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Textile Industry Efficiency in Eastern European Countries

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Abstract
In the global world where competition is increasing constantly, efficient use of resources is becoming more important for the textile industry. In this study, the efficiency scores and inefficiency effects of the textile industry in selected Eastern European countries were investigated using stochastic frontier analysis. The results indicate that age has a negative impact on inefficiency in the Czech Republic and Hungary. The current ratio decreases the inefficiency in Slovakia, Poland and Hungary, while time decreases that in Slovakia, the Czech Republic and Hungary.

Keywords
Efficiency, textile companies, Eastern Europe, Stochastic Frontier Analysis, company size.

1. Introduction

The textile industry has a very important and special place in the European Union (EU) since the EU is in second place in the list of textile exporting countries. While China was the leading textile exporter in 2021, it was followed by the European Union, India, Turkey, and the United States of America [1].

Although the European Union is a very important player in the World, certain countries have become prominent including Italy, Germany, Spain, France, etc.

In terms of textile exports, the incomes of textile companies in Eastern Europe are more limited, as they have a smaller share of the pie compared to countries such as China, Italy, and Germany. In this respect, they need to use their resources extremely efficiently.

Efficient use of resources is possible only if the factors affecting efficiency or inefficiency are known. When literature on efficiency is examined, it is seen that most of studies have focused on the efficiency of banking [2,3] and insurance industry [4,5].

There are a limited number of studies investigating the efficiency of textile companies. For example, Wadud (2004) [6] investigated the efficiency of Australian textile and clothing firms for the period 1995-1998 using stochastic frontier analysis.

Kapelko and Rialp-Kriado (2009) [7] calculated the efficiency scores of the textile and clothing industry for Poland and Spain for the period 1998-2001 using data envelopment analysis. They concluded that the difference between the efficiency of those countries' textile and clothing companies is not statistically significantly different.

In another study conducted by Bhandari and Ray (2012) [8], the efficiency of textile companies in India was measured. They state that the size of the firm has a positive impact on the technical efficiency.

Mahmoud (2012) [9] measured the technical efficiency of textile industries in Pakistan with data envelopment analysis (DEA). The author implemented Tobit regression analysis in the second step.

Bhaskaran (2013) [10] conducted a study on the efficiency of textile industry clusters in India. The study also provided projections for those clusters.

Saricam and Erdumlu (2012) [11] applied DEA for Turkish textile and apparel companies. They state that the textile industry should increase the gross value added to reach higher efficiency levels.

Ho (2013) [12] used DEA to measure the operating performance of 12 textile manufacturers in Taiwan for the period 2010-2012. The study results show that only two firms have an overall efficiency score of 1.

Kapelko and Lansink (2014) [13] measured technical efficiency in the international textile and clothing industry for the time period 1995-2004. They stated that intangible assets were positively related to the technical efficiency of textile and clothing companies.

Jorge-Moreno and Carrasco (2015) [14] investigated the technical efficiency and its determinants of the Spanish textile sector for the years from 2002 to 2009 using stochastic frontier analysis (SFA).

Goyal et al (2018) [15] measured the efficiency scores of the Indian textile industry. They found the Indian textile industry inefficient and stated that, on average, but the firms in the industry have the potential to decrease their inputs by 34.12 percent to obtain the same level of outputs as before.

Abdulla and Kumar (2021) [16] investigated the technical efficiency and the determinants of efficiency in the Indian textile garment sector. Their findings indicate that small scale firms have the highest mean efficiency scores.

Amaliyah et al. (2022) [17] calculated the technical efficiency scores of the textile and textile product industry in Indonesia.

To our knowledge, the efficiency of the textile industry in Eastern Europe has never been investigated with stochastic frontier analysis (SFA). Also the inefficiency effects of those countries' textile industry has never been studied, although some studies exist for the textile industry in other countries.

It is important to know whether the older and thus more experienced firms may have advantages in technical inefficiency. Therefore, the first hypothesis of the study is stated below.

H0a: There is no effect of age on the inefficiency of the textile industry.

Another important issue is whether the liquidity of a firm would be helpful in improving the firm's technical efficiency.

H0b: There is no effect of the current ratio on the inefficiency of the textile industry.

Also, it would be helpful for decision makers to know whether the industry's technical efficiency exhibited a clear time trend.

H0c: There is no effect of time on the inefficiency of the textile industry.

The purpose of this study is to reveal how efficient the textile companies in Eastern Europe are, and to determine what factors affect the inefficiency. In this context, this study is assumed to make a significant contribution to the existing literature.

2. Data and Methodology

The data used in this study covers the period from the year 2012 to 2021. The firms which have NACE Rev 2 code 13-manufacture of textile, were included in the data, taken from the Orbis database – Bureau Van Dijk, however, most of the textile company data were not available. Some firms did not have fixed assets and had only one or two employees. The companies having less than $5,000 of fixed assets and having fewer than three employees were not included, since they are too small to make a healthy analysis.

In this research, after deleting the missing observations, 867 observations from Slovakia, 1075 from Czech Republic, 405 from Poland and 227 from Hungary were used.

The number of enterprises were obtained from Eurostat [18] in order to see to what extent the firms included in the analysis represent the sector. However, the number of companies changed from year to year. In this case, since there is no data for 2021 in Eurostat, the average number of enterprises for the period 2012-2020 was calculated. Considering the period 2012-2020, the average number of textile companies in the Czech Republic was 2471, while it was 1203 in Hungary, 5604 in Poland and 1430 in Slovakia.

The percentage of representation was calculated by dividing the average number of observations subject to the research by the average number of companies in the sector. For example, Slovakia has an average of 86.7 observations, and since there is an average of 1430 companies in the sector for the 2012-2020 period, the percentage of representation is calculated as 6.06. In this case, 0.72% of the textile industry in Poland, 4.35% of that in Czech Republic and 1.89% of that in Hungary are represented in this study.

Following Kapelko and Rialp- Kriado (2009) [7], this study used revenues as the output variable, and fixed assets, the cost of goods sold and the number of employees as the input variables. To represent revenue, the operating revenue was used, which includes net sales, other operating revenues and stock variations. Fixed assets (after depreciation) include tangible, intangible and other fixed assets. The number of employees is the total number of employees included in the company's payroll.

There is no consensus on which variables should be used for inefficiency effects. Due to limited data, firm age, current ratio, and year were used in this study. Age is the number of years passed until today since the establishment of the firm. The current ratio is calculated by dividing current assets by current liabilities. The variable year takes the value 1 for observations belonging to 2012, 2 for observations belonging to 2013, and so on.

The purpose of this study is to measure the efficiency scores of the textile industry in the selected countries and understand the factors which affect inefficiency. One possible way is to calculate efficiency scores using data envelopment analysis and perform a Tobit regression analysis to see the factors affecting efficiency scores. Instead of following this two-step procedure, this study used SFA to calculate the necessary variables in one step.

SFA was proposed by Aigner et al (1977) [19] and Meeusen and Van den Broeck (1977) [20].

There are a number of panel SFA models which could have served the purpose of this paper. However, most of them do not discriminate between unobserved individual heterogeneity and inefficiency.

The Wang and Ho (2010) [21] model considers both time-varying inefficiency and time-invariant individual effects. The model can be stated as follows:

$$y_{it}=\alpha_i+x'_{it}\beta+\varepsilon_{it} \quad (1)$$

$$\varepsilon_{it}=v_{it}-u_{it} \quad (2)$$

$$v_{it}\sim N(0,\sigma^2_v) \quad (3)$$

$$u_{it}=h_{it}\cdot u^*_i \quad (4)$$

$$h_{it}=f(z'_{it}\delta) \quad (5)$$

$$u^*_i\sim N^+(\mu,\sigma^2_u) \quad (6)$$

$$i=1,\ldots,N,\ t=1,\ldots,T.$$

The fixed unobservable effect of the individual i is α_i; x_{it} is the vector of explanatory variables; v_{it}- the error term with zero mean, u_{it} - the inefficiency term, and h_{it} is a positive function of the vector of z_{it}. Here, z_{it} are inefficiency determinants.

3. Results

Table 1 shows the SFA results, according to which, age has a negative and significant impact on the inefficiency scores of the Czech Republic and Hungary.

SFA Results	Slovakia				The Czech Republic			
	Number of observations		=	867 Obs	Number of observations		=	1075 Obs
	Number of firms		=	169	Number of firms		=	208
		Wald chi2(3)	=	2551.09		Wald chi2(3)	=	1969.32
		Prob > chi2	=	0.0000		Prob > chi2	=	0.0000
		Log likelihood	=	219.32439		Log likelihood	=	383.88928
_lnoprev_M	**Coef.**	**Std. Err.**	**z**	**P>|z|**	**Coef.**	**Std. Err.**	**z**	**P>|z|**
frontier								
_lnfixed_M	0.0859255	0.0108841	7.89	0.000	0.0101052	0.0122612	0.82	0.410
_lncogs_M	0.5757908	0.016938	33.99	0.000	0.7658616	0.0207871	36.84	0.000
_lnemp_M	0.2507083	0.0234899	10.67	0.000	0.1637122	0.0281475	5.82	0.000
h1eq								
lnage	0.1209253	0.1885278	0.64	0.521	-2.402012	0.2844746	-8.44	0.000
lncurr	-0.5890669	0.1615071	-3.65	0.000	-0.132602	0.0943596	-1.41	0.160
year	-0.0335753	0.0149108	-2.25	0.024	-0.6843704	0.0687696	-9.95	0.000
vsigmas								
_cons	-3.588947	0.0583926	-61.46	0.000	-4.029029	0.0545292	-73.89	0.000
usigmas								
_cons	-2.296648	1.387868	-1.65	0.098	15.70052	1.930479	8.13	0.000
SFA Results	**Poland**				**Hungary**			
	Number of observations		=	405 Obs	Number of observations		=	227 Obs
	Number of firms		=	91	Number of firms		=	45
		Wald chi2(3)	=	2342.39		Wald chi2(3)	=	195.29
		Prob > chi2	=	0.0000		Prob > chi2	=	0.0000
		Log likelihood	=	301.44688		Log likelihood	=	-9.237606
_lnoprev_M	**Coef.**	**Std. Err.**	**z**	**P>|z|**	**Coef.**	**Std. Err.**	**z**	**P>|z|**
frontier								
_lnfixed_M	0.0465063	0.0121806	3.82	0.000	0.2176991	0.0577631	3.77	0.000
_lncogs_M	0.9055401	0.0218595	41.43	0.000	0.0863001	0.0222157	3.88	0.000
_lnemp_M	-0.0066373	0.0180113	-0.37	0.712	0.4226283	0.0521856	8.1	0.000
h1eq								
lnage	0.180815	0.3681815	0.49	0.623	-6.524074	1.276117	-5.11	0.000
lncurr	-0.6309809	0.3070013	-2.06	0.040	-1.550453	0.6181122	-2.51	0.012
year	0.0372415	0.0358795	1.04	0.299	-1.036397	0.2333588	-4.44	0.000
vsigmas								
_cons	-4.782043	0.0818227	-58.44	0.000	-3.004888	0.1091964	-27.52	0.000
usigmas								
_cons	-5.433195	2.920341	-1.86	0.063	41.10338	7.675375	5.36	0.000

Table 1. SFA Results

This means that older companies tend to be more efficient. This finding is in line with Wadud (2004) [6]. While experience in the textile industry is an important factor in the Czech Republic and Hungary, the variable is insignificant for Poland and Slovakia.

Another important factor is the current ratio for the textile industry. The effect of the current ratio is negative and significant for Slovakia, Poland and Hungary. In those countries liquidity decreases inefficiency, which may happen because firms with more liquidity

	2021	2020	2019	2018	2017	2016	2015	2014	2013	2012	2021-2012
Slovakia	0.825	0.828	0.808	0.803	0.796	0.812	0.804	0.827	0.771	0.772	0.805
The Czech Rep.	0.995	0.982	0.987	0.976	0.968	0.969	0.957	0.928	0.897	0.842	0.950
Hungary	0.952	0.999	0.998	0.996	0.985	0.917	0.916	0.987	0.921	0.910	0.958
Poland	0.916	0.917	0.914	0.921	0.925	0.925	0.945	0.941	0.938	0.944	0.929

Table 2. Mean Efficiency Scores

	Slovakia			Czech Republic			Hungary			Poland		
Size	Mean Eff.	Obs.	N. Of Firms	Mean Eff.	Obs.	N. Of Firms	Mean Eff.	Obs.	N. Of Firms	Mean Eff.	Obs.	N. Of Firms
Small	0.768	389	105	0.933	196	65	0.933	26	7	0.933	33	15
Medium	0.823	377	51	0.946	630	109	0.965	66	16	0.926	205	47
Large & very large	0.871	101	13	0.957	249	34	0.962	135	22	0.916	167	29
Total		867	169		1075	208		227	45		405	91

Table 3. Size and Mean Efficiency Scores

have greater flexibility in managing their resources and operations.

The impact of the year variable is negative and significant for Slovakia, the Czech Republic and Hungary, meaning that inefficiency tends to decrease over time. One possible reason for the time effect is the increased knowledge and skills in using the existing technology. Table 2 provides insight into how the mean efficiency changed throughout the years.

Efficiency improvement was achieved in Slovakia, the Czech Republic and Hungary. For example, the mean efficiency of the textile industry in Slovakia was 0.772 in 2012, reaching 0.825 in 2021. Similarly, in the Czech Republic, while the efficiency score was 0.842 in 2012, it reached 0.995 in 2021.

Regarding the mean of the whole period, Slovakia has the lowest efficiency score, 0.805, indicating that efficiency improvement still can be achieved.

Table 3 gives an idea of the firm sizes and the mean efficiency scores. While the highest mean efficiency scores belong to large and very large firms in Slovakia and the Czech Republic, they belong to small firms in Poland and medium-sized firms in Hungary.

4. Conclusion

This study investigated the efficiency of the textile industry in selected Eastern European countries.

Unlike previous studies, the Wang and Ho (2010) [21] model was used and inefficiency effects were examined.

The results of the study show that age is an important factor for the Czech Republic and Hungary. Older textile firms tend to have higher efficiency scores in those countries. The current ratio negatively affects inefficiency in Slovakia, Poland and Hungary, while time decreases the inefficiency of textile companies in Slovakia, the Czech Republic and Hungary.

Eastern European textile companies should consider the factors which make them more inefficient, as well as the size effect and the efficiency trend of the industry when they make their strategies, since there is no room for inefficient firms in this highly competitive world.

The limitation of this study is the low representation rate of textile companies in Poland and Hungary. In future studies, the efficiency levels of textile industries should be reexamined, taking into account all eastern European countries and with higher percentages of representation.

Conflict of Interest

The Author declares there is no conflict of interest.

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