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ANALYSING AND FORECASTING COMPETITIVENESS: THE CASE OF THE TURKISH COTTON INDUSTRY

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Abstract

Cotton is a significant raw material source for textiles, food, and other sectors, as well as a major influence in worldwide and national trade and industry. The primary goals of this research are to examine the cotton production and trade in which Türkiye plays a significant role in global production; to analyse international competitiveness; and to forecast the next ten years using data from 1961 to 2020. The Revealed Symmetric Comparative Advantage (RSCA) method will be employed to investigate its international competitiveness, and the Autoregressive Integrated Moving Average (ARIMA) Box-Jenkins model will be used to forecast the comparative advantage of the Turkish cotton industry. According to the findings, Türkiye ranks seventh in cotton production, but there was a 21% decrease in 2020 (1.8 million tonnes) compared to 2005 (2.3 million tonnes). When world cotton exports were examined, the USA, Brazil, and India came to the fore, while Türkiye ranked 14th with 87 thousand tonnes in 2020. When the observed cotton RSCA indices for Türkiye were examined, the results revealed no competitive advantage and no specialisation in cotton exports over time. While the RSCA index was 0.68 in 1980, it was down until -0.42 in 2010. In 2020, the RSCA index was -0.03. Furthermore, the forecasting analysis shows that the RSCA indices for cotton export will gradually decline due to periodic fluctuations, eventually falling to -0.18 by 2030. Consequently, the inadequacy of cotton production to meet consumption, as well as cotton imports, may be expressed as reasons for Türkiye's comparative disadvantage.

Key words: *competitiveness, cotton industry, revealed symmetric comparative advantage, Box-Jenkins*

INTRODUCTION

Cotton is a significant raw material source for textiles, food, and other sectors, as well as a major influence in worldwide and national trade and industry. Cotton production is, therefore, strategically important for countries. Making effective use of this power will also contribute significantly to the growth of agriculture-based industries in these countries [10].

The fact that there are just a few countries suitable for cotton farming on the globe increases the plant's importance and worth. China, India, the United States of America (USA), Brazil, Pakistan, Uzbekistan, and Türkiye hold significant cotton agricultural positions in the 2019/2020 production period [51]. In Türkiye, one of the cotton-producing countries, the total cotton area planted in 2020 is 3,592,200 da, with a total production amount of 1,773,646 tonnes [50]. This production level accounts for approximately 2.1% of global cotton production. Despite Türkiye's major position in cotton production, cotton production area and amount have decreased throughout the years [50]. The causes of this drop are as follows: prices are not at an acceptable level; insufficient support; decreased inefficiencies; and increased costs [11, 32, 50]. All of these factors cause manufacturers to create goods that are alternatives to cotton, posing a threat to the sustainability of cotton production. Cotton, which is strategic for the countries, also helps with the development of Türkiye's agriculture-based industry. As a result, with the proper agricultural strategies, these common issues in cotton production should be eliminated as soon as possible.

The impact of agricultural subsidies, one of the most important agricultural policies in cotton farming, on production is fairly significant. According to certain international research [24, 52], cotton subsidies in the USA and Europe diminish cotton supply and raise global cotton prices. [47], on the other hand, indicated that a reduction in the USA cotton subsidies raises international cotton prices only to a certain amount, but this conclusion is not statistically significant.

In this study, the primary goal of the research is to examine the cotton production and trade, in which Türkiye is significant in world production, to analyse international competitiveness, and to forecast the next ten years. In order to analyse international competitiveness and identify the best model and forecast the comparative advantage of the Turkish cotton industry over the next ten years, time series data from 1961 to 2020 are employed. The Autoregressive Integrated Moving Average (ARIMA) Box-Jenkins model will be used to forecast the comparative advantage of the Turkish cotton industry, and the Revealed Symmetric Comparative Advantage (RSCA) method will be employed to investigate its international competitiveness.

As far as we know, no such procedure has been reported to be used in forecasting the Turkish cotton industry's comparative advantage. This research differs significantly from previous studies on the cotton trade. With this study, Türkiye's international competitiveness was revealed and it was aimed to assist the government in decision-making by offering appropriate policy recommendations. The realisation of these goals is of great importance in determining the sustainability of cotton production. Furthermore, the study could serve as an essential source in the design of future large-scale research on cotton.

MATERIALS AND METHODS

Data

The data on cotton export value ($) was collected to calculate RSCA for a period of 60 years from 1961 to 2020 by [16]. The RSCA data from 1961 to 2020 was used to create the best ARIMA model structure. Furthermore, academic studies from national and international scientific journals and books were used.

Competitiveness Calculation Method (RSCA)

The concept of comparative advantage was first introduced by David Ricardo [40] in his book "On the Principles of Political Economy and Taxation" published in 1817. According to this theory, some individuals or countries are more productive than others, and a country that exports the goods and services for which it has the highest comparative advantage in terms of productivity gains from this trade by importing those goods or services at the lowest level of comparative advantage. Afterwards, [5] established a method for determining a country's relative advantage or disadvantage in a specific product class using trade flows. This method, the Revealed Comparative Advantages (RCA) index, serves as the foundation for the computation of comparative advantages. The RCA index is generally used to measure the international competitiveness of countries in certain products or sectors. This index is widely used in agricultural sector research [7, 17, 26, 29, 48]. A country's comparative advantage determines a country's productivity level and explains the country's pattern of specialisation in the international market [43]. Therefore, it is paramount to investigate.

Balassa's [5] RCA index is shown in the equation below:

$$RCA_j^i = \frac{x_j^i / \sum x^i}{\sum x_j^w / \sum x^w} \quad \text{..............................(1)}$$

where:

RCA_j^i: The Revealed Comparative Advantage index of country i in product j,

x_j^i: The export value of product j of country i,

Σx^i: Total agricultural export value of country i,

Σx_j^w: Total world export value of product j,

Σx^w: Total world agricultural export value.

When RCA_j^i>1, it is said that the country has a comparative advantage. However, if RCA_j^i<1, the country is considered to have a comparative disadvantage for the particular product. The problem with this index is that the values are asymmetrical. For this reason, [13] proposed the Revealed Symmetric Comparative Advantage (RSCA) index to mitigate the effects of this problem. Because of this issue, the competitiveness of the cotton sector in Türkiye was calculated by using the RSCA index. The formula is as follows:

$$RSCA_j^i = \frac{RCA_j^i - 1}{RCA_j^i + 1} \quad \text{.........................(2)}$$

The result varies between -1 and +1. Accordingly, if the RSCA value is between 0 and 1, the country is a net exporter, and if it is between 0 and -1, it is a net importer.

[25] states that RSCA should be used instead of RCA. The reason for this is that the RCA index changes from 0 to 1 if a country is not specialised in a particular sector, and from 1 to infinity, if a country is specialised. This leads to an erroneous interpretation of the results. For this reason, RSCA values were used instead of RCA in the study.

ARIMA Estimation Method

Time series analysis methods are classified into two types: multivariate and univariate time series estimation methods. [9] estimation method is one of the techniques employed in univariate time series that uses statistical methods to make forward-looking estimations. This estimation method was used in the study to forecast the competitiveness of the cotton industry in Türkiye. To apply the method, the time series must have discrete, stationary, and evenly spaced observation values [2]. Autoregressive (AR), moving average (MA), and autoregressive moving average (ARMA), which combines AR and MA models, are the three most common linear stationary Box-Jenkins models [4]. The ability of the Box-Jenkins method to use previous observation values as an explanatory variable is a significant advantage. Box-Jenkins estimation techniques are an experimental process, not a method expressed with a predetermined model. They can select the appropriate model from a variety of model options and monitor the examination suitability of the chosen model at each stage.

An ARMA model is commonly denoted as ARMA (p, q), where p and q represent the orders of autoregression and moving average, respectively. In the ARMA model, the time series is a linear function of actual past values and random shocks [22]. Equation (3) defines a stationary time series, ARMA (p, q):

$$Y_t = \alpha + \vartheta_1 Y_{t-1} + \vartheta_2 Y_{t-2} + \cdots + \vartheta_P Y_{t-p} + \epsilon_1 + \theta_1 \epsilon_{t-1} + \cdots + \theta_q \epsilon_{t-q} \quad \text{.........(3)}$$

where:

α is a constant term for the mean of Y. At time t, Y_t is the dependent variable, and Y_{t-1}, $Y_{t-2} \ldots Y_{t-p}$ denotes the independent variables at lags t-1, t-2,…, t-p. ϑ s denotes the coefficients to be estimated. ϵs are the error terms, uncorrelated random variables with constant variance and zero means. θs are also estimated coefficients.

The AR, MA, and ARMA processes are used on stationary series. Therefore, it is necessary to make a non-stationary process stationary. A non-stationary time series can be made stationary by calculating the difference to the appropriate degree. The original series is referred to as a homogeneous non-stationary series in this case. The time series that are not stationary yet are made stationary by taking the difference and complying with the autoregressive integrated moving average [ARIMA (p, d, q)] processes. Here, the letter d stands for integration (difference). Visual inspection of the data graph, the structure of the autocorrelation, and partial correlation coefficients are useful for confirming stationarity. Another method for determining stationarity is to use unit root tests. If the model is found to be non-stationary, differencing the series will bring it into stationarity. The Generalized Least Square Dickey-Fuller (DF-GLS) [15] unit root test was used in the study to achieve this goal. Furthermore, autocorrelation function (ACF) and partial autocorrelation function (PACF) graphs were created, and it was attempted to visually determine (correlogram) what type of development the series contained.

After determining whether the series is stationary, the identifying process moves on to selecting the initial values for the orders of parameters, p and q. During the identification phase, one or more models that seem to provide statistically appropriate representations of the relevant data are tentatively chosen. The parameters of the model are then precisely estimated using least squares.

Several models are run separately and collectively for various AR and MA combinations. Low Akaike (AIC) or Schwarz (SIC) information criterion, the lack of autocorrelations for residuals, and the importance of the parameters are used to evaluate which model is the best. The information criteria proposed by [1] and [45] are two criteria employed to choose among time series models. The SIC and AIC must have low values. The delayed order, in which values are small, is recognised as the appropriate delay order. As a result, the model with the smallest information criteria value is chosen.

RESULTS AND DISCUSSIONS

Production and trade analysis of the Turkish cotton industry

World cotton production was 29.5 million tonnes in 2020. The top five countries that come to the fore in cotton production are, respectively, China (35.5%), India (21.3%), the USA (11.7%), Brazil (8.5%), and Pakistan (4.2%). These countries account for 81.2% of the total cotton production in the world. China has the highest production share (Table 1).

According to [27], China has a significant share of cotton production and the world price of cotton is the price of cotton in China and nearby ports. Benin experienced the greatest increase in production during the study period. It is, however, still far behind other countries. The reason for this is improper fertiliser application in Benin's cotton production [19]. Türkiye ranks seventh in global cotton production, accounting for 2.1% of world production. It was discovered that Türkiye's cotton production had gradually decreased over time, with a 21% decrease in cotton production in 2020 compared to the production period of 2005 (Table 1). Among the reasons for this, the high cost of cotton production in Türkiye, the existence of alternative product diversity in regions such as the Aegean and Cukurova, and the agricultural policies implemented by countries such as the USA are mentioned [3]. Another reason is the decrease in domestic prices due to the effect of cotton stock policies of countries such as China, which play a significant role in cotton agriculture, on the price of the product [36].

Table 1. Volume of world cotton production (1,000 tonnes)

Countries	2005	2010	2015	2016	2017	2018	2019	2020
China	17,142	17,910	16,830	16,029	17,130	18,493	23,505	29,500
India	9,828	17,760	15,943	17,308	17,425	14,657	18,558	17,731
The USA	12,876	9,474	8,469	10,083	12,000	11,133	12,819	9,737
Brazil	3,668	2,950	4,007	3,464	3,843	4,956	6,893	7,070
Pakistan	6,337	5,614	4,872	5,237	5,855	4,828	4,480	3,454
Uzbekistan	3,728	3,443	3,361	2,959	2,854	2,286	2,692	3,064
Türkiye	2,245	2,150	2,050	2,100	2,450	2,570	2,200	1,774
Argentina	448	754	795	673	616	814	873	1,046
Burkina Faso	713	530	769	785	844	482	724	783
Benin	191	137	269	451	598	678	715	728
Others	12,454	8,504	8,667	8,388	10,227	11,153	10,401	8,226
World	69,632	69,224	66,033	67,478	73,842	72,049	83,859	83,113

Source: [16].

According to [38], foreign dependency on production factors raises production costs; the advantage of producing alternative products profitably and with less labour, as well as the inability to supply domestically required and qualified raw materials, are the cotton industry's weaknesses in Türkiye.

The world cotton export amount increased by 4.7% in 2020 compared to 2005 and reached 9.2 million tonnes, and the export value increased by 39.6% and reached 14 billion dollars (Table 2). Cotton exports are dominated by the USA (42.5%), Brazil (23%), India (10.3%), Greece (3.2%), and Benin (3.2%). These countries account for 82.3% of the total global export value. The USA has the highest amount and value of cotton exports. The USA is a major producer and exporter of cotton in the global cotton market [28]. The highest increase in the amount and value of exports belongs to Brazil. Cotton production is important for Brazil in terms of both social and economic terms, as in most countries [8]. Furthermore, Brazil is one of the world's leading cotton producers and is a major competitor of the USA in cotton markets in Asia and Europe [21]. Türkiye ranked 14th in cotton exports in the production period of 2020, with lower global export amounts (0.9%) and values (1.1%) than other countries. Among the reasons why Türkiye lags in cotton exports are as follows: the fluctuations in world prices; the increase in production costs; and the increase in importation due to the need for raw materials in the textile industry [35].

Table 2. World cotton export volume and value

	Countries	2005	2010	2015	2016	2017	2018	2019	2020
Export Volume (1,000 tonnes)	The USA	3,400	2,962	2,397	2,469	3,253	3,575	3,563	3,822
	Brazil	391	512	834	805	834	916	1,614	2,125
	India	598	1,566	1,251	866	945	1137	616	965
	Greece	232	226	219	218	232	215	360	289
	Benin	161	67	233	122	218	260	270	280
	Australia	599	474	448	717	873	478	541	170
	Burkina Faso	195	164	248	307	226	198	218	167
	Argentina	28	43	51	58	33	105	92	117
	Tajikistan	138	72	66	87	76	93	94	100
	Uzbekistan	1,020	466	345	155	279	116	159	100
	Türkiye	38	29	48	76	59	95	131	87
	Others	2,006	1,171	1,330	1,116	1,048	1,138	1,300	1,001
	World	8,808	7,754	7,470	6,995	8,076	8,325	8,959	9,225
Export Value (1,000 $)	The USA	3,923,870	5,747,637	3,889,807	3,959,220	5,827,921	6,545,933	6,147,102	5,969,433
	Brazil	449,732	821,547	1,290,394	1,215,457	1,357,711	1,587,344	2,640,378	3,226,916
	India	639,704	2,972,199	1,860,980	1,345,899	1,673,471	2,198,729	1,075,032	1,448,516
	Greece	260,561	487,791	326,645	344,201	393,970	399,685	582,635	449,992
	Benin	168,667	98,332	262,356	175,462	345,437	445,433	450,976	448,829
	Australia	770,495	957,524	813,350	1,207,109	1,617,545	977,425	1,086,133	307,109
	Burkina Faso	210,651	222,846	285,427	397,617	332,531	320,077	352,017	263,296
	Argentina	24,866	74,708	47,598	70,405	48,673	165,402	121,126	113,673
	Tajikistan	144,000	123,622	85,679	120,931	121,026	165,303	139,601	135,994
	Uzbekistan	1,170,000	810,155	511,172	229,415	477,102	222,136	281,638	147,318
	Türkiye	52,826	64,206	76,441	124,443	115,659	178,585	229,206	159,811
	Others	2,234,704	1,884,104	1,940,598	1,677,400	1,809,111	1,996,050	2,034,034	1,361,809
	World	10,050,076	14,264,671	11,390,447	10,867,559	14,120,157	15,202,102	15,139,878	14,032,696

Source: [16].

In 2020, global cotton imports increased in quantity (2.5%) and value (34.2%) over 2005, reaching 8.5 million tonnes and 13.7 billion dollars (see Table 3). China (26.6%), Vietnam (15.8%), Bangladesh (14.6%), Türkiye (12%), and Pakistan (9.6%) are the leading cotton importers. China appears to have the highest import amount and value. Since China could not produce enough cotton, it started to import cotton from international markets to meet the demand [42]. However, later on, it decided to reduce its reliance on the global market and began stocking large quantities of cotton in 2010 for this purpose [27]. However, despite this move by China, imports have decreased over time, and it remains the leader in fibre cotton imports (Table 3). During the research period, the highest increase in cotton import amount (9.19 fold) and value (13.01 fold) was experienced in Vietnam. Most of the imported cotton in Vietnam, which ranks second in cotton imports, is from the USA, and this import is usually re-exported to China as yarn [30]. Türkiye ranked fourth in cotton imports in the production period of 2020. It accounted for 12.5% of the total import volume and 12% of the total import value. Türkiye has come to the fore in imports as a result of the decrease in the production area of cotton [12]. Other reasons contributing to the increase in imports include fluctuations in global prices, increases in production costs, and the increase in the need for raw materials in the textile sector [35]. It is also claimed that the tariff applied by China with the increase in imports harms countries such as Türkiye and Argentina [44].

Table 3. World cotton import volume and value

	Countries	2005	2010	2015	2016	2017	2018	2019	2020
Import Volume (1,000 tonnes)	China	2,922	3,123	1,663	1,038	1,283	1,720	1,968	2,158
	Vietnam	151	357	938	1,018	1,269	1,408	1,341	1,389
	Bangladesh	515	401	1,320	655	1,008	1,049	1,142	1,191
	Türkiye	776	889	803	821	914	752	946	1,065
	Pakistan	388	343	275	333	388	606	399	819
	Indonesia	455	613	673	678	788	763	654	486
	Egypt	21	45	85	64	111	113	239	190
	India	83	33	215	464	446	270	687	174
	Thailand	504	384	504	257	255	259	205	134
	Malaysia	55	47	87	92	91	170	205	122
	Others	2,425	1,536	1,179	1,080	1,062	1,043	921	773
	World	8,294	7,771	7,742	6,501	7,616	8,153	8,708	8,500
Import Value (1,000 $)	China	3,580,704	6,171,348	2,846,653	1,777,016	2,408,675	3,419,363	3,754,031	3,661,535
	Vietnam	167,210	673,516	1,607,212	1,643,254	2,331,827	2,727,485	2,400,181	2,176,156
	Bangladesh	665,581	794,399	2,229,517	1,163,288	1,997,370	2,308,893	2,131,906	2,014,804
	Türkiye	908,201	1,720,010	1,232,451	1,238,673	1,676,281	1,395,590	1,585,807	1,652,640
	Pakistan	519,977	596,094	543,748	580,537	761,455	1,048,967	708,505	1,315,549
	Indonesia	576,004	1,148,391	1,087,557	1,087,200	1,268,050	1,441,949	1,117,648	774,649
	Egypt	51,032	120,574	143,588	121,386	236,963	254,343	236,285	168,794
	India	155,766	84,107	386,494	878,983	956,123	621,694	1,320,897	344,649
	Thailand	612,944	735,252	531,971	433,431	484,050	520,954	367,415	218,573
	Malaysia	77,890	90,010	156,844	154,372	169,404	329,646	289,523	209,468
	Others	2,941,103	2,921,086	2,047,097	1,780,467	2,020,321	2,113,627	1,711,225	1,223,539
	World	10,256,412	15,054,787	12,813,132	10,858,607	14,310,519	16,182,511	15,623,423	13,760,356

Source: [16].

The analysis of the competitiveness of the Turkish cotton industry

According to the Revealed Symmetric Comparative Advantage index, Tajikistan (0.98), Benin (0.97), Burkina Faso (0.96), Uzbekistan (0.80), Greece (0.74), India (0.66), the USA (0.62), and Brazil (0.60) had a revealed symmetric comparative advantage in world cotton exports. It was determined that Australia (0.03), Türkiye (-0.07), and Argentina (-0.47) had a comparative disadvantage in 2020 (see Table 4). In Tajikistan, the country with the highest revealed symmetric comparative advantage, cotton is a dominant product of the agricultural sector and the largest source of export revenues [49]. For Benin, which ranks second in terms of comparative advantage, [31] stated that cotton is an important foreign exchange provider in Benin. Other countries with revealed symmetric comparative advantages, including the USA and Brazil, have long been in contentious disagreement over the USA's policies that support cotton producers and exporters through various subsidies and credit guarantees [41]. The USA implemented these policies to increase its competitiveness in cotton against other countries. However, while this situation has an impact on world cotton prices, it also prevents competition [38]. As a matter of fact, it was so, and the cotton trade in Brazil, which competes in the same foreign markets as the USA, has recently stagnated, and the reasons for this have been shown to be decreasing prices, high transportation costs, and a lack of capital to increase productivity [39, 41].

According to the findings of the study, Türkiye lacks competitiveness in the cotton trade. Türkiye has shown a fluctuating course in terms of comparative advantage over the years, eventually becoming a disadvantaged country in 2020. Table 4 shows that Türkiye's comparative disadvantage in exports has become increasingly chronic since the 1980s. The reasons for this are the decisions of January 24, 1980, which had a significant impact on agricultural policies and the military coup of September 12th. The approach to market liberalisation in these decisions altered the course of agricultural policies. Input and product subsidies have been severely reduced or eliminated, the privatisation of public institutions that regulate markets has gained prominence, and markets have been opened to foreign capital [20, 37]. All these have transformed Türkiye from an exporter to an importer of agricultural products. For instance, the RSCA index was 0.68 in 1980 and fell to -0.42 in 2010. The RSCA index was -0.03 in 2020. Consequently, cotton production in Türkiye is insufficient to meet demand, so an average of 900,000–950,000 tonnes of cotton is imported each year [6].

Table 4. RSCA indices for the cotton industry in the world

RSCA	**1961**	**1970**	**1980**	**1990**	**2000**	**2010**	**2015**	**2016**	**2017**	**2018**	**2019**	**2020**
Tajikistan	-1.00	-1.00	-1.00	-1.00	0.95	0,95	0.97	0.98	0.97	0.98	0.97	0.98
Benin	0.16	0.60	0.73	0.94	0.96	0,85	0.97	0.97	0.97	0.97	0.97	0.97
Burkina Faso	-0.68	0.65	0.87	0.93	0.95	0,96	0.96	0.97	0.96	0.95	0.96	0.96
Uzbekistan	-1.00	-1.00	-1.00	-1.00	0.96	0,96	0.96	0.93	0.94	0.88	0.88	0.80
Greece	0.27	0.44	-0.18	0.29	0.76	0,76	0.73	0.74	0.73	0.70	0.79	0.74
India	-0.22	-0.24	0.33	0.70	-0.68	0,85	0.76	0.72	0.69	0.74	0.56	0.66
The USA	0.37	0.01	0.33	0.41	0.37	0,57	0.52	0.55	0.61	0.63	0.62	0.62
Brazil	0.11	0.24	-0.93	-0.28	-0.73	-0,02	0.33	0.35	0.26	0.29	0.52	0.60
Australia	-1.00	-0.90	-0.61	0.17	0.57	0,47	0.45	0.63	0.62	0.45	0.51	0.03
Türkiye	0.42	0.76	0.68	0.33	-0.22	-0.42	-0.31	-0.03	-0.16	0.01	0.08	-0.07
Argentina	-0.70	-0.49	-0.21	-0.05	-0.53	-0,71	-0.72	-0.61	-0.74	-0.33	-0.51	-0.47

Source: Authors' calculations.

Forecasting the comparative advantage of the Turkish cotton industry

As previously stated, trend analysis using the ARIMA Box-Jenkins technique was used in this research to anticipate Turkish cotton competitiveness from 2020 to 2030. In the study, a unit root test was first conducted to get reliable findings from the model evaluation. Therefore, the Generalized Least Square Dickey-Fuller (DF-GLS) [15] and Kwiatkowski, Phillips, Schmidt, and Shin (KPSS) [23] unit root tests were employed, and the results of the tests are presented in Table 5. [15] expanded on the ADF test by proposing the DF-GLS unit root test, which is an efficient approach for detecting if a single time series has a unit root. The DF-GLS test surpasses the augmented Dickey-Fuller (ADF) test [14] in terms of small sample size and power. Furthermore, the Modified Akaike Information Criterion (MAIC) of [34] determines the optimal lag order, while the Schwert Criteria indicate the maximum lag length [46]. Regarding the KPSS test, it is assumed that the series is stationary. For the majority of unit root tests, the null hypothesis is that the series is non-stationary. The KPSS test, on the other hand, takes a different technique, and the null hypothesis is the inverse. Hence, the test is generally performed as a confirmatory analysis. To obtain correct results, lag length selection is critical, and [33] suggested an automatic lag order selection technique for this test. Consequently, the maximum lag length is found in the research using this technique since it provides the highest performance in small samples [18]. The data series were examined under the linear trend and constant cases, as in the DF-GLS test. In the DF-GLS test, the series was non-stationary in the constant and linear trend cases, although it was non-stationary with a significance of 5% in the constant case and a significance of 10% in the linear trend case in the KPSS test. Overall, evidence suggests that all series are non-stationary. The first-order differencing approach was employed to make it stationary, and the results are reported as I(1) in Table 5.

Table 5. DF-GLS and KPSS time series unit root tests

		Lag Length	Constant	Lag Length	Trend
DF-GLS	**I(0)**	2	-1.016	2	-1.861
	I(1)	1	-10.054	1	-10.085
KPSS	**I(0)**	6	0.789	5	0.134
	I(1)	4	0.088	4	0.088

Notes:
(1)The test was performed in EViews 10.
(2)In the DF-GLS test, the asymptotic critical values for constant case are -2.606 (1%), -1.947 (5%) and -1.613 (%10), and for the trend case are -3.743 (%1), -3.168 (%5) and -2.869 (%10).
(3)In the KPSS test, the asymptotic critical values for constant case are 0.739 (1%), 0.463 (5%) and 0.347 (%10), and for the trend case are 0.216 (%1), 0.146 (%5) and 0.119 (%10).
Source: Authors' calculations.

Thus, no further differentiation of the time series is required, and d = 1 for the ARIMA (p, d, q) model. This test allows us to move forward in the development of the ARIMA model by selecting appropriate values for p in AR and q in MA in the model. As a result, the next step is to analyse the ACF and PACF graphs and statistics for stationary and non-stationary time series (Figure 1).

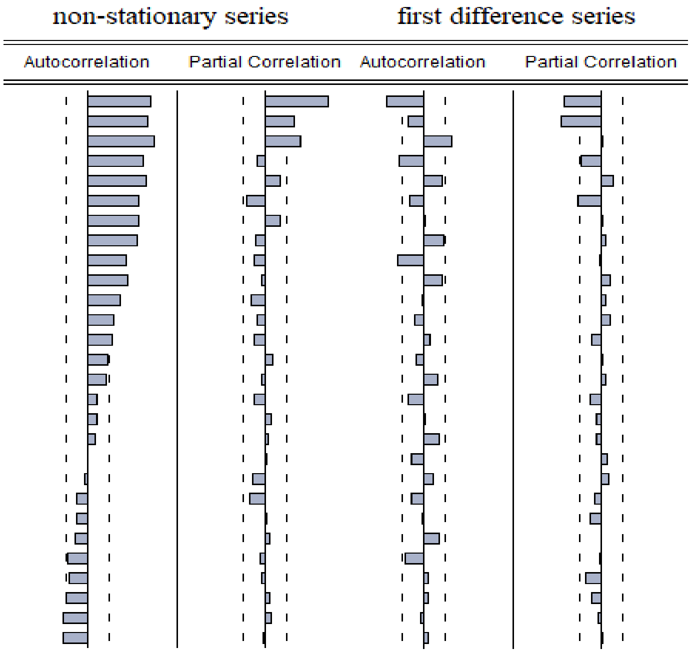

Fig. 1. ACF and PACF graphs of non-stationary and first differenced series
Note: The correlogram was performed in EViews 10.

The ARIMA model for the RSCA of cotton series was detected using the ACF and PACF graphs. There is no autocorrelation or partial autocorrelation in the series because the lag values were determined to be within the limits, and the coefficients were not related to each other.

Following the examination of the correlograms, many different ARIMA models were explored, and the ARIMA (2, 1, 3) model yielded the best statistical results.

Table 6 displays the model's results, and all variables were found to be statistically significant.

Table 6. Results for the ARIMA (2, 1, 3) model of the RSCA index series

TYPE	Coefficient	Std. Error	P-value
C	0.200031	0.174711	0.2571
AR(2)	0.562565	0144448	0.0003
MA(3)	0.352634	0.105801	0.0015
SIGMASQ	0.082101	0.019837	0.0001
R-squared	0.561244		
F-statistics	23.87787		
AIC	0.489977		
SIC	0.629600		
HQ	0.544591		
Durbin-Watson stat.	1.437373		

Note: The model was performed in EViews 10.
Source: Authors' calculations.

Furthermore, the DF-GLS and KPSS unit root tests were used to assess the model's accuracy by creating the residual variable. Consequently, the residual series is stationary (Table 7).

Table 7. DF-GLS and KPSS time series unit root tests for residuals

	Lag Length	Constant	Lag Length	Trend
DF-GLS	0	-5.399	1	-7.255
KPSS	1	0.832	11	0.130

Notes:
(1)The test was performed in EViews 10.
(2)In the DF-GLS test, the asymptotic critical values for constant case are -2.606 (1%), -1.947 (5%) and -1.613 (%10), and for the trend case are -3.743 (%1), -3.168 (%5) and -2.869 (%10).
(3)In the KPSS test, the asymptotic critical values for constant case are 0.739 (1%), 0.463 (5%) and 0.347 (%10), and for the trend case are 0.216 (%1), 0.146 (%5) and 0.119 (%10).
Source: Authors' calculations.

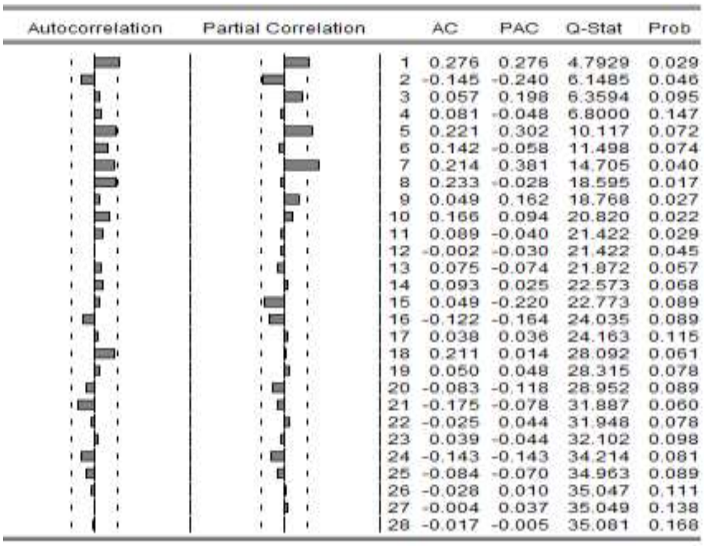

Fig. 2. ACF and PACF graphs of the residual values of the ARIMA (2, 1, 3) model
Note: The correlogram was performed in EViews 10.
Source: Authors' calculations.

It was discovered that there was no fluctuation, the levels of significance were not surpassed, and the model had appropriate levels for forecasting, when the ACF and PACF graphs of the ARIMA (2, 1, 3) model's residual values were examined (Figure 2). Based on these results, it is evident that ARIMA (2, 1, 3) is the best fitting model for the RSCA series.

The RSCA indices were calculated using cotton export data from 1961 to 2020. The ARIMA model was employed to forecast for the period 2020–2030 after analyzing the competitiveness level of the Turkish cotton industry using the RSCA indices. Figure 3 shows the RSCA indices' actual and forecast graphs for the considered period.

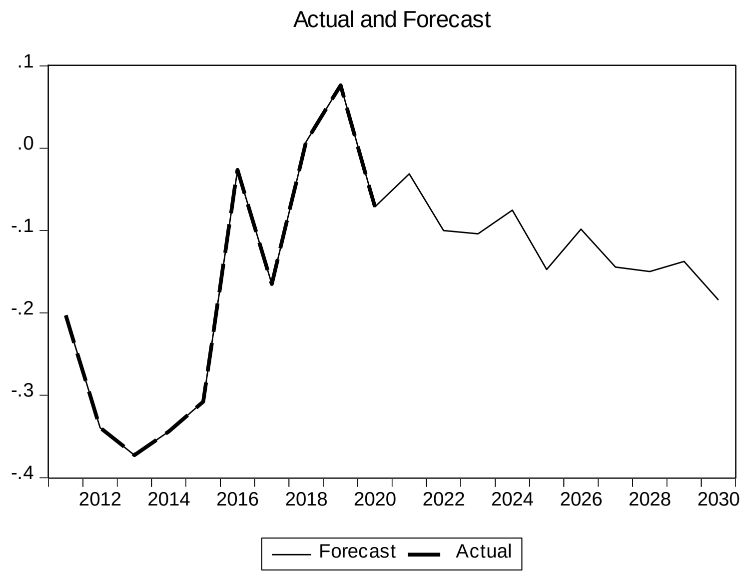

Fig. 3. Actual (1961-2020) and forecasted (2020-2030) data graphs for cotton RSCA index of Türkiye
Note: The graph was performed in EViews 10.
Source: Authors' calculations.

Furthermore, the RSCA indices for the cotton forecast from 2020 to 2030 will have gradually decreased by experiencing periodic fluctuations and will have dropped to -0.18 by 2030. It shows that the competitiveness of the cotton industry will deteriorate over the years. It can be a guide for policymakers as they prepare to determine policies based on future cotton export and increase competition to take necessary action and make changes.

CONCLUSIONS

Cotton is one of the most important agricultural products traded globally, contributing to the country's economy. Cotton is a strategic product due to the limited number of countries in the world that are suitable for cotton farming. When it comes to foreign trade, it is critical to the economy of every country, especially in today's globalising world. For this purpose, calculating and forecasting the competitiveness of such significant commercial crops is crucial for the future of the cotton industry. Firstly, in this study, production and trade analysis of the cotton industry was examined. Secondly, Türkiye's international competitiveness in the cotton industry is demonstrated by the Revealed Symmetric Comparative Advantage (RSCA) index. Finally, the cotton RSCA indices in Türkiye for the following ten years were estimated using the time series estimation technique of the ARIMA Box-Jenkins model.

It was revealed that the most important cotton producers in the world are China, India, the USA, Brazil, Pakistan, Uzbekistan, Türkiye, Argentina, Burkina Faso, and Benin. Türkiye ranks seventh in cotton production, but it was seen that there was a 21% decrease in production in 2020 (1.8 million tonnes) compared to the production period of 2005 (2.3 million tonnes). When world cotton exports were examined, the USA, Brazil, and India came to the fore, while Türkiye ranked 14th with 87 thousand tonnes in 2020. Among the reasons why Türkiye lags in cotton exports are the fluctuations in world prices, the increase in production costs, and the increase in importation due to the need for raw materials in the textile sector.

According to the RSCA index used in the study, Tajikistan, Benin, Burkina Faso, Uzbekistan, Greece, India, the USA, and Brazil have a revealed symmetric comparative advantage in world cotton exports, while Australia, Türkiye, and Argentina have a comparative disadvantage. When the observed cotton RSCA indices for Türkiye were specifically investigated, the results revealed no competitive advantage and no specialization in cotton exports over time. For example, while the RSCA index was 0.68 in 1980, it was down until -0.42 in 2010. In 2020, the RSCA index was -0.03. The inadequacy of cotton production to meet consumption, as well as cotton imports, are expressed as reasons for Türkiye's comparative disadvantage.

Regarding the forecasting of cotton RSCA indices in Türkiye for the following ten years, the best model structure was developed using data from 1961 to 2020. Furthermore, the forecasting analysis shows that the RSCA indices for cotton export will gradually decline due to periodic fluctuations, eventually falling to -0.18 by 2030.

Foreign trade is critical to the economies of all countries, especially in the modern globalising world. Trade policy, as one of the most important political tools used by developing countries for industrialisation, plays a particularly active role in economic growth. Economic growth is the leading determinant of welfare worldwide, and it is driven by exports and imports. For this purpose, the policies affecting the most important agricultural products of a country are of great importance. Therefore, to increase the competitiveness of Türkiye's cotton exports and ensure stability, policies that disrupt producers and entrepreneurs investing in the sector should be avoided. Furthermore, problems such as the high cost of cotton production in Türkiye, agricultural policies implemented by countries such as the USA, the effect of cotton stock policies of countries such as China on the price of the product, and the country's inability to obtain qualified raw materials should be resolved with appropriate policies covering research and practises for stronger cotton production. Hence, medium- and long-term projects that will increase cotton production and export may be developed. Also, adequate assistance may be provided by the government. Türkiye's cotton exports may be able to increase significantly with the help of new production strategies and bilateral trade relations.

This type of application may allow policymakers to plan ahead of time for the storage, export, or import of cotton. Also, taking these precautions may prevent resource waste. As far as we know, no projection study on the competitiveness of cotton in Türkiye has been conducted. As a result, the study intends to contribute to the literature by addressing this gap.

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