(REFEREED RESEARCH)

THE EXPORT EFFICIENCY OF TURKISH TEXTILE AND APPAREL FIRMS: AN INVESTIGATION EMPLOYING DATA ENVELOPMENT ANALYSIS (DEA) AND ANALYTIC HIERARCHY PROCESS (AHP) METHODS*

TÜRK TEKSTİL VE HAZIR GİYİM FİRMALARININ İHRACAT ETKİNLİĞİ: VERİ ZARFLAMA ANALİZİ (VZA) VE ANALİTİK HİYERARŞİ SÜRECİ (AHS) KULLANIMIYLA BİR İNCELEME

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ABSTRACT

In this study, we examine the export efficiency of textile and apparel firms listed in the 2012 Istanbul Chamber of Industry (ICI) 500 report. The export efficiency of 30 textile and apparel firms with complete data for 2012 was evaluated via Data Envelopment Analysis (DEA) and Analytic Hierarchy Process (AHP) methods. Output-oriented DEA method was applied using four input variables (number of employees, net assets, number of exporting countries and export experience) and one output variable (export sales) to determine firm export efficiency levels. Based on the analysis results, four firms were identified as efficient units. The AHP method was employed to identify the extent to which qualitative and quantitative factors affect the export efficiency of efficient firms. Pairwise comparisons were made through in-person interviews with managers of efficient firms using DEA. "Product policies" were found to be the most influential factor affecting the export performance of Turkish textile and apparel firms. Overall, apparel firms are found to be more efficient than textile firms.

Keywords: Data Envelopment Analysis, Analytic Hierarchy Process, Export Performance, Textile and Apparel Industry.

ÖZET

İstanbul Sanayi Odası (İSO) 500 listesinde yer alan tekstil ve hazır giyim firmalarının 2012 yılı ihracat etkinliklerinin değerlendirilmesi amacıyla yürütülen bu çalışmada, 30 tekstil ve hazır giyim firmasının 2012 yılı verilerine göre ihracat etkinlikleri Veri Zarflama Analizi (VZA) ve Analitik Hiyerarşi Süreci (AHS) yöntemleri ile değerlendirilmiştir. Firmaların ihracattaki etkinlik düzeylerinin belirlenmesi amacıyla 4 girdi (çalışan sayısı, aktif toplamı, ihracat yapılan ülke sayısı, ihracat tecrübesi) ve 1 çıktı (ihracat satış tutarı) değişkeni kullanılarak çıktıya yönelik VZA uygulanmıştır. Analiz sonucunda 4 firma etkin bulunmuştur. Etkin durumdaki firmaların etkinliklerinde önemli olan nitel/nicel faktörlerin ve bu faktörlerin göreli önem düzeylerinin belirlenmesi amacıyla AHS yöntemi de kullanılmıştır. Analizdeki ikili karşılaştırmalar VZA yöntemine göre etkin çıkan firmaların üst düzey yöneticileriyle yüz yüze görüşülerek yapılmıştır. Analiz sonuçlarına göre, Türk tekstil ve hazır giyim firmalarının ihracat performansında en önemli kriter "ürün politikalarıdır". Genel olarak değerlendirildiğinde, hazır giyim firmaları tekstil firmalarına göre daha etkin durumdadır.

Anahtar Kelimeler: Veri Zarflama Analizi, Analitik Hiyerarşi Süreci, İhracat Performansı, Tekstil ve Hazır Giyim Sektörü.

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1. INTRODUCTION

The Turkish Textile and Apparel Industry's (TTAI) critical role in industrialization, adding value to production processes, GDP shares, exports, net exchange incomes and employment, combined with its vulnerability in crisis periods renders this industry central to the Turkish economy. An analysis of Turkish Textile and Apparel firms is thus warranted.

In related literature, several studies have evaluated the efficiency of firms in various respects and using several methodologies. The DEA method was been widely used to measure the efficiency of textile and apparel firms [1-11]. The AHP method is another commonly used tool applied to multi-criteria decision-making problems related to the textile and apparel industry [12-18]. While these two techniques are widely used in domestic and foreign literature, studies employing both techniques together are limited, especially in the domestic literature [19-26].

DEA and AHP methods have been used frequently in recent years, especially in foreign studies. The two techniques were used together in various industries, including the packing (27), port (28), railway system (23, 29), banking (25, 26), manufacturing (30) and government agency (31) sectors. Other studies have employed these techniques in conjunction to rank decision-making units (19, 32), derive and aggregate DEA weights (20, 33), select suppliers (21), solve facility layout design problems (27) and evaluate performance measures (26, 34). However, no study employing both DEA and AHP techniques has yet examined the efficiency of textile and apparel firms. Thus, in this study, both DEA and AHP techniques are employed to measure the export efficiency of textile and apparel firms.

This study evaluates the export efficiency of textile and apparel firms listed in the 2012 Istanbul Chamber of Industry (ICI) 500 report using DEA and AHP techniques. Firm export efficiency levels were determined using DEA methods. From the DEA results, ways in which inefficient firms may improve are presented in reference to efficient firms. AHP methods are then used to identify the extent to which certain qualitative and quantitative factors affect the export efficiency of efficient firms.

Textile and apparel firms listed in the "Top 500 Industrial Enterprises" report published by the ICI in 2012 were examined in this study. The study universe thus includes 51 textile and apparel firms listed in the 2012 ICI 500. Records for 2012 include 37 textile and apparel firms with complete data. As this study examines export performance, firms with export intensity levels falling below 0.0005 were excluded from the analysis. In turn, 30 firms were included in the efficiency analysis. Firm names were not revealed, as requisite permission from related firms was not obtained.

Determinative factors are required to compare the export performance of firms. Our investigations show that while numerous factors affect export performance, clear distinctions have not been made regarding the impact of each factor. Hence, determinants of export performance frequently discussed in the literature were identified to determine the nature of export performance to be examined in this study. Factors identified through the literature review were then presented to apparel firm research specialists. It was found that factors widely discussed in the literature align with expert opinions. These factors form the framework of variables and criteria used in the analyses.

Both qualitative (product policy, market research, pricing policy, distribution policy, promotion policy, ownership, managerial policy, branding, design, quality, etc.) and quantitative variables (total assets, net sales, number of employees, number of export markets, export experience (year), etc.) affect export performance. The study was thus carried out over two stages. First, the export efficiency of firms was measured using quantitative variables and the DEA method. The AHP multi-criteria decision-making technique was then employed to determine qualitative factors that affect the performance of efficient firms identified through the DEA method.

2. DEA APPLICATION FOR THE DETERMINATION OF EXPORT EFFICIENCY

DEA is a non-parametric mathematical programming method based on principles of linear programming that can compare relative efficiency levels between organizations in cases of multiple inputs and outputs. DEA constitutes an efficiency frontier in that it employs observation values without specific functions (35).

The DEA technique aims to determine the efficiency of decision-making units (DMUs) using similar inputs and outputs based on a frontier. Accordingly, DEA identifies a frontier by determining the best input/output combination that produces maximum outputs using minimum inputs for the observation set evaluated. In turn, DMUs in an efficient frontier are determined. Using a relevant frontier as a reference, DMU efficiency is deemed "relative" based on the radial distance to this frontier. In the results of analyse, inefficient DMUs are improved using information on certain variables (input/output) (36).

Basic DEA models can be divided into CCR and BCC varieties. While the CCR model assumes "constant returns to scale", the BCC model assumes "variable returns to scale". The efficiency value calculated through the CCR model is the "overall technical efficiency" value, whereas the efficiency value calculated through the BCC model is the "pure technical efficiency" value. "Overall technical efficiency" divided by "pure technical efficiency" produces "scale efficiency". Hence, if the CCR model deems a DMU efficient, it will also be deemed efficient through the BCC model. However, DMUs deemed efficient via the BCC model are not necessarily deemed efficient via the CCR model (37). Hence, the CCR model, which generates overall firm technical efficiency scores, was used in this study.

Both models (CCR and BCC) can be either input- or output-oriented. In input-oriented models, inputs are minimized and outputs are maintained at current levels. In output-oriented models, outputs are maximized based on a given number of inputs. As this study measures firm export performance and thus identifies maximum export revenues, the output-oriented model was employed.

In this study, export efficiency records for 30 textile and apparel firms with complete data listed in the 2012 ICI 500 were examined. Twenty-two of these firms operate in the textile industry, and the remaining eight operate in the apparel industry. The firms examined present similar production features and produce similar outputs using

similar inputs. The selection of appropriate input and output variables is essential to successful DEA application. Four input variables (total assets, number of employees, export experience (in years) and number of export markets) and one output variable (export sales) were used for the DEA. If the number of inputs is “m” and the number of outputs is “s”, the number of DMUs employed must be at least “m+s+1” to conduct a DEA. Constraints on the number of DMUs used were applied (30>4+1+1).

An efficiency value of between 0 and 1 (between 0 and 100 in %) is obtained for each DMU. DMUs with efficiency scores equal to 1 (100%) form the best observation set and are situated on the efficient frontier. DMUs with efficiency scores of less than 1 (<100%) are less efficient. The relative efficiency value of DMUs corresponds to their distance from the efficiency frontier (38). Firm efficiency scores were obtained by using Frontier Analysis 3.2.2 software.

Table 1, which presents 2012 efficiency scores for the 30 textile and apparel firms, shows that firms achieving 100% efficiency scores include F10, F17, F20 and F27. The other 26 firms are inefficient. For example, the relative efficiency value for F5 is 87.14%. Thus, there is an 87.14% chance that F5 could obtain maximum outputs with current inputs

Table 1. Output-oriented CCR Efficiency Scores

Firms	Efficiency Scores	Result
F20	100	Efficient
F10	100	Efficient
F17	100	Efficient
F27	100	Efficient
F5	87,14	Inefficient
F30	81,05	Inefficient
F14	77,58	Inefficient
F28	76,66	Inefficient
F25	71,70	Inefficient
F21	47,10	Inefficient
F22	44,82	Inefficient
F16	43,93	Inefficient
F18	34,04	Inefficient
F9	31,58	Inefficient
F29	31,35	Inefficient
F1	30,93	Inefficient
F7	30,57	Inefficient
F11	26,68	Inefficient
F24	25,99	Inefficient
F4	24,93	Inefficient
F23	22,79	Inefficient
F6	20,16	Inefficient
F12	19,57	Inefficient
F3	17,35	Inefficient
F15	17,03	Inefficient
F8	16,54	Inefficient
F2	13,92	Inefficient
F13	11,45	Inefficient
F26	10,43	Inefficient
F19	7,97	Inefficient

Of all 30 firms examined, four firms were deemed efficient and 26 were deemed inefficient. The ratio of efficient firms to total firms is 13.33%. The average firm efficiency value is 44.11% (1323.26/30). The average efficiency value for the apparel industry is 56.12% (448.93/8), while the average efficiency value for the textile industry is 39.74% (874.35/22).

It is assumed that inefficient DMUs can achieve higher efficiency values by employing methods applied by efficient DMUs. Efficient DMUs are thus presented in reference to inefficient DMUs. Differences between targeted and performed values of inefficient DMUs are potential improvement values. Improvement values provide information on input and output adjustments required for inefficient DMUs to reach the efficient frontier.

Table 2 shows potential improvement values and reference sets for inefficient firms with efficiency values of over 50%. According to the table, if F5 reduces total assets at a rate of 14.13%, reduces the number of export markets at a rate of 79.59% and increases export sales at a rate of 14.76%, it can become efficient. Improvement values for other firms are also shown in Table 2. Potential improvement values for other inefficient firms are given in appendix-1.

Efficiency rates evaluated through DEA are determined based on DMUs considered in the observation set. Efficient firms are thus best endowed in terms of current variables and with respect to DMUs included in the observation set. In other words, an efficient firm can be considered inefficient when evaluated in another sample or with other variables. Thus, efficient firms can be referred to as “relatively efficient firms”.

3. AHP APPLICATION FOR IDENTIFYING DETERMINANT FACTORS OF EXPORT EFFICIENCY

Owing to the structure of DEA, while recommendations have addressed inefficient firms, few have focused on efficient firms. Furthermore, though DEA generates information on input and output adjustments required for inefficient DMUs to become efficient, recommendations do not address “how” such improvements may be realized. AHP was thus used to determine which factors significantly affect efficiency levels in efficient firms. As the AHP technique was employed to comment on the efficiency of efficient firms, paired comparisons in AHP were constructed through meetings with senior executives of efficient firms

The AHP model, developed by American mathematician and management scientist Thomas L. Saaty, is an analysis tool for solving complicated decision problems that include more than one criterion (39). The AHP is superior to other multi-criteria decision-making techniques in that the tool can evaluate both qualitative and quantitative criteria (40).

The AHP is based on the following three principles: *decomposition*, *comparative judgment* and *priority synthesis* (41). *Decomposition* is related to the construction of a hierarchical model structure to present a problem, with the highest level representing the overall goal, the midlevel representing evaluation decision criteria (sub-criteria) and with the lowest level denoting decision alternatives in the decision hierarchy (42).

Criteria and sub-criteria were developed based on a literature review and preliminary interviews with industry experts. Interviews were conducted with export managers of the two firm types. Factors were determined by posing the following open-ended question: “What factors affect export performance in the textile and apparel industry?” Qualitative and quantitative variables that affect export performance criteria and sub-criteria according to comprehensive literature research, expert views and general assessments are presented in Figure 1.

Table 2. Potential Improvement Rates and Reference Sets for Inefficient Firms

Firm	Variables		Actual	Target	Improvement (%)	Reference Set
F5	Inputs	total assets	355.699.690	305.451.286,21	-14,13	F20 F17
		employees	1.151	1.151	00,00	
		export experience	11	11	00,00	
		exp. markets	80	16,33	-79,59	
	Output	exp. sales	223.696.800	256.714654	14,76	
F30	Inputs	Total assets	914.023.332	460.789.149,88	-49,59	F20 F17
		employees	1.767	1.767	00,00	
		export experience	15	15	00,00	
		exp. markets	41	20,68	-49,56	
	Output	exp. sales	288.608.400	356.084.488,26	23,38	
F14	Inputs	Total assets	1.059.355.582	409.389.390,15	-61,35	F20 F17
		employees	1.317	1.317	00,00	
		export experience	37	26,48	-28,44	
		exp. markets	51	51	00,00	
	Output	exp. sales	445.014.000	573.601.667,08	28,90	
F28	Inputs	Total assets	186.554.524	186.554.524	00,00	F20 F17 F10
		employees	2.342	2.342	00,00	
		export experience	20	14,46	-27,68	
		exp. markets	15	15	00,00	
	Output	exp. sales	238.192.200	310.704.034,82	30,44	
F25	Inputs	Total assets	2.401.041.841	1.168.396.624,98	-51,34	F20
		employees	6.740	4.635	-31,23	
		export experience	30	30	00,00	
		exp. markets	50	32,50	-35,00	
	Output	exp. sales	534.655.800	745.730.999,98	39,48	

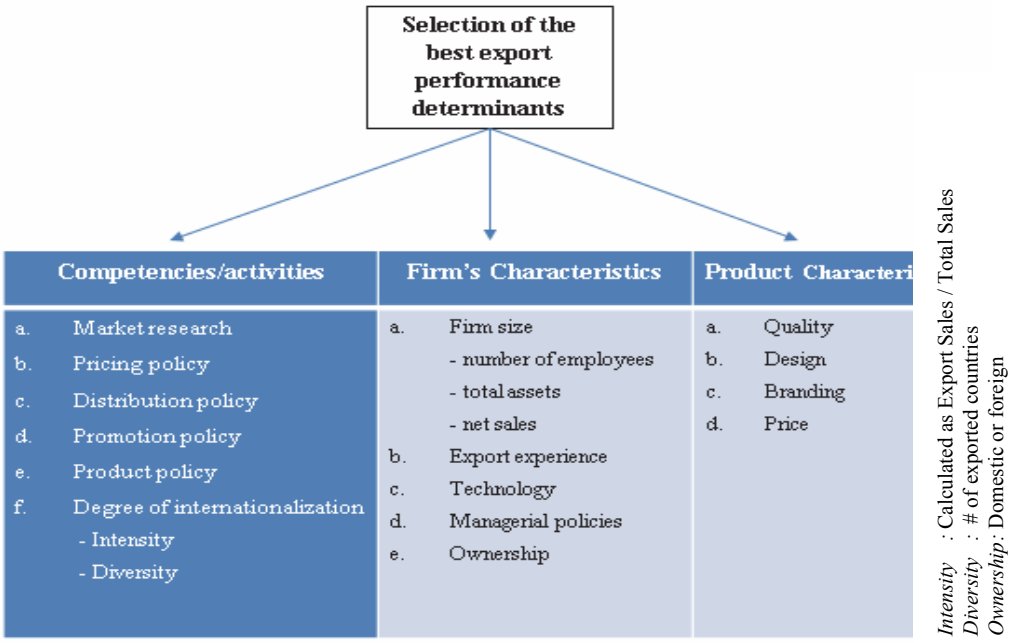

Figure 1. Hierarchical Ranking of Export Performance Determinants

The relative importance of criteria was calculated after individual participant judgments were entered as main criteria and sub-criteria. Table 4 presents relative importance values provided by the participants for various criteria. The table shows that the most influential determinant of strong export performance is *firm characteristics* according to F12, while *competencies/ activities* are the most essential according to the other three participants. For F24, all criteria are of equal importance. *Competencies/activities* were considered the most important (0.438) based on common judgment values generated by calculating the geometric mean of individual participant judgements. *Firm characteristics* (0.304) and *product characteristics* (0.259) correlate with *competencies/ activities*.

Criteria and sub-criteria effects on textile and apparel firm export performance are shown in Figure 2. The AHP results on the most influential export performance determinants for Turkish textile and apparel firms show that the most important criterion is *competencies/activities* (0.438). This criterion is respectively followed by *firm characteristics* (0.304) and *product characteristics* (0.259). Among *competencies/activities*, the most influential sub-criterion is *product policy* (0.357). This criterion is respectively followed by *pricing policy* (0.272), *promotion policy* (0.146), *market research* (0.118), *distribution policy* (0.057) and *internalization level* (0.051). Among *firm characteristics*, the most influential sub-criterion is *managerial policies* (0.227). This is respectively followed by *export experience* (0.269), *technology* (0.268), *firm size* (0.118) and *ownership* (0.068). Among *product characteristics*, the most influential sub-criterion is *quality* (0.318). This is respectively followed by *design* (0.274), *branding* (0.208) and *price* (0.200).

Criteria and sub-criteria paired comparison matrices for all participants are presented in appendix-2. Only paired comparison matrices and relative importance values for main criteria are shown. The results were obtained from the Expert Choice 11 package.

Table 3 presents a paired comparison matrix of mutual participant judgment values for the main criteria. We note that the importance of *firm characteristics* is recorded at 1/1.315=0.760 based on *competencies* (x_{21}), while the importance of *competenc*ies is recorded at 1.315 based on *firm characteristics* (x_{12}). Thus, while *competencies* are 1.315 times more important than *firm characteristics* as export performance determinants of efficient Turkish textile and apparel firms, *firm characteristics* are 1/1.315=0.760 times more important than *competencies*. Paired comparisons of other criteria are presented in the table.

Comparative judgment involves a pairwise comparison of factors at the same level to measure factor contributions to decision-maker judgments. This approach helps decision-makers identify contributions of each criterion to the goal (43). In the hierarchical structure, main criteria, sub-criteria based on main criteria and alternatives are compared based on an upper level. Methods of paired comparison for criteria and alternatives are depicted in the “paired comparison matrix” (44).

The consistency rate (CR) measures whether decision-makers are consistent with respect to criteria and alternative measures employed. The upper limit of the consistency rate was shown to be 0.10 by Saaty. As such, judgments exceeding 0.10 are deemed inconsistent. On the other hand, CR values lower than 10% are considered adequate to interpret results (43). Consistency rates for each process and decision matrix were determined after participant feedback data were entered into the Export Choice 11 package. The program found consistency rates of less than 0.10 for each decision matrix.

The AHP method allows one to evaluate judgments for more than one individual in the paired comparison process. Judgments can be combined only when each member of a group makes judgments for each hierarchy level. In the present study, group members employed two different strategies to come to a consensus on each element of the paired comparison matrices and the geometric mean of the individual judgments was calculated (45). Group decision-making was performed using a geometric mean of individual judgments.

For the AHP decision phase, priorities of the paired comparison matrix were synthesized to determine relative element importance levels. Priority syntheses compute a composite weight for each alternative based on preferences identified in the comparison matrix. From the composite weight value (global priorities or “normalized priority weights”), the relative value of each alternative can be obtained (46). Weighted relative importance values for all criteria are shown in Table 5.

As shown in Table 5, the most influential export performance determinants for Turkish textile and apparel firms are *product policies* (13.37%) and *pricing policies* (10.19%). The least important criteria include *distribution policies* (2.14%) and *ownership* (2.29%).

Table 3. Pairwise Comparison Matrix for Criteria

Criteria	Competencies	Firm characteristics	Product characteristics
Competencies	1	1,315	1,861
Firm characteristics	0,760	1	1,071
Product characteristics	0,537	0,933	1

Consistency Rates: 0.01

Table 4. Relative Importance Values for Criteria

Criteria	F12 [0,05]*	F21 [0,05]	F24 [0,04]	F32 [0,05]	Geo. Mean [0,01]
Competencies	0,210 (3)**	0,594 (1)	0,333	0,528 (1)	0,438 (1)
Firm characterisrtics	0,550 (1)	0,249 (2)	0,333	0,140 (3)	0,304 (2)
Product characterisrtics	0,240 (2)	0,157 (3)	0,333	0,333 (2)	0,259 (3)

* Consistency rates ** the order of importance

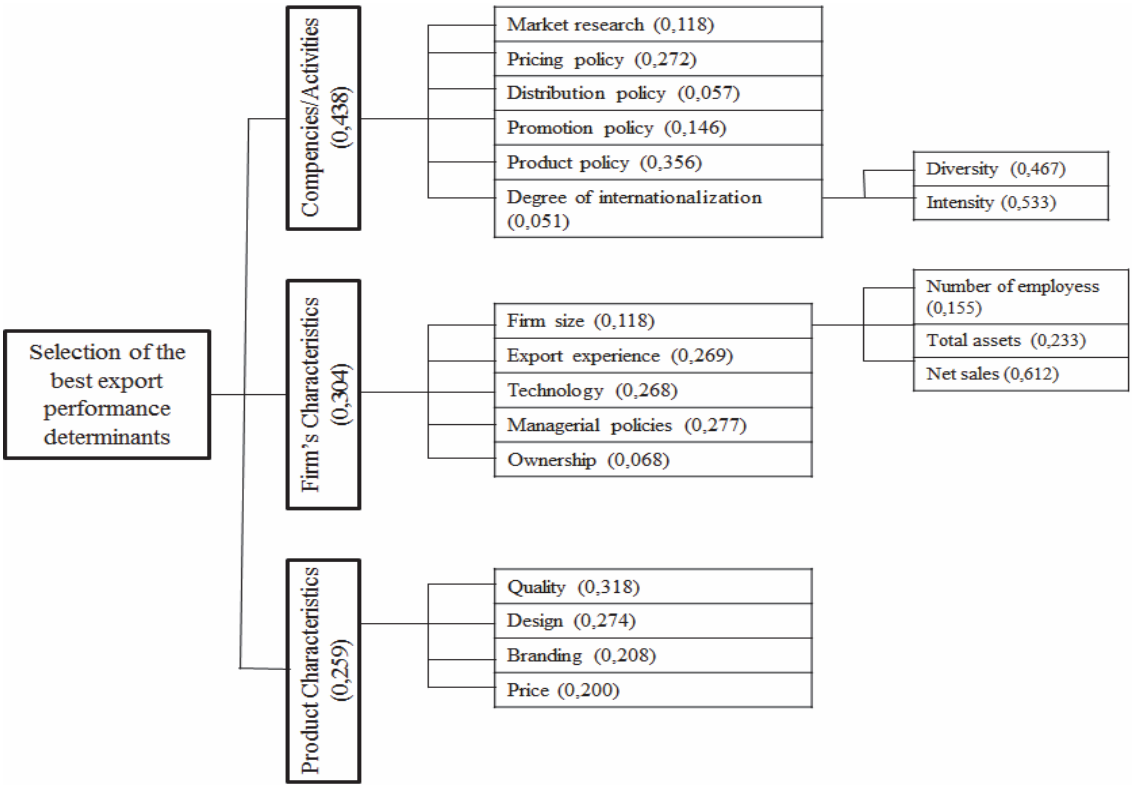

Figure 2. Relative Importance Value

Table 5. Weighted Relative Importance Values

No	Criteria	Importance Values (%)	No	Criteria	Importance Values (%)
1	Product policy	13,37	9	Promotion policy	5,46
2	Pricing policy	10,19	10	Branding	5,17
3	Managerial policies	9,29	11	Price	4,96
4	Export experience	9,00	12	Market research	4,41
5	Technology	8,99	13	Degree of internationalization	3,56
6	Quality	7,91	14	Ownership	2,29
7	Design	6,81	15	Distribution policy	2,14
8	Firm size	6,45			

4. CONCLUSION AND RECOMMENDATIONS

The export efficiency of textile and apparel firms listed in the 2012 Istanbul ICI 500 was examined. Thirty firms were analysed via DEA in terms of export efficiency for determined variables. The AHP method was then employed in the DEA through in-person interviews with senior executives of efficient firms to identify factors that affect export performance.

According to the DEA efficiency measure, only four of the 30 firms examined were deemed efficient, with the remaining 26 firms deemed inefficient. The proportion of efficient firms to total firms is 13.33%. The average efficiency value of firms is 44.11%. Thus, firms turn available inputs into maximum outputs with 44.11% certainty. This average firm efficiency of below 50% is striking. Causes of such low efficiency levels in the textile and apparel industry and means of mitigating such issues must be examined in future studies.

Such low efficiency results may be partly attributable to decision units examined in this study. Future studies may measure the export performance of heavily export-oriented or 100% export-oriented firms. In addition, study variables were selected based on a general assessment of export performance literature and expert opinions. However, clear distinctions between determinants of export performance are present in the literature. As DEA input and output sets affected the results of this study, future studies must distinguish between these factors further. In this study, firm export efficiency levels were determined based on 2012 data. Future studies may generate more detailed sector efficiency results from panel datasets.

According to the DEA results, three of the efficient firms (of four firms) are apparel firms. While 22 of the 30 firms examined are textiles firms and eight are apparel firms, three of the efficient firms are apparel firms. Furthermore, the average efficiency of apparel firms is 56.12% (448.93/8), while that of the textile industry is 39.74% (874.35/22).

Apparel firms are thus more efficient than textile firms. Future studies may examine textile and apparel sub-sectors using distinct models. Also, three of the efficient firms (of four firms) are located in Izmir.

The DEA method assumes that inefficient DMUs can become efficient by employing methods applied in efficient DMUs. The DEA results illustrate the extent to which certain inputs and outputs may render inefficient DMUs efficient. The study results show that inefficient firms should increase output (export) levels. While the DEA results offer information on input and output adjustments required to increase firm efficiency, they do not illustrate "how" such improvements may be realized. Furthermore, pairwise AHP comparisons were made for export managers of efficient firms. AHP results thus only referred to efficient firms. Hence, if inefficient firms focus on important factors identified through the AHP, these firms can become efficient and increase export levels.

The AHP results are consistent with former studies. Export marketing strategies and firm and management characteristics represent the most widely explored topics in the literature. According to existing export performance studies, the most important factors include *product policies* and *pricing policies* as **export marketing strategies**; *export experience* and *technologies* as **firm characteristics** and *managerial policies* as **management characteristics**. *Distribution policies* and *ownership* are the least important factors according to the present study and related export performance studies. Future studies must examine these criteria further.

Gaps in the literature were addressed by determining the relative importance of factors affecting Turkish textile and apparel firm export performance using AHP methods. Analytic Network Process (ANP) methods may be employed to identify relationships between criteria and to rank their relative importance. Grey Relationship Analysis (GRA) methods may also be employed to rank efficient firms via DEA. Other industries central to the Turkish economy may also be examined. Moreover, the apparel industry, which was found to be more efficient in this study, may be examined separately.

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APPENDİX 1: Potential Improvement Rates and Reference Sets for Inefficient Firms

Table 1: Potential Improvement Rates and Reference Sets for Inefficient Firms (continued)

Firm	Variables		Actual	Target	Improvement (%)	Reference Set
F21	Inputs	total assets	572.007.638	572.007.638	00,00	F20 F17
		employees	2.272	2.272	00,00	
		export experience	15	15	00,00	
		exp. markets	70	16,62	-76,26	
	Output	exp. sales	174.859.200	371.219.657,67	112,30	
F22	Inputs	Total assets	487.849.939	374.776.367,15	-23,18	F20 F17
		employees	1.335	1.335	00,00	
		export experience	31	17,51	-43,51	
		exp. markets	30	30	00,00	
	Output	exp. sales	176.400.000	393.534.708,98	123,09	
F16	Inputs	Total assets	255.624.002	255.624.002	00,00	F20 F17 F10
		employees	1.392	1.392	00,00	
		export experience	17	17	00,00	
		exp. markets	55	28,41	-48,34	
	Output	exp. sales	161.708.400	368.080.863,80	127,62	
F18	Inputs	Total assets	276.864.447	276.864.447	00,00	F20 F17 F10
		employees	2.150	2.150	00,00	
		export experience	21	12,54	-40,28	
		exp. markets	12	12	00,00	
	Output	exp. sales	96.840.000	284.499.640,51	193,78	
F9	Inputs	Total assets	441.223.247	439.512.391,56	-0,39	F20 F17
		employees	1.505	1.505	00,00	
		export experience	35	23,69	-32,32	
		exp. markets	43	43	00,00	
	Output	exp. sales	165.211.200	523.148.938,36	216,65	
F29	Inputs	total assets	212.748.534	212.748.534	00,00	F17 F10
		employees	1.859	1.859	00,00	
		export experience	25	22,17	-11,34	
		exp. markets	38	36,75	-3,28	
	Output	exp. sales	145.569.600	464.311.749	218,96	
F1	Inputs	Total assets	298.264.599	228.094.972,77	-23,53	F20 F17
		employees	768	768	00,00	
		export experience	28	12,97	-53,67	
		exp. markets	24	24	00,00	
	Output	exp. sales	88.083.000	284.778.211,84	223,31	

Table 2. Potential Improvement Rates and Reference Sets for Inefficient Firms (continued)

Firm	Variables		Actual	Target	Improvement (%)	Reference Set
F7	Inputs	total assets	218.692.183	218.692.183	00,00	F20 F17 F10
		employees	1.332	1.332	00,00	
		export experience	27	17,47	-35,30	
		exp. markets	30	30	00,00	
	Output	exp. sales	113.838.800	372.402.987,46	227,13	
F11	Inputs	Total assets	221.104.861	221.104.861	00,00	F20 F17 F10
		employees	1.000	1.000	00,00	
		export experience	15	6,89	-54,06	
		exp. markets	8	8	00,00	
	Output	exp. sales	44.035.200	165.050.206,33	274,81	
F24	Inputs	Total assets	193.693.435	166.029.953,96	-14,28	F20 F17
		employees	606	606	00,00	
		export experience	7	7	00,00	
		exp. markets	50	11,41	-77,18	
	Output	exp. sales	41.452.200	159.509.129,64	284,80	
F4	Inputs	Total assets	445.963.907	445.963.907	00,00	F20 F17 F10
		employees	2.500	2.500	00,00	
		export experience	61	36,53	-40,12	
		exp. markets	65	65	00,00	
	Output	exp. sales	193.689.000	776.846.450,61	301,08	
F23	Inputs	Total assets	190.160.110	190.160.110	00,00	F20 F17 F10
		employees	1.075	1.075	00,00	
		export experience	25	12,29	-50,83	
		exp. markets	20	20	00,00	
	Output	exp. sales	60.832.800	266.953.430,36	338,83	
F6	Inputs	total assets	268.146.274	268.146.274	00,00	F20 F17 F10
		employees	1.077	1.077	00,00	
		export experience	35	23,05	-34,14	
		exp. markets	45	45	00,00	
	Output	exp. sales	98.350.200	487.845.951,60	396,03	
F12	Inputs	Total assets	216.811.356	216.811.3556	00,00	F20 F17 F10
		employees	785	785	00,00	
		export experience	22	22	00,00	
		exp. markets	60	44,89	-25,18	
	Output	exp. sales	90.045.000	460.162.297,57	411,04	

Table 3: Potential Improvement Rates and Reference Sets for Inefficient Firms (continued)

Firm	Variables		Actual	Target	Improvement (%)	Reference Set
F3	Inputs	total assets	587.102.105	587.102.105	00,00	F20 F17 F10
		employees	3.109	3.109	00,00	
		export experience	22	22	00,00	
		exp. markets	42	26,27	-37,46	
	Output	exp. sales	88.750.800	511.409.426,02	476,23	
F15	Inputs	Total assets	1.171.635.731	533.750.375,24	-54,44	F20 F17
		employees	2.054	2.054	00,00	
		export experience	17	17	00,00	
		exp. markets	71	23,02	-67,57	
	Output	exp. sales	69.012.000	405.129.257,46	487,04	
F8	Inputs	Total assets	267.293.393	267.293.393	00,00	F20 F17 F10
		employees	1.050	1.050	00,00	
		export experience	30	25,54	-14,88	
		exp. markets	51	51	00,00	
	Output	exp. sales	88.705.800	536.364.682,52	504,66	
F2	Inputs	Total assets	744.883.392	476.268.335,95	-36,49	F20 F17
		employees	1.775	1.775	00,00	
		export experience	56	18,17	-67,55	
		exp. markets	28	28	00,00	
	Output	exp. sales	58.489.200	420.286.444,29	618,57	
F13	Inputs	Total assets	179.712.559	179.712.559	00,00	F20 F17 F10
		employees	886	886	00,00	
		export experience	35	13,79	-60,59	
		exp. markets	25	25	00,00	
	Output	exp. sales	33.739.200	294.740.074,96	773,58	
F26	Inputs	total assets	438.289.214	438.289.214	00,00	F20 F17 F10
		employees	2.142	2.142	00,00	
		export experience	22	22	00,00	
		exp. markets	63	34,01	-46,01	
	Output	exp. sales	51.199.200	490.770.170,36	858,55	
F19	Inputs	Total assets	287.585.332	287.585.332	00,00	F20 F17 F10
		employees	1.292	1.292	00,00	
		export experience	20	16,49	-17,56	
		exp. markets	28	28	00,00	
	Output	exp. sales	28.841.400	362.091.649,52	1.155,46	

APPENDİX 2: Pairwise Comparison Matrix and Relative Importance Values for Efficient Firms

Table 4: Pairwise Comparison Matrix and Relative Importance Values for Criteria (F10)

Criteria	Competencies	Firm characteristics	Product characteristics	Importance Value
Competencies	1	0,333	2	0,210
Firm characteristics	3	1	2	0,550
Product characteristics	0,50	0,50	1	0,240

C.R.: 0.02

Table 5: Pairwise Comparison Matrix and Relative Importance Values for Criteria (F17)

Criteria	Competencies	Firm characteristics	Product characteristics	Importance Value
Competencies	1	3	3	0,594
Firm characteristics	0,333	1	2	0,249
Product characteristics	0,333	0,50	1	0,157

C.R.: 0.05

Table 6: Pairwise Comparison Matrix and Relative Importance Values for Criteria (F20)

Criteria	Competencies	Firm characteristics	Product characteristics	Importance Value
Competencies	1	1	1	0,333
Firm characteristics	1	1	1	0,333
Product characteristics	1	1	1	0,333

C.R.: 0.00

Table 7: Pairwise Comparison Matrix and Relative Importance Values for Criteria (F27)

Criteria	Competencies	Firm characteristics	Product characteristics	Importance Value
Competencies	1	3	2	0,528
Firm characteristics	0,333	1	0,333	0,140
Product characteristics	0,50	3	1	0,333

C.R.: 0.05

Table 8: Pairwise Comparison Matrix and Relative Importance Values for *Competencies/Activities* (F10)

Criteria	Market research	Pricing policy	Distribution policy	Promotion policy	Product policy	Degree of internationalization	Importance Value
Market research	1	0,25	3	3	0,25	3	0,140
Pricing policy	4	1	5	4	1	5	0,327
Distribution policy	0,33	0,20	1	0,25	0,20	2	0,052
Promotion policy	0,333	0,25	4	1	0,333	4	0,110
Product policy	4	1	5	3	1	9	0,334
Degree of internationalization	0,333	0,20	0,50	0,25	0,111	1	0,037

C.R.: 0.07

Table 9: Pairwise Comparison Matrix and Relative Importance Values for *Competencies/Activities* (F17)

Criteria	Market research	Pricing policy	Distribution policy	Promotion policy	Product policy	Degree of internationalization	Importance Value
Market research	1	0,333	3	0,25	0,333	3	0,098
Pricing policy	3	1	5	0,50	0,50	5	0,201
Distribution policy	0,333	0,20	1	0,20	0,143	1	0,043
Promotion policy	4	2	5	1	2	5	0,342
Product policy	3	2	7	0,50	1	5	0,269
Degree of internationalization	0,333	0,20	1	0,20	0,20	1	0,046

C.R.: 0.03

Table 10: Pairwise Comparison Matrix and Relative Importance Values for *Competencies/Activities* (F20)

Criteria	Market research	Pricing policy	Distribution policy	Promotion policy	Product policy	Degree of internationalization	Importance Value
Market research	1	1	3	1	0,333	1	0,144
Pricing policy	1	1	5	7	1	3	0,289
Distribution policy	0,333	0,20	1	3	0,20	1	0,082
Promotion policy	1	0,143	0,333	1	0,20	1	0,066
Product policy	3	1	5	5	1	5	0,338
Degree of internationalization	1	0,333	1	1	0,20	1	0,082

C.R.: 0.08

Table 11: Pairwise Comparison Matrix and Relative Importance Values for *Competencies/Activities* (F27)

Criteria	Market research	Pricing policy	Distribution policy	Promotion policy	Product policy	Degree of internationalization	Importance Value
Market research	1	0,333	3	0,333	0,20	3	0,090
Pricing policy	3	1	5	2	0,333	7	0,237
Distribution policy	0,333	0,20	1	0,25	0,143	2	0,048
Promotion policy	3	0,50	4	1	0,333	5	0,171
Product policy	5	3	7	3	1	5	0,415
Degree of internationalization	0,333	0,143	0,50	0,20	0,20	1	0,039

C.R.: 0.05

Table 12: Pairwise Comparison Matrix and Relative Importance Values for *Degree of Internationalization* (F10)

Criteria	Diversity	Intensity	Importance Value
Diversity	1	0,20	0,167
Intensity	5	1	0,833

C.R.: 0.00

Table 13: Pairwise Comparison Matrix and Relative Importance Values for *Degree of Internationalization* (F17)

Criteria	Diversity	Intensity	Importance Value
Diversity	1	0,333	0,250
Intensity	3	1	0,750

C.R.: 0.00

Table 14: Pairwise Comparison Matrix and Relative Importance Values for *Degree of Internationalization* (F20)

Criteria	Diversity	Intensity	Importance Value
Diversity	1	3	0,750
Intensity	0,333	1	0,250

C.R.: 0.00

Table 15: Pairwise Comparison Matrix and Relative Importance Values for *Degree of Internationalization* (F27)

Criteria	Diversity	Intensity	Importance Value
Diversity	1	3	0,750
Intensity	0,333	1	0,250

C.R.: 0.00

Table 16: Pairwise Comparison Matrix and Relative Importance Values for *Firm Characteristics* (F10)

Criteria	Firm size	Exp. Experience	Technology	Managerial policy	Ownership	Importance Value
Firm size	1	0,20	0,25	0,20	0,50	0,053
Exp. Experience	5	1	3	1	3	0,327
Technology	4	0,333	1	0,25	3	0,160
Managerial policy	5	1	4	1	4	0,374
Ownership	2	0,333	0,333	0,25	1	0,086

C.R.: 0.05

Table 17: Pairwise Comparison Matrix and Relative Importance Values for *Firm Characteristics* (F17)

Criteria	Firm size	Exp. Experience	Technology	Managerial policy	Ownership	Importance Value
Firm size	1	0,20	0,167	0,50	3	0,080
Exp. Experience	5	1	0,50	2	5	0,269
Technology	6	2	1	5	5	0,460
Managerial policy	2	0,50	0,20	1	5	0,145
Ownership	0,333	0,20	0,20	0,20	1	0,047

C.R.: 0.07

Table 18: Pairwise Comparison Matrix and Relative Importance Values for *Firm Characteristics* (F20)

Criteria	Firm size	Exp. Experience	Technology	Managerial policy	Ownership	Importance Value
Firm size	1	0,333	0,20	0,333	3	0,088
Exp. Experience	3	1	0,333	1	5	0,205
Technology	5	3	1	3	5	0,454
Managerial policy	3	1	0,333	1	5	0,205
Ownership	0,333	0,20	0,20	0,20	1	0,048

C.R.: 0.05

Table 19: Pairwise Comparison Matrix and Relative Importance Values for *Firm Characteristics* (F27)

Criteria	Firm size	Exp. Experience	Technology	Managerial policy	Ownership	Importance Value
Firm size	1	2	4	1	3	0,317
Exp. Experience	0,50	1	2	0,333	3	0,171
Technology	0,25	0,50	1	0,333	2	0,104
Managerial policy	1	3	3	1	3	0,330
Ownership	0,333	0,333	0,50	0,333	1	0,078

C.R.: 0.04

Table 20. Pairwise Comparison Matrix and Relative Importance Values for *Firm Size* (F10)

Criteria	Number of employees	Total assets	Net sales	Importance Value
Number of employees	1	1	0,25	0,167
Total assets	1	1	0,25	0,167
Net sales	4	4	1	0,667

C.R.: 0.05

Table 21. Pairwise Comparison Matrix and Relative Importance Values for *Firm Size* (F17)

Criteria	Number of employees	Total assets	Net sales	Importance Value
Number of employees	1	3	0,333	0,268
Total assets	0,333	1	0,25	0,117
Net sales	3	4	1	0,614

C.R.: 0.07

Table 22. Pairwise Comparison Matrix and Relative Importance Values for *Firm Size* (F20)

Criteria	Number of employees	Total assets	Net sales	Importance Value
Number of employees	1	0,20	0,20	0,091
Total assets	5	1	1	0,455
Net sales	5	1	1	0,455

C.R.: 0.00

Table 23. Pairwise Comparison Matrix and Relative Importance Values for *Firm Size* (F27)

Criteria	Number of employees	Total assets	Net sales	Importance Value
Number of employees	1	0,333	0,25	0,117
Total assets	3	1	0,333	0,268
Net sales	4	3	1	0,614

C.R.: 0.07

Table 24. Pairwise Comparison Matrix and Relative Importance Values for *Product Characteristics* (F10)

Criteria	Quality	Design	Branding	Price	Importance Value
Quality	1	1	2	2	0,334
Design	1	1	0,50	3	0,251
Branding	0,50	2	1	3	0,307
Price	0,50	0,333	0,333	1	0,109

C.R.: 0.09

Table 25. Pairwise Comparison Matrix and Relative Importance Values for *Product Characteristics* (F17)

Criteria	Quality	Design	Branding	Price	Importance Value
Quality	1	3	0,333	1	0,212
Design	0,333	1	0,333	1	0,121
Branding	3	3	1	5	0,529
Price	1	1	0,20	1	0,138

C.R.: 0.07

Table 26. Pairwise Comparison Matrix and Relative Importance Values for *Product Characteristics* (F20)

Criteria	Quality	Design	Branding	Price	Importance Value
Quality	1	3	5	1	0,383
Design	0,333	1	5	0,333	0,175
Branding	0,20	0,20	1	0,20	0,060
Price	1	3	5	1	0,383

C.R.: 0.06

Table 27. Pairwise Comparison Matrix and Relative Importance Values for *Product Characteristics* (F27)

Criteria	Quality	Design	Branding	Price	Importance Value
Quality	1	0,333	3	1	0,200
Design	3	1	5	5	0,567
Branding	0,333	0,20	1	1	0,100
Price	1	0,20	1	1	0,133

C.R.: 0.04