Significance of Efficiency for Sustainable Development :
A Practice of Data Envelopment Analysis on Textile Sector

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Abstract: Resources in the nature are limited and mankind has to use these resources economically or otherwise next generations might have difficulty in surviving. That is why today's decision makers has to be able to think and plan the futures resources for not to danger future's generations. In this perspective sustainable development policies can be considered as a solution for the next generation's wealth. Sustainable development policy requires a balance while consuming the natural resources. For sustainable development efficient uses of resources is essential. In this study we try to assess the efficiency of the Turkish textile sector companies, regarding to sustainable development. In this study Data Enveloping Analyses is practiced to the data gathered from Istanbul Stock Exchange (ISE) quoted textile companies. Results of the survey indicates that efficiency rates affected negatively from the Chinese factor, domestic structural deficiencies in textile sector and economic situation.

Introduction

Nowadays, industrialized countries have recognized that their economical growth has a limit. At this point they also recognized that even though there was an economic growth there are also limits for economic development. Developed countries, are taking procoutions against the risks in relation to sustainablility. However developing countries has not been recognized that the importance of the subject. On the other hand it can be assumed that there are limited activities in relation to the subject. Contries are trying to impliment new sustainable development strategies. This could be as a solution for to reach their targets.

In this perspective Turkey as a developing country has to set up similar development strategies and plans. Sustainable development has a direct relationship with the development of reel sector. Textile sector is a high significant sector for Turkish economy. Turkish textile sector is dinamic and has a high potantial for the growth. Espacialy after 1980's with establishment of open economic policies exportation is increased and textile sector became the engine of the economy. Cotton production in Turkey has played a crucial role in the development of the economy.

In consideration of globalization which increased the competition, assesment of effiency and effectiveness has became more important for the decision makers. Textile sector is contributing to the Turkish economy in terms of value add, employment and exportation. It is suggested that for sustainablity of textile sector performance measurement of efficiency and effectiveness of the sector has became more significant.

Sustainable development, productivity and efficiency are related consepts. Productivity can be described as obtaining an output by using least input. Which means efficient uses of limited resouces. Performance can be considered as degree of success with in certain period of time. Managers can not /should not take desicions without having performance information. Hence it might be suggested that using performance measuring methods are significant for decision makers. One of the methods used for measuring performance is Data Enveloping Analyses.

Sustainable Development

The structures of imperial and colonial power which dominated the world in the nineteenth and early twentieth centuries made little provision for economic and social advance in what we now call the developing world. Colonial regions functioned primarily to supply imperial powers with raw materials and cheap labor – including slave labor as late as the mid-nineteenth century (Harris, 2000). Industrialization is an important target for the countries, however, there are some problems they face in this process inevitably. Environmental problem is one of them. Although it has some negative effects on environment, industrialization may not be abandoned. But it is obvious that some necessary measures should be taken for a sustainable development.(Ekinci, 2007)

Whilst earlier literature discussed a wide range of issues around the emerging concept of sustainable development, the following statement from the World Conservation Strategy (IUCN/WWF/UNEP, 1980) appears to be the first actual attempt to define sustainable development: "For development to be sustainable, it must take account of social and ecological factors, as well as economic ones; of the living and non-living resource base; and of the long-term as well as the short-term advantages and disadvantages of alternative action" The World Conservation Strategy was frequently criticised for being concerned mainly with ecological sustainability rather than sustainable development per se. The most universally quoted definition is that produced in 1987 by the World Commission on Environment and Development (WCED), otherwise known as the Brundtland Commission (after its Chairperson, Gro Harlem Brundtland, Prime Minister of Norway): "Economic and social development that meets the needs of the current generation without undermining the ability of future generations to meet their own needs". (Dalal-Clayton, 2000)

In the extensive discussion and use of the concept since then, there has generally been a recognition of three aspects of sustainable development:(Harris, 2000)

- Economic: An economically sustainable system must be able to produce goods and services on a continuing basis, to maintain manageable levels of government andexternal debt, and to avoid extreme sectoral imbalances which damage agricultural or industrial production.
- Environmental: An environmentally sustainable system must maintain a stable resource base, avoiding over-exploitation of renewable resource systems or environmental sink functions, and depleting non-renewable resources only to the extent that investment is made in adequate substitutes. This includes maintenance of biodiversity, atmospheric stability, and other ecosystem functions not ordinarily classed as economic resources.
- Social: A socially sustainable system must achieve distributional equity, adequate provision of social services including health and education, gender equity, and political accountability and participation.

With these aspects sustainable development has got some strategies. Sustainable development strategies can be summarized under 9 headings: (Özyol, 2007)

- Environment: Nature has its own value. None of the creature should not abuse the nature for their own needs.
- The Future: While satisfying our needs we should think and take care of next generations needs and we should not forget that we have to live a world where the next generations could be able to satisfy their own needs.
- Living Standards: We should not forget that living standarts of the people is not rely on materialistic needs but also it relies on social, cultural, ethical and spiritual needs.
- Justice: Prosperity, chances, rights and responsibilities should be divided in between the nations, different social groups in a fairway. The needs of the poor and discriminated people's needs has to be put in the consideration. Similar fair sharing should be made in between existing generation and future generation.
- Cautions: If we are not sure about environmental results of our behaviors we should take precautions. Because the environmental problems are global the precautions has to be taken inconsideration of social responsibilities.
- Holistic Thinking: Environmental problems includes unnumbered factors and while solving these problems all these factors and stake holders should be taken in to consideration.
- Social Dimension: Educational activities should be informed about the sustainable development aspects to increase for their and next generation's living standards.
- Economical Dimension: Every resources on earth is limited. That is why they should be used efficiently and in a way that does not destruct the nature. Fair distribution of the resources is also an other aspect should be taken in to consideration.
- Environmental Dimension: Every natural resources, whether or not it is recyclable, should be used in a way that ensures the continuity of resources.

Sustainable development is significant factor for economies. These strategies should considered in the economy. Textile sector has great place in the Turkish economy than we can give some information regarding textile sector in Turkey.

Turkish Textile Sector

Turkish textile and apparel industry is a very dynamic one, in fact it is the most dynamic industry in Turkey. Becouse of having the advantage of producing the raw materials required by the industry textiles and apparels are always going to be one of the most important industries for the Turkish economy (Akalın, 2001). As in many other developing countries, the textile and clothing industries have played an important role in the

process of industrialization of Turkey. Textile sectors are now the driving force in the Turkish export industry, and they have become one of the key players in the world over the years. (Çukul, 2008)

We can evaluate Turkish economy in terms of GDP, employment and exports. The share of this sector in the country's GDP is more than 10 % , share in the total employment is around 10 %. There are about 40 thousand manufacturing companies and around 2 million employees in the sector. Turkish textile and clothing exports reached to US$ 20 billion in 2008. With this amount, it had a share of 22% in total exports of Turkey (İGİAD, 2009) .

Turkish textile industry uses modern technology. Existance of a well-developed textile finishing industry in Turkey makes also possible production and marketing of highly value added fashionable and quality production. The main items are knitted fabrics, cotton woven fabrics, woven fabrics of synthetic filament yarns, bed sheets and bags-sacks for packaging. Main advanteges of Turkish textile industry in production and supply of raw materials: (ITKIP, 2010)

-   Reachness in basic raw materials,
-   Geographical proximity to main markets, especially European markets,
-   Short logistics period due to geographical proximity,
-   Qualified and well-educated labor force
-   Liberal trade policies
-   Well-developed textile finishing industry
-   Giving importance to quality, environment and human health, sensitivity on working conditions of workers
-   Customs Union agreement with the European Union and free trade agreements with many other countries

Turkey as being one of the most prominent textile and clothing producers in the world, now, has the production capacity to meet almost all the raw material needs of clothing industry. Some part of cotton and artificial and synthetic fibers needed by the industry are met by means of importation. Turkey has also gained valuable experience in fabric design and it is started to present its special designs with fashion shows in prominent markets. Turkish textile industrialists most of whom has created their own trademark together with the patent rights, provide the most important foreign home textile and clothing companies with their fabric. (ITKIP, 2010)

Turkey is currently the second larger exporter of textile to the European Union following China. It has the largest production capacity in the EU and the fourth largest in the world. Since the EU and U.S are major markets for Turkish textile and clothing products, it is necessary to explore the competitive position of Turkish products in these markets, and they have to be prepared to the attack of its competitor such as China, India and other Asian countries. There is no doubt that China will be the largest force in the global textile sector. According to a forecast by World Bank, China is likely to raise its current share of 20 % in the world textile market to 50 % in recent years. (Çukul, 2008)

Many pattern design competitions that make important contributions to development of fabric design in Turkey are organized by different institutions leading to emergence of young designers and creation of product diversity. Turkey takes part in many famous international fairs in textile sector, international textile fairs were organized within Turkey and Turkey's potential is shown successfully all over the world. (ITKIP, 2010)

Textile sector is significant for the Turkish economy. So doing a research for textile sector is necessary. We can evaluate the sector with performance, efficiency and effectiveness values. In this study it is practicing Data Envelopment Analyses (DEA) for finding efficiency rates.

Data Envelopment Analysis

DEA is an extension of Farrell's (1957) idea of linking the computation of technical efficiency with production frontiers. The first DEA model was developed by Charnes Cooper and Rhodes (1978) (CCR). The CCR model is a fractional programming model, which measures the relative technical efficiency of a firm by calculating the ratio of weighted sum of its outputs to the weighted sum of its inputs. The fractional program is run for each firm to determine the set of input-output weights, which maximizes the efficiency of that firm subject to the condition that no firm can have a relative efficiency score greater than unity for that set of weights. Thus, the DEA model calculates a unique set of factor weights for each firm. The set of weights has the following characteristics: (Kabnurkar, 2001)

-   It maximizes the efficiency of the firm for which it is calculated and
-   It is feasible for all firms.

Since DEA does not incorporate price information in the efficiency measure, it is appropriate for not for profit organizations where price information is not available. These not for profit organizations are referred to as Decision-Making Units (DMUs) by Charnes Cooper and Rhodes (1978). Since the efficiency of each DMU is

calculated in relation to all other DMUs and using actual observed input-output values, the efficiency calculated in DEA is called relative efficiency. Charnes, Cooper and Seiford (1994) define DEA as "DEA produces a piecewise empirical extremal production surface which in economic terms represents the revealed best-practice production frontier – the maximum output empirically obtainable from any DMU in the observed population, given its level of inputs." In addition to calculating the efficiency scores, DEA also determines the level and amount of inefficiency for each of the inputs and outputs. The amount of inefficiency is determined by comparison with a convex combination of two or more DMUs, which lie on the efficient frontier, utilize the same level of inputs, and produce the same or higher level of outputs.

The aim of DEA is to quantify the distance to the efficient frontier for every DMU. The measure of performance is expressed in the form of efficiency score. After the evaluation of the relative efficiency of the present set of units, the analysis shows how inputs and outputs have to be changed in order to maximize the efficiency of the target DMU. DEA suggest the bencmark for each inefficient DMU at the level of its individual mix of inputs and outputs (Mantri, 2008)

DEA is a typical statistical approach and characterized as a central tendency approach. It evaluates producers relative to an average producer. In contrast DEA campares each producer with only the "best" producers. A fundamental assumption behind this method is that if a given producer, A, is capable of producing Y(A) units of output with X(A) inputs, then other producers should also be able to do the same if they were to operate efficiently. Similarly, if producer B is capable of the same production schedule. Producers A, B, and others can then be combined to form a composite producer with composite inputs and composite outputs. Since this composite producer does not necessarily exist, it is typically called a virtual producer. The heart of the analysis lies in finding the "best" virtual producer for each real producer. If the virtual producer is beter than the orginal producer by either making more output with the same input or making the same output with less input then the orginal producer is inefficient. The subtleties of DEA are introduced in the various ways that producers A and B can be scarld up or down and combined. (Cornuejols & Trick, 1998)

In this study DEA practiced. Aims and methods of the research is as follows.

Aims and Methods of Research

In this study it is tried to be evaluated the textile sector firms financial efficiencies that are quoted to ISE. In the study DEA method is used. The aim of the study is to investigate financial efficiency and effectiveness of leading Turkish textile sector companies. Economical dimension of sustainable development includes fair distiribution of the resources, avoidance of unnecessary usage of resources and efficient usage of resources. Financial resources are also significant inputs of companies and they should be used efficiently.

The steps while practicing DEA can be listed as follows;
- Selection of decision making units,
- Determination of inputs and output sets
- Relative efficiency measurement by DEA
  - Availability and reliability of the data
  - Relative efficiency measurement
  - Efficiency degree-efficiency limits
  - Evaluation of the results

In first step of the study decision making units are selected. For the study balance sheets and income statements that are belong to the firms gathered from the ISE. These data includes the time period in between 2004 and 2008. Decision making units which were the subject of the study is listed in Table 1.

BOSSA Bossa Ticaret ve Sanayi İşletmeleri T.A.Ş.	**LUKS** Lüks Kadife Ticaret ve Sanayi A.Ş.
CEYLAN Ceylan Giyim Sanayi ve Ticaret A.Ş.	**OKAN** Okan Tekstil Sanayi ve Ticaret A.Ş.
DERİMOD Derimod Konfeksiyon Ayakkabı Deri Sanayi ve Ticaret A.Ş.	**SASA** Advansa Sasa Polyester Sanayi A.Ş.
EDİP Edip İplik Sanayi ve Ticaret A.Ş.	**VAKKO** Vakko Tekstil ve Hazır Giyim Sanayi İşletmeleri A.Ş.
ESEM Esem Spor Giyim Sanayi ve Ticaret A.Ş.	**YATAS** Yataş Yatak ve Yorgan Sanayi ve Ticaret A.Ş.
KARTEKS Karsu Tekstil Sanayii ve Ticaret A.Ş.	**YUNSA** Yünsa Yünlü Sanayi ve Ticaret A.Ş.

Second step of the study was the determination of input and output sets. These are used for measurement of financial efficiency of textile firms. Input and Output sets which were the subjects of the study is listed in Table 2.

INPUT	Short-Term Dept	Long-Term Dept	Capital Stock
OUTPUT	Sales Revenues	Non-Operating Income	

Table 2: Input and Output Data Sets Used in Research

These set of input and output units are used to determine the financial efficiency of the textile sector firms. For this study textile sector inputs were determined as: Short Term Debts, Long Term Debts and Capital Stock. Where as the outputs were: Sales Revenues and Non Operating Income.

Analysing the Model

In this study, it is perefered to used the data gathered from textile firms that are belong to ISE, because of the availability and reliability of data.

For the analysis DEAP Version 2.1 is used for processing mathematical data. Inputs of the textile sector are considered as manageable data. So in the analysis input focused method is used. Lack of free market conditions prevented the firms to identify the financial problems that causes difficulties in reaching optimum levels. That is why variable income scaled efficiency model is used for solution. In this search 5 different solutions are generated by linear programming.

There are three different factors are used to describe the efficiency levels; Constant Income Technical Efficiency, Variable Income Technical Efficiency and Scale Efficiency. Here technical efficiency could be described as every input's impact on output. Whereas scale efficiency describes the aggregate impact of all inputs to compound outputs. Scale Efficiency is measured with dividing Constant Income Technical Efficiency by Variable Income Technical Efficiency.

After processing the data, DEA efficiency results, from the year 2004 and 2008, belong to the decision making units are determined and listed on the Table 3 as below.

	2004	**2005**	**2006**	**2007**	**2008**
BOSSA	0,966	0,682	0,79	1	1
CEYLAN	0,408	1	1	1	1
DERİMOD	1	1	1	1	0,863
EDİP	0,859	0,9	0,325	0,245	0,045
ESEM	1	1	0,147	0,068	0,087
KARTEKS	0,613	0,752	0,658	0,818	0,640
LUKS	1	1	1	1	0,535
OKAN	1	1	1	1	0,774
SASA	0,939	0,862	1	0,912	0,660
VAKKO	1	1	1	1	1
YATAS	0,86	0,549	0,659	0,573	0,556
YUNSA	0,651	0,527	0,488	0,554	0,674
ORTALAMA	0,858	0,856	0,756	0,764	0,653

Table 3: Constant Income Technical Efficiency (2004-2008)

There is a reduction in Constant Income Technical Efficiency in between 2004 and 2008. This reduction could be interpreted as Chinese factor in the international trade.

Regarding to Turkish textile sector Variable Income Technical Efficiency values are as below.

	2004	2005	2006	2007	2008
BOSSA	1	1	1	1	1
CEYLAN	0,435	1	1	1	1
DERİMOD	1	1	1	1	1
EDİP	0,902	1	0,560	0,246	0,047
ESEM	1	1	0,153	0,087	0,129
KARTEKS	0,671	1	1	0,863	0,676
LUKS	1	1	1	1	0,553
OKAN	1	1	1	1	0,780
SASA	1	1	1	1	1
VAKKO	1	1	1	1	1
YATAS	1	1	1	1	0,791
YUNSA	1	1	1	1	1
ORTALAMA	0,917	1	0,893	0,850	0,748

Table 4: Variable Income Technical Efficiency (2004-2008)

In terms of Variable Income Technical Efficiency there is a steady decrease in averages from 2006-2008. Large and famous firms like BOSSA, VAKKO, SASA, YÜNSA are still keeping their high stakes in the market.

Regarding to Turkish textile sector Scale Efficiency values are as below.

	2004	2005	2006	2007	2008
BOSSA	0,966	0,682	0,79	1	1
CEYLAN	0,939	1	1	1	1
DERİMOD	1	1	1	1	0,863
EDİP	0,953	0,9	0,580	0,997	0,974
ESEM	1	1	0,960	0,778	0,675
KARTEKS	0,914	0,752	0,658	0,948	0,946
LUKS	1	1	1	1	0,967
OKAN	1	1	1	1	0,993
SASA	0,939	0,862	1	0,912	0,660
VAKKO	1	1	1	1	1
YATAS	0,86	0,549	0,659	0,573	0,703
YUNSA	0,651	0,527	0,488	0,554	0,674
ORTALAMA	0,935	0,856	0,845	0,897	0,871

Table 5: Scale Efficiency (2004-2008)

As you can see from the Table 5. there is a steady decrease in the values of scale efficiencies in between 2004 and 2008. Internal and external results are also indicates that leading Turkish textile companies efficiencies

are decreased. In addition to Chinese factor in textile sector, structural deficiencies in the Turkish textile sector, deficiencies in branding, financial problems and deficiencies in marketing would be other reasons for the reduction.

Conclusion

Textile sector plays a crucial role in the Turkish economy. Sector seriously affected from the several threads: Chinese factor which criticly reduced the competitiveness of the Turkish textile sector, domestic structural deficiencies in textile sector and reductions in domestic cotton production because of the market forces.

Deficiencies in investment climate lead the textile investers to invest more competitive countries in terms of wages, input costs (like electricity etc.) gradual weaknesses of the textile sector in Turkey is a serious problem. Because textile sector can be considered as engine of the economy. It used to provide considerable amount of employment, export revenue, value add, tax revenue.

Result of the study clearly indicates that Turkish textile companies can not efficiently uses the financial resources they have. Government interventions would be as suggestion for more efficient sector for instance tax reductions, direct and indirect financial supports, lower currency policy and improvements in investing climate.

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