operations. This data was enriched by company profile data from the textile industry development institute. Before conducting technical efficiency analysis, both these inputs and output were deflated by GDP deflator taken from Ministry of Finance and Economic Development of the Federal Democratic Republic of Ethiopia. This deflator was determined based on 2003 base year. Then this data was converted to natural logarithm.

3.2. Model Specification

The technical efficiency estimation model used in technical efficiency analysis was the inefficiency effects model for panel data defined by Battese and Coelli (1995) in the trans-log form. This model has two components-the production function component and the technical inefficiency effects component. The trans-log stochastic frontier production function estimated was defined by the following equation.

$$Ln(Y_{it}) = \beta_0 + \beta_1 \ln(L_{it}) + \beta_2 \ln(K_{it}) + \beta_3 \ln(M_{it}) + \beta_4 \ln(O_{it}) + \beta_5 t + 1/2\, \beta_{11} \ln(L_{it})^2 + 1/2\, \beta_{22} \ln(K_{it})^2 + 1/2\, \beta_{33} \ln(M_{it})^2 + ½\, \beta_{44} \ln(O_{it})^2 + 1/2\, \beta_{55} (t)^2 + \beta_{12} \ln(L_{it})*\ln(K_{it}) + \beta_{13} \ln(L_{it})*\ln(M_{it}) + \beta_{14} \ln(L_{it})*\ln(O_{it}) + \beta_{23} \ln(K_{it})*\ln(M) + \beta_{24} \ln(K_{it})*\ln(O_{it}) + \beta_{34} \ln(M_{it})*\ln(O_{it}) + \beta_{15} \ln(L_{it})*t + \beta_{25} \ln(K_{it})*t + \beta_{35} \ln(M_{it})*t + \beta_{45} \ln(O_{it})*t + (V_{it} - U_{it}) \quad (1)$$

Where:

Y_{it}- represents output for company i for period t measured in log of the value of net sales in birr at 2003 constant price.

L_{it}- represents labour for company i for period t measured in log of the value of wages and salaries in birr at 2003 constant price.

K_{it}- represents capital for company i for period t measured in log of net fixed asset in birr at 2003 constant price at the end of the period. Fixed asset is determined as beginning fixed asset plus additional investment for the year less value of disposed off fixed asset for the year.

M_{it}- represents material inputs used in production for company i for period t measured in log of raw material in birr at 2003 constant price.

O_{it}- represents other production inputs for company i for period t measured in log of the value of electric power and water inputs costs in birr at 2003 constant price.

T-represents time of observation from 1 to 9 which is represents the period from 2006-07 to 2014-2015.

The technical inefficiency effects model is represented by the following equation.

$$U_{it} = \delta_0 + \delta_1 \ln(AGE_{it}) + \delta_2 \ln(SIZE_{it}) + \delta_3 EXPORT_{it} + \delta_4 PVT_{it} + \delta_5 TEXT_{it} + \delta AA_{it} + \delta_{70} YEAR_{i\,t} + W_{it} \quad (2)$$

Where:

$Ln(AGE_{it})$ is the logarithm of age of the i^{th} company for the t^{th} period measured by the natural logarithm of the difference between the year of observation and establishment year of company.

$Ln(SIZE_{it})$ represents the logarithm of the total asset of i^{th} company for the t^{th} period.

$TEXT_{it}$ represents the sector classification and has a value of 1 if a company is a textile company and 0 otherwise.

$EXPORT_{it}$ represents exporting activity and has a value of 1 if a company has some amount of export sales and 0 otherwise.

PVT_{it} represents ownership types and have a value of 1 if it is privately owned or 0 otherwise.

AA_{it} represents location of the company. It has a value of 1 if a company is located in AA or 0 otherwise.

Maximum likelihood estimates for the preferred frontier model were obtained after testing various null hypotheses in order to evaluate suitability and significance of the adopted model. As testing procedure adopted was the Generalised likelihood-ratio test, which allows evaluating a restricted model with respect to the adopted model. The statistic associated with this test is defined as:

$$\lambda = -2\,[\ln L(H0) - \ln L(H1)] \quad (3)$$

where L(H1) and L(H0) are the log-likelihood value of the adopted and restricted models respectively. The statistic test λ has approximately a chi-square or a mixed-square distribution with a number of degrees of freedom equal to the number of parameters or restrictions. The number of restrictions is assumed to be zero in the null-hypothesis. When λ is lower than the correspondent critical value for a given significance level, we cannot reject the null-hypothesis.

The measure of technical efficiency relative to the production frontier is defined as:

$$TE_i = E(Y_i^*|U_i, X_i)/ E(Y_i^*|U_i=0, X_i), \quad (4)$$

where Y_i^* is the production of the i-th firm, which will be equal to $\exp(Y_i)$ when the dependent variable is in logs. In the case of a production frontier, TE_i will take a value between zero and one. The efficiency measures of this study used a production function with a logged dependent variable and itwas defined as:

$$TE_{it} = \frac{(xi;)\exp(vi-ui)}{(xi;)\exp(vi)} = \exp(-U_{it}) \quad (5)$$

where $0 \leq TE \leq 1.$)

The above four expressions for TE_{it} rely upon the value of the unobservable U_i being predicted. This is achieved by deriving expressions for the conditional expectation of these functions of the U_i, conditional upon the observed value of (V_i - U_i).

A computer program, FRONTIER Version 4.1, was used to obtain maximum likelihood estimates of the stochastic frontier production. The computer program calculates predictions of individual firm technical efficiencies from estimated stochastic production frontiers. The program gives parameters for the production function and inefficiency effect model where the variance parameters are expressed as $\sigma^2_s = \sigma^2_v + \sigma^2_u$ and $\gamma = \sigma^2_u/\sigma^2_s$.

3.3. Model Selection

A number of hypotheses were tested using the generalised likelihood-ratio in order to select the appropriate model that represents the data. These tests are summarized in table 1.The first hypothesis was tested in order to determine the appropriate production function by choosing between the Trans log and the Cobb Douglas models. This test constrained some coefficients in order to get a null hypothesis of Cobb Douglas. Hence the test was $\beta_{11}= \beta_{22}= \beta_{33}= \beta_{44}= \beta_{55}= \beta_{12}= \beta_{13}= \beta_{14}= \beta_{23}= \beta_{24}= \beta_{34}=0$. The log-likelihood value λ of (130.86) is greater than the table value (19.68)for the x^2 distribution at11 degree of freedom at, 95% confidence interval. Hence, the null hypothesis of Cobb Douglas production function is rejected and the Trans-log production function is considered as the appropriate representation of the data.

Table 1: hypothesis testing for the adopted model

Null Hypothesis	L(Ho)	$^a\lambda$	df	X^2 @ 5%	Decision
Ho: Trans log function	122.73	-	-	-	**Initial**
Ho: Cobb Douglas Model $\beta_{11}= \beta_{22}= \beta_{33}= \beta_{44}= \beta_{55}= \beta_{12}= \beta_{13}= \beta_{14}= \beta_{23}= \beta_{24}= \beta_{34}=0$	-188.16	130.86 ***	11	19.68	Reject Ho
Ho: No technical change $\beta_5= \beta_{55}= \beta_{15}= \beta_{25}= \beta_{35}= \beta_{45}=0$	-132.67	19.88***	6	12.59	Reject Ho
Ho: No inefficiency (Uit =0) $\gamma = \delta_0=\delta_1 = \delta_2 =\delta_3 = \delta_4 = \delta_5 =\delta_6 =\delta_7=0$	-134.09	22.73***	9	16.92	Reject Ho
Ho: No explanatory variables for inefficiency. $\gamma = \delta_1 = \delta_2 =\delta_3 = \delta_4 = \delta_5 =\delta_6 =\delta_7=0$	-134.09	22.72***	7	14.97	Reject Ho

[a]Statistic λ showed a mixed x^2 distribution & [***]Significant at 1%.

The second hypothesis was tested in order to determine the existence of technical change. This test constrained the coefficients for time and its products with input factors in the Trans log production function in order to get a null hypothesis of Neutral change-with no time dummy. The null hypothesis was $\beta 5= \beta_{55}= \beta_{15}= \beta_{25}= \beta_{35}= \beta_{45}=0$. The log-likelihood value of λ (19.88) is again greater than the table value (12.59)for the x^2 distribution at6 degree of freedom at, 95% confidence interval. Hence, the null hypothesis of no technical change is not rejected. Hence, there is a technological change in the production function and time is included in the production function model in order to represent this change.

The third hypothesis was about the existence of technical inefficiency in the model. This test constrained the coefficients for the technical inefficiency effects. The presence of technical inefficiency was tested using the null hypothesis $\gamma = \delta_0=\delta_1 = \delta_2 =\delta_3 = \delta_4 = \delta_5 =\delta_6 =\delta_7 =0$. The log-likelihood value λ of (22.73) is greater than the table value (16.92)for the x^2 distribution at9 degree of freedom at, 95% confidence interval. The null hypothesis is rejected and technical inefficiencies were present in the model. That means; medium and large scale textile and garment companies in Ethiopia were not working at technically efficient level.

The fourth hypothesis was about the existence of inefficiency effects in the model. The null hypothesis was $\delta_1 = \delta_2 =\delta_3 = \delta_4 = \delta_5 =\delta_6 =\delta_7 =0$. The log-likelihood value of λ (22.72) is greater than the table value (14.97)for the x^2 distribution at7 degree of freedom at, 95% confidence interval. Hence, the null hypothesis is rejected and the Battese and Coelli (1995) efficiency model is appropriate.

Based on the results of the above four hypotheses tests for appropriate model, the trans-log form of the production function with technical inefficiency effects was selected as the appropriate model to estimate technical efficiency level for the selected medium and large scale textile and garment companies in Ethiopia. The result of the estimate is presented in table 2.

3.4. Data Analysis

Data analysis of this research has used two methods. The first method estimated technical efficiency scores and sees its association with some variables. The second method tries to test the existence of significance difference among the technical efficiency of different groups. The analysis used a stochastic frontier analysis (SFA) using inefficiency effects model for panel data proposed by Battese and Coelli (1995), which determines the causes of inefficiency. Production function for four inputs of labour, capital, material and other costs and firm specific characteristics was used to estimate technical efficiency. In order to determine output variable to be used in the analysis of technical efficiency, natural logarithm of total sales was used in the study as the output variable (Taymaz and Saatçi ,1997; Alvarez and Crespi ,2003; Önder ,2003;Usman et al. ,2014;Çalmaşur ,2016). In addition, natural logarithm of wages and salary, net fixed asset, raw materials and other production inputs such as power and water were used as an input for the production function.Maximum likelihood ratio test was used in order to select the appropriate model for the data. Tran slog production function with technical change and technical effects model was chosen as the appropriate model. Technical efficiency scores of these companies were generated using FRONTIER 4.1 computer program. After, estimating the technical efficiency level of these companies, the association between firm level characteristics and technical efficiency of these companies was analysed using Kruskal Wallis and Mann Whitney tests.

4. Results

The results of technical efficiency, the sources of technical inefficiency and hypothesis tests about the existence of statistically significant difference among the different groups of selected companies during the study period are presented in this section.

4.1. Descriptive Statistics of Production Output and Inputs

The descriptive statistics for the variables used in the production function in order to estimate technical efficiency score for the sample companies during the study period are summarized in table 2.The mean value of output, measured by sales value was Birr 45,287,502.93. The mean value of labour, measured by costs of salaries and wages, was Birr 6,964,646.07. The mean value of capital, measured by costs of fixed assets, was Birr 148,118,377.23. The mean value of material, measured by costs of raw material used in production, was Birr 26,550,308.24. The mean value of overhead costs, measured by costs of power and water and repair costs was Birr 4,963,753.28.

Table 2: descriptive statistics for production output and inputs

Variable	Obs	Mean	SD	Min	Max
Output	342	45,287,502.93	83,051,647.71	71,776.16	576,166,090.28
Labour	342	6,964,646.07	12,799,212.56	2,509.05	86,189,394.50
Capital	342	148,118,377.23	560,845,220.16	8,777.00	5,671,827,908.33
Material	342	26,550,308.24	48,792,578.28	9,564.88	328,567,305.00
Energy	342	4,963,753.28	9,122,090.72	1,788.22	61,427,800.50

Source: Secondary Source

The results of estimation for the production function and technical inefficiency function are presented in tables 3 and 5 respectively. As shown in table 3, the result of maximum likelihood estimation of stochastic frontier trans-log production function with firm specific effects model (Battese and Collie, 1995) shows that all the factors of production are statistically significant in estimating the value of production for textile and garment companies during the study period.

Table 3: *Estimates of Production Function*

Production Function			
Variables	**Parameter**	**Coefficient**	**t-value**
Intercept	β_0	34.583***	36.893
$\ln(L_{it})$	β_1	15.198**	16.652
$\ln(K_{it})$	β_2	-86.975***	11.105
$\ln(M_{it})$	β_3	7.523***	9.082
$\ln(O_{it})$	β_4	67.125***	74.958
t	β_5	104.592***	133.673
$1/2\ln(L_{it})^2$	β_{11}	3.141***	3.284
$1/2\ln(K_{it})^2$	β_{22}	0.038**	2.461
$1/2\ln(M_{it})^2$	β_{33}	39.308***	46.542
$1/2\ln(O_{it})^2$	β_{44}	72.773***	78.660
$1/2t^2$	β_{55}	0.00002	0.002
$\ln(L_{it})*\ln(K_{it})$	β_{12}	79.268***	100.365
$\ln(L_{it})*\ln(M_{it})$	β_{13}	8.119***	10.001
$\ln(L_{it})*\ln(O_{it})$	β_{14}	3.957***	5.258
$\ln(K_{it})*\ln(M)$	β_{23}	67.772***	128.98
$\ln(K_{it})*\ln(O_{it})$	β_{24}	11.557***	16.478
$\ln(M_{it})*\ln(O_{it})$	β_{34}	3.152***	3.818
$\ln(L_{it})*t$	β_{15}	58.514***	74.094
$\ln(K_{it})*t$	β_{25}	0.005	0.993
$\ln(M_{it})*t$	β_{35}	74.199***	141.51
$\ln(O_{it})*t$	β_{45}	015.693***	22.380
Sigma square	σ^2	0.115***	10.853
Gamma	γ	0.52***	3.29
Efficiency		0.8685	
Log likelihood		-122.73	

*Source: Frontier Program output.***,**&*sig. at1%,5%&10% respectively*.

Parameter σ^2 of the inefficiency model is significant, t(0.16) = 10.85, indicating the presence of some inefficiency in the model. This means that there are some errors in the production systems of the selected companies in producing the maximum possible output. Gamma (γ) is the ratio of the variance parameter of the inefficiency term to the sum of variances of the two error terms ($v_{it}$and u_{it}) and measures the proportion of total variability resulted from technical inefficiency. The value of gamma (γ) is 0.52, indicating that 52% of the deviation in the data is due to technical inefficiency of the companies. And thisparameter γ is significantly different from zero, indicating that inefficiency effects are significant to determine value of production for these companies during the study period, t(.52) = 3.2. The mean technical efficiency of selected medium and large textile and garment companies in Ethiopia during 2006-07 to 2014-15 is 86.65. Details of this mean technical efficiency score is presented in table 4.

4.2. Level of Technical Efficiency

The technical efficiency scores of selected medium and large scale textile and garment companies in Ethiopia and their related technical inefficiencies are presented in table 5. The average technical efficiency of these companies during 2006-07 to 2014-15 is 86.86%. This means, the average level of technical inefficiency for these companies is 13.14%, indicating that these companies can maximize their production output by 13% without additional inputs and simply by improving their technical efficiencies of the production process. In addition, the technical efficiency of selected medium and large scale textile and garment companies in Ethiopia during 2006-07 to 2014-15 ranges from 47% to 99%. Moreover, the standard deviation is 13.62%, indicating that each company is a deviates by 14% from the average technical efficiency level, which is 86.87%. This shows that there is a huge variation in the technical efficiency performance of these companies during 2006-07 to 2014-15. We will look at the source of these variations in the subsequent discussions.

Table 4: technical efficiency scores

Year	TE	TIE
2006-07	.8931	0.1069
2007-08	.8814	0.1186
2008-09	.8872	0.1128
2009-10	.8762	0.1238
2010-11	.8707	0.1293
2011-12	.8623	0.1377
20012-13	.8586	0.1414
2013-14	.8503	0.1497
2014-15	.8373	0.1627
Mean	.8686	
SDV	.13620	
Min	.47	
Max	.99	

Source: secondary data, TE=Technical Efficiency, TIE=Technical Inefficiency=1-TE

4.3. Sources of Technical Efficiency

After estimating the level of technical efficiency of the selected companies for study, the association of firm level characteristics and technical inefficiency was tested using the Battese and Coelli (1995) inefficiency effects model. The explanatory variables included in the test were company age, size, ownership type, sector, exporting activity, region and time trend. The coefficient of these variables and t-values are presented in table 5. Technical inefficiency equals one minus amount of technical efficiency. So, a negative sign of coefficient for technical inefficiency effect represents a positive effect on technical efficiency, and vice versa. Size of company showed a statistically significant negative association with technical inefficiency, indicating that size has a positive association with technical efficiency of selected medium and large scale textile and garment companies in Ethiopia during 2006-07 to 2014-15 at 1% significance level, t(-0.102)=-3.56. Again, there was a statistically significant negative association between participation in export market and technical efficiency of selected medium and large scale textile and garment companies in Ethiopia during 2006-07 to 2014-15 at 5% significance level, t(-0.173)=-2.50. In addition, type of ownership showed a statistically significant association with technical efficiency of selected textile and garment companies in Ethiopia during 2006-07 to 2014-15 at 5% significance level, t(.350)=2.23. Moreover, type of sector showed a statistically significant association with technical efficiency of selected medium and large scale textile and garment companies in Ethiopia during 2006-07 to 2014-15 at 1% significance level, t(-.185)=3.09.

Table 5: estimates of inefficiency effects model

Variables	Parameter	Coefficient	t-value
Intercept	δ_0	1.730***	3.15
(Age_{it})	δ_1	-0.060*	-1.28
$\ln(Size_{it})$	δ_2	-0.102***	-3.56
$EXPORT_{it}$	δ_3	-0.173**	-2.50
Pvt_{it}	δ_4	0.350**	2.23
$Textile_{it}$	δ_5	-0.185***	-3.09
AA_i	δ_6	-0.028	-0.39
Time $trend_i$	δ_7	0.033*	1.53

Source: Frontier Program Output

*, **&***significant at 10%, 5% and 1% respectively.*

Even though age of a company showed a positive association with technical efficiency of selected medium and large scale textile and garment companies in Ethiopia during 2006-07 to 2014-15, it is not statistically significant at 5% level of significance, t(-.060)=-1.28. In addition, year of observation showed a negative association with technical efficiency of selected medium and large scale textile and garment companies in Ethiopia during 2006-07 to 2014-15. But, it is not statistically significant at 5% level of significance, t(0.03)=1.53.Moreover, location of a company did not show a statistically significant association with technical efficiency of selected medium and large scale textile and garment companies in Ethiopia during 2006-07 to 2014-15.

Now, let us see the results of hypotheses tests in order to know the existence of statistically significant difference among the technical efficiency of selected medium and large scale textile and garment companies in Ethiopia which were grouped by size, export activity, ownership type and sub-sector.

4.3.1. Company Size and Technical Efficiency

In order to know the existence of difference in technical efficiency of companies with different size groups, number of employees was grouped as per the definition of central statistical authority of Ethiopia as small (less than 10), medium (between 10 to 49) and large (50 and above) . Since the scope of the study is medium and large scale companies, there were no small scale companies in this study. In order to see the difference clearly, large companies were divided in to two- large (50 to 199) and big (200 and above) and the following null hypothesis was formulated and used.

H_{0_1}: There is no difference in the technical efficiency among the different sizes of selected medium and large scale textile and garment companies in Ethiopia during 2006-07 to 2014-15.

Kruskal Wallis test of difference in technical efficiency grouped by size was conducted for the selected medium and large textile and garment companies in Ethiopia during 2006-07 to 2014-15. Result of mean ranks and test statics is shown in table 6.The mean technical efficiency of selected textile and garment companies in Ethiopia was 93.42%, 74.10% and 90.15% for medium, large and big companies respectively. This shows that medium and big textile and garment companies had higher average technical efficiency than large companies. In addition, companies with the biggest number of employees showed the highest rank in technical efficiency and companies with the smallest number of employees show the second rank. The lowest ranks in technical efficiencies were shown for large companies (with employees between 50 and 199).

Table 6: Kruskal Wallis test of technical efficiency by size

	Size Group	N	Mean TE	Mean Rank
Technical Efficiency	10 to 49 Emp.	9	.9342	183.33
	50 to 199 Emp.	72	.7410	100.85
	200 and above Emp.	261	.9015	190.38
	Total	342	.9342	
Chi Square =46.58, degree of freedom=2, and p<0.001.				

Source: Secondary data.

Technical efficiencies are poor for large companies compared to medium and big sized companies for the selected medium and large textile and garment companies in Ethiopia. The Kruskal Wallis test showed that there is a statistically significant difference in technical efficiency among the different sizes of selected textile companies in Ethiopia during 2006-07 to 2014-15, $x^2(2) = 46.572$, p<0.001.Having a statistically significant difference in technical efficiency among the three size groups, we had conducted a Mann Whitney test as a follow up test in order to look at the specific difference among pairs of groups. It appeared that technical efficiency for companies with 10 to 49 number of companies have higher technical efficiency than companies with 50 to 199, (U=128, p<.001, r=0.32). However, the technical efficiency for companies with 200 and above did not show statistically significant difference in technical efficiency from companies with employees of 10-49. Hence, we can conclude that technical efficiency of the selected medium and large scale textile and garment companies was significantly affected by size. Smaller and very large sized companies showed the highest technical efficiency while moderate sized companies showed lower technical efficiency scores. In other words, the relationship between size of a company and technical efficiency of the selected companies is a U-shaped where the moderate sized companies had the lowest technical efficiency.

Table 7: Mann Whitney test for technical efficiency by size group

Test	Age Group	Mean rank	U	p-value	r
10-49 Emp. Vs 50-199 Emp.	10-49 Emp.	62.78	128	.003***	0.32
	50-199 Emp.	38.28			
10-49 Emp. Vs 200 and above	10-49 Emp.	131.56	1139	.878	-
	200 and above	135.64			

*Source: secondary data, ***sig. at 1%, U= test Statistic, r= effect size.*

This positive association between size of a company and company performance is in line with the liability of smallness theory which says that expectations of success are brighter for large organizations and that on the average, small firms have a higher likelihood of failure as result of limited access to capital, problem is attracting and retaining skilled workers and higher administrative costs, (Aldrich and Anster, 1986). This is true for Ethiopian companies where there is a special support to small and medium sized companies by Ethiopian government and the economies of scale for big companies. The large sized companies may be disadvantaged by resource access and government support.

4.3.2. Export Activity and Technical Efficiency

In order to know the existence of a statistically significant difference between the technical efficiency of exporting and non-exporting selected companies, the following null hypothesis was formulated and used.

H_{O2}: There is no difference between the technical efficiency of exporting and non exporting companies for selected medium and large scale textile and garment companies in Ethiopia during 2006-07 to 2014-15.

Table 8: Mann-Whitney test of technical efficiency by export activity

	Export Activity	N	Median TE	Mean Ranks
Technical Efficiency	Non-Exporting	198	.8831	148.01
	Exporting	144	.9619	203.80
	Total	342		
U=9604.5, p< .001, r=-0.28.				

Source: SPSS output.

Mann Whitney test of the difference in technical efficiency for selected exporting and non-exporting selected medium and large scale textile and garment companies in Ethiopia was conducted. The result of mean ranks and test statics for this test is presented in table 8. The mean technical efficiency of selected medium and large scale exporting companies was 89.82% while it was 84.70% for non-exporting companies.

Selected exporting medium and large scale textile and garment companies have higher average technical efficiency than their non-exporting counter parts. The mean rank of exporting companies is higher than the mean rank of non-exporting companies. And the test statistics result of Mann Whitney test result showed that technical efficiency of exporting companies (Mdn=0.9619) is higher than non-exporting companies (Mdn=0.8831), U=9604.5, p< .001, r=-0.28.

4.3.3. Ownership Type and Technical Efficiency

According to the Agency theory, there may be inefficiencies in public ownerships as managers of state-owned enterprises may pursue objectives that differ from the interest of the owners. In other words, private ownership has advantages over public ownership in terms of being inherently more efficient and profitable.

Table 9: Mann-Whitney test of technical efficiency by ownership type

	Ownership Type	N	Median TE	Mean Ranks
Technical Efficiency	Private	288	.9191	161.75
	Public	54	.9719	223.51
	Total	342		
U=4967.5, p<0.001, r=-0.23.				

Source: SPSS output

Because of this fact, ownership type was included in the study in order to see if there is a statistically significant difference in technical efficiency between private and state owned selected medium and large scale textile and garment companies in Ethiopia during the study period. The result of the Batesse and Coelli (1995) model for technical inefficiency effects model showed the existence of significant positive association between privately owned companies and technical efficiency, t (0.350) = 2.23.

Hence, in order to test further the existence of significant difference between technical efficiency scores of privately owned and publicly owned companies, the following null hypothesis was formulated and used.

Ho₃: There is no statistically significant difference between the technical efficiency of privately owned and publicly owned companies for the selected medium and large scale textile and garment companies in Ethiopia during 2006-07 to 2014-15.

Mann Whitney test of the difference in technical efficiency for selected privately owned and publicly owned medium and large textile and garment companies in Ethiopia was conducted. Result of mean ranks and test statics for this test is shown in table 9. The mean technical efficiency of privately owned companies was 85.65% while it was 93.29% for publicly owned companies. In addition, the minimum technical efficiency value is higher for publicly owned companies compared to privately owned companies. Moreover, the mean rank of publicly owned companies is higher than the mean rank of privately owned companies. And the result of Mann Whitney test showed that technical efficiency for selected publicly owned medium and large textile and garment companies (Mdn=0.9329) is higher than privately owned companies (Mdn=0.8565), $U=4967.5, p<0.001, r=-0.23$.

The result of the hypothesis result is contrary to the agency theory which assumes that privately owned companies have higher company performance than public owned companies. This may be due to the fact that most of the privately owned companies had been under public ownership for long time and privatized within the last few years companies.

5. Conclusion

This paper tried to analyse the technician efficiency level of textile and garment companies during 2006-07 to 2014-15 using 38 companies over nine years. The results of the analysis showed that sample companies studied during 2006-07 to 2014-15 were not fully technically efficient. The average technical efficiency determined by stochastic frontier analysis was 86.85. The result of the study showed that size of a company, participation in export market, ownership type and sector showed a statistically significant association with technical efficiency of selected companies during the study period. However, age of a company, location of a company and year of observation did not show statistically significant association with technical efficiency of the companies studied. Smaller and very large sized companies showed the highest technical efficiency while moderate sized companies showed lower technical efficiency scores. Moreover, technical efficiency of exporting companies is higher than non-exporting companies. Finally, technical efficiency for selected publicly owned companies is higher than privately owned companies.

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