

# Research on Competitiveness in Technical Textiles: Comparison of Countries Having the Lion's Share of Technical Textile World Exports and Turkey

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## Abstract

After the end of quotas in 2005, Turkey and many other countries confronted fierce competition from countries having cheap labour. Producing technical textile products that require high technology and skilled labour is one way to cope with this competition. The degree of specialisation (comparative cost advantage) and export competitiveness of Turkey in technical textiles is gaining significance. Therefore, this study aims to examine comparatively the level of specialisation and export competitiveness of Turkey and the countries with the lion's share in world exports of technical textiles in the period 2008-2019. Technical textile products are not coded under a specific category in the HS system, thus Turkey's technical textile product groups, which are reported by the exporters' association, were examined in this research. In this context, there are a total of 39 technical textile product groups consisting of 4-digit and 6-digit product groups. In this study, in which the revealed comparative advantage (RCA) method was used, Relative trade advantage (RTA), net export advantage (NEI), and relative export advantage (RXA) analyses were performed for technology classification. Considering the RTA results, the number of product groups in which China, Korea, USA, Turkey, Japan, Italy, Germany, France, Belgium, Vietnam and Mexico gained a competitive advantage is 33, 23, 23, 22, 22, 21, 20, 16, 14, 11 and 10, in sequence. Under the NEI results, which measure the country's own commercial performance, the number of product groups that China, Korea, Germany, Japan, Italy, Belgium, Turkey, USA, France, Vietnam and Mexico specialised in is 38, 22, 22, 22, 22, 19, 18, 17, 15, 11 and 10, respectively. According to the results, Turkey has high positive NEI (close to +1) and RTA values especially in the product groups of 540219 (high tenacity yarn other than textured yarn/sewing thread, of nylon/other polyamides, not put up for retail sale), 540600 (man-made filament yarn (other than sewing thread)), and 630533 (sacks & bags of the kind used for the packing of goods, of polyethylene/polypropylene strip/the like). Turkey specialised in these products above the world average (RTA) and in the export of them from the domestic market (NEI). On the contrary, both NEI (close to -1) and RTA values are negative in the product groups of 540220 (high tenacity yarn other than textured yarn/sewing thread, of polyester.), 6113 (garments, knitted or crocheted, rubberised or impregnated, coated or covered with plastics or other materials), 540211 (high tenacity yarn other than textured yarn/sewing thread, of aramid.), and 540310 (high tenacity yarn other than sewing thread, of viscose rayon.). Turkey specialised in these products below the world average and in the import of these products to the domestic market. In the RXA analysis conducted according to the technology classification for technical textile exporting countries, it was determined that other countries except Turkey specialised in R&D-based product groups above the world average and had gained a competitive advantage.

**Key words:** technical textiles, Turkey, export, competitiveness, specialisation, comparative cost advantage.

## Introduction

With its obvious contribution to industrial production, job creation and providing foreign exchange income, the presence of the textile and apparel sector in the world economy is inevitable. Because of its labour-intensive structure, the textile and apparel industry is the backbone of most developing countries [1]. Therefore, the importance of competition in this sector is increasing day by day.

Competitiveness implies that the goods produced by a country can compete with those of other countries in terms of price, quality, design, reliability and timely delivery [2]. The export competitiveness of countries depends on the comparative cost advantages they obtain. A compara-

tive cost advantage is based on the opportunity cost of producing a product. The opportunity cost of a good is equal to the amount that must be given up from the production of another good to increase the production of that good by one unit. In other words, opportunity cost is the amount of production that is forgone to produce 1 more unit of one good. In this context, if a country can produce a particular commodity at a lower opportunity cost than any other country, then it can be said that it has a comparative advantage. This means that the country specializes in the relevant sector and gains a competitive advantage. In short, the comparative cost advantage is the ability to produce goods and services at a lower opportunity cost. Comparative cost advantage in this way gives domes-

tic businesses the ability to sell goods and services to the country at a lower price than its competitors and provide stronger sales margins.

Countries develop policies to increase their competitiveness, thus aiming for relevant sectors to have a voice in the international market and to increase their contribution to the national economy. For this goal, sometimes certain sectors are supported and policies implemented for the entire economy. However, supporting sectors that do not have a competitive advantage and do not show any specialisation (comparative cost advantage) causes inefficient use of scarce resources. On the other hand, identifying sectors that do not show specialisation is also a result and policies can also be applied to im-

prove them and achieve competitiveness. To determine in which sector or product group a country specialises in export is only possible by competitiveness analyses on a sectoral or product basis. In addition to revealing in which sectors countries are strong in exports and in which are weak, such analyses play another important role in that countries can have a say in the international arena in an economic and political sense and survive in the global competitive environment.

The importance of the textile and apparel sector in a country's economy has made the study of the competitiveness of countries the focus of attention. To date, many studies have been conducted to examine the competitiveness of nations in the garment and textile industry.

Karaalp and Yilmaz examined the Turkish textile and clothing industries' comparative advantage and competitiveness by using Balassa's revealed comparative advantage index and Vollrath's indices of competitive advantage between 1988 and 2008 in the enlarged EU market. They concluded that while the competitiveness indices displayed an increasing trend for the textile industry; they found a decreasing trend for the clothing industry for the years 2005-2008. Compared to that of the EU12, the decrease in the competitiveness of clothing was more intense in the enlarged EU market [3].

Karaalp and Yilmaz analysed the competitiveness of Bangladesh, China, Germany and Turkey in the textile and apparel sector in relation to the US, EU15 countries and world markets with Balassa's revealed comparative advantage (RCA) index for the period 2000-2010. The findings revealed that both the textile and clothing industries of Bangladesh, China and Turkey have a strong comparative advantage in the world markets, the US and the EU-15. However, Germany has no significant comparative advantage in any of these markets. In addition, Turkish textiles show the strongest comparative advantage in all three markets [4].

Yilmaz and Karaalp-Orhan analysed the competitiveness of the textile and clothing sector of the Czech Republic, Hungary, Poland, Romania and Turkey with Balassa's revealed comparative advantage (RCA) index and intra-industry trade (IIT) index for the period 2002-2013. The results indicated just Turkey has a comparative advantage in the

global textile market among the selected countries. Romania has a comparative advantage in the world's clothing market, like Turkey. Additionally, it was found that while the Czech Republic, Hungary and Poland have a high intra-industry trade index, Romania displays an inter-industry trade structure for the textile and clothing industry. According to the findings, they concluded that Turkey offers intra-industry specialisation in textiles and has an inter-industry trade structure in clothing [5].

Kanat analysed the international competitiveness of the Turkish textile and apparel sector in the EU-28 market for the period 2007-2016 by using the Balassa and Vollrath indexes and unit export prices. It was concluded that the Turkish textile and clothing sector keeps its importance and competitiveness in the EU market in terms of average export prices per kilogram, and Balassa and Vollrath index values [6].

Sarıçoban and Yalcin determined Turkey's export competitiveness of 659-carpet and other floorings in the carpet sector and made a comparison of the export specialisation levels of the countries having the lion share of carpet exports (Belgium, China, India, and the Netherlands). Analyses were conducted by using the revealed comparative advantage (RCA) method, Vollrath index, and net export index for the years 2008-2017. According to the results of the Vollrath index, the number of product groups in which the countries have a comparative advantage was determined as Turkey 4, China 2 and India 5. The results of the net export index revealed that Turkey and China had specialised in all carpet product groups [7].

Bashimov examined the competitiveness of the Turkish textile and apparel sector over ASEAN-5 countries for the period 2000-2014 using RCA, RSCA, and trade balance indices. It was found that Turkey had strong competitiveness in the textile and ready-to-wear sectors over ASEAN-5 countries. However, in recent years, index values have been steadily declining [8].

Dziuba et al. investigated the competitiveness of the textile sector of the Visegrad Group countries in trade with the European Union in the period 2004-2016 by using the revealed comparative advantage, the index of import penetration and that

of the relative advantage of trade. They concluded that the Visegrad Group countries' accession to the European Union had had a positive impact on entrepreneurship development and improving the competitiveness of the textile sector [9].

Saki and Moore studied the comparative advantage of the US textile and apparel sectors in terms of revealed comparative advantage (RCA) and normalized revealed comparative advantage (NRCA) for the long term (1996-2016) and short term (2010-2016). They found a positive correlation in the product-level comparison between the two indices. The other findings displayed that US textile and apparel products' export advantage comes from cotton fibre HS5201, artificial filament tow HS5502, non-woven HS5603, cotton yarn HS5205, carpet and other floor coverings HS5703, and worn clothing HS6309 [10].

Tripa et al. investigated the competitiveness of the Romanian textile and clothing industry in the global market by applying Balassa's, Vollrath's and Lafay's indices for the period 1990-2014. The values of the indices indicated that Romania had a comparative advantage and the competitiveness of the clothing products had been increasing until 2003 and decreased steadily after this year [11].

Tapsin and Alitoska examined the comparative advantage of Macedonia in international markets for the period of 2013-2016 by calculating the revealed comparative advantages index and RCA4 index for 150 product groups consisting of 4 digits. They concluded that Macedonia's competitive advantage continues and that its external trade structure turns into capital-intensive products [12].

Dziuba and Jabłońska investigated the competitiveness of the textile industry in Croatia for the period 2005-2016. The RCA-comparative advantage ratio of exports, the IMP-import penetration index, and RTA-index of the relative trade advantage were calculated in the study. RCA values over 1.0 after 2013 showed that Croatia got a comparative advantage in exports of textile products after accession to the European Union, with IMP and RTA ratios confirming this competitiveness [13].

Vu and Pham examined the international competitiveness of Vietnam's clothing and textile industry and made a com-

**Table 1.** Technical textile product codes exported by Turkey. *Source:* Comtrade, 2021 [24].

5401	Sewing thread of man-made filaments.	5911	Textile products and articles for technical uses, specified in Note 7 to this Chapter 59.
5601	Wadding of textile materials and articles.	6113	Garments, knitted or crocheted, rubberised or impregnated, coated or covered with plastics or other materials.
5602	Felt, whether or not impregnated, coated, covered or laminated.	6210	Garments made up of fabrics of heading 5602, 5603, 5903, 5906 or 5907.
5603	Nonwovens, whether or not impregnated, coated, covered or laminated.	6306	Tarpaulins, awnings and sunblinds.
5604	Rubber thread and cord, textile covered.	7019	Glass fibres (including glass wool) and articles thereof (for example, yarn, woven fabrics).
5605	Metallised yarn, whether or not gimped, being textile yarn, or strip or the like of heading 5404 or 5405, combined with metal in the form of thread, strip or powder or covered with metal.	8804	Parachutes (including dirigible parachutes and paragliders) and rotochutes.
5607	Twine, cordage, ropes and cables, whether or not plaited or braided and whether or not impregnated, coated, covered or sheathed with rubber or plastics.	540211	High tenacity yarn other than textured yarn/sewing thread, of aramids, not put up for retail sale.
5608	Knotted netting of twine, cordage or rope.	540219	High tenacity yarn other than textured yarn/sewing thread, of nylon/other polyamides (excl. of 540211), not put up for retail sale.
5609	Articles of yarn, strip or the like of heading 5404 or 5405, twine, cordage, rope or cables, not elsewhere specified or included.	540220	High tenacity yarn other than textured yarn/sewing thread, of polyesters, not put up for retail sale.
5806	Narrow woven fabrics other than goods of heading 5807.	540310	High tenacity yarn other than sewing thread, of viscose rayon, not put up for retail sale.
5807	Labels, badges and similar articles of textile materials, in the piece, in strips or cut to shape or size, not embroidered.	540600	Man-made filament yarn (other than sewing thread), put up for retail sale.
5809	Woven fabrics of metal thread and woven fabrics of metallised yarn of heading 5605, of a kind used in apparel, as furnishing fabrics or for similar purposes, not elsewhere specified or included.	540710	Woven fabrics obt. from high tenacity yarn of nylon/other polyamides/polyesters.
5902	Tyre cord fabric of high tenacity yarn of nylon or other polyamides, polyesters or viscose rayon.	540810	Woven fabrics obt. from high tenacity yarn of viscose rayon.
5903	Textile fabrics impregnated, coated, covered or laminated with plastics, other than those of heading 5902.	630532	Flexible intermediate bulk containers of a kind used for the packing of goods, of man-made textile materials.
5904	Linoleum, whether or not cut to shape.	630533	Sacks & bags, of a kind used for the packing of goods, of polyethylene/polypropylene strip/the like.
5906	Rubberised textile fabrics.	630710	Floor-cloths, dish-cloths, dusters & similar cleaning cloths.
5907	Textile fabrics otherwise impregnated, coated or covered.	630720	Life-jackets & life-belts.
5908	Textile wicks, woven, plaited or knitted, for lamps, stoves, lighters, candles or the like.	870821	Safety seat belts of motor vehicles of 8701-87005.
5909	Textile hose piping and similar textile tubing, with or without lining, armour or accessories of other materials.	870895	Safety airbags with inflator system.
5910	Transmission or conveyor belts or belting, of textile material, whether or not impregnated, coated, covered or laminated with plastics, or reinforced with metal or other material.		

parison with China using the generalized double diamond model. According to the results, Vietnam was less competitive than China [14].

Corovic et al. analysed the competitiveness of Serbia's textile industry in the EU-27 market for the period 2001-2011 by examining the simplified national export profile – NEP and the Balassa index of revealed comparative advantage (RCA). They concluded that the indicators and the industry's specialisation concerning the global average and export performances of the primary export product are sufficient [15].

Rundassa et al. aimed to assess the comparative advantage of the Ethiopian textile and apparel industry for the period 2007-2016 using the Balassa index and Lafay index. The findings revealed that the textile industry had more competitiveness [16].

In these studies, the competitiveness of the textile and apparel sectors of different countries in the markets they export to were examined in comparison with their competitors by using different indices and methods for the periods specified. The common emphasis in the studies is the importance of the sector for the economy. The textile and apparel sector is also one of the leading sectors in Turkey's traditional manufacturing industry. Turkey has to increase its production, product quality and competitiveness to succeed in the increasingly competitive environment of the globalising world. The above papers on the Turkish textile and clothing industries examine the competitive strength of Turkey and its competitors comparatively [3-8]. In all these researches, it is seen that the Turkish textile and clothing sector still has the advantage of competitiveness. Knowledge in the sector, a qualified workforce, and a quality culture can be stated as the most

important reasons for this. However, today, when international competition is being reshaped, there is intense competition in the textile and apparel sector. International economic conditions, such as globalisation, increased competition due to low-cost countries, the removal of quotas and restrictions on textiles and clothing, are forcing Turkey to adapt to this competitive atmosphere in international trade [17]. That countries with cheap labor have seized competitive advantage has increased the importance of high value-added products. The textile and clothing industry, which has a significant place in terms of the Turkish economy, is in the process of renewal. As part of this regeneration process, technical textiles have begun to replace conventional ones in Turkey as quickly as in the rest of the world [18]. In the report of the exporters' association prepared for the sector, the vision of the Turkish textile and clothing industries is stated as increasing the

**Table 2.** Export values of the technical textiles product group (x \$1.000) and Shares (%). **Source:** Table was prepared by the authors using Trade Map (2021) [23] and WITS (2021) [25] data.

	Belgium	China	France	Germany	Italy	Japan	Korea, Rep. of	Mexico
2008	2.872.789	15.827.373	3.490.291	9.454.822	4.869.928	2.941.068	2.766.256	2.300.654
2009	2.269.792	15.045.286	2.727.923	7.477.223	3.774.952	2.507.836	2.269.099	1.714.588
2010	2.436.710	20.027.922	2.912.293	8.458.423	4.299.434	3.168.448	2.783.264	2.573.550
2011	2.700.951	25.112.372	3.318.002	9.670.185	5.005.830	3.404.554	3.183.853	2.787.893
2012	2.338.838	24.463.490	3.240.814	9.057.465	4.680.910	3.445.228	3.105.071	3.177.647
2013	2.610.564	26.963.517	3.352.273	9.581.222	4.744.798	3.120.160	3.240.007	3.492.455
2014	2.452.916	28.544.289	3.331.228	9.987.035	4.856.608	3.092.302	3.376.651	3.748.118
2015	2.208.165	27.403.503	2.732.554	8.527.785	4.190.787	2.865.925	3.054.979	4.162.317
2016	2.090.136	26.598.582	2.795.072	8.831.385	4.259.378	3.295.532	3.033.382	4.180.548
2017	2.595.503	28.007.673	2.959.691	9.609.747	4.446.088	3.589.341	3.093.270	4.159.311
2018	3.005.954	30.477.644	3.134.341	10.361.697	4.638.186	3.683.621	3.241.805	3.931.810
2019	3.026.308	30.182.345	3.007.954	9.552.446	4.505.214	3.493.936	3.200.849	3.688.994
	Turkey	USA	Viet Nam	Total	World	Share 1. %	Share 2. %	Share 3. %
2008	1.286.392	7.279.745	604.093	53.693.411	88.778.960	60.5	4.1	0.6
2009	1.048.227	6.220.975	675.986	45.731.887	74.990.607	61.0	4.6	0.6
2010	1.335.474	7.563.181	949.727	56.508.426	89.623.498	63.1	4.3	0.6
2011	1.594.214	7.957.797	1.311.298	66.046.949	103.520.314	63.8	4.3	0.6
2012	1.515.641	8.457.851	1.493.134	64.976.089	100.654.123	64.6	4.2	0.6
2013	1.663.823	8.899.335	1.773.652	69.441.806	106.461.678	65.2	4.4	0.6
2014	1.719.198	9.246.388	2.066.086	72.420.819	112.662.635	64.3	4.7	0.6
2015	1.554.475	9.209.131	2.082.280	67.991.901	103.729.418	65.5	4.8	0.6
2016	1.592.380	9.034.142	2.162.439	67.872.976	104.471.643	65.0	4.8	0.7
2017	1.679.920	9.355.004	2.547.714	72.043.262	111.332.692	64.7	4.6	0.7
2018	1.890.016	9.450.314	2.965.642	76.781.030	118.592.084	64.7	4.5	0.6
2019	1.865.760	9.141.018	3.540.848	75.205.672	115.204.115	65.3	4.5	0.6

share of high value-added, innovative, competitive technical textile products in traditional textile and clothing products and having high technology [19].

In this context, the principal subject of this study is the determination of the level of specialisation and competitiveness of the countries which have the lion's share in the technical textile sector in the world, and of Turkey. Technical textile products have started to be used extensively in homes, garments, roads, airplanes, automobiles, agriculture, health and many other areas. It has reached a significant share in the traditional textile and apparel sectors and is growing constantly. Therefore, it has a promising future for Turkey and many other countries. It is also seen that academic studies and the activities of businesses have shifted in this direction. For this reason, it is aimed to present the current situation comparatively by examining the competitiveness of Turkey and 10 countries that have a say in technical textile export. In this study, unlike other researches, technical textile products, which are in the vision of the Turkish textile and apparel industries, were examined. No study has been met that determines the competitiveness of countries in technical textiles. Hence, it is thought

to contribute to the sector and academic literature.

### General view of technical textile exports

In 2005, with the abolition of quotas all over the world, the textile and apparel trade experienced fluctuations around the world, and countries with cheap labour significantly seized market dominance. In countries whose competitiveness in textile products is negatively affected, the textile industry has rapidly started to move towards products with high added value [19], among which technical textiles also occupy an important place. Technical textiles are textile materials and products manufactured mainly for the technical and performance characteristics that they have, rather than for their aesthetic or decorative properties [20]. Technical textiles are used in many areas, from agriculture to industry, from military areas to medical facilities, from packaging to construction textiles, from geology to sports [21]. High technology and qualified labour are required for the production of technical textiles. Consequently, technical textiles are still produced in developed countries and are the key to success in global competition.

However, technical textiles are seen as a promising sector, constantly growing strongly in contrast to the traditional textile and ready-to-wear sectors. Turkey ranks 20<sup>th</sup> with a 1.6% share of world exports of technical textiles [19]. Investments in technical textiles in Turkey have been increasing exponentially in recent years. Because of these characteristics, related institutions and organisations carry out intensive work on the sector in most countries.

In this study, total technical textile export and import data of countries and the world were obtained using the 39 product codes above. In the later part of the study, separate analyses were performed for each code, but the code names are not given because they would be both long and repeated.

**Table 2** shows the total export values of the 11 countries selected and the world in the product groups whose codes are given above. The 11 countries consists of Turkey and 10 countries that have the lion's share of exports of these product groups in the world. In the total column, the total export values of technical textile product groups of these 11 countries, and in the world column, the total export values of



technical textile product groups of the world are included. In the “share 1” column, the share of the total technical textile exports of the countries selected in the total world technical textile exports, in the “share 2” column, the share of the total world textile exports in the total world exports, and in the “share 3” column, the share of world technical textile exports in the total world exports, are shown.

Accordingly, the total technical textile exports of the countries selected accounted for 60.5% of world technical textile exports in 2008, 65.5% in 2015, and 65.3% in 2019. This shows that the 11 countries examined have a significant share in this sector. In 2008, the share of textile exports in the world’s total exports was 4.1%, while the share of technical textile exports was 0.6%. In 2019, the share of textile exports in the world’s total exports was 4.5%, but the share of technical textile exports remained 0.6%.

Examining **Table 2**, it is seen that the 11 countries account for over 60% of the world’s technical textile exports. For this reason, these countries were covered by the study, and the level of specialisation in each technical textile product group of each country was analysed with the approach of comparative advantages.

## Methodology

Technical textile export and import data for the 2008-2019 period used in the study was downloaded from the Trade Map [23] and WITS [25] database using HS 2007 (Harmonized Commodity Description and Coding Systems (HS)) and SITC Rev. 3 (Standard International Trade Classification, Revision 3) product classification.

First, the RTA and NEI indices, which measure the countries’ level of specialisation in exports, were calculated separately for the 39 technical textile product groups given in **Table 1**. Later, a competitiveness analysis was also performed with regard to the density of technology used in the production of exported goods of the countries. Calculations and comments on these indexes are given below.

### Relative Trade Advantage (RTA)

In the study, the relative trade advantage index developed by Thomas L. Vollrath in the article titled “The Latest Measures of RCA”, published in 1991, was used to determine export competitiveness. RTA

is derived from the difference between the relative export advantage (RXA) and relative import advantage (RMA).

RXA can be defined as the ratio of a country’s inland specialisation of a particular export of goods or sectors to world specialisation of the same export of goods or sectors. RMA, on the other hand, shows the advantage and disadvantage that a country has compared to the world based on product groups imported. RXA and RMA are formulated as follows [26, 27]:

$$RXA_k^j = \frac{X_k^j / X_{-kT}^j}{X_{kT}^{-j} / X_{-kT}^{-j}} \quad (1)$$

$$RMA_k^j = \frac{M_k^j / M_{-kT}^j}{M_{kT}^{-j} / M_{-kT}^{-j}} \quad (2)$$

$X_k^j$  → ‘j’ country’s export of ‘k’ goods in ‘t’ period,  
 $X_{-kT}^j$  → ‘j’ country’s total export except ‘k’ goods in ‘t’ period,  
 $X_{kT}^{-j}$  → World’s total export of ‘k’ goods except ‘ $X_k^j$ ’ in ‘t’ period,  
 $X_{-kT}^{-j}$  → World’s total export except ‘ $X_{kT}^j$ ’ and ‘ $X_{kT}^{-j}$ ’ in ‘t’ period.

RMA is very similar to RXA. The only difference is that the import (M) is included in the formula instead of the export (X). Therefore, the explanations made above for the RXA formula are the same for RMA. Here, If  $RXA > 1$ , country ‘j’ has specialised in the export of ‘k’ and has a competitive advantage.

If  $RXA < 1$ , country ‘j’ has not been able to specialise in the export of ‘k’ and has a competitive disadvantage.

If  $RXA = 1$ , country ‘j’ has the same specialisation as the world in exports of ‘k’ and there is a balance in its competitiveness.

If  $RMA > 1$ , country ‘j’ has a comparative disadvantage in ‘k’.

If  $RMA < 1$ , country ‘j’ has a comparative advantage in ‘k’.

If  $RMA = 1$ , there is a balance in the competitive advantage of ‘j’ in country k. So far, the RXA and RMA indexes have been shown. RTA consists of the difference between these two indices [26, 28].

$$RTA_k^j = RXA_k^j - RMA_k^j \quad (3)$$

$$RTA_k^j = \left[ \frac{X_k^j / X_{-kT}^j}{X_{kT}^{-j} / X_{-kT}^{-j}} \right] - \left[ \frac{M_k^j / M_{-kT}^j}{M_{kT}^{-j} / M_{-kT}^{-j}} \right] \quad (4)$$

Here,

If  $RTA > 0$ , country j specialises in the export of ‘k’ goods and has a comparative advantage/competitive advantage.

If  $RTA < 0$ , country j has not been able to specialise in the export of ‘k’ goods and has a competitive disadvantage.

The RTA index has been developed in response to criticism that foreign trade does not consist only of exports, imports should also be taken into account, and has been a method often used in the literature.

In the study, the average of 12-year RTA coefficients was calculated using the ‘appropriate average’ method. The appropriate average is the average calculated by subtracting extreme values in the series, i.e. outliers or extreme values that go beyond normal from the series. In this respect, the appropriate average was used in the study as a method that optimally summarises the central trend of observation values [29].

### Net Export Index (NEI)

The net export index is calculated by dividing net exports for a given sector by the sum of exports and imports [30]. The NEI Index assesses a country’s trade movements with the rest of the world in relation to its total trade [31]. Therefore, it is possible to say that the NEI index mainly measures intra-industry trade and can only be used to determine a country’s own commercial (domestic) performance. The NEI index is shown as follows [32, 33]:

$$NEI_k^j = \frac{X_{kt}^j - M_{kt}^j}{X_{kt}^j + M_{kt}^j} \quad (5)$$

In the formula ‘X’ represents exports, ‘M’ imports, ‘j’ the country, ‘k’ the goods group (or sector), and ‘t’ the period.

The NEI index takes values between ‘-1’ and ‘+1’. Negative values indicate imports are more important in that commodity (or sector), that the country cannot demonstrate specialisation in that commodity (or sector) and has a competitive disadvantage, while positive values indicate exports are more important and that the country specialises in that commodity (or sector). If the index results are  $NEI = -1$ , it refers to full import specialisation, in which case there is the highest comparative disadvantage. If  $NEI = +1$ , this result refers to full export specialisation, and in this case, the high-

est comparative superiority is at stake. If  $NEI=0$ , this means that there is balanced and maximum intra-industry trade.

### Technology Classification (T-RXA)

Technology classification is the classification of goods subject to foreign trade according to the density of technology used in production. In this method, which was first used by Haufbauer and Chilas [34], goods subject to foreign trade are divided into five groups based on the classification of SITC Rev.3: raw material-intensive, labour-intensive, capital-intensive, research-based goods that can be easily imitated and difficult to imitate. The cumulative sum of export data for these five groups, whose codes are given below, was found and then analysed with the RXA index, which measures export specialisation relative to the world average. Here, the index is called T-RXA as it is an analysis according to technology classification.

Technology classification comprises digit-1 and digit-2 product groups belonging to the SITC Rev. 3 classification. These codes are as follows [34]:

- Raw Material Intensive Goods: 0, 23, 24, 25, 27, 28, 29, 22, 21, 32, 33, 34, 4, 56
- Labor Intensive Goods: 26, 61, 63, 64, 65, 66, 69, 81, 82, 83, 84, 85, 89
- Capital Intensive Goods: 1, 35, 53, 55, 62, 67, 68, 78
- Easy to Imitate Science-Based Goods: 51, 52, 54, 58, 59, 75, 76
- Hard to Imitate Science-Based Goods: 57, 71, 72, 73, 74, 77, 79, 87, 88

However, the resulting T-RXA coefficients are grouped as follows to better interpret the degrees of advantage [35]:

- $0 < RXA \leq 1$  Disadvantage (Dis.),
- $1 < RXA \leq 2$  Weak Advantage (Weak)
- $2 < RXA \leq 4$  Moderate Advantage (Mod.),
- $4 < RXA$  Strong Advantage (Strong).

### ■ Results

Positive RTA values mean that the country has a higher specialisation in related product group exports than the world average. In other words, positive values indicate the country has a comparative advantage in that product group and has a competitive advantage globally. Negative values of RTA mean that the country has a specialisation below the world average in exports of the relevant product group and therefore has a competitive

disadvantage. Positive values of NEI, which measures the country's commercial performance, indicate that the country specialises in the export of this product group, while negative values show that the country specialises in the import of the relevant product group.

First, RTA and NEI indices, which measure the level of specialisation of countries in exports, were calculated separately for the 39 technical textile product groups. In **Table 3**, both the RTA and NEI coefficients of the countries are given in detail and the overall results that display the number of product groups having positive RTA and NEI coefficients are summarized in the last row (total row) of this table.

According to the positive RTA results in **Table 3**, the number of product groups that China demonstrated a specialisation in above the world average was 33, and it achieved a competitive advantage in these product groups. The USA and Korea followed China with 23 product groups in which they had a specialisation, with Turkey and Japan next with 22 product groups. On the other hand, the countries which had the least comparative advantage (RTA) in exports of the 39 technical textile products were Mexico, Vietnam and Belgium, showing specialisation in 10, 11 and 14 product groups, respectively.

The overall NEI results in **Table 3**, which measure the country's domestic performance, in other words, whether the country specialises in exports or imports of the relevant product group in its own foreign trade, reveal that China specialised in exports of 38 of the 39 technical textile product group. Germany, Korea, Italy and Japan were next with 22 product groups, followed by Belgium – 19 product groups, Turkey – 18 product groups, and the USA – 17 product groups. In terms of their commercial performance, Mexico, Vietnam and France were the countries with the least specialisation in exports, with 10, 11 and 15 product groups, respectively.

When the overall results of the RTA and NEI indices are examined, it is possible to say that the two give close results, the reason for which can be explained through the NEI results. As the country specialises in the export rather than the import of a product group in terms of its commercial performance (especially as

the NEI coefficient approaches +1), this is generally manifested in the RTA, and the country can achieve specialisation above the world average.

In the results of both indexes, positive values mean that the country specialises in exporting this product group, while negative ones mean that it cannot demonstrate a specialisation in exporting. For example, the number of product groups of Belgium with positive RTA and NEI coefficients are 14 and 19, respectively. That is to say, Belgium specialised in 14 product groups globally and in exports of 19 product groups in terms of its own commercial performance. In Turkey, the RTA index of 22 product groups and the NEI coefficients of 18 product groups are positive. This means that Turkey demonstrated a specialisation above the world average in 22 product groups, while 18 product groups with a positive NEI index also showed specialisation in exports.

From the point of view of competitive relations between countries when considering the RTA results, all countries, except Vietnam and Mexico, demonstrated a specialisation above the world average in the 5602 and 540810 coded product groups. This result indicates that the remaining 9 countries were in strict competition for exports of this product group. In the 5608 coded product group, only China and Vietnam were able to achieve a comparative advantage, with other countries having a competitive disadvantage. It is possible to say that there was also strong competition between China and Vietnam in the export of this product group. While only China, Korea and the USA gained a competitive advantage in exports of the 540310 coded product group, all other countries, except Belgium, Vietnam and Mexico, gained a comparative advantage by specialising above the world average in the product groups with codes 5603 and 5807.

Besides monitoring the coefficients and establishing a competitive relationship between countries, a comparison can be made between domestic specialisation and world specialisation by considering the positive values of both the RTA and NEI indices. RTA and NEI index results of 5401, 5602, 5603, 5604, 5807, 5809, 5902, 5904, 5907, 5908, 6306, 540219, 540600, 540710, 540810, 630532, 630533 and 870821 coded product groups of Turkey are both positive. This

Table 3. RTA and NEI coefficients of countries.

Codes	BEL		CHN		FRA		DEU		ITA		JPN		KOR		MEX		TUR		USA		VNM	
	RTA	NEI	RTA	NEI	RTA	NEI	RTA	NEI	RTA	NEI	RTA	NEI	RTA	NEI	RTA	NEI	RTA	NEI	RTA	NEI	RTA	NEI
5401	-0.13	-0.47	<b>2.26</b>	<b>0.67</b>	-0.32	<b>0.08</b>	<b>1.48</b>	<b>0.48</b>	-0.23	-0.10	<b>0.44</b>	<b>0.56</b>	<b>0.70</b>	<b>0.56</b>	-2.52	-0.57	<b>1.41</b>	<b>0.20</b>	<b>0.96</b>	<b>0.47</b>	-3.69	-0.49
5601	-0.18	-0.23	<b>0.50</b>	<b>0.41</b>	-0.22	-0.49	<b>0.01</b>	<b>0.10</b>	<b>2.43</b>	<b>0.59</b>	<b>0.24</b>	<b>0.10</b>	-0.42	-0.18	-0.21	-0.16	<b>0.39</b>	-0.06	<b>0.30</b>	<b>0.00</b>	-2.77	-0.71
5602	<b>0.01</b>	<b>0.06</b>	<b>0.37</b>	<b>0.37</b>	<b>0.19</b>	-0.18	<b>1.60</b>	<b>0.55</b>	<b>2.80</b>	<b>0.65</b>	<b>0.37</b>	<b>0.35</b>	<b>0.17</b>	<b>0.23</b>	-1.82	-0.51	<b>2.01</b>	<b>0.23</b>	<b>0.81</b>	<b>0.20</b>	-1.32	-0.86
5603	-0.02	<b>0.05</b>	<b>0.46</b>	<b>0.36</b>	<b>0.28</b>	-0.97	<b>0.71</b>	<b>0.33</b>	<b>1.75</b>	<b>0.45</b>	<b>0.03</b>	<b>0.05</b>	<b>0.12</b>	<b>0.16</b>	-1.46	-0.68	<b>1.07</b>	<b>0.07</b>	<b>1.14</b>	<b>0.22</b>	-2.30	-0.74
5604	-0.12	-0.12	<b>2.94</b>	<b>0.69</b>	<b>1.62</b>	0.74	0.25	0.36	2.90	0.68	<b>0.31</b>	<b>0.21</b>	-0.20	-0.05	-1.42	-0.93	<b>1.03</b>	<b>0.22</b>	<b>0.40</b>	<b>0.02</b>	-19.60	-0.76
5605	0.92	<b>0.22</b>	<b>3.12</b>	<b>0.82</b>	<b>0.49</b>	<b>0.61</b>	<b>0.02</b>	<b>0.19</b>	-2.14	-0.51	<b>2.70</b>	<b>0.94</b>	<b>0.37</b>	<b>0.49</b>	-0.47	-0.61	-0.56	-0.18	<b>0.41</b>	<b>0.16</b>	-0.55	-0.97
5607	-0.04	<b>0.11</b>	<b>1.86</b>	<b>0.79</b>	-0.60	<b>0.71</b>	-0.24	<b>0.01</b>	-0.29	-0.16	-0.23	-0.14	<b>1.27</b>	<b>0.66</b>	-0.58	-0.16	<b>0.13</b>	-0.01	-0.38	-0.32	-0.66	-0.09
5608	-0.16	-0.36	<b>3.56</b>	<b>0.93</b>	-0.53	-0.07	-0.21	<b>0.01</b>	-0.02	<b>0.12</b>	-1.66	-0.35	-0.55	-0.03	-0.22	-0.08	-0.24	-0.32	-0.25	-1.00	<b>4.44</b>	<b>0.41</b>
5609	-0.11	-0.20	<b>4.31</b>	<b>0.85</b>	<b>0.03</b>	<b>0.07</b>	<b>0.53</b>	<b>0.33</b>	-0.11	-0.17	-0.73	-0.65	<b>0.25</b>	<b>0.20</b>	-0.44	-0.28	<b>0.22</b>	-0.05	-2.71	-0.76	-2.23	-0.50
5806	<b>0.45</b>	<b>0.46</b>	<b>2.14</b>	<b>0.62</b>	<b>0.61</b>	-0.11	<b>0.29</b>	<b>0.34</b>	<b>0.59</b>	<b>0.35</b>	<b>0.19</b>	<b>0.24</b>	<b>0.42</b>	<b>0.56</b>	-3.58	-0.73	-0.24	-0.24	<b>0.55</b>	<b>0.05</b>	-4.31	-0.67
5807	-0.11	-0.29	<b>1.16</b>	<b>0.52</b>	<b>0.63</b>	-0.13	<b>0.18</b>	<b>0.39</b>	<b>1.69</b>	<b>0.64</b>	<b>0.41</b>	<b>0.76</b>	<b>4.06</b>	<b>0.91</b>	-0.48	-0.44	<b>0.66</b>	<b>0.03</b>	<b>0.16</b>	<b>0.02</b>	-19.90	-0.90
5809	-0.03	-0.25	<b>0.88</b>	<b>0.57</b>	<b>3.78</b>	<b>0.79</b>	-0.14	-0.28	<b>2.68</b>	<b>0.62</b>	<b>1.99</b>	<b>0.83</b>	<b>1.55</b>	<b>0.78</b>	-0.59	-0.88	<b>0.44</b>	<b>0.25</b>	<b>0.40</b>	-0.08	-2.61	-0.95
5902	0.16	<b>0.57</b>	<b>1.50</b>	<b>0.69</b>	-0.54	<b>0.22</b>	-0.84	-0.49	<b>0.26</b>	<b>0.18</b>	-0.74	-0.49	<b>1.79</b>	<b>0.36</b>	-0.15	-0.15	<b>4.85</b>	<b>0.49</b>	-0.32	-0.46	<b>13.20</b>	0.67
5903	<b>0.35</b>	<b>0.49</b>	<b>3.16</b>	<b>0.63</b>	<b>0.09</b>	-0.60	<b>0.46</b>	<b>0.51</b>	<b>0.73</b>	<b>0.44</b>	<b>0.63</b>	<b>0.65</b>	<b>1.75</b>	<b>0.75</b>	-2.92	-0.78	-0.37	-0.20	<b>0.32</b>	<b>0.05</b>	-8.02	-0.83
5904	<b>1.22</b>	<b>0.35</b>	<b>0.59</b>	<b>0.57</b>	-0.76	-0.74	<b>0.25</b>	<b>0.01</b>	<b>3.35</b>	<b>0.78</b>	-0.17	-0.99	-0.21	-0.81	-0.04	-0.93	<b>0.47</b>	<b>0.23</b>	-0.50	-0.67	-0.27	-0.73
5906	<b>0.97</b>	<b>0.44</b>	-0.12	<b>0.05</b>	-0.22	-0.39	<b>1.45</b>	<b>0.36</b>	<b>1.25</b>	<b>0.42</b>	<b>0.52</b>	<b>0.37</b>	<b>0.04</b>	<b>0.10</b>	-2.26	-0.85	-0.77	-0.60	<b>1.27</b>	<b>0.13</b>	-1.00	-0.94
5907	<b>0.12</b>	<b>0.15</b>	<b>3.22</b>	<b>0.67</b>	<b>0.22</b>	<b>0.89</b>	-0.82	-0.29	<b>2.45</b>	<b>0.73</b>	<b>0.45</b>	<b>0.70</b>	<b>1.73</b>	<b>0.83</b>	<b>0.03</b>	<b>0.03</b>	<b>1.74</b>	<b>0.20</b>	<b>1.52</b>	<b>0.48</b>	-7.05	-0.73
5908	-0.41	-0.46	<b>0.66</b>	<b>0.56</b>	-0.25	<b>0.84</b>	<b>4.27</b>	<b>0.59</b>	-0.01	-0.09	<b>0.38</b>	<b>0.51</b>	<b>0.87</b>	<b>0.64</b>	-2.50	-0.96	<b>0.45</b>	<b>0.32</b>	<b>0.67</b>	-0.09	-5.81	-0.98
5909	-0.11	<b>0.01</b>	<b>2.64</b>	<b>0.92</b>	<b>1.13</b>	<b>0.71</b>	<b>1.20</b>	<b>0.69</b>	-0.70	-0.72	-0.66	-0.41	-0.50	-0.65	-1.38	-0.58	-0.20	-0.39	<b>0.88</b>	<b>0.12</b>	-3.56	-0.81
5910	-0.39	-0.59	<b>0.62</b>	<b>0.42</b>	-0.54	<b>0.04</b>	<b>1.78</b>	<b>0.52</b>	<b>3.26</b>	<b>0.73</b>	<b>1.21</b>	<b>0.66</b>	-0.89	-0.69	-0.68	-0.77	-0.54	-0.50	-0.01	-0.30	-1.37	-0.99
5911	<b>0.79</b>	<b>0.48</b>	-0.19	<b>0.01</b>	<b>0.05</b>	-1.00	<b>1.01</b>	<b>0.31</b>	<b>0.50</b>	<b>0.17</b>	<b>1.01</b>	<b>0.37</b>	-0.21	-0.15	-0.92	-0.34	-0.39	-0.51	<b>0.50</b>	-0.13	-0.75	-0.45
6113	<b>0.11</b>	<b>0.18</b>	<b>1.95</b>	<b>0.98</b>	-1.02	-0.50	-0.80	-0.34	<b>6.83</b>	<b>0.77</b>	-0.71	-0.97	-0.21	-0.63	<b>0.00</b>	<b>0.10</b>	-0.28	-0.77	-1.54	-0.73	<b>4.25</b>	<b>0.95</b>
6210	-0.07	<b>0.06</b>	<b>5.98</b>	<b>0.98</b>	-0.31	-0.98	-0.88	-0.31	<b>1.87</b>	<b>0.50</b>	-1.17	-0.99	-1.01	-0.96	<b>0.00</b>	<b>0.07</b>	-0.91	-0.63	-1.28	-0.78	<b>5.20</b>	<b>0.98</b>
6306	-0.14	<b>0.05</b>	<b>7.56</b>	<b>0.99</b>	-0.94	-0.20	-0.59	-0.10	<b>0.03</b>	<b>0.12</b>	-0.62	-0.84	-0.60	-0.65	-0.21	-0.62	<b>0.56</b>	<b>0.45</b>	-1.14	-0.68	<b>1.79</b>	<b>0.90</b>
7019	1.12	0.34	0.78	0.39	0.09	-0.89	-0.85	-0.26	-0.43	-0.21	<b>0.01</b>	<b>0.01</b>	-0.81	-0.49	-0.17	-0.07	-0.18	-0.27	<b>0.79</b>	<b>0.04</b>	-0.69	-0.84
8804	-0.31	-0.92	<b>0.12</b>	<b>0.76</b>	-0.10	<b>0.80</b>	-0.36	<b>0.02</b>	-0.56	-0.35	-1.15	-0.92	<b>0.18</b>	<b>0.25</b>	<b>0.01</b>	<b>0.15</b>	-0.25	-0.71	<b>3.90</b>	<b>0.56</b>	<b>8.12</b>	<b>0.91</b>
540211	<b>0.61</b>	0.00	-1.00	-0.78	-0.85	<b>0.49</b>	-2.86	-1.00	-2.24	-0.77	<b>1.36</b>	<b>0.72</b>	<b>2.73</b>	<b>0.75</b>	-0.67	-0.94	-0.97	-0.84	<b>0.64</b>	-0.17	-0.53	-0.99
540219	-0.18	-0.60	<b>1.68</b>	<b>0.55</b>	-0.49	<b>0.90</b>	-0.68	-1.00	<b>0.42</b>	<b>0.13</b>	<b>2.40</b>	<b>0.78</b>	-0.91	-0.33	-0.70	-0.85	<b>7.84</b>	<b>0.71</b>	-0.21	-0.44	-3.79	-0.71
540220	-0.49	-0.27	<b>4.44</b>	<b>0.83</b>	<b>0.31</b>	-0.46	<b>0.06</b>	<b>0.09</b>	-0.97	-0.78	<b>0.01</b>	<b>0.04</b>	<b>2.89</b>	<b>0.53</b>	-0.39	-0.23	-1.94	-0.79	-0.67	-0.63	-1.69	-0.58
540310	-0.01	-0.47	<b>0.24</b>	<b>0.35</b>	-0.77	-0.41	-1.07	-1.00	-6.01	-0.92	-1.41	-1.00	<b>0.02</b>	<b>0.36</b>	-0.18	-0.97	-0.49	-0.85	<b>0.01</b>	-0.71	-0.75	-0.92
540600	-0.38	-0.27	<b>5.91</b>	<b>0.96</b>	-0.54	-0.04	-0.33	-0.28	<b>0.81</b>	<b>0.35</b>	<b>0.01</b>	<b>0.07</b>	<b>0.16</b>	<b>0.24</b>	<b>1.36</b>	<b>0.54</b>	<b>4.80</b>	<b>0.90</b>	-1.40	-0.50	-1.82	-0.94
540710	<b>0.15</b>	<b>0.25</b>	-0.01	<b>0.17</b>	-0.17	<b>0.25</b>	<b>0.29</b>	<b>0.29</b>	<b>0.62</b>	<b>0.34</b>	<b>0.07</b>	<b>0.29</b>	<b>0.81</b>	<b>0.71</b>	-2.30	-0.97	<b>0.30</b>	<b>0.25</b>	<b>0.64</b>	<b>0.41</b>	-8.82	-0.84
540810	0.28	<b>0.35</b>	<b>0.22</b>	<b>0.55</b>	<b>1.34</b>	-0.73	<b>0.01</b>	-0.20	<b>6.06</b>	<b>0.31</b>	<b>0.10</b>	<b>0.22</b>	<b>0.35</b>	-0.09	-0.12	-0.97	<b>2.54</b>	<b>0.68</b>	<b>0.38</b>	<b>0.31</b>	-44.13	-0.99
630532	-0.54	-0.19	<b>2.63</b>	<b>0.98</b>	-1.65	-0.98	-1.09	-0.49	-0.74	-0.72	-4.10	-0.99	-2.82	-0.97	<b>1.10</b>	<b>0.81</b>	<b>17.63</b>	<b>0.97</b>	-1.13	-0.91	<b>8.36</b>	<b>0.98</b>
630533	-0.32	-0.11	<b>7.23</b>	<b>0.98</b>	-0.59	-0.04	-0.19	-0.50	-0.83	-0.75	-0.93	-0.98	-0.90	-0.70	<b>0.15</b>	<b>0.25</b>	<b>6.26</b>	<b>0.95</b>	-0.95	-0.78	<b>7.96</b>	<b>0.94</b>
630710	-0.60	-0.11	<b>4.66</b>	<b>0.93</b>	-1.05	-0.94	-0.34	-0.02	-0.47	-0.19	-0.76	-0.67	<b>0.47</b>	<b>0.56</b>	-0.46	-0.44	<b>0.14</b>	-0.03	-2.14	-0.79	<b>1.23</b>	<b>0.69</b>
630720	-0.02	<b>0.01</b>	<b>4.27</b>	<b>0.83</b>	-0.46	-0.35	-0.13	-0.09	-0.29	-0.23	-0.32	-0.68	-0.43	-0.72	0.32	<b>0.32</b>	-0.14	-0.37	-1.45	-0.60	<b>0.90</b>	<b>0.63</b>
870821	-0.58	-0.65	-0.16	<b>0.01</b>	-0.74	-0.96	-3.56	-0.34	-0.15	-0.08	-1.25	-0.60	<b>0.55</b>	<b>0.48</b>	<b>7.33</b>	<b>0.75</b>	<b>1.73</b>	<b>0.24</b>	<b>0.25</b>	<b>0.04</b>	-0.45	-0.90
870895	-0.25	-0.68	-0.18	<b>0.00</b>	<b>0.20</b>	-0.77	<b>0.59</b>	<b>0.24</b>	-0.14	-0.29	-0.71	-0.22	-0.83	-0.40	<b>4.62</b>	<b>0.25</b>	-0.89	-0.64	<b>0.32</b>	-0.18	<b>2.31</b>	<b>0.81</b>
TOTAL	14	19	33	38	16	15	20	22	21	22	22	22	23	22	10	10	22	18	23	17	11	11

means Turkey had specialisation in exports in terms of domestic performance and showed specialisation above the world average in these product groups. On the contrary, both NEI and RTA index values of 17 product groups in *Table 3* are negative. Turkey did not have neither domestic specialisation nor world specialisation in the export of these product groups. When the RTA and NEI values of China are examined, it is seen that both index values of 33 product groups are positive. China specialised in the export of 33 of the 39 product groups examined, both domestically and globally. Only in the 540211 coded product group are both index values negative. China specialised in the import of this product group. As

a third example, Germany's RTA and NEI index results of the 5401 coded product group are positive. Germany gained a global competitive advantage in the relevant product group by both specialising in exports in terms of domestic performance and showing a specialisation above the world average.

An evaluation can be made in terms of the closeness of the NEI value to zero. Turkey achieved a global competitive advantage by showing specialisation above the world average in the 5601, 5607 and 5609 coded product groups with positive RTA values. However, Turkey could not show domestic specialisation in exports of these product groups, as NEI values

are negative; in other words, Turkey specialised in imports of these product groups. The reason for such a situation may be intense intra-industry trade. That NEI values are also close to zero indicates that balanced trade is involved. On the other hand, China specializes in product code 5906 below the world average due to its negative RTA value. The NEI value is positive but very close to zero. Therefore, China also had nearly balanced trade in this product and achieved small domestic specialisation.

According to the closeness of NEI values to +1 or -1 values, the status of countries becoming full exporters or full importers can also be monitored. For example, Chi-



**Table 4.** Specialisation levels of countries by technology density (T-RXA).

	BEL		CHN		FRA		DEU		ITA		JPN	
Raw Material Intensive Goods	0.87	Dis.	0.16	Dis.	0.55	Dis.	0.29	Dis.	0.44	Dis.	0.13	Dis.
Labour Intensive Goods	<b>1.06</b>	<b>Weak</b>	<b>3.25</b>	<b>Mod.</b>	0.93	Dis.	0.86	Dis.	<b>2.10</b>	<b>Mod.</b>	0.37	Dis.
Capital Intensive Goods	<b>1.41</b>	<b>Weak</b>	0.48	Dis.	<b>1.59</b>	<b>Weak</b>	<b>1.94</b>	<b>Weak</b>	<b>1.20</b>	<b>Weak</b>	2.45	<b>Mod.</b>
Easy-to-Imitate, Science-Based Goods	<b>1.75</b>	<b>Weak</b>	<b>2.31</b>	<b>Mod.</b>	0.92	Dis.	0.96	Dis.	0.59	Dis.	0.76	Dis.
Hard-to-Imitate, Science-Based Goods	0.69	Dis.	<b>1.20</b>	<b>Weak</b>	<b>1.48</b>	<b>Weak</b>	<b>1.61</b>	<b>Weak</b>	<b>1.40</b>	<b>Weak</b>	<b>2.40</b>	<b>Mod.</b>
	KOR		MEX		TUR		USA		VNM			
Raw Material Intensive Goods	0.36	Dis.	0.70	Dis.	0.65	Dis.	<b>1.07</b>	<b>Weak</b>	1.14	<b>Weak</b>		
Labour Intensive Goods	0.45	Dis.	0.60	Dis.	<b>2.69</b>	<b>Mod.</b>	0.88	Dis.	3.02	<b>Mod.</b>		
Capital Intensive Goods	<b>1.48</b>	<b>Weak</b>	<b>2.01</b>	<b>Mod.</b>	<b>1.97</b>	<b>Weak</b>	0.88	Dis.	0.29	Dis.		
Easy-to-Imitate, Science-Based Goods	<b>1.08</b>	<b>Weak</b>	<b>1.27</b>	<b>Weak</b>	0.27	Dis.	0.89	Dis.	1.60	<b>Weak</b>		
Hard-to-Imitate, Science-Based Goods	<b>2.63</b>	<b>Mod.</b>	0.99	Dis.	0.57	Dis.	<b>1.13</b>	<b>Weak</b>	0.40	Dis.		

na's NEI values in codes such as 6113, 6210, 6306 are quite close to +1. These results indicate China is almost a full exporter in these product groups. Similarly, Japan in 5605, Korea in 5807, and Turkey in 630532 and 630533 are almost full exporters. An NEI value approaching -1 indicates that countries are on the way to becoming full importers. France in 630532, Vietnam in 540211 and Japan in 5904 are almost full importers.

In addition, if a country's inland performance shows specialisation not in imports of the relevant product groups but in exports (If the NEI coefficient approaches +1), as mentioned before, the country achieves specialisation over the world average and gains a comparative advantage in the global market. For example, all NEI coefficients belonging to 33 product groups with positive RTA values in China are also positive, while NEI values are positive in 13 of Belgium's 14 product groups, with positive RTA values (5602, 5605, 5806...). Likewise, while 22 positive RTA values for Turkey; NEI results of 18 product groups are also positive. As the country achieves positive NEI coefficients, in other words its domestic specialisation is not in the import of the relevant product but in its exports, it achieves a comparative advantage and gains a competitive advantage by showing specialisation above the world average in this product group in general. When the table is examined, the results of other countries, except for France, also support this.

So far, for technical textile product groups, the country's own specialisation and that according to the world average have been determined, the results of which are shown in *Table 3*. Finally, in this part of the study, a competitiveness analysis is conducted according to the technology classification of the countries.

In 2005, with the abolition of quotas all over the world, the textile and apparel trade shifted to far eastern countries where labour is cheap, and it became difficult for countries that have a say in the sector, such as Turkey, to compete with these countries. This has also led to countries turning to products with a high added value. Due to the low share of the labour cost in the production of technical textiles in the total cost, the need for R&D, and the industry being capital-intensive, the share of underdeveloped and developing countries in world trade in this sector is quite low compared to their share in the textile and ready-made clothing industries [36].

Technical textiles are high value-added products, and they require high technology. From this point of view, the ability of countries to gain a competitive advantage in technical textile exports in the global market is closely related to the competitive advantage of export goods according to the technology classification. For example, if a country has a specialisation in R&D-based products in its exports, it is expected to have a say in technical textile exports.

*Table 4* shows which production technology the countries have a comparative advantage in when it comes to exports. For example, China has a competitive advantage in the export of R&D-based, easy-to-imitate product groups and R&D-based, hard-to-imitate product groups. Of these, it is moderately superior in easy imitation and mildly superior in difficult imitation. It was previously determined that China specialised over the world average in 33 of the 39 product groups (*Table 3*). This significantly explains the success of China in technical textile product groups. Belgium specialised in the export of labour-intensive, capital-intensive and easily imitated products, therefore it

achieved a poor comparative advantage. France and Germany specialised in the export of capital-intensive and hard-to-imitate products, and thus had a poor comparative advantage. Turkey, on the other hand, is moderately superior in the export of labour-intensive goods, while it is mildly superior in that of capital-intensive goods.

From here, it is possible to make a general inference: If a country as a whole has demonstrated specialisation in the export of R&D-based products, it can also achieve a certain specialisation in the technical textile sector. In the table, all other countries except Turkey achieved a certain specialisation in the export of R&D-based products and have a say in the technical textile sector.

Turkey's lack of competitive advantage in R&D-based sectors, despite the fact that it specialises in 22 technical textile product groups above the world average, can be explained by Turkey's traditional situation, which is formed by knowledge, experience, machinery and a skilled labour force. Turkey achieved a competitive advantage in 19 of the 24 textile product groups for SITC Rev. 3, digit 3 in the 1996-2015 period [37]. This indicates that Turkey has important specialisation in the traditional textile sector. However, especially after 2005, the shift of traditional labour-intensive textile production to far eastern countries where labour is cheap, has forced countries such as Turkey to produce products with a high added value based on R&D, like technical textiles.

## ■ Conclusions

In the study, export specialisation levels and competitive forces in the technical textile product groups of Turkey and countries that have a say in the world



technical textile sector were determined. For this, the relative trade advantage (RTA), net export advantage (NEI) and, for technology classification, relative export advantage (RXA) indices were used. By examining the RTA index, it was revealed whether the country can demonstrate specialisation above the world average in the technical textile product group exported. With NEI, it was determined whether the country specialises in the export or import of the relevant technical textile product group in terms of its own commercial performance. Finally, a competitiveness analysis was made according to the density of technology used in the production of exported goods, and an evaluation was made of the competitiveness of the technical textile sector among the countries studied, which includes intensive R&D.

According to RTA results, the number of product groups that China, the USA, Korea, Turkey, Japan, Italy, Germany, France, Belgium, Vietnam and Mexico achieved global specialisation in is 33, 23, 23, 22, 22, 21, 20, 16, 14, 11 and 10, respectively. The NEI results revealed that the number of product groups which China, the USA, Korea, Turkey, Japan, Italy, Germany, France, Belgium, Vietnam and Mexico specialised in exports of are 38, 17, 22, 18, 22, 22, 22, 15, 19, 11 & 10, respectively.

In the RTA and NEI analysis, the two indices displayed close results. As a reason for this, the country's own commercial performance can be shown. In other words, as the country specialises in the export rather than the import of a product in terms of its commercial performance (NEI coefficient approaches +1), this situation is manifested in the RTA, and the country can achieve specialisation above the world average.

For example, all the NEI coefficients of the 33 product groups in which China has a higher specialisation (positive RTA) than the world average, are also positive. The NEI results of Turkey's 18 product groups are also positive, while the RTA values of 22 product groups (5602, 5605, 5806...) are positive. Consequently, as a country achieves positive NEI coefficients in a particular product group, in other words, as the country improves its commercial performance in exports rather than imports, it can gain a competitive advantage in a global sense by showing specialisation above the global average

in this product group in general. The results from 10 countries included in the analysis, excluding France, support this. In this study, which was carried out based on the product groups Turkey exports, the technical textile product groups in which Turkey has advantages and disadvantages are revealed. Turkey has high positive NEI and RTA values especially in the product groups of 540219 (high tenacity yarn other than textured yarn/sewing thread, of nylon/other polyamides (excl. of 540211), not put up for retail sale), 540600 (man-made filament yarn (other than sewing thread), put up for retail sale), and 630533 (sacks & bags, of a kind used for the packing of goods, of polyethylene/polypropylene strip/the like). The NEI values of these products are close to +1. Turkey specialises in these products above the world average (RTA) and in the export of them from the domestic market (NEI). On the contrary, both the NEI and RTA values are negative in the product groups of 540220 (high tenacity yarn other than textured yarn/sewing thread, of polyester, not put up for retail sale), 6113 (garments, knitted or crocheted, rubberised or impregnated, coated or covered with plastics or other materials), 540211 (high tenacity yarn other than textured yarn/sewing thread, of aramid, not put up for retail sale), 540310 (high tenacity yarn other than sewing thread, of viscose rayon, not put up for retail sale) and 5906 (rubberised textile fabrics). NEI values are close to -1. For this reason, Turkey specialised in these products below the world average and in the import of these products from the domestic market.

Technical textiles are products that require high technology with high added value. For this reason, the general export goods of the selected countries were classified according to the density of technologies used in their production, and it was determined which technology classification the country has a global competitive advantage in. According to the results obtained, all other countries except Turkey achieved a specialisation above the world average in the export of R&D-based products. There seems to be a relationship between the fact that the countries selected have a competitive advantage in technical textile product groups that require high technology based on R&D and their having a competitive advantage in the R&D-based classification. This relationship can be tested in another econometric or statistical study.

On the other hand, despite not having a competitive advantage in the R&D-based industry according to the technology classification of Turkey's, its being specialised in 22 of the 39 technical textile product groups can be explained by its traditional infrastructure, in that it includes knowledge, experience, machinery and a skilled labour force. Especially after the year 2005, the shift of traditional labour-intensive textile production to far eastern countries where labor is cheap, forced countries such as Turkey to produce products with a high added value based on R&D, such as technical textiles. To survive in the global competitive environment and maintain its competitive advantage in the textile sector, Turkey will have to increase its expertise in this sector by transferring existing production factors from labour intensive to R&D-based production techniques over time.

Turkey should support industries in the technical textile sector, especially where the product groups herein have a competitive advantage; and should support it with appropriate trade, export or incentive policies and introduce tax regulations that reduce production costs in the sector as well as comprehensive policies, especially for intermediate goods and input costs. In the same way, Turkey should pay attention to the issue of increasing R&D investments, ensuring university-industry cooperation and branding. Thus, the sustainability of the textile sector, which is one of the main sectors of Turkey, can be ensured with high value-added technical textile products that will support competitiveness.

## ■ Limitations and future studies

The fact that the codes of technical textile products are not gathered under a main code required the relevant product codes to be handled one by one. Therefore, the paper includes the codes given in the report of the exporters' association. Since it is the first study, all the product codes in that report are discussed, which increased the number of data in the study. For this reason, the representation of the results in graphics became difficult, and it was only possible to give them in tables. In the following studies, it is planned to create a paper that will shed light on the products of technical textiles in certain areas by making detailed examinations in the sector. Retrospective analyses will be made for specific products. □

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