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Research Article

SELECTION OF SOCKS EXPORT MARKETS FOR TURKEY USING MULTI-CRITERIA DECISION MAKING METHODS

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ABSTRACT

Export provides foreign exchange inflow and reduces unemployment and is, therefore, an important field of economic activity promoted by every country. Turkey is the sixth-largest exporter in the socks industry, which is a strategic export product. In this context, it wants to take first place by increasing its export volume. For this, it must choose the markets which will export well. However, there are many criteria that are effective in selecting the export market place and are independent of exporting countries. It is beneficial to use multi-criteria decision-making (MCDM) methods in the solution of such problems.
The aim of this study is to select the most suitable export market to increase Turkey's socks export volume. Firstly, a survey of export market selection criteria is developed based on a literature review. The survey is completed by export specialists of socks exporting companies in Turkey to determine the most important criteria in the selection of socks export markets. Afterward, between 2014-2018 criterion data of the top 11 countries accounting for 70 percent of the world's total socks imports are derived from the Trade Map Database. 2020 values were obtained using regression analysis. TOPSIS (Technique for Order-Preference by Similarity to Ideal Solution), GRA (Grey Relational Analysis) and ANP (Analytical Network Process) methods are used to evaluate the alternative socks export markets. Sensitivity analysis is performed using TOPSIS, GRA and ANP data. The results are compared to select the best export market for the Turkish socks industry.
Keywords: Socks export, market selection, TOPSIS, GRA, ANP.

1. INTRODUCTION

Advances in communication and transportation have driven developing countries to invest heavily in the garment sector since the second half of the 20th century, which, in turn, has resulted in intense global competition (Özbek, 2018). In this intense competitive environment, clothing manufacturing countries have turned to exports to build a strong position in the market and to adapt to the competitive environment (Şarkgüneşi et al., 2017). Exports allows those countries to make the most profit out of their products, extend their service life, avoid the drawbacks of the limited demand in the domestic market, diversify the market, reduce dependence on a single market, increase productivity, gain new opportunities and reduce risks (Shahbandarzadeh and Haghighat, 2010; Shabani et al, 2013; Nunes and De Souza Lequain,

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2016; Sings and Yaras, 2016; Kalafsky, 2017). Research shows that countries will need to have access to raw materials and an infrastructure to communicate with their customers to be able to export their products in the long term in the future (Uzbek, 2009a; Ragland et al., 2015). The geographical location of Turkey makes it suitable for cotton production (TCAE), 2018). Using its abundant and high quality cotton, Turkey was a successful exporter of cotton and cotton fabrics in the 1970s and a cotton garment exporter in the 1980s (Özbek, 2009b). This trend indicates that it will continue to be an important cotton garment exporter in the future. Denim pants and socks contain high amounts of cotton, and therefore, are strategic products for Turkey. Table 1 shows the distribution of global socks exports across countries.

Table 1. Distribution of Global Socks Exports across Countries (1000$)

Exporting Countries	2014	2015	2016	2017	2018	%
China	2.923.900	2.890.102	2.540.561	2.582.461	2.953.127	56.73
Germany	263.184	229.055	229.041	250.382	269.895	5.18
Italy	271.488	197.854	187.966	213.196	224.272	4.31
El Salvador	35.631	36.368	47.969	128.573	165.699	3.18
USA	130.715	130.302	116.504	144.365	156.072	3.00
Turkey	140.285	128.412	132.676	150.144	150.969	2.90
Belgium	115.933	103.273	114.231	126.076	126.898	2.44
Netherlands	52.870	52.635	65.581	106.543	110.536	2.12
Pakistan	113.914	103.203	124.260	74.787	76.214	1.46
France	44.222	37.376	45.422	52.862	62.503	1.20
Vietnam	21.582	26.114	28.501	29.763	60.590	1.16
Slovakia	49.631	36.457	36.253	42.153	52.365	1.01
Poland	49.099	39.965	44.491	46.415	46.696	0.90
Thailand	47.873	46.194	41.177	40.060	40.858	0.78
United Kingdom	35.905	36.375	33.703	39.045	37.269	0.72
Top 15 Countries Total	4.296.232	4.093.685	3.788.336	4.026.825	4.533.963	
Top 15 Countries (%)	86,23%	87,09%	86,48%	86,42%	87,10%	
Global	4.982.508	4.700.455	4.380.623	4.659.545	5.205.344	

Source: www.trademap.org database

In 2018, global socks exports were over $ 5 billion, and the top 15 exporters accounted for about 87 percent of total exports. Of those countries, China accounted for 56.73 percent of total exports, holding more than half of the market, followed by Germany, Italy and El Salvador. Turkey is the world's sixth exporter of socks.

The aim of this study is to select the best export market for the Turkish socks sector. We believe that this will help Turkey move to the top of the list. For this, criteria and alternative markets are determined, and TOPSIS, GRA and ANP methods are used. Sensitivity analysis is performed on TOPSIS, GRA and ANP data to select the best market. The second section of the study reviewed previous studies on the selection of export markets. The third section explained the materials and methods used. The fourth section addressed the results of the analysis. The final section drew conclusions and made evaluations.

2. EXPORT MARKET SELECTION

The significant increase in consumer demand, recent emergence of multinational companies, exponential growth of internet use and the fact that companies see exports as a means of acquiring information about foreign markets have resulted in an increased interest in exports (Shabani and

Saen, 2016; Cheng and Huang, 2019). Entering a new export market has become a critical strategy for companies and countries to stay in competition and to grow their production volumes (Azar, 2014). Selecting the right market is, therefore, of paramount significance because it allows companies to make short-, medium- and long-term plans and use time, money and other resources effectively (Shabani and Saen, 2016). Export market selection also plays a key role in the success of companies because it affects target market development, effectiveness of marketing strategies, coordination of external operations and positioning strategies (Farzipoor Saen, 2011). Export market selection involves uncertainty and complexity due to such factors as marketing mix (product, price, distribution and promotion), environmental variables, market share, potential profitability and strategic importance of the market. It is, therefore, a time consuming problem that requires multi-criteria decision-making approaches (Farzipoor Saen, 2011; Shipley et al., 2013; Yavuz, 2016; Cano et al, 2017; Silva et al, 2018). Decision makers need to have sufficient knowledge of potential export markets to select the best one. However, information on markets is generally little and/or of poor quality. Methods based on classical logic or statistics fail to cope effectively with limited information. Therefore, MCDM methods taking expert decisions into consideration are used in multi-criteria decision-making cases (Shipley et al., 2013). Some studies on the problem of export market selection are described below.

Wang and Le (2018) used Data Envelopment Method (DEA) to determine the ideal export market for Vietnam. Their export market selection criteria were export, total export, import tariff rates, exchange rates and ease of operation. They reported that low tariff rates, low exchange rates and high ease of operation were the most important criteria for countries and that Vietnam's ideal export markets for the 2014-2017 period were Malaysia, Singapore and the USA.

Cano et al. (2017) used the market, logistics, foreign trade, socio-cultural and financial-economic criteria and concluded that the USA was the best market for Colombian frozen beef exports.

Yılmaz et al. (2017) focused on domestic target market selection for the Turkish furniture sector. They used the Analytical Hierarchy Process (AHP) method to determine the weights of sales, import-export volume, number of marriages, population growth rate and income and then used VIKOR (Vise Kriterijumska Optimizacija I Kompromisno Resenje) method to assess Ankara, Bursa, Istanbul, Eskisehir, Izmir and Kayseri to select target markets based on the weights. They concluded that the most ideal target market was Istanbul, followed by Ankara, Izmir, Bursa, Kayseri and Eskisehir.

Tosun (2017) conducted a study on the decision makers of eight Turkish companies exporting fresh fruit and vegetables and used the fuzzy VIKOR method for export market selection. The market selection criteria were market competition, purchasing volume of the country, growth potential of the country's consumption, logistic opportunities and profit potential. They found that the United Arab Emirates was a better market than others.

Schu and Morschett (2017) investigated the foreign market selection behavior of 140 online retailers in Europe and concluded that market size, the rule of law, information on local markets, the use of common language and logistical opportunities increased the likelihood of a country being selected as a target market.

Yavuz (2016) used PROMETHEE (Preference Ranking Organization Method for Enrichment Evaluations) and Entropy methods to select a target market for Hatay furniture sector. The selection criteria were population size, number of marriages, population growth, population density, home sales rate, distance between, the number of furniture manufacturers and employees and income per capita.

Koohi and Alikhani (2014) developed a questionnaire to determine factors affecting the selection of a target petrochemical export market. The factors were policies, culture, regulations, economy, infrastructure, market potential and buyers' potentials and positions.

Zhao et al. (2011) used the AHP method to determine factors affecting China's textile and apparel exports. The factors were market purchasing power, capacity of the market, the degree of

market monopoly, political stability and market requirements for product quality level. They concluded that China's target markets for textile and apparel exports were EU, USA, Japan and Hong Kong.

3. MATERIAL AND METHOD

The aim of this study is to select the best export market for Turkish socks companies. We believe that this study will help those companies obtain maximum benefit-minimum cost advantages, have higher export shares and climb up the list of the top socks exporters. The steps in the flow chart in Figure 1 were followed for export market selection.

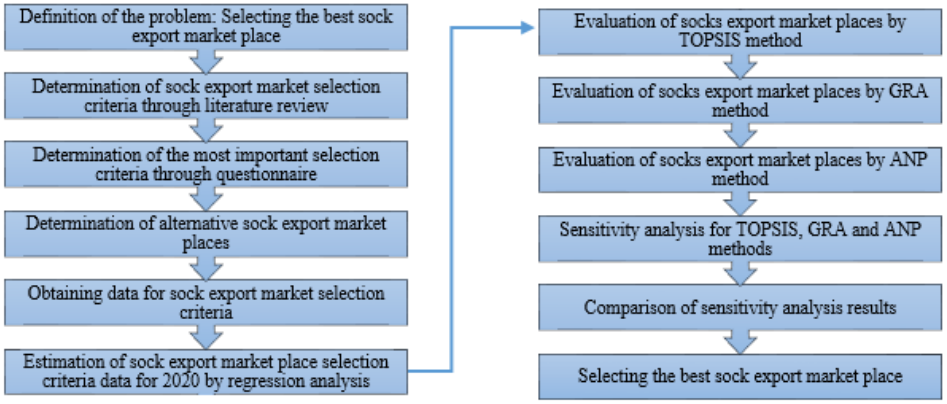

Figure 1. Flowchart for solution of socks export market selection problem

Determining socks export market selection criteria: First, a survey containing several criteria was developed based on literature review to determine the criteria with the greatest effect on the selection of export markets. The study population consisted of export specialists of 196 socks exporters, which are members of Istanbul Apparel Exporters' Association (IAEA). Export specialists were contacted by phone and informed about the study. 50 of them agreed to participate and were asked to complete the electronic questionnaire. Table 2 shows the job positions of the participants.

Table 2. Participants' Job Positions

Position	Frequency	
	N	%
General Manager	20	40.00
Assistant General Manager	2	4.00
Export Director	4	8.00
Marketing Director	10	20.00
Production Manager	4	8.00
Chairman of the Board	4	8.00
Board Member	6	12.00
Total	50	100.00

All participants were senior executives and had sufficient information on socks exports and an average of 14.08 years of work experience.

Table 3 shows the export market selection criteria with a frequency greater than 50% determined by participants. The frequency values of the criteria were normalized and converted to importance weights (Table 3).

Table 3. Socks export market selection criteria and their importance weights

Criteria	N	(%)	Importance Weights
Tax Rate	48	96	0.154
Import Expense	45	90	0.145
Population	44	88	0.141
Income Per Capita	40	80	0.129
Exchange Rate	42	84	0.135
Distance	33	66	0.106
Export Revenue	32	64	0.103
Inflation Rate	27	54	0.087

According to Table 3, the two most important criteria for participants were the "tax rate" (96%) and "import expense" (90%).

Determining alternative socks export markets and criterion data: The world's top 15 socks importing countries were determined using the Trade Map Database (Table 4).

Table 4. Distribution of global socks imports by country (1000$)

Importing Countries	2014	2015	2016	2017	2018	%
USA	1.158.977	1.313.315	1.228.039	1.360.557	1.543.161	32.81
Japan	565.735	539.229	506.260	497.000	531.577	11.30
Germany	268.637	241.755	92.444	250.471	250.424	5.32
France	175.014	148.600	166.033	155.839	177.333	3.77
United Kingdom	182.638	179.329	164.268	148.894	175.812	3.74
Canada	135.998	143.792	146.755	157.683	166.523	3.54
Netherlands	86.920	84.635	110.298	117.842	128.364	2.73
Vietnam	2.569	2.408	2.285	3.623	91.901	1.95
Spain	75.438	75.121	70.022	18.824	89.064	1.89
Italy	96.557	37.141	82.852	72.243	87.609	1.86
Belgium	88.868	33.972	84.691	35.782	80.592	1.71
Russia	95.053	62.782	34.417	51.911	78.842	1.68
Australia	48.414	47.720	47.947	54.869	56.777	1.21
Mexican	60.899	54.645	37.531	38.628	47.876	1.02
Poland	31.646	31.337	33.625	41.709	46.125	0.98
Top 15 Countries	3.073.363	2.995.781	2.807.467	3.005.875	3.551.980	
Top 15 Countries (%)	78.51%	76.98%	74.23%	72.25%	75.53%	
Global Total	3.914.642	3.891.387	3.781.967	4.160.460	4.702.833	

Source: www.trademap.org

In 2018, global socks imports were over $ 4.7 billion, and the top 15 exporters accounted for about 75 percent of total imports. Of those countries, the USA accounted for 32.81 percent of total imports, followed by Japan, Germany and France. Vietnam was not taken into account as an important importing country, because what placed it in the eighth position was the excessive

increase in its imports only in 2018 in the last five years. Moreover, this study took into account the export markets, which account for about 70 percent of the world's import of socks (Table 5).

Table 5. Selection criteria data for socks export markets

Markets	Year	Import Expense ($)	Export Revenue ($)	Population (x1000)	Income Per Capita ($)	Inflation Rate (%)	Tax Rate (%)	Exchange Rate	Distance (Hour)
USA	2014	1.158.977	130.715	318.853	54.952	1.61	14.70	2.19	480
	2015	1.313.315	130.302	321.224	56.718	0.12	14.70	2.72	
	2016	1.228.039	116.504	323.572	57.814	1.27	14.70	3.02	
	2017	1.360.557	144.365	325.886	59.792	2.14	14.00	3.65	
	2018	1.543.161	156.072	328.116	62.517	2.40	14.70	4.82	
Japan	2014	565.735	6.279	127.120	38.156	2.76	6.43	2.07	840
	2015	539.229	6.873	126.978	34.612	0.79	6.43	2.25	
	2016	506.260	8.039	126.960	38.989	-0.11	6.43	2.78	
	2017	497.000	7.597	126.746	38.448	0.47	6.43	3.25	
	2018	531.577	7.153	126.431	40.105	1.20	6.43	4.35	
Germany	2014	268.637	263.184	80.983	48.218	0.77	0.00	2.91	20
	2015	241.755	229.055	81.687	41.415	0.14	0.00	3.02	
	2016	92.444	229.041	82.349	42.460	0.39	0.00	3.34	
	2017	250.471	250.382	82.660	44.769	1.70	0.00	4.12	
	2018	250.424	269.895	82.786	48.669	1.81	0.00	5.67	
France	2014	175.014	44.222	64.028	44.616	0.61	0.00	2.91	28
	2015	148.600	37.376	64.301	37.937	0.09	0.00	3.02	
	2016	166.033	45.422	64.558	38.200	0.31	0.00	3.34	
	2017	155.839	52.862	64.801	39.932	1.17	0.00	4.12	
	2018	177.333	62.503	65.098	42.930	1.86	0.00	5.67	
United Kingdom	2014	182.638	35.905	64.597	47.003	1.46	0.00	2.91	32
	2015	179.329	36.375	65.110	44.494	004	0.00	3.02	
	2016	164.268	33.703	65.648	40.657	0.66	0.00	3.34	
	2017	148.894	39.045	66.040	39.800	2.68	0.00	4.12	
	2018	175.812	37.269	66.466	42.260	2.51	0.00	5.67	
Canada	2014	135.998	10.373	35.487	50.702	1.92	16,67	1.98	480
	2015	143.792	11.173	35.804	43.559	1.12	16,67	2.13	
	2016	146.755	6.139	36.205	42.418	1.42	16,67	2.28	
	2017	157.683	8.435	36.657	45.094	1.61	16,67	2.81	
	2018	166.523	7.488	37.098	46.733	2.57	16,67	3.71	
Netherlands	2014	86.920	52.870	16.865	52.914	0.32	0.00	2.91	28
	2015	84.635	52.635	16.937	45.205	0.22	0.00	3.02	
	2016	110.298	65.581	17.030	46.027	0.11	0.00	3.34	
	2017	117.842	106.543	17.140	48.555	1.30	0.00	4.12	
	2018	128.364	110.536	17.190	52.931	1.45	0.00	5.67	
Spain	2014	75.438	29.433	46.455	29.686	-0.15	0.00	2.91	37
	2015	75.121	29.224	46.410	25.821	-0.50	0.00	3.02	
	2016	70.022	32.254	46.399	26.676	-0.20	0.00	3.34	
	2017	18.824	36.102	46.333	28.358	1.96	0.00	4.12	
	2018	89.064	33.673	46.268	31.059	1.81	0.00	5.67	

	2014	96.557	271.488	60.783	35.456	0.23	0.00	2.91	
	2015	37.141	197.854	60.796	30.163	0.11	0.00	3.02	
Italy	2016	82.852	187.966	60.666	30.662	-0.05	0.00	3.34	25
	2017	72.243	213.196	60.589	31.996	1.33	0.00	4.12	
	2018	87.609	224.272	60.756	34.349	1.35	0.00	5.67	
	2014	88.868	115.933	11.181	47.546	0.49	0.00	2.91	
	2015	33.972	103.273	11.237	40.514	0.62	0.00	3.02	
Belgium	2016	84.691	114.231	11.311	41.352	1.77	0.00	3.34	28
	2017	35.782	126.076	11.352	43.488	2.22	0.00	4.12	
	2018	80.592	126.898	11.411	46.978	2.19	0.00	5.67	
	2014	95.053	2.391	143.761	14.354	7.82	12.06	0.06	
	2015	62.782	2.091	143.888	9.510	1.55	11.14	0.04	
Russia	2016	34.417	2.066	143.965	8.923	7.05	10.20	0.05	48
	2017	51.911	3.986	143.990	10.955	3.67	10.20	0.06	
	2018	78.842	4.101	143.965	10.950	2.83	10.20	0.08	

According to Table 5, import expense, export revenue and tax rate values were derived from the International Trade Center. Exchange rate values were derived from the Central Bank of the Republic of Turkey.

2020 data should be calculated to select export markets, because it seems to be the earliest for Turkish socks exporters to enter new markets. Therefore, regression analysis was performed on 2014-2018 data (Table 5). 2020 values were estimated for each criterion (Table 6). Japan had an inflation rate of –0.1 percent in 2016, which was, therefore, not included in 2020 inflation forecast.

Table 6. values estimated for 2020

Markets	Import Expense	Export Revenue	Population	Income Per Capita	Inflation Rate	Tax Rate	Exchange Rate	Distance
USA	1647053.8	161502.4	332805.4	65640.2	2.948	14.28	5.76	480
Japan	483742.2	8177	126203	41155.6	1.046	6.43	5.16	840
Germany	209662.2	262211	83924.6	46808.6	2.418	0	6.46	20
France	169314.6	69296.2	65613.2	40172.2	2.24	0	6.46	28
United Kingdom	152553.4	38618.6	67439.4	37170.8	3.366	0	6.46	32
Canada	180126.6	5318.4	37880.2	43140	2.444	16.67	4.24	480
Netherlands	152049.8	145329	17373.6	50480	2.016	0	6.46	28
Spain	54075.8	38280.4	46192.6	30433.2	3.136	0	6.46	37
Italy	82162.8	187319.2	60613.6	32372.8	1.978	0	6.46	25
Belgium	58884.2	135175.4	11528.4	44710.8	3.458	0	6.46	28
Russia	47283.8	5053	144117.8	8793.2	1.44	8.89	0.082	48

Determining methods to select export markets: Markets can be selected using numerous methods, some of which are MCDM methods that take both qualitative and quantitative criteria into consideration. The MCDM methods used in this study and their advantages are briefly described below.

3.1. TOPSIS Method

TOPSIS developed by Hwang and Yoon (1981) is one of the most widely used MCDM methods (Chen, 2019; de Farias Aires and Ferreira, 2019; Shukla et al., 2017; Zyoud and Fuchs-Hanusch, 2017). TOPSIS determines the optimum alternative by calculating the distance between the positive ideal solution (PIS) and negative ideal solution (NIS) of each alternative and by ranking the alternatives for decision making problems (Baranitharan et al., 2019; Chen, 2019; de Farias Aires and Ferreira, 2019; Shukla et al. , 2017; Akgün and Erdal, 2019; Mateusz, 2018; Yayla et al., 2012). In TOPSIS, the best alternative is the closest to PIS and the farthest from NIS. PIS is a hypothetical alternative that maximizes benefit criteria and minimizes cost criteria whereas NIS minimizes benefit criteria and maximizes cost criteria (de Farias Aires and Ferreira, 2019; Shukla et al., 2017; Zyoud and Fuchs-Hanusch, 2017). Due to its comprehensibility, computational efficiency and ability to integrate other methods, TOPSIS is an effective method used in risk management, e-commerce, supplier selection, renewable energy, water resources management, climate change and sustainability assessment, risk management, logistics, energy management, design, engineering, production systems, health and safety management (Chen, 2019; Akgün and Erdal, 2019; Zyoud and Fuchs-Hanusch, 2017), location selection for solar farms, and selection of process parameters in computer networks and manufacturing industries (Baranitharan et al., 2019). The steps of TOPSIS are as follows:

Step 1: Construct the decision matrix (*A*): Alternatives and criteria are listed on the rows and columns, respectively.

$$A=\begin{bmatrix} a_{11} & a_{12} & \dots & a_{1n} \\ a_{21} & a_{22} & \dots & a_{2n} \\ . & . & . & . \\ . & . & . & . \\ . & . & . & . \\ a_{m1} & a_{m2} & \dots & a_{mn} \end{bmatrix}$$

where a_{ij} is the real value of the alternative *i* according to the criteria *j*.

Step 2: Construct the normalized decision matrix using Equation (1).

$$r_{ij}=\sqrt{\sum_{i=1}^{m} a_{ij}^{\,2}} \qquad i=1, 2, ..., m \text{ and } j=1, 2, ..., n. \tag{1}$$

Step 3: Calculate the weighted normalized decision matrix. The weighted normalized value v_{ij} is calculated as follows:

$$v_{ij}=r_{ij}.w_j \tag{2}$$

where w_j is the weight of the j^{th} criterion or attribute and $\sum_{j=1}^{n} w_j=1$.

Step 4: Determine the positive ideal A^* and negative ideal A^- solutions.

$$A^*=\left\{(\max_i v_{ij} \,\middle|\, j\in B),(\min_i v_{ij} \,\middle|\, j\in C\right\} \tag{3}$$

$$A^{-} = \left\{ (\min_{i} v_{ij} \,|\, j \in B), (\max_{i} v_{ij} \,|\, j \in C \right\} \tag{4}$$

Where B and C are the benefit and cost criteria, respectively.

Step 5: Calculate the separation measures using the m-dimensional Euclidean distance. The separation measures of each alternative from the positive ideal solution (S_i^*) and the negative ideal solution (S_i^-), respectively, are as follows:

$$S_i^* = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^*)^2} \tag{5}$$

$$S_i^- = \sqrt{\sum_{j=1}^{n} (v_{ij} - v_j^-)^2} \tag{6}$$

Step 6: Calculate the relative closeness to the ideal solution.

$$C_i^* = \frac{S_i^-}{S_i^- + S_i^*} \qquad 0 \le C_i^* \le 1 \tag{7}$$

Step 7: Sort alternatives by the relative proximity (C_i^*) to the ideal solution.

3.2. Grey Relational Analysis Method

The grey system theory was developed by Julong Deng in 1982 (Li et al., 2019; Yaser and Shunmugesh, 2019; Baranitharan et al., 2019). It can model and solve problems that stochastic or fuzzy decision making methods cannot, and therefore, is widely used for cross-system analysis, modeling, and forecasting and decision-making problems. Not all factors of real life problems can be characterized as full positive or full negative. Similarly, not all factors can be characterized as completely specific or completely uncertain (Kursun et al., 2016). A system with no uncertainty is defined as white, a system whose all factors are completely uncertain is defined as black and partially definite and partially indeterminate systems are defined as grey (Li et al., 2019; Yaser and Shunmugesh, 2019; Baranitharan et al., 2019). The grey relational analysis (GRA), which is a sub-part of grey system, is a decision-making method (Uzun, 2019). GRA is used in problems with multivariate statistical and inadequate data that do not fit into any distribution and cannot be modeled due to uncertainty (Uzun, 2019; Yaser and Shunmugesh, 2019, Anand et al., 2019). Due to its simplicity and evaluation capacity, GRA is used in various engineering applications (Baranitharan et al., 2019). GRA is a multi-response optimization method used to transform single-objective problems into single-response optimization problems (Baranitharan et al., 2019; Yazdani et al., 2019; Anand et al., 2019). It can even compute the basic relationship by using small and weak information. It examines the geometric proximity of different curves to evaluate the relationship between them (Li et al., 2019). GRA first converts the performance of all alternatives into a comparable sequence and then defines a reference sequence (ideal target sequence). It then calculates the grey relational coefficient between all comparability sequences and the reference sequence. Lastly, it calculates the grey relational grade between the reference sequence and every comparability sequences based on grey relational coefficients (Kuo et al., 2008). The steps are summarized as follows (Uzun, 2019):

Step 1: Prepare the dataset and construct the decision matrix
Step 2: Construct the reference sequence and comparison matrix

$$x_0 = \left(x_0(j),...,x_0(n)\right) \quad j = 1,2,...,n \tag{8}$$

Step 3: Normalize the data and construct the normalized matrix

If larger sequence values contribute positively, then normalization for "the larger the better" attributes is as follows:

$$x_i(k) = \frac{x_i^0(k) - \min x_i^0(k)}{\max x_i^0(k) - \min x_i^0(k)} \tag{9}$$

where $x_i^0(k)$ is the original value in the row k. in the sequence i. $x_i(k)$ is the value in the row k. in the sequence i after normalization, $\min x_i^0(k)$ is the minimum value in the sequence i and $\max x_i^0(k)$ is the maximum value in the sequence i.

If larger sequence values contribute positively, then normalization for "the larger the better" attributes is as follows:

$$x_i(k) = \frac{\max x_i^0(k) - x_i^0(k)}{\max x_i^0(k) - \min x_i^0(k)} \tag{10}$$

Normalization for "the nominal the better" is as follows:

$$x_i(k) = 1 - \frac{\left|x_i^0(k) - x^0\right|}{\max x_i^0(k) - x^0} \tag{11}$$

where x^0 is the nominal value.

Step 4: Create the absolute value table and grey relational coefficient matrix

Let k be the row k. on a n-length sequence and $\varepsilon\left(x_0(k), x_i(k)\right)$ be the grey relational coefficient at the point k. calculated using Equations (12), (13), (14) and (15).

$$\varepsilon\left(x_0(k), x_i(k)\right) = \frac{\Delta_{\min} + \xi\Delta_{\max}}{\Delta_{0i}(k) + \xi\Delta_{\max}} \tag{12}$$

$$\Delta_{0i}(k) = \left|x_0(k) - x_j(k)\right| \tag{13}$$

$$\Delta_{\min} = \min_j \min_k \left|x_0(k) - x_j(k)\right| \tag{14}$$

$$\Delta_{\max} = \max_j \max_k \left|x_0(k) - x_j(k)\right| \tag{15}$$

where $\xi \in (0,1)$ is a coefficient between 0 and 1. The function ξ sets the difference between Δ_{0i} and $\Delta_{\max}$.

Step 5: The grey relational degree is calculated using Equation (16).

$$\gamma(x_0, x_i) = \frac{1}{n}\sum_{k=1}^{n} \varepsilon(x_0(k), x_i(k)) \tag{16}$$

$\gamma(x_0, x_i)$ is a measure of the geometric similarity between the sequence x_i and the reference sequence x_0 in a grey system. If the weights of criteria are given in advance, grey correlation coefficients are calculated by the multiplying grey relationship coefficients and weights of the criteria.

$$\gamma(x_0, x_i) = \frac{1}{n}\sum_{k=1}^{n} \varepsilon(x_0(k), x_i(k).(W_i(k))) \tag{17}$$

3.3. ANP Method

AHP and ANP are the most commonly used MCDM methods (Nedjati and Izbirak, 2013). Saaty (1980) developed AHP method to solve complex decision-making problems, especially multi-criteria decision-making problems. AHP is used in many areas due to its ability to form hierarchical structures of decision-making problems easily and its computational efficiency. It has, however, some disadvantages such as not taking into account dependencies between criteria (Rad et al., 2018; Chou, 2018; Liang et al., 2013) because most decision-making problems cannot be hierarchically structured. It sometimes involves the interaction of various factors with high-level factors, depending on low-level factors. Structuring a problem with functional dependencies allows for feedback between clusters and is regarded as a network system (Liang et al., 2013). Saaty, therefore, developed ANP, which is a revised decision-making tool used to overcome the disadvantage of the traditional AHP (1996). The main difference between AHP and ANP is that the latter takes into account the dependence and feedback among criteria, and thus, approaches the problem area from a more holistic perspective (Mahmoudkelaye et al., 2018; Rad et al., 2018; Nedjati and Izbirak, 2013; Chou, 2018; Liang et al., 2013; Kilic et al., 2015). AHP represents a framework with a one-way hierarchy relationship while ANP establishes complex relationships among decision levels and qualifications (Liang et al., 2013). The hierarchical structure of AHP, which falls within one-objective criteria, sub-criteria and alternatives, becomes a network in ANP. All clustered elements of the network can be associated with feedback and dependency relationships among all clustered elements of the network (Mahmoudkelaye et al., 2018). In general, ANP involves four main steps: (1) Model construction, (2) making pairwise comparisons and constructing a priority vector, (3) supermatrix formation and transformation, and (4) making the final ranking/determining priorities (Yıldız, 2014; Mahmoudkelaye et al., 2018; Kilic et al., 2015; Yildiz and Ergul, 2015; Chou, 2018).

ANP is used to evaluate R&D projects, the performance of spa hotels, green suppliers and green supplier development programs, to select maintenance performance indicators, machine tools, product development and logistics service providers, to determine basic technologies, to measure sectoral competition level and performance and to perform SWOT analysis for the airline industry (Mahmoudkelaye et al., 2018; Kilic et al., 2015; Chou, 2018).

4. RESULTS

4.1. TOPSIS Results

In this section, it is aimed to select the best market place by using the above steps of TOPSIS method. Firstly, the estimated criterion data of the alternative export markets in Table 6 for the

year 2020 are used as the decision matrix. Then, the data in the decision matrix were normalized using the Equation (1) (Table 7).

Table 7. Normalized Matrix

Markets	Import Expense	Export Revenue	Population	Income Per Capita	Inflation Rate	Tax Rate	Exchange Rate	Distance
USA	0.93	0.38	0.80	0.47	0.35	0.58	0.30	0.44
Japan	0.27	0.02	0.31	0.29	0.13	0.26	0.27	0.78
Germany	0.12	0.62	0.20	0.33	0.29	0.00	0.34	0.02
France	0.10	0.16	0.16	0.29	0.27	0.00	0.34	0.03
United Kingdom	0.09	0.09	0.16	0.27	0.40	0.00	0.34	0.03
Canada	0.10	0.01	0.09	0.31	0.29	0.68	0.22	0.44
Netherlands	0.09	0.35	0.04	0.36	0.24	0.00	0.34	0.03
Spain	0.03	0.09	0.11	0.22	0.38	0.00	0.34	0.03
Italy	0.05	0.44	0.15	0.23	0.24	0.00	0.34	0.02
Belgium	0.03	0.32	0.03	0.32	0.41	0.00	0.34	0.03
Russia	0.03	0.01	0.35	0.06	0.17	0.36	0.00	0.04

The values in the matrix normalized using Equation (2) were multiplied by the criterion weights (Table 3) obtained using the survey results in order to obtain a weighted normalized matrix given in Table 8.

Table 8. Weighted Normalized Matrix

Markets	Import Expense	Export Revenue	Population	Income Per Capita	Inflation Rate	Tax Rate	Exchange Rate	Distance
USA	0.135	0.039	0.114	0.060	0.031	0.090	0.040	0.047
Japan	0.040	0.002	0.043	0.038	0.011	0.040	0.036	0.082
Germany	0.017	0.064	0.029	0.043	0.025	0.000	0.045	0.002
France	0.014	0.017	0.022	0.037	0.023	0.000	0.045	0.003
United Kingdom	0.013	0.009	0.023	0.034	0.035	0.000	0.045	0.003
Canada	0.015	0.001	0.013	0.040	0.025	0.105	0.030	0.047
Netherlands	0.012	0.036	0.006	0.046	0.021	0.000	0.045	0.003
Spain	0.004	0.009	0.016	0.028	0.033	0.000	0.045	0.004
Italy	0.007	0.046	0.021	0.030	0.021	0.000	0.045	0.002
Belgium	0.005	0.033	0.004	0.041	0.036	0.000	0.045	0.003
Russia	0.004	0.001	0.049	0.008	0.015	0.056	0.001	0.005

Import expense, population, income per capita and exchange rate were the benefit criteria while export revenue, inflation rate, tax rate and distance were the cost criteria. The Equation (3) was used to obtain PIS (A^*). The Equation (4) was used to obtain NIS (A^-).

$$A^* = \{0.135, 0.001, 0.114, 0.060, 0.011, 0.000, 0.045, 0.002\}$$
$$A^- = \{0.004, 0.064, 0.004, 0.008, 0.036, 0.105, 0.001, 0.082\}$$

In the next step, the separation measures of each alternative from the positive ideal solution (S_i^*) and the negative ideal solution (S_i^-) were calculated using Equations (5) and (6). The relative closeness of the alternatives to the ideal solution was calculated using Equation (7). The alternatives were ranked according to the closeness values shown in Table 9.

Table 9. S_i^*, S_i^-, C_i^* Values and Ranking

Markets	S_i^*	S_i^-	C_i^*	**Ranking**
USA	0.109	0.189	0.633	1
Japan	0.151	0.117	0.436	9
Germany	0.160	0.147	0.479	4
France	0.155	0.152	0.495	2
United	0.157	0.153	0.494	3
Canada	0.196	0.086	0.304	11
Netherlands	0.168	0.148	0.469	6
Spain	0.168	0.151	0.473	5
Italy	0.168	0.144	0.462	7
Belgium	0.176	0.146	0.453	8
Russia	0.171	0.122	0.416	10

Of the export market alternatives, the USA, France and the United Kingdom ranked 1st (0.633), 2nd (0.495) and 3rd (0.494), respectively while Canada ranked last (0.304).

4.2. GRA Results

In GRA, Table 6 was the decision matrix, and the data were normalized using Equations (9) and (10). The import expense, population, income per capita and exchange rate were the benefit criteria and normalized for "the larger the better" attribute while the export revenue, inflation rate, tax rate and distance were the cost criteria and normalized for "the smaller the better" attribute. Table 10 shows the normalized matrix.

Table 10. Normalized Matrix

	Import Expense	Export Revenue	Population	Income Per Capita	Inflation Rate	Tax Rate	Exchange Rate	Distance
Reference	1.000	1.000	1.000	1.000	1.000	1.000	1.000	1.000
Markets	Max	Min	Max	Max	Min	Min	Max	Min
USA	1.000	0.392	1.000	1.000	0.211	0.143	0.890	0.439
Japan	0.273	0.988	0.357	0.569	1.000	0.614	0.796	0.000
Germany	0.102	0.000	0.225	0.669	0.431	1.000	1.000	1.000
France	0.076	0.750	0.168	0.552	0.505	1.000	1.000	0.990
United Kingdom	0.066	0.869	0.174	0.499	0.038	1.000	1.000	0.985
Canada	0.083	0.999	0.082	0.604	0.420	0.000	0.652	0.439
Netherlands	0.065	0.455	0.018	0.733	0.598	1.000	1.000	0.990
Spain	0.004	0.871	0.108	0.381	0.133	1.000	1.000	0.979
Italy	0.022	0.291	0.153	0.415	0.614	1.000	1.000	0.994
Belgium	0.007	0.494	0.000	0.632	0.000	1.000	1.000	0.990
Russia	0.000	1.000	0.413	0.000	0.837	0.467	0.000	0.966

In the next step, absolute values were calculated using Equation (13). The grey relational coefficient matrix (Table 11) was obtained using Equations (14), (15) and (12).

Table 11. Grey Relational Coefficient Matrix

Markets	Import Expense	Export Revenue	Population	Income Per Capita	Inflation Rate	Tax Rate	Exchange Rate	Distance
USA	1.000	0.451	1.000	1.000	0.388	0.369	0.820	0.471
Japan	0.407	0.976	0.437	0.537	1.000	0.565	0.710	0.333
Germany	0.358	0.333	0.392	0.601	0.468	1.000	1.000	1.000
France	0.351	0.667	0.375	0.527	0.502	1.000	1.000	0.981
United Kingdom	0.349	0.793	0.377	0.500	0.342	1.000	1.000	0.972
Canada	0.353	0.998	0.353	0.558	0.463	0.333	0.590	0.471
Netherlands	0.349	0.478	0.337	0.652	0.554	1.000	1.000	0.981
Spain	0.334	0.795	0.359	0.447	0.366	1.000	1.000	0.960
Italy	0.338	0.414	0.371	0.461	0.564	1.000	1.000	0.988
Belgium	0.335	0.497	0.333	0.576	0.333	1.000	1.000	0.981
Russia	0.333	1.000	0.460	0.333	0.754	0.484	0.333	0.936
Weights	1.000	0.451	1.000	1.000	0.388	0.369	0.820	0.471

Lastly, Equation (17) was used to multiply the criterion weights (Table 4) by the grey relational coefficients using Equation (17) to calculate the weighted grey relational degrees (Table 12). The alternative export markets were ranked according to the total grey relational degrees.

Table 12. Weighted Grey Relational Degrees and Ranking

Markets	Import Expense	Export Revenue	Population	Income Per Capita	Inflation Rate	Tax Rate	Exchange Rate	Distance	Total grey relational degree	Ranking
USA	0.145	0.046	0.141	0.129	0.034	0.057	0.111	0.050	0.0891	1
Japan	0.059	0.100	0.062	0.069	0.087	0.087	0.096	0.035	0.0745	9
Germany	0.052	0.034	0.055	0.077	0.041	0.154	0.135	0.106	0.0819	6
France	0.051	0.069	0.053	0.068	0.044	0.154	0.135	0.104	0.0847	2
United Kingdom	0.050	0.082	0.053	0.064	0.030	0.154	0.135	0.103	0.0840	4
Canada	0.051	0.103	0.050	0.072	0.040	0.051	0.080	0.050	0.0621	11
Netherlands	0.050	0.049	0.048	0.084	0.048	0.154	0.135	0.104	0.0841	3
Spain	0.048	0.082	0.051	0.057	0.032	0.154	0.135	0.102	0.0827	5
Italy	0.049	0.043	0.053	0.059	0.049	0.154	0.135	0.105	0.0808	7
Belgium	0.048	0.051	0.047	0.074	0.029	0.154	0.135	0.104	0.0804	8
Russia	0.048	0.103	0.065	0.043	0.065	0.075	0.045	0.099	0.0679	10

Of the export market alternatives, the USA, France and the Netherlands ranked 1st (0.0891), 2nd (0.0847) and 3rd (0.0841), respectively whereas Canada ranked last (0.0621).

4.3. ANP Results

First, Super Decisions was used to generate a network structure in given Figure 2 based on the export market selection criteria and alternative markets.

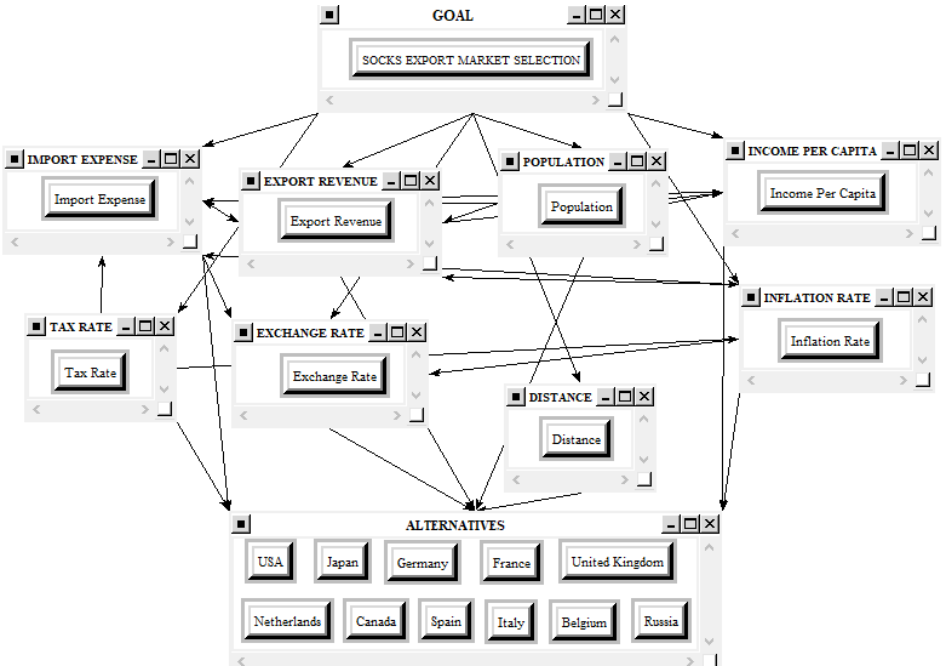

Figure 2. Export Market Selection Problem Network Structure

Then, the relationships among the criteria were considered, and the criteria affecting each other (Table 13) were determined by two export experts (Textile engineer and industrial engineer).

Table 13. Criteria Interactions

Criteria	*Criteria that affect*
Population	import expense, export revenue, income per capita
Export revenue	import expense, income per capita, inflation rate
Import expense	export revenue, income per capita, inflation rate, exchange rate
Inflation rate	import expense, export revenue, exchange rate
Tax rate	import expense, inflation rate
Distance	import expense, export revenue

The criterion weights in Table 3 and the criterion values of the alternatives were entered in the Super decision program and the ranking in Table 14 was obtained from the result screen of the program.

Table 14. Ranking of Alternatives

Graphic	Alternatives	Total	Normal	Ideal	Ranking
	Belgium	0.0464	0.1040	0.8456	4
	Canada	0.0377	0.0845	0.6874	10
	France	0.0441	0.0989	0.8041	5
	Germany	0.0475	0.1065	0.8666	3
	Italy	0.0400	0.0896	0.7290	7
	Japan	0.0398	0.0893	0.7261	8
	Netherlands	0.0494	0.1106	0.8999	2
	Russia	0.0048	0.0109	0.0884	11
	Spain	0.0391	0.0876	0.7124	9
	United Kingdom	0.0425	0.0953	0.7750	6
	USA	0.0548	0.1229	1.0000	1

Of the export market alternatives, the USA, the Netherlands and Germany ranked 1st (0.1229), 2nd (0.1106) and 3rd (0.1065), respectively, whereas Russia ranked last (0.0109).

4.4. Sensitivity Analysis

The TOPSIS, GRA and ANP rankings were compared in Table 15. The USA ranked 1st in all of them. France ranked 2nd in TOPSIS and GRA and 5th in ANP.

Table 15. Alternative Rankings

Markets	***Methods***		
	TOPSIS	*GRA*	ANP
USA	1	1	1
Japan	9	9	8
Germany	4	6	3
France	2	2	5
United	3	4	6
Canada	11	11	10
Netherlands	6	3	2
Spain	5	5	9
Italy	7	7	7
Belgium	8	8	4
Russia	10	10	11

Sensitivity analysis was performed to determine and evaluate the effect of the criterion weights on the rankings in Table 15. In the sensitivity analysis, the first criterion was assigned the lowest and highest criteria weight while the weights of the others were kept constant, and the criteria were ranked again using 16 scenarios. In this way, all three methods were used for analysis. Figure 3 shows the results.

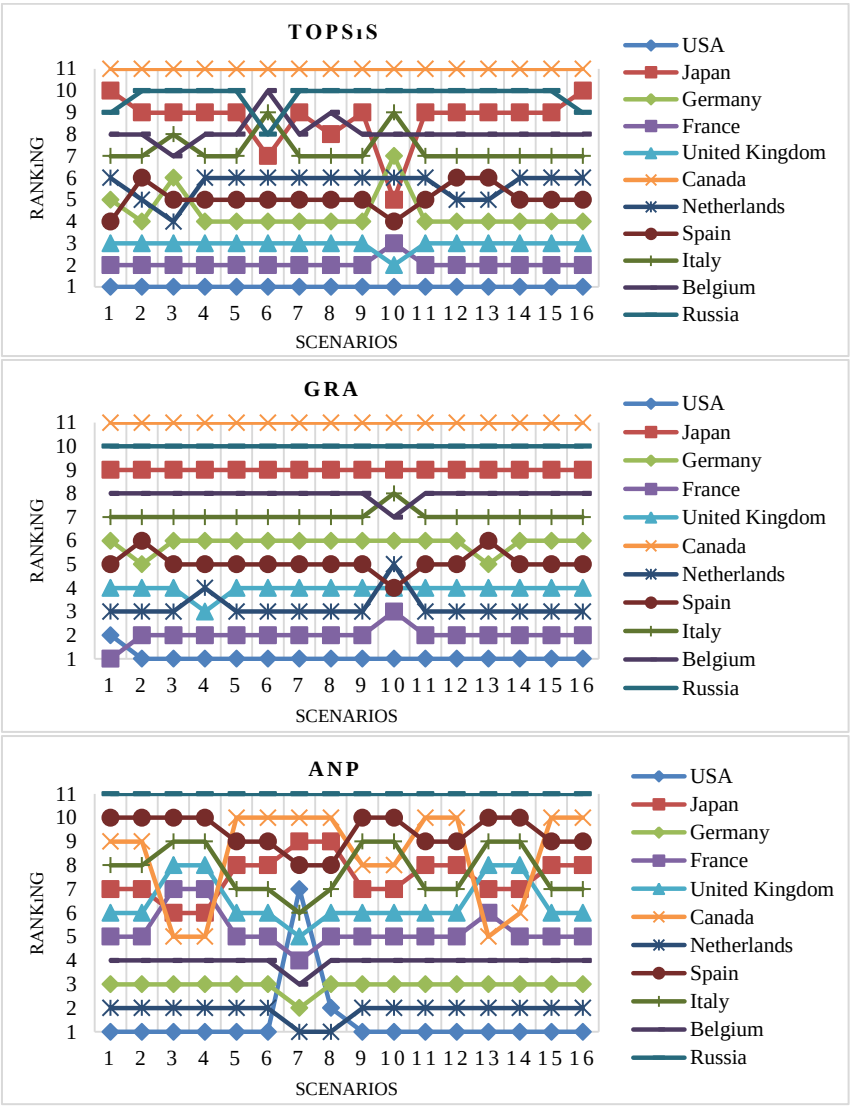

Figure 3. Sensitivity Analysis

The USA ranked 1st in all scenarios according to the sensitivity analysis results for TOPSIS method (Figure 3). France and England ranked 2nd and 3rd, respectively, except in scenario 10 where "export revenue" was assigned the highest criterion weight. Canada ranked last in all scenarios. According to the sensitivity analysis results for GRA, the USA ranked 1st, except in scenario 1 where "import expense" was assigned the lowest criterion weight. France ranked 2nd, expect in scenarios 1 and 10. The Netherlands ranked 3rd, except in scenario 4 where "income per capita" was assigned the lowest criterion weight and in scenario 10. According to the sensitivity analysis results for ANP, The USA ranked 1st, expect in scenarios 7 and 8 where "exchange rate"

and "distance" were assigned the lowest criterion weight. The Netherlands ranked 2nd, expect in scenarios 7 and 8 while Germany ranked 3rd, expect in scenario 7. Russia ranked last.

These results are the same as those of the three methods, which means that even though criterion weights change, rankings remain the same, indicating that the results of the methods are sensitive.

According to the sensitivity analysis results, the USA ranked 1st in all three methods and is therefore the best export market for Turkish socks enterprises. France ranked 2nd in TOPSIS and GRA, which do not take into account interactions among criteria. However, it was the Netherlands that ranked 2nd in ANP, which takes into account interactions among criteria. In other words, France and the Netherlands are alternative markets to the USA.

5. CONCLUSION AND SUGGESTIONS

Export provides foreign exchange inflow and job opportunities, and therefore, is an important field of economic activity promoted by every country. Turkey has a 500 billion export target and a relatively high unemployment rate. Turkey should increase the volume of value added exports to achieve the export target and reduce the unemployment rate. Cotton is a very important raw material of Turkey. Turkey converts cotton into a value-added product by first converting it into yarn, then into fabric and finally into ready-made garments. 100 percent cotton denim jeans and socks are strategic products for Turkey. If Turkey achieves to select the right export market for those products, it can create short-, medium- and long-term plans and increase productivity and profit by using time, money and other resources efficiently. It can also increase its knowledge of the target market and develop effective marketing strategies. However, Turkey has to choose from a large number of markets with different capacities and potentials. However, this time-consuming problem requires multicriteria decision-making approaches that involve uncertainties and complexities due to conflicting objectives and various factors.

This study addressed the problem of export market selection for the Turkish socks sector. First, criteria for the selection of export markets were determined. A survey was developed using those criteria. The survey was completed by export specialists of 50 socks exporting companies, which are members of IAEA. According to frequency analysis, the most important criteria for the socks export market were import expense, export revenue, population, income per capita, inflation rate, tax rate, exchange rate and distance. Alternative export markets were determined and analyzed using TOPSIS, GRA and ANP. In the sensitivity analysis of all three methods, the USA ranked 1st as the best stocking export market. According to the data of www.trademap.org, the USA is Turkey's seventh largest stocking export market. It ranked 1st in all three methods due to high import expenditures depending on population and high income per capita. Turkey's socks export volume to the USA is small due to high taxes and distance. However, our results show that Turkey can increase its export volumes if it selects the USA as the target market in the coming years. The high potential purchasing power of American consumers will compensate for the reduced profitability arising from logistic costs and tax rates due to distance. Although France ranked 2nd in TOPSIS and GRA, which do not take into account interactions among criteria, it ranked 5th in ANP, which takes into account interactions among criteria. Proximity, lack of taxation, relatively low inflation and high population were the reasons why France ranked 2nd in TOPSIS and GRA. The Netherlands ranked 6th in TOPSIS, 3rd in GRA and 2nd in ANP. ANP results show that the Netherlands and France are the best markets after the USA. Despite its small population, the Netherlands has high socks import expenditures and a high GDP and does not impose tax on Turkey. It is, therefore, a potential and attractive alternative market. Russia and Canada ranked last as alternative markets due to high tax rates, low exchange rate and distance (Canada).

This study is a guide for Turkey in particular and for all countries that would like to increase their export volume in general. Different aspects of TOPSIS, GRA and ANP can be considered to

select different markets. The selection criteria are generally quantitative criteria. However, further research should take into account qualitative criteria and use methods that consider fuzzy sets.

Data Availability

All data, models, and code generated or used during the study appear in the submitted article.

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