Productivity and Efficiency Analysis of Pakistani Textile Industry using Malmquist Productivity Index Approach

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Abstract

The key purpose of this study is to evaluate the total factor productivity of the textile sector by using DEA (Data Envelopment Analysis) and also identifying the components which play a significant role in the growth of productivity. This paper examines productivity performance of the Pakistan's textile manufacturing industry using firm-level panel data of a total of 64 firms for the period 2011-2015. Moreover, the sources of expansion and compression in output are recognized for the whole textile industry as well as for the three sub sectors comprising of 35 firms from spinning, 21 from composite and 8 from weaving textile sector. Empirical results suggest that total factor productivity growth of composite, spinning and weaving textile sectors are not presenting skewed distribution. Moreover, the component of technological change had a negative impact on spinning textile sector. Technical efficiency and technological change, both, had a positive impact on the productivity of composite and weaving textile sectors. Overall, the spinning textile sector has no contribution in the productivity growth. A critical

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evaluation of the production factors is necessary for the maintenance of the performance of the organization. This paper provides information to the decision makers and policy makers about the allocation, acquisition and anticipation of the resources. To eradicate the industry's pitfalls, textile sector in combination of subsectors has been selected providing a comparative analysis of the efficiencies adding to the existing body of literature by detecting the primary zones for improving productivity performance in Pakistani textile manufacturing as the pure efficiency component.

Keywords: textile sectors, total factor productivity, malmquist index approach, nonparametric approach

1. Introduction

A booming economy is the one which provides facilitation to improve efficiency of the contributing sectors, towards the economic development of a country. Earlier, studies revealed the fact that the manufacturing sector of an economy not only has a resilient influence on the growth of the economy but also leads the country towards excellence in terms of productivity and efficiency. In Pakistan, the manufacturing sector contributes to almost 64.71% of the total GDP ("Economic Survey of Pakistan," 2015-2016). Both, internal and external factors have a huge impact on the manufacturing sector.

Moreover, textile industry, after agriculture, is a predominant manufacturing sector and a vital source of employment in our country. It is a life blood of our economy because this sector directs the investment trends, contributes around 0.11% in the economic development and most importantly is one of the major source of income and job opportunities. A contemporary observation relating to the textile industry has shown a growth rate of 0.50% over the last few years. The textile industry covers three sub sectors, including textile composite, textile weaving and textile spinning. Every textile manufacturing sector is significantly important for economic development (Wasti & Imtiaz, 2016-2017).

The textile industries use diverse methods of analysis that helps in performance evolution to estimate the level of expertise in

attaining the targeted goals. The textile industry needs cost-effective raw material to produce a standard output. Different performance approaches provide efficiency basis to re-allocate their resources periodically which enhances the level of productivity. It is necessary to utilize the resources properly because firm's growth depends on it. The labor, capital and raw material are main resources of the textile industries that adds to the value of output (Mondal & Ahmad, 1984) .

In the last two decades, due to increasing struggle in regional market, Pakistan has faced competition particularly from India, Bangladesh and Vietnam. In international textile market statistics has shown a significant decrease of Pakistan's share that is 1.7 percent from 2.2 percent in last ten years (Rehman et al., 2016). Thus, for the development of this sector it is fundamental to provide suggestion and recommendations because this is imperative to recover the productivity of textile industry for its survival.

Productivity growth also contributes in GDP of the country. Every country has manufacturing sectors but leading sector of every country differs from another country. Like in Indonesia, metal, food, chemical and textile sectors have a tremendous influence on the economic development. Whereas for Japan, electronic assembling sector is the dominating one over other sectors and economic growth depends on it (Cimoli, Dosi, & Stiglitz, 2009). Similarly, in Pakistan, agriculture and textile sector growth have strong impact on the economy.

The evaluation of productivity on macro level is immensely important for a close analysis of economic growth and development, considering a variation in contribution ratio of various sectors in several countries ("Economic Survey of Pakistan," 2015-2016). Therefore, it is the aim of our study to evaluate the productivity on average basis. There are large numbers of studies that predict productivity and analyze the efficiency at macro level. Deb and Ray (2014) conducted a study on the evidence of productivity and its components from all the Indian manufacturing sectors and results of the study apply on the Indian economy largely.

The main objective of the study is to estimate the impact of Total Factor of productivity and its elements on the growth of textile

industries registered in Pakistan stock exchange. There are two factors of productivity; labor and capital (its elements include the change and adoption of modern technology). It provides the knowledge regarding allocation, anticipation and acquisition of the resources. Productivity defines the efficiency of production on average basis. Productivity refers to the economic development and it is based on input and output variables. We deduct input from output to get an original surplus that expresses the growth of production (Färe, Grosskopf, & Lovell, 2013). Growth in production is vital for a long-term existence of a firm. If a firm is unable to maintain its growth then it becomes difficult for the firm to boost future production and survive in the market (Margono & Sharma, 2006).

A rise in productivity can be estimated by a firm's hierarchal enhancement, skill level of labor and use of modern technology. All of these developments are possible when firm effectively utilizes the production resources. An increase in productivity does not only enhances the value of output but also enables the firm to compete with their competitors. It is necessary for the underdeveloped countries to enhance the growth of its manufacturing sector as it notably contributes in the economic development (Papaconstantinou & Polt, 1997).

The measurement of factor of productivity is important for the policy makers and decision makers to predict the level of efficiency about the procedure and unit which are produced in production. Growth depends on two important components which are productivity change and technical efficiency. A rise in productivity and use of advanced technology in the production process increases the total production. For the technical efficiency, it is necessary to measure the input accurately like capital and labor (Balakrishnan, 2004).

In Pakistan, Ilyas, Ahmad, Afzal, and Mahmood (2010) conducted a research on the textile industries that identified those constituents which contributed in the growth of manufacturing sector by using non-parametric approach. The impact of productivity on manufacturing sector was compared by Ali and Hamid (1996) using time varying efficiency approach but these studies were based

on the data up to 2010.There are only a few studies which are conducted at macro level for individual markets.

The key purpose of this study is to evaluate the productivity from the individual manufacturing sector like textile sector by using a linear approach that is known as Data envelopment analysis and also identifying the components which play a strategic role in the rise of productivity. Only those textile firms have been selected which are registered in Pakistan Stock Exchange.

2. Literature Review

Total factor of Productivity and its components have been evaluated in various researches (Bhandari & Ray, 2012; Charnes, Clark, Cooper, & Golany, 1984; Cook & Seiford, 2009; Cooper, Seiford, & Zhu, 2004; Din, Ghani, & Mahmood, 2007; Goyal, Kaur, & Aggarwal, 2017; Oberholzer, 2013) that were based on both non-parametric and parametric approach. For a non-linear approach, Malmquist index of TFP analysis has been conducted. Other than that, Data Envelopment analysis has also been used for the linear approach (Ozcan, 2014).

Clark and Olsen (1959) measured the influence of change in technology on the textile industry's productivity for the period 1949 to 1955. Five most important elements were selected that had an integral part in the technical change because technical change is associated with the production process. They estimated the total factor of productivity of six textile mills and also developed a comparison between them. The methodology of regression model was used to identify the technical change. At the end, an empirical result presented that change in technology has a significant impact on the textile industry production, but all of the textile firms may not have high technological change due to a low income level or a non-capital-intensive method of production.

In Bangladesh a research was carried out based on the manufacturing industries as Bangladesh again is one of those countries where the ratio of manufacturing industries in the GDP share is high. Productivity in textile industry influences the economy largely thus this study selects the textile sector keeping in consideration the size, credit worthiness and assets related to the very industry. DEA was

used to estimate the growth of productivity and the observation presented that productivity growth rate decreased by 4.4% but capital and labor efficiency increased in textile sectors (Ahmad & Anwaruzzaman, 1973).

The effectiveness of textile industry was measured for, both before and after the liberation in Bangladesh using the Ken-drick methodology in which output is divided by input to measure the level of productivity (Mondal & Ahmad, 1984). Results of the study showed that labor showed a positive rate of growth but capital input had a negative trend in textile industry while in the jute industry, both of the factors of production, *viz*. input and output, had a negative trend. This study showed that both cotton and jute textile industries did not have an increasing trend in capital, before and after the liberation, thus indicating the production growth of both these industries is not satisfactory.

Decades ago the concept of competitiveness and change in technology was improvised by Khanna (1989) focusing on the productivity of textile industries in India . The research sheds light on how technical efficiency may not be all that beneficial for some textile industry as mechanization wouldn't support the structure of manufacturing firm which uses a total labor-intensive method of production so instead of capital investment an improvement in labor may be beneficial for such firms.

A research conducted in respect of an economic aspect of Nadu relating to its total factor productivity was commenced, subjected to the textile industry of Nadu, the results summed up that productivity had a decreasing trend from 1976-1989 considering the input being constant (Subramanian, 1992).

In the late 90s with more improvisation of advanced technology we saw studies (Ali & Hamid, 1996; Papaconstantinou & Polt, 1997; Taymaz & Saatci, 1997) supporting the use of capital for productivity and growth. The study was conducted under a parametric approach stressing upon the effectiveness of technology on the level of productivity. Shortly after that, Yean (1997) assessed the productivity growth of Malaysian manufacturing industries defining the components to estimate productivity and then determined the

components that had some significant influence on production growth by using index of Translog-Division methodology.

The estimation showed that Malaysian manufacturing industry's productivity inclined optimistically and simultaneously with the increase in resources, betterment in exports policies and investment in foreign countries. On the other hand, an increase in capital use in the production process had a pessimistic impact on the productivity. After using this methodology, the results suggested that in order to improve its productivity, Malaysia needs to support friendly export policies and increase in foreign investment.

Mahmood and Siddiqui (2000) determined the impact of technology and the factor of production on assembling area of Pakistan and also identified the causes of low productivity growth. The data was derived from the Pakistan Economic Survey and from the Annual reports of the concerned firms, while, Solow's methodology of research was used. The results presented, that productive efficiency is very important for the assembling sector and provided many policies to enhance the level of efficiency, *viz.* increase the international standard of product, privatization and measuring the input accurately because accurate input leads to high quality of products.

Kim and Han (2001) measured the productivity of manufacturing industry of Korea and also decomposed the productivity into technical and efficiency change and suggested that overall productivity declined in manufacturing sectors, while, the textile sector had a very low rise in the level of efficiency. In China a low productivity was experienced in the manufacturing sector during the late 90s primarily due to low level of skilled workers and less advanced technology. Fu's (2004) paper supports this argument, where he conducted a research under a model of frontier and regression model selecting 26 industries and the focus of the research was the efficiency level and the technological advancement and its effect on productivity.

Margono and Sharma (2006) analyzed the influence of productivity and effectiveness on the Indonesian manufacturing areas from 1993 to 2000, using frontier methodology to estimate the impact of the inputs and technical efficiencies on the growth of food,

textile, chemical and metal manufacturing industries. These four sectors were dominating the manufacturing areas in Indonesia as they majorly contributed to the GDP thus total 733 industries were selected from these four manufacturing sectors. The results suggested that productivity of the three sectors decreased except the textile sector. Technical efficiency growth had an optimistic impact, whereas, technological progress had a pessimistic impact on these four areas.

Bhandari and Ray (2012) have used the Annual Survey of Industries of the Indian textiles industry to measure the stages of technical efficiency at the firm level to ascertain the support of technological metamorphoses through groups of firms in the assessment of the overall measure of technical efficiency. Results suggested a considerable scope for cumulative output without increasing further inputs simply through properly altering the input synthesis which leads to pull down the average cost of production in the textile industry.

We have seen diversifying and contradicting effect of capital and labor in different countries or in different periods. Furthermore, another study by Din, Ghani, and Mahmood (2007) improvised that the level of efficiency reduced in large manufacturing industries because they did not utilize the resources effectively. Some recent research (Raheman, Afza, Qayyum, & Bodla, 2008) supports the idea of both labor and capital having an impact on productivity and the research strongly stressed upon the fact that the inputs that need coverage for a greater output is both efficiency of labor and advancement in technology.

Ilyas et al. (2010) conducted a study based on production progress in Pakistani manufacturing industries was for the period 1965 to 2007. Three different types of variables were selected that identified the level of progress in production. The auto regressive distribution log was used to examine value added in manufacturing industries, and it also identified the components that affected the level of production.

The empirical results showed that growth level of production was favorable in manufacturing industries and investment had a strong influence on production process. Another research by

Mahmood (2012) concluded that the size of firm had an instantaneous effect on efficiency and had a positive correlation with the level of productivity in Pakistan. The two type of methodology used were data envelopment analysis that predicted the impact of technical efficiency and regression TOBIT mechanism was used to identify the influence of components.

Deb and Ray (2014) analyzed the performance of Indian manufacturing firms for the 1970 to 1971 and 2007 to 2008 before and after the growth in whole productivity, and evaluated the factors of production and its components by using parametric or non-parametric accounting practices. The data used was gathered from the industries annual surveys that were given by Indian states. There was an increasing trend in the manufacturing industries performance after the productivity growth but it is possible that this was a result of an appropriate utilization of resources. Whereas, on a smaller scale where a partial research focusing primarily on spinning industry was carried out by Bedi (2003) estimated productivity grew in the spinning textile Industry.

The research of Deb and Ray (2014) highlighted the most important factor to play a key role in performance improvement was change in efficiency. Some other researches (Abri & Mahmoudzadeh, 2015; Pitt & Lee, 1981) have also presented the same argument supporting the debate saying that efficiency brings about a positive impact on the level of production. Observations have also emphasized on the need of improved management methods in order to achieve higher outputs (Wadud, 2007).

Gambhir and Sharma (2015) emphasized on the sources of productivity gain in the large and small-scale Indian manufacturing firms using panel data of 160 companies for the period 2007-2008 to 2012-2013 for composite textile industries in addition to the small and large-scale sector companies individually. Findings revealed that scale efficiency and technology change appeared to be the key driver of the sources of productivity gain, whereas pure efficiency change is inadequate for all firms regardless of firm scale.

Recently Goyal, Kaur, and Aggarwal (2017) calculated scale, pure as well as the overall technical efficiencies in the textile

industry and provided a comprehensive analysis using Data Envelopment Analysis (DEA) on cross-sectional data of 101 Indian companies for the year 2014-15. The empirical findings presented a proportion of 16.44% of Overall Technical Inefficiency (OTIE) segmented into 11.79% of managerial inefficiency. The study emphasizes to control and eradicate the managerial inefficiencies by improving the balance of resource utilization and refining processes through intensive efforts of technology infusion.

3. Methodology

3.1 Malmquist Index

DEA: Data Envelopment Analysis is a non-parametric linear programming model, used to measure the technical efficiency. This approach is favorable for the research based on decision making units. Only those sectors cover such kind of approaches that use both input and output for decision making. Under **Frontier methods** there are two leading methods in the approximation of total factor productivity growth that is the **Malmquist Index approach** (nonparametric approach) and the **stochastic frontier** (parametric) approach. Both **parametric** and **non-parametric** approach is available but for this study the non-parametric accounting approach has been used to estimate the growth of production. It is a popular methodology which supports the evolution of Total factor of productivity growth (Charnes, Cooper, & Rhodes, 1978).

Benefits of DEA approach: This methodology is appropriate for this study due to the following reasons; firstly, analysis of data envelopment approach is more useful rather than the Translog approach because data envelopment analysis not only measures the whole factor of productivity, but also measures the level of efficiency and technical change, whereas, the Translog approach does not measure the technical change and efficiency. Secondly, this approach is helpful for the policy and decision makers since they can allocate the resources more appropriately. Data Envelopment approach provides information about how a firm can utilize inputs in effective manners, which ultimately enhances the value of output. Malmquist Productivity Index computes technical change, efficiency and also productivity growth by using a geometric mean of

technical change and efficiency. The non-parametric approach predicts the influence of the entire input on the output (Charnes, Clark, Cooper, & Golany, 1984).

3.2 Assumptions under DEA

For the use of Data envelopment analysis, we must develop the following assumption:

All inputs and outputs are arranged in such a manner that is suitable for the methodology.

- All the outputs and inputs are expandable.
- There is possibility of production growth in selected firms.
- Don't take any negative values.

Index measures the productivity in following method:

$$m_o^{\,s}(\mathbf{q}_s, \mathbf{q}_t, \mathbf{x}_s, \mathbf{x}_t) = \frac{d_o^{\,s}(\mathbf{q}_t, \mathbf{x}_t)}{d_o^{\,s}(\mathbf{q}_s, \mathbf{x}_s)}$$

$$m_o(\mathbf{q}_s, \mathbf{q}_t, \mathbf{x}_s, \mathbf{x}_s) = \frac{d_o^{t}(\mathbf{x}_t, \mathbf{q}_t)}{d_o^{s}(\mathbf{x}_s, \mathbf{q}_s)} \left[\frac{d_o^{s}(\mathbf{x}_t, \mathbf{q}_t)}{d_o^{t}(\mathbf{x}_t, \mathbf{q}_t)} \times \frac{d_o^{s}(\mathbf{x}_s, \mathbf{q}_s)}{d_o^{t}(\mathbf{x}_s, \mathbf{q}_s)} \right]^{0.5}$$

Efficiency change Technical change

Malmquist Index of Productivity is a combination of technological change and level of efficiency. Both technological change and efficiency level components are measured from previous period to current period and it also provides the evidence about the influence of advance technology on productivity growth. If panel data on input and output quantities are available then price data is not required. The output based analysis has been used for the productivity of textile Sector because the objectives are to utilize the resources appropriately and maximize the sales (Cooper, Seiford, & Zhu, 2004).

3.3 Input and output Variable

The DEA methodology can be applied on those companies which generate income because these firms are those which convert the firm's pecuniary performance in firm's technical effectiveness. Data

envelopment analysis is based on inputs and outputs thus pecuniary indicators are converted into input and output (Cooper, Seiford, & Zhu, 2004).

Equation 1

$$EquityReturn = \frac{NetProfit}{Sales} * \frac{TotalSales}{TotalAssets} * \frac{TotalAssets}{SHEquity}$$

3.4 Limitations of DEA approach

By using Equation-1 we can measure the equity return but it is not an appropriate procedure as profit is the only measure used in this while there are several other factors that needs to be assumed when measuring performance. The Data Envelopment Analysis does not process the figures, for instance if the firm has a negative value (net loss) then accurate results cannot be assessed, with that said it is not appropriate to use net profit as an output. However, this issue can be dealt with by using total sales as an output and shareholder equity, total assets, operating expense or cost of goods sold as an input as shown in Table 1. For this purpose, both long and short term resources are used to generate the return (Cook & Seiford, 2009).

Table 1

Table of Input and Output variables

Input variables	Output variables
Shareholder equity= (Total Assets- Total Liabilities)	Total sales
Total assets= (Current Assets + Non-current Assets)	
Operating expense	
Cost of goods sold	

4. Research Design

The study is based on quantitative research in which statistical mechanism is used to evaluate the variables (input, output) and this method is appropriate for the analysis of productivity and its components (Cooper et al., 2004). The study is based on investigation to discover the productivity of the leading textile Industries in Pakistan and a comparative analysis between different textile sectors.

4.1 Criteria for Sample Selection

Sample Selection was made on the basis of greater share price in market, minimum loss and maximum profit, to comprehend a factual representation of productivity and efficiency. The data was collected from the annual financial reports of textile industries which had a positive equity as that was the pre-requisite of the employed methodology and analysis in this study. The population covered by the study is three textile Sectors listed in Karachi Stock Exchange in Pakistan. In total there are 155 textile firms listed in Karachi Stock Exchange out of which 64 firms were selected from sub-textile sector comprising of 35 from spinning, 21 from composite and 8 from weaving textile sector.

5. Results and Discussion

5.1 Growth of Textile Industry

Industries growth in terms of output during period 2011 to 2015 is presented in Table-2. The average normal growth is also adjusted for the effect of inflation resulting in average real growth rate. The total factors of productivity mechanism were used to decompose the Malmquist index that is based on three textile sectors data. We compared each company of textile sector with Malmquist Index. Malmquist index have been used to measure the technical efficiency of each sector and how much the technical change has occurred during these five years by observing inputs. We have calculated Malmquist index efficiency change, technical change, pure technical efficiency, scale change and total factors of productivity for all the textile sectors. A summary of average performance of textile sectors from 2011 to 2015 is presented in Table 2.

Table 2
Malmquist Index Averages of Textile Sector (2011-2015)

Textile Industry	Efficiency	Tech Change	PE Change	SE Change	TFPE Change
Composite Textile Sector	0.923	1.197	1.000	0.924	1.105
Spinning Textile Sector	0.000	0.000	1.000	0.000	0.000
Weaving Textile Sector	0.625	1.821	1.000	0.652	1.188

The total factor of productivity index of Malmquist has been used to estimate the efficiency of panel data. Basically, it defines the level of change that has occurred in the firm's productivity over the passage of time. The Malmquist index is combination of five components.

The average change of composite textile sector is 1.105 percent from 2011 to 2015 that presents positive change of total factor of productivity. The major two components efficiency and technical change have contributed greatly in the productivity growth of composite textile sector. The spinning textile sector is one of the largest sectors of Pakistan but is presenting zero percent change in total factor of productivity from preceding last five years. All Malmquist index components contributed zero percent in the growth of spinning textile sector productivity. The weaving textile sector average productivity change is 1.188 percent that also leads to a positive change in productivity growth but in weaving textile sector, pure technical efficiency change and technological change largely contributed in the development of total productivity.

Total Factor Productivity Growth in Textile Sector

Table 3
Managerial Efficiency Growth

Textile Industry	2011-2012	2012-2013	2013-2014	2014-2015
Composite Textile Sector	0.021	1.045	0.090	9.319
Spinning Textile Sector	0.000	0.923	0.000	0.000
Weaving Textile Sector	1.364	0.841	0.407	0.388

The change in technical efficiency helps the firm to utilize all input to produce large numbers of products. It is necessary for the firm to take few modifications in manufacturing process that contribute higher amount of productivity. The above Table 3 of managerial efficiency change suggests that change in technical efficiency is vital for the TFP. The table demonstrates the technical efficiency of three textile sectors. The average technical efficiency of composite textile sector is 0.021 percent during 2011-2012, thus directing that this sector has been showing positive trend in technical efficiency.

During 2013 and 2015, it had technical efficiency greater than 1 but in 2015, it was less than range 1 that is 0.090. The average change in technical efficiency of the spinning textile sector is zero percent in 2011 to 2015 except 2013. It has presented negative growth in efficiency. In 2012-2013 the spinning textile sector has been presenting 0.923 percent change but gradually reducing the efficiency growth to zero percent, because they did not utilize the resources appropriately. This means the growth of technical efficiency has been showing a downward trend from 2011 to 2015.

The average change in technical efficiency in the weaving sector is 0.388 percent in 2015. In 2012; it had technical efficiency greater than range 1.These results suggest that weaving sector has an increasing and decreasing trend during these years. All these results suggest that composite sector has presented a highest technical efficiency change as compared to the remaining textile sectors during 2011 to 2015, implying that composite sector performed well because they utilize their inputs in appropriate manners. The composite textile sector has presented strong positive contribution in textile production growth due to adoption of advance technology.

Table 4
Technology Adoption

Textile Industry	2011-2012	2012-2013	2013-2014	2014-2015
Composite Textile Sector	9.950	0.05	1.038	0.957
Spinning Textile Sector	0.000	1.614	0.000	0.000
Weaving Textile Sector	0.192	0.799	4.181	1.143

The second important component of total factor of productivity is technological adoption. It plays a key role in the growth of productivity. The use of new technology and advance machinery in the production process represents an increasing trend in the Malmquist Index. Table 4 represents the technical change in the three textile sectors during 2011 to 2015. The average technical change in composite textile sector is positive 0.957 percent but less than range 1. This indicates that composite textile sector has a positive but moderate technical change. In 2012, it measured slow growth in technical change as compared to the remaining years.

The technical change in the spinning textile sector is zero percent on average basis. It presents downward trend in the technological advancement during 2011 to 2015 but in 2013, it had the highest technical change that is 1.614 percent. The average technical change in weaving textile sector is 1.143 percent that represents the positive technical change. During 2011 to 2015, this sector represents upward trend that is 0.192, 0.799, and 4.181 percent respectively. All the above results suggest that weaving textile sector is one of the most appropriate sectors which uses advanced technology. During these years, it represented the highest technical change.

Table 5
Total Factor Productivity

Textile Industry	2011-2012	2012-2013	2013-2014	2014-2015
Composite Textile Sector	0.262	0.671	1.703	6.645
Spinning Textile Sector	0.000	1.489	0.000	0.000
Weaving Textile Sector	8.464	0.212	0.093	8.919

The total factor of productivity growth depends upon the efficiency change and technological change. Both of the two compo-

nents of productivity play a key role in the textile industry productivity growth. In 2015, the productivity growth of composite textile was 6.645 percent on average basis as shown in Table 5. During 2011 the TFP was 0.262 percent, showing a very low productivity growth. The productivity growth of composite textile sector has increased over time. The productivity growth of textile spinning sector is presenting zero percent growth on average basis. During 2012 and 2013, it had the highest productivity growth, i.e. 1.489 percent, suddenly the growth of spinning sector declined. The weaving textile sector showed the productivity growth rate of 8.919 percent on average basis and has been presenting the highest productivity growth during the last five years in the textile sector.

All these results represent that the weaving textile sector is presenting highest productivity growth except composite and spinning textile sectors. Having said that, the weaving textile sector represented good performance during the last five years except the composite and spinning textile sectors. Both of these two sectors reveal a poor performance from 2011 to 2015 except weaving textile sector. The spinning textile sector had presented worse performance during 2011 to 2015.

Table 6
Ranking of Textile Sector based on TEP

Textile Sector	Efficiency	Technical Change	TFP
Weaving Textile Sector	0.625	1.821	1.188
Composite Textile Sector	0.923	1.197	1.105
Spinning Textile Sector	0.000	0.000	0.000

The table 6 presents the ranking of all textile sectors on average basis in the term of technical change, efficiency change and total factor of productivity. The weaving textile sector has the highest total factor of productivity, i.e. 1.188 on average basis that showed the positive and increasing trend because two components efficiency change and technical change range is 0.625 and 1.821 on average basis. The weaving textile sector uses high quality of skillful labor and advance technology that's why this sector has a highest productivity growth. The Composite sector has a second ranking in

efficiency, technical change and TFP that is 0.923, 1.197 and 1.105 percent respectively.

The composite textile sector has comparatively shown a better progress in technological change than the spinning textile sector but low progress in efficiency change mainly due to poor allocation of resources. Due to these components, the composite sector has a moderate trend in TFP growth. The spinning textile sector has a third number in ranking. It has a very low productivity growth compared to the other textile sectors. The composite textile sector has a strong trend of technological change and that is why it is performing well. Thus, it is important for spinning textile sector to utilize their resources in an appropriate manner.

6. Conclusion

The basic purpose of this study is to measure the productivity growth and its component that contributed in the textile industries by using the DEA approach. Pakistan's textile industries were selected for this reason and panel data was used to measure the productivity growth through 2011 to 2015.The Malmquist index of productivity was selected to estimate the growth in productivity. This study also decomposed the index into both productivity components. The process of decomposition also helped to identify the contribution of technology and efficiency in growth of production in textile industries of Pakistan, which measured the output growth of the entire textile sectors in Pakistan.

The overall empirical results of the textile industries represented a striking trend. The productivity growth of the textile sectors was 1.000 through 2011 to 2014 but in the last year the productivity growth declined to 0.999. The major cause of low productivity growth was lack of skilled labor and low level of advancement in machinery along with the shortage of power resources. The individual results of textile industries showed divergent trends. The weaving textile sector had a highest productivity growth due to a technical change rather than efficiency change. It suggests that spinning textile sector is lacking in skilled labor and there is poor implementation of advance technology.

The main focus of the composite sector is to use advance technology to enhance the output. The composite textile sector had

moderate productivity growth, *viz.* 1.105, due to lack of efficiency. The textile sector lacked in research and development, while technical efficiency totally relies upon research and this explains the downward trend. The spinning textile sector has very slow progress in productivity growth because both efficiency and technical change have a zero contribution in productivity growth.

This study suggests there is a need that Pakistani textile industries must enhance their productivity growth and must ensure rigorous efforts to maintain the productivity growth. It is important for the textile sectors to focus on efficiency and get a good value from the available accommodation and resources spending cost. Investment and improvement in capital and labor enhances the quality of output (sales) and management play a key role in improving these components. It comes under the responsibilities of the management to arrange for the training programs of labor and also to invest in the research and development activities that brings about a technological change. By using all these strategies textile industries can improve their total productivity growth and can play a key role in Pakistan's economic growth.

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