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Regional Comprehensive Economic Partnership (RCEP): Evaluation of Trade Relations Between Member Countries Using the Social Network Analysis Method

Bölgesel Kapsamlı Ekonomik Ortaklık (RCEP): Üye Ülkeler Arasındaki Ticari İlişkilerin Sosyal Ağ Analizi Yöntemi İle Değerlendirilmesi

Fatma Gül ALTIN
Assoc. Prof., Burdur Mehmet Akif Ersoy University
gulaltin@mehmetakif.edu.tr
https://orcid.org/0000-0001-9236-0502

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Mervin YALÇINKAYA
Master Student, Burdur Mehmet Akif Ersoy University
mervinyalcinkaya@gmail.com
https://orcid.org/0000-0002-2302-457X

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ABSTRACT

The Regional Comprehensive Economic Partnership (RCEP) agreement was signed in 2020 as a giant free trade agreement signed by 15 countries, including China. In this context, the RCEP agreement is the world's largest free trade agreement in terms of GDP and trade volume. In this study, commercial relations between RCEP countries between 2012 (the year when negotiations of the RCEP agreement began) and 2021 were examined using social network analysis. In the analyses, export values of RCEP countries to each other were used and the data were obtained from Trade Map. In the study, social network analyzes for the years 2012, 2015, 2018 and 2021 were analyzed using the Ucinet program, while trade networks were visualized with the Gephi program. For social network analyses, basic ego network indicators, degree centrality values, hub and authority centrality values and eigenvector values were calculated. As a result of the analysis, it is seen that the hub and authority country in trade between RCEP countries is China for all four years (2012, 2015, 2018 and 2021). On the other hand, it has been determined that China's most important trade partners are Japan and South Korea. Additionally, the development in Vietnam's trade level during this period is remarkable.

Anahtar Kelimeler:
RCEP,
Sosyal Ağ Analizi,
Uluslararası Ticaret

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ÖZET

Bölgesel Kapsamlı Ekonomik Ortaklık (RCEP) anlaşması, Çin'in de aralarında bulunduğu 15 ülkenin taraf olduğu dev bir serbest ticaret anlaşması olarak 2020 yılında imzalanmıştır. Bu bağlamda, RCEP anlaşması GSYİH ve ticaret hacmi açısından dünyanın en büyük serbest ticaret anlaşmasıdır. Bu çalışmada, 2012 (RCEP anlaşmasının müzakerelerinin başladığı yıl) ile 2021 yılları arasındaki RCEP ülkeleri arasındaki ticari ilişkiler sosyal ağ analizi kullanılarak incelenmiştir. Analizlerde, RCEP ülkelerinin birbirlerine yaptıkları ihracat değerleri kullanılmış ve veriler Trade Map'ten elde edilmiştir. Çalışmada, 2012, 2015, 2018 and 2021 yıllarına ilişkin sosyal ağ analizleri Ucinet programı kullanılarak analiz edilirken, Gephi programıyla ticaret ağları görselleştirilmiştir. Sosyal ağ analizleri için temel ego ağ göstergeleri, derece merkeziliği değerleri, odak ve otorite merkeziliği değerleri ve özvektör değerleri hesaplanmıştır. Analizler sonucunda RCEP ülkeleri arasında yapılan ticarette odak ve otorite konumunda olan ülkenin dört yıl (2012, 2015, 2018 and 2021) için de Çin olduğu görülmektedir. Öte yandan Çin'in en önemli ticaret ortaklarının Japonya ve Güney Kore olduğu tespit edilmiştir. Ayrıca, Vietnam'ın bu dönemde ticaret düzeyindeki gelişme dikkat çekicidir.

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1. INTRODUCTION

Since the mid-20th century, global trade has experienced a long period of growth with increasing trade volumes. But since the 1990s, the size of the world economy has doubled, giving rise to a new era of economic globalization (Jiang & Yu, 2021: 144). This change in the world economy has caused developing countries to disrupt the old order dominated by developed countries and to come to the fore as the main driving force of global trade (Hanson, 2012: 41). Increasing integration in trade has accelerated the spread of information and technology all over the world and encouraged the increase of global cooperation (Grossman & Helpman, 2015: 100).

The Association of Southeast Asian Nations (ASEAN) was established in 1967 and has been leading economic integration since then, despite many changes in the world economy. In this context, ASEAN established the ASEAN Free Trade Area (AFTA) in 1992 and the ASEAN Economic Community (AEC) in 2015 (Shimizu, 2021: 1). The AEC is an economic integration that enables the freer movement of goods, services, investment, skilled workers and capital (Ishikawa, 2021: 24). The AEC 2025 Plan consists of five core items that support each other, one of which is the completion of the Regional Comprehensive Economic Partnership (RCEP). In this way, ASEAN's centrality in global and regional participation is moved to a stronger position (Permatasari, 2020: 87).

In August 2012, the Guiding Principles and Objectives for Negotiating the Regional Comprehensive Economic Partnership were approved by the 16 Ministers of Economy. The RCEP negotiations were initiated by 10 ASEAN Member States (Brunei Darussalam, Cambodia, Indonesia, Lao PDR, Malaysia, Myanmar, the Philippines, Singapore, Thailand and Viet Nam) and six ASEAN FTA partners (Australia, People's Republic of China, India, Japan, Republic of Korea, and New Zealand) at the 21st ASEAN Summit in Cambodia in November 2012 (Asean, 2016). RCEP is promising not only for regional integration but also for regional cooperation. Particularly in the transportation and information and communication technologies sectors, it is possible to achieve significant gains for member countries (Kimura & Chen, 2016: 4).

On 15 November 2020, after eight years of negotiations, the Regional Comprehensive Economic Partnership (RCEP) Agreement was signed by the Leaders of the ASEAN Member States (Australia, China, Japan, Republic of Korea and New Zealand) (Asean, 2020). The agreement is notable in that it accounts for 30% of global GDP, 28% of global trade and 30% of the world's population (Drysdale and Armstrong, 2021: 128). In November 2019, India withdrew from the RCEP Agreement and declared a non-reciprocal trade relationship with RCEP member states. This move of India caused various discussions in the international community (Zhao et al., 2021: 1).

It is expected that the signing of the RCEP, the world's largest trade bloc, during the COVID-19 pandemic, will play a non-negligible role in the recovery of the region after the pandemic (Zhang et al., 2023: 717). The agreement will improve market access by removing tariffs and quotas on more than 65% of traded goods and make trade more active with common rules of origin and regulations. This will encourage firms to invest more in the region by creating supply chains and services, and associated employment generation (Asean, 2020).

After former US President Trump's withdrawal from the Trans-Pacific Partnership (TPP) in 2017, the US imposition of high tariffs on imports from many countries has done great harm to countries in East Asia. This has turned the region's economic attention to the RCEP and the Comprehensive and Progressive Agreement for the Trans-Pacific Partnership (CPTPP) (Tan & Soong, 2021: 273). The successful implementation of the RCEP agreement can be attributed to the strong support of China, the active participation of Japan, the cooperation of ASEAN and the withdrawal of the US from the TPP in 2017 (Wu, 2020: 112-113).

Table 1. Export Values for RCEP Countries (US Dollar thousand)

Year	Total Exports by RCEP Countries	Exports between RCEP Countries	Exports from RCEP Countries to non-RCEP Countries	Total World Exports	Share of RCEP Countries in World Export %
2012	4,953,852,856	1,992,665,288	2,961,187,568	18,399,916,743	26.92
2013	5,060,469,676	2,027,328,652	3,033,141,024	18,858,694,469	26.83
2014	5,196,469,419	2,033,380,151	3,163,089,268	18,862,720,756	27.54
2015	4,818,339,228	1,817,769,723	3,000,569,505	16,416,919,480	29.34
2016	4,623,331,522	1,767,866,320	2,855,465,202	15,923,091,279	29.03
2017	5,119,721,751	2,014,016,432	3,105,705,319	17,562,644,182	29.15
2018	5,573,137,851	2,202,824,311	3,370,313,540	19,327,913,341	28.83
2019	5,479,817,448	2,164,827,930	3,314,989,518	18,748,620,037	29.22
2020	5,426,904,395	2,129,396,637	3,297,507,758	17,499,876,321	31.01
2021	6,869,663,374	2,656,018,614	4,213,644,760	22,138,761,100	31.03

Source: Edited by the authors using data from Trade Map.

Table 1 shows the annual export values for the RCEP countries between 2012 (the year the deal negotiations started) and 2021. While the total exports of RCEP countries increased by 38.67% in 2021 compared to 2012, it is seen that their share in world exports increased to 31.03% in 2021. This situation emphasizes the importance of RCEP countries in world trade. On the other hand, it is seen that in this process, both the export value between RCEP countries (33.29%) and the export value from RCEP countries to non-RCEP countries (42.30%) increased.

In the study, the change in commercial relations over the years between the countries that are parties to the RCEP (Regional Comprehensive Economic Partnership) agreement, a free trade agreement signed in 2020 as a result of negotiations that started in 2012 and lasted for 8 years, was examined using the social network analysis method. The aim of the study is to examine the export performance of RCEP countries, to determine the positions of the union member countries in the trade network and how they affect each other. In the literature, the RCEP agreement has been examined from many different perspectives. However, no research has been found that investigates export relations between member countries using social network analysis. It is thought that the study will contribute to the literature in this aspect.

The rest of this study is created as follows: In the subsequent section a brief literature review is given. In section 3, a detailed explanation of social network analysis is given. In Chapter 4, after giving information about the data set, social network analyzes regarding the export relations of RCEP countries are made and empirical findings are discussed. Finally, the results are evaluated and suggestions for the next studies are presented.

2. LITERATURE REVIEW

Examining international trade networks also gives researchers information about the structure of the international economic system (Deguchi et al., 2014: 1). There are many studies in the literature that research international trade networks using social network analysis. Some of the current research on the RCEP agreement and social network analysis is summarized below.

Zhu & Huang (2023) examined the effects of countries' tariff policies based on the RCEP agreement within the framework of social network theory. In the study, trade data regarding various production industries of the countries were used. Zhao et al. (2021) analyzed goods trade data of India and RCEP member countries for the period 2006-2019 using social network theory. The results of the analysis show that it would be to the advantage of India, which has withdrawn from RCEP membership, to participate in RCEP's regional cooperation. Although Taiwan is geographically located at the center of the RCEP trade area, it remains outside this agreement. Che et al. (2022) explored Taiwan's perception of exclusion and the concerns of the Taiwanese people using Semantic Network Analysis. Taiwanese netizens are more focused on political relations with China than RCEP.

Liu (2022) designed the revised gravity model to create a spatial association network of trade in RCEP countries. In the study, social network results show that China, Australia and Korea are at the center of the network. Karim et al. (2023) researched how RCEP was discussed on Twitter with 345,015 tweets using big data and network analysis. In the analyses, topic classification and sentiment analyses were performed. In the findings, it was concluded that RCEP was discussed as a strategic issue and the sentiment was slightly more negative. Zhou et al. (2021) examined the spatial correlation and evolution characteristics of the trade network of wood-based products in RCEP countries and the structure of the network using social network analysis. In the study, data for the period 2000-2019 was used. In the findings, it was determined that the centrality and evolution characteristics of RCEP countries differ according to years.

Li et al. (2022) focused on the global container transportation impact of RCEP and designed a new global container transportation network based on complex (social) network theory. In the study, a new model is proposed for restructuring the global containerized shipping network, which includes a combination of connectivity frequency, throughput, port distance and route. Qui & Gong (2021) examined the mechanisms between imports of producer services and the advantages of manufacturing in RCEP economies. In the analyses, a hierarchical linear model (HLM) was developed using data for the period 2007 to 2017. On the other hand, in the study, the percentage of producer services of RCEP countries is shown using complex (social) network analysis.

In the literature, there are many studies on RCEP countries using social network analysis. In this study, changes in the trade networks of RCEP countries in the 2012-2021 period were examined using social network analysis. In this respect, the study is thought to offer a different perspective to the literature.

3. METHODOLOGY

In this section, a detailed explanation is given about the social network analysis. The methodological framework of the study is shown in Figure 1 below.

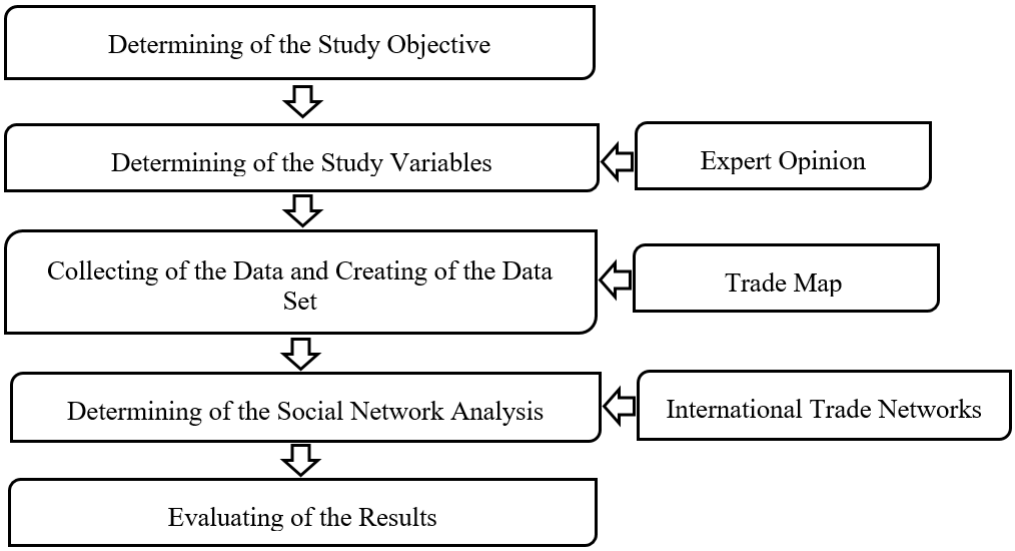

Figure 1. Methodological Framework

The 21st century has witnessed the emergence of new economies structured around data, information and knowledge flows. In parallel, social networks have become more efficient as a form of organization of individuals, groups, organizations and related systems. In this context, social networks consist of nodes of individuals, groups, organizations, and related systems connected to one or more types of interdependencies. These nodes include many different topics, such as shared values, visions, ideas, social connections, financial exchanges, trade, and joint membership in organizations (Serrat, 2017: 39-40).

The term social network was first used by anthropologist Barnes to study relationships between people living in Norway (Barnes, 1954: 39-40). In his research, Barnes expressed social interactions as a cluster of points combined with the lines to create the total network form of the relations (Can & Alatas, 2019: 3). Although social network analysis was first considered within the field of sociology, it is an interdisciplinary technique that later included many fields such as mathematics and computer science (Otte & Rousseau, 2002: 441).

Social network analysis applies the functions of graph theory to identify patterns of connections in a social structure. In this context, it aims to reflect the features of the visual image of a sociogram, using various concepts and measurements, the language of points and lines (Scott, 2012: 34-35). A graph G consists of a set V of p points together with a set X of q unordered pairs of distinct points of V. Each pair x = {u,v} of points in X is a line of C, and x is supposed to join u and v. (Harary, 2018: 9).

Equation (1) is the overall graph representation.

$$G= (V, X) \quad (1)$$

where; V is the node (point, vertex) set and X is the edge (line, arc) set.

In the international trade network structure, countries represent nodes and edges represent trade relations between countries (Howell, 2013: 6). Visualizing a network of trade flows provides a significant advantage as it shows the interconnectedness of countries in the network and the structure of the network. Therefore, the application of social network analysis to international trade can play a complementary role to other empirical analyzes of trade (Benedictis & Tajoli, 2011: 4-5).

In the study, an export network with directed ties was created. This export network has the feature of an ego-centered network matrix. Ego-centric network shows an actor's social contacts and relationships within the network (O'Malley et al., 2012: 1). Social networks have a dynamic structure. In this context, the characteristics of a network's nodes and links change over time. Ego-centric analysis of dynamic networks aims to discover the temporal changes of a subnetwork around a particular actor (Zhao et al., 2016: 5003).

In the analysis, the Hyperlink Induced Subject Search (HITS) algorithm was used for the created export network. The HITS algorithm was designed by Kleinberg (1999) to rate the importance of a node in a directed network

using authority and hub centrality values (Kleinberg, 1999: 611). In a network, authority and hub centrality values follow a parallel course (Deguchi et al., 2014: 2). A detailed explanation of the authority and hub centrality measures is given below.

A component of a graph is a subset with the property that there is a path between one node and any other. If the all graph forms a single component, it is concluded that the nodes are fully connected to each other (Otte and Rousseau, 2002: 442). There are many measures in the literature that show the structure of networks and the role played by nodes within the network. However, only the measurements used in the study are described below.

- Density:

In social network research, it is necessary to examine the weak and strong ties between actors in the network in order to obtain new information (Borgatti & Cross, 2003: 434). The density of the social network has a significant impact on the way information is transmitted between actors within the network (Anastasiei et al., 2023: 5). The density of ingroup relations stands out as an indicator of structural cohesion in terms of the network (Friedkin, 1981: 41). Determining the roles of the actors in the group using social network analysis is important in terms of examining the impact of the roles on the network structures (Ergün & Koçak Usluel, 2016: 36).

The density is determined by the frequency of interactions of actors within the network. The density of a network is the ratio of the number of ties it has to the total number of possible ties in the network (Faust, 2006: 193). This ratio is shown in equation (2).

$$Density = \frac{Number\ of\ ties}{Probable\ ties} \tag{2}$$

- Centrality:

Social network refers to the connection of individuals or groups to each other through various relationships. The concept of centrality describes the key node or the most influential node within a network. Therefore, measuring centrality has a very important role in network research (Das et al., 2018: 1). There are many centrality measures for networks. The centrality measurements used in the study below are explained as degree centrality, hub and authority centrality and eigenvector centrality.

The simplest centrality measure in a network is the degree of a node, that is, the number of edges connected to it. In social network research, the concept of degree centrality is used as a measure of degree centrality. Directed networks have both in-degree and out-degree, and both may be useful as measures of centrality when necessary (Newman, 2010: 169). The degree k_i of a node i is k_i =n and is shown in equation (3).

$$k_i = \sum_{j=1}^{n} A_{iJ} \tag{3}$$

The higher the degree centrality value in a network, the more centrality of node i increases.

Eigenvector centrality is a measure of centrality that calculates the centrality of an actor by considering the centrality of its connections as well as the connections it has (Iacobucci et al., 2017: 1). Eigenvector centrality weights not only direct connections but also indirect connections. In this way, eigenvector centrality provides a systemic and overview of a node's role (Laporta et al., 2018: 2). In eigenvector centrality, the centrality of a node increases more with a connection to an important node compared to a connection to a less important node (Bonacich, 2007: 564).

The eigenvector centrality measure is shown in equation (4).

$$\sigma_E(i) = \frac{1}{\lambda_{max}(A)} \sum_{i=1}^{n} a_{ji} v_j \tag{4}$$

In equation (3), the vector $v = (v_1, \dots, v_n)^T$ represents the eigenvector of A.

Hub and authority centrality was first designed as a web-page rating algorithm. Authorities are nodes with useful information. On the other hand, hubs are nodes that provide information on where the best authorities are (Park et al., 2020: 5). Hub and authority centrality are metrics used in directed networks, and they are often calculated together. They may be expressed as a mix of in-degree/out-degree centrality and eigenvector centrality (Morselli et al., 2013: 2). Hub and authority centrality measurements are obtained by normalizing the eigenvector centrality. Eigenvector centrality calculates the influence of a node in the network and distributes relative scores across all nodes (Jeon et al., 2019: 261-262). If the relevant node is connected to nodes with high metrics in the network, hub and authority centrality metrics will increase even more (Esteve-Pérez et al., 2022: 7-8).

The authority centrality of a node is formulated to be proportional to the sum of the hub centralities of the nodes connected to that node (Newman, 2010: 179):

$$x_i = \alpha \sum_j A_{ij} y_j \quad (5)$$

In equation (5), α is a constant. Similarly, the hub centrality of a node is proportional to the sum of the authority centralities of the nodes it is connected to (Newman, 2010: 180):

$$y_i = \beta \sum_j A_{ji} x_j \quad (6)$$

where β is another constant. In the second equation, the indices on the Aji matrix element are replaced. Equations (5) and (6) may be represented in matrix terms as follows (Newman, 2010: 180):

$$x=\alpha A y \quad (7)$$

$$y=\beta A^T x \quad (8)$$

or can be shown as follows by combining equations (7) and (8) (Newman, 2010: 180):

$$AA^T x = \lambda x \quad (9)$$

$$A^T A y = \lambda y \quad (10)$$

where $\lambda = (\alpha\beta)^{-1}$. In Equations (9) and (10), the hub and authority centralities are respectively obtained by the eigenvectors of AA^T and A^TA with the same eigenvalue.

4. ANALYSIS AND FINDINGS

Free trade agreements made between countries have the power to change the trade balances in the world and, as a result, affect the welfare and development level of countries. The fact that RCEP is the world's largest free trade agreement in terms of the GDP of its member countries and the first multilateral agreement involving China are the factors that make this research important.

In this research, only product trade of RCEP countries was taken a basis and export data for the 2012-2021 period was collected from Trade Map. Social network analyses were conducted using the Ucinet program for three-year periods, based on the years 2012, 2015, 2018 and 2021. On the other hand, the Gephi program was used to visualize the networks. A 15X15 matrix was created for product export data in dollar terms of the countries subject to analysis. While making network visualizations, a $1,000,000 constraint was used for the data in the matrix. The data were analyzed according to density, degree and centrality characteristics. Nodes are colored according to their degrees and networks are colored according to their weights. The sizes of the nodes were sized according to their eigenvector centrality and the network map view was created by selecting the Fruchterman-Reingold algorithm.

The Fruchterman-Reingold algorithm was developed for visualizing directed networks (Fruchterman and Reingold 1991: 1129-1164). According to the algorithm, initially the nodes are ring-shaped. However, two forces are then calculated: attractive force and repulsive force. While the attractive force captures the connected nodes between the nodes, the repulsive force repels the unrelated nodes. This process continues iteratively in the algorithm (Jalel et al., 2021: 2990-2991).

Figure 2 shows the network diagrams of trade between RCEP countries. The degree of closeness between countries may be explained by the density of trade networks in network analysis. The higher the trade relations between countries, the higher their network density. In this context, it is seen that China, which has been the hub and authority country for four years, has the most two relations with Japan and South Korea. The thickness of the lines between these three countries in the diagrams shows intense trade links.

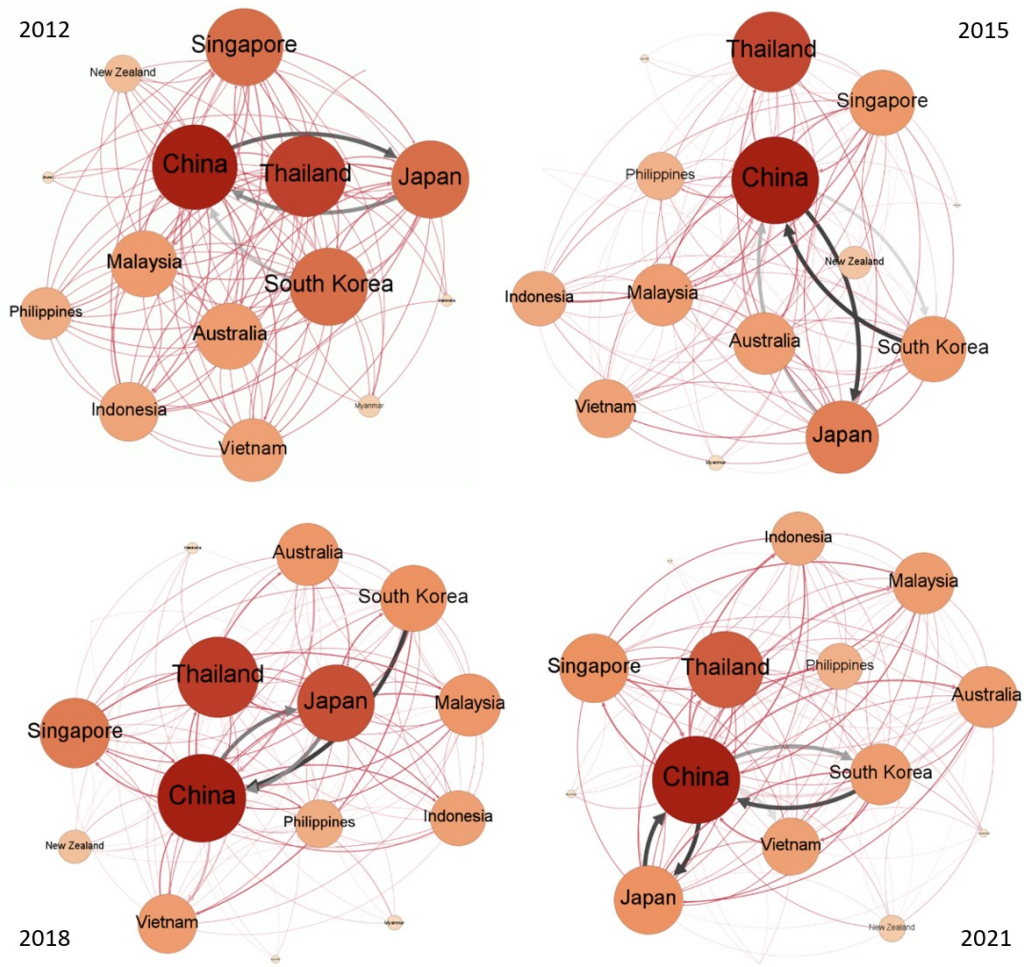

Figure 2. Network Diagrams of 2012, 2015, 2018 and 2021

In 2012, it is seen that China, Japan and South Korea have more export relations than other countries. The fact that the arrows are bidirectional in the network is an indication that this relationship is reciprocal. On the other hand, apart from these three countries, Thailand and Singapore stand out with the abundance of network connections they have.

In 2015, the countries at the center of the network were China, Japan, South Korea and Thailand. This year, compared to 2012, the trade relationship between China and South Korea has increased mutually. It is possible to comment that commercial ties between China and South Korea strengthened during this period. The country to which China exports the most is again Japan.

In 2018, the countries at the center of the network (China, Japan, South Korea and Thailand) remained unchanged. It can be seen in the diagram that network density increased more from South Korea to China this year. In this context, China's imports from South Korea have increased compared to other years.

In 2021, China, Japan, South Korea and Thailand form the center of the network. In addition, it is understood from their positions and number of connections in the network that Australia and Vietnam have increased their centrality. On the other hand, it can be said that China has dominated the network by increasing its influence in the network. This year, it was observed that China exported the most to Japan, Vietnam and South Korea.

Table 2 shows the basic ego network indicators (size, ties, pairs and density) created based on the product trade of RCEP countries with each other for the years 2012, 2015, 2018 and 2021. When the table is examined, it is seen that in 2012, the ego-network size of all countries except Brunei (13) and the Philippines (13) was 14. This is due to the fact that Laos did not export to Brunei and the Philippines in 2012. In this context, countries except Brunei and the Philippines have export relations with each other. On the other hand, it is noteworthy that the ties and pairs values of Brunei and the Philippines are lower. The ratio of the number of existing ties in the network to the highest possible number of ties is expressed as the density value. In the table, the density value for Laos, Brunei and the Philippines, which do not have any export relations, is 100, while this value is 98.90 for other countries.

In 2015, since all countries have trade with each other, the ego network size value was found to be 14, and also the number of existing ties and the number of possible ties were equal to 182. In this context, it can be said that communication and information exchange within the network was quite strong in 2015.

In 2018, since Laos did not export to Brunei, Brunei's ego network size appears to be 13. Depending on this situation, ties and pairs values were found to be 156 for Brunei, 182 for Laos and 181 for other countries. Density values are 100 for Laos and Brunei and 99.45 for other countries. In 2021, in contrast to 2018, Laos has no exports to Brunei, and therefore the network ego size for Laos is 13.

Table 2. Basic Ego Network Indicator Values of RCEP Countries (2012, 2015, 2018 and 2021)

2012		1 Size	2 Ties	3 Pairs	4 Density	2015		1 Size	2 Ties	3 Pairs	4 Density
1	Australia	14.00	180.00	182.00	98.90	1	Australia	14.00	182.00	182.00	100.00
2	Brunei	13.00	156.00	156.00	100.00	2	Brunei	14.00	182.00	182.00	100.00
3	China	14.00	180.00	182.00	98.90	3	China	14.00	182.00	182.00	100.00
4	Indonesia	14.00	180.00	182.00	98.90	4	Indonesia	14.00	182.00	182.00	100.00
5	Philippines	13.00	156.00	156.00	100.00	5	Philippines	14.00	182.00	182.00	100.00
6	South Korea	14.00	180.00	182.00	98.90	6	South Korea	14.00	182.00	182.00	100.00
7	Japan	14.00	180.00	182.00	98.90	7	Japan	14.00	182.00	182.00	100.00
8	Cambodia	14.00	180.00	182.00	98.90	8	Cambodia	14.00	182.00	182.00	100.00
9	Laos	14.00	182.00	182.00	100.00	9	Laos	14.00	182.00	182.00	100.00
10	Malaysia	14.00	180.00	182.00	98.90	10	Malaysia	14.00	182.00	182.00	100.00
11	Myanmar	14.00	180.00	182.00	98.90	11	Myanmar	14.00	182.00	182.00	100.00
12	Singapore	14.00	180.00	182.00	98.90	12	Singapore	14.00	182.00	182.00	100.00
13	Thailand	14.00	180.00	182.00	98.90	13	Thailand	14.00	182.00	182.00	100.00
14	Vietnam	14.00	180.00	182.00	98.90	14	Vietnam	14.00	182.00	182.00	100.00
15	New Zealand	14.00	180.00	182.00	98.90	15	New Zealand	14.00	182.00	182.00	100.00
2018		**1 Size**	**2 Ties**	**3 Pairs**	**4 Density**	**2021**		**1 Size**	**2 Ties**	**3 Pairs**	**4 Density**
1	Australia	14.00	181.00	182.00	99.45	1	Australia	14.00	181.00	182.00	99.45
2	Brunei	13.00	156.00	156.00	100.00	2	Brunei	14.00	182.00	182.00	100.00
3	China	14.00	181.00	182.00	99.45	3	China	14.00	181.00	182.00	99.45
4	Indonesia	14.00	181.00	182.00	99.45	4	Indonesia	14.00	181.00	182.00	99.45
5	Philippines	14.00	181.00	182.00	99.45	5	Philippines	14.00	181.00	182.00	99.45
6	South Korea	14.00	181.00	182.00	99.45	6	South Korea	14.00	181.00	182.00	99.45
7	Japan	14.00	181.00	182.00	99.45	7	Japan	14.00	181.00	182.00	99.45
8	Cambodia	14.00	181.00	182.00	99.45	8	Cambodia	14.00	181.00	182.00	99.45
9	Laos	14.00	182.00	182.00	100.00	9	Laos	13.00	156.00	156.00	100.00
10	Malaysia	14.00	181.00	182.00	99.45	10	Malaysia	14.00	181.00	182.00	99.45
11	Myanmar	14.00	181.00	182.00	99.45	11	Myanmar	14.00	181.00	182.00	99.45
12	Singapore	14.00	181.00	182.00	99.45	12	Singapore	14.00	181.00	182.00	99.45
13	Thailand	14.00	181.00	182.00	99.45	13	Thailand	14.00	181.00	182.00	99.45
14	Vietnam	14.00	181.00	182.00	99.45	14	Vietnam	14.00	181.00	182.00	99.45
15	New Zealand	14.00	181.00	182.00	99.45	15	New Zealand	14.00	181.00	182.00	99.45

Table 3 shows the degree centrality values of RCEP countries for the years 2012, 2015, 2018 and 2021. In the table, the number of connections to which a country exports is shown by the out-degree parameter, while the in-degree parameter represents the number of connections that export to that country. When the table is examined, it is seen that China has the highest both out-degree and in-degree parameters in all four years. On the other hand, in 2012, while China's out-degree parameter was lower than the in-degree parameter, in the following period, the number of connections China exported increased while the number of connections it imported decreased.

Similarly, in terms of both out-degree and in-degree parameters for four years, Japan ranks second and South Korea ranks third. Except for 2012, the number of connections Japan exports is also higher. South Korea's out-degree parameter is higher than the in-degree parameter in all four years. In this process, while both out-degree and in-degree parameters of Vietnam increased, the increase in the number of import connections is especially noteworthy.

Table 3. Degree Centrality Values of RCEP Countries (2012, 2015, 2018 and 2021)

2012		1 Outdeg	2 Indeg	2015		1 Outdeg	2 Indeg
1	Australia	163143440.000	119585592.000	1	Australia	113485720.000	105633328.000
2	Brunei	11671897.000	3818027.000	2	Brunei	5182489.000	3543571.000
3	China	485173888.000	500702688.000	3	China	561586944.000	450379776.000
4	Indonesia	113625096.000	142523872.000	4	Indonesia	78397824.000	105164760.000
5	Philippines	29143108.000	59457988.000	5	Philippines	30319952.000	67875544.000
6	South Korea	262970416.000	225651728.000	6	South Korea	249699408.000	203953696.000
7	Japan	355482144.000	357709536.000	7	Japan	263367792.000	285939904.000
8	Cambodia	987076.000	13007335.000	8	Cambodia	1974136.000	13696900.000
9	Laos	1493421.000	5380017.000	9	Laos	2677312.000	6313078.000
10	Malaysia	135460016.000	148864848.000	10	Malaysia	116412472.000	128110896.000
11	Myanmar	5357537.000	14077259.000	11	Myanmar	9504015.000	19668592.000
12	Singapore	231793296.000	161630656.000	12	Singapore	193304432.000	150711840.000
13	Thailand	122697936.000	132412824.000	13	Thailand	112441600.000	117814760.000
14	Vietnam	52300636.000	87515984.000	14	Vietnam	61009124.000	139322752.000
15	New Zealand	20968496.000	19930036.000	15	New Zealand	18406462.000	19640400.000
2018		**1 Outdeg**	**2 Indeg**	**2021**		**1 Outdeg**	**2 Indeg**
1	Australia	145375744.000	119498744.000	1	Australia	209355232.000	139163728.000
2	Brunei	5509586.000	3429832.000	2	Brunei	9770511.000	3839924.000
3	China	630268608.000	589999680.000	3	China	873144896.000	738554688.000
4	Indonesia	101578208.000	128216480.000	4	Indonesia	132569600.000	142383776.000
5	Philippines	31989492.000	90931368.000	5	Philippines	37567044.000	116014184.000
6	South Korea	304341344.000	236801984.000	6	South Korea	313498976.000	293468352.000
7	Japan	330699904.000	320924672.000	7	Japan	348332128.000	342360128.000
8	Cambodia	3209477.000	24290028.000	8	Cambodia	4197410.000	32446080.000
9	Laos	5364981.000	6451401.000	9	Laos	5363433.000	6520922.000
10	Malaysia	140137072.000	146813936.000	10	Malaysia	166119952.000	182517920.000
11	Myanmar	11634824.000	21619294.000	11	Myanmar	10272046.000	20537666.000
12	Singapore	222984656.000	156188208.000	12	Singapore	242654432.000	171603088.000
13	Thailand	139380032.000	140536112.000	13	Thailand	143891344.000	167430224.000
14	Vietnam	107545024.000	193670464.000	14	Vietnam	131911640.000	270518976.000
15	New Zealand	22805330.000	23452192.000	15	New Zealand	27369992.000	28658856.000

Table 4 shows the hub and authority centrality values of RCEP countries for the years 2012, 2015, 2018 and 2021. A node in the network with many outgoing export connections is called a hub, and a node with incoming export connections is called an authority. In 2012, the three countries with the highest hub centrality were Japan (0.535), China (0.516) and South Korea (0.458), while the three countries with the highest authority centrality were China (0.683), Japan (0.463) and South Korea (0.344). In this context, in 2012, the country with the highest total number of connections for hub and authority centrality was China.

In 2015, the three countries with the highest hub centrality were China (0.692), South Korea (0.433) and Japan (0.402), while the three countries with the highest authority centrality were China (0.555), Japan (0.496) and South Korea (0.392). In this context, in 2015, the country with the highest total number of connections for hub and authority centrality was again China.

In 2018, there is a similar situation to 2015 for both hub centrality (China (0.569), South Korea (0.496) and Japan (0.472)) and authority centrality (China (0.674), Japan (0.415) and South Korea (0.339)). In 2021, the top three country rankings for both hub centrality (China (0.710), Japan (0.387) and South Korea (0.377)) and authority centrality (China (0.553), Japan (0.425) and South Korea (0.397)) are the same.

Table 4. Hub and Authority Centrality Values of RCEP Countries (2012, 2015, 2018 and 2021)

2012		1 Hub	2 Authority	2015		1 Hub	2 Authority
1	Australia	0.291	0.156	1	Australia	0.203	0.177
2	Brunei	0.015	0.005	2	Brunei	0.008	0.006
3	China	0.516	0.683	3	China	0.692	0.555
4	Indonesia	0.156	0.189	4	Indonesia	0.112	0.170
5	Philippines	0.043	0.085	5	Philippines	0.051	0.120
6	South Korea	0.458	0.344	6	South Korea	0.433	0.392
7	Japan	0.535	0.463	7	Japan	0.402	0.496
8	Cambodia	0.001	0.012	8	Cambodia	0.003	0.017
9	Laos	0.001	0.005	9	Laos	0.004	0.007
10	Malaysia	0.176	0.186	10	Malaysia	0.160	0.207
11	Myanmar	0.007	0.019	11	Myanmar	0.015	0.035
12	Singapore	0.258	0.207	12	Singapore	0.247	0.241

13	Thailand	0.149	0.193	13	Thailand	0.141	0.191
14	Vietnam	0.073	0.132	14	Vietnam	0.093	0.277
15	New Zealand	0.027	0.025	15	New Zealand	0.026	0.028
2018		**1 Hub**	**2 Authority**	**2021**		**1 Hub**	**2 Authority**
1	Australia	0.238	0.160	1	Australia	0.258	0.177
2	Brunei	0.006	0.004	2	Brunei	0.009	0.003
3	China	0.569	0.674	3	China	0.710	0.553
4	Indonesia	0.128	0.165	4	Indonesia	0.143	0.175
5	Philippines	0.043	0.125	5	Philippines	0.041	0.152
6	South Korea	0.496	0.339	6	South Korea	0.377	0.397
7	Japan	0.472	0.415	7	Japan	0.387	0.425
8	Cambodia	0.004	0.024	8	Cambodia	0.005	0.033
9	Laos	0.006	0.006	9	Laos	0.005	0.005
10	Malaysia	0.162	0.178	10	Malaysia	0.154	0.223
11	Myanmar	0.018	0.028	11	Myanmar	0.011	0.026
12	Singapore	0.240	0.189	12	Singapore	0.224	0.180
13	Thailand	0.150	0.180	13	Thailand	0.130	0.206
14	Vietnam	0.156	0.296	14	Vietnam	0.149	0.379
15	New Zealand	0.032	0.028	15	New Zealand	0.031	0.031

Table 5 gives the eigenvector values of product exports of RCEP countries for the years 2012, 2015, 2018 and 2021. The eigenvector centrality measure indicates a country's neighborhood relationship with other countries with which it has important connections. If countries with high eigenvector centrality values are removed from the network, other countries in the network may be affected by this situation and the structure of the network may change. When Table 5 is examined, it is seen that China's eigenvector centrality was the highest in all four years. Japan ranks second and South Korea ranks third. On the other hand, it is seen that the eigenvector centrality values of Vietnam, Cambodia and the Philippines are gradually increasing, and the increase in the eigenvector centrality value of Vietnam is noteworthy.

Table 5. Eigenvector Values of RCEP Countries (2012, 2015, 2018 and 2021)

	2012	**2015**	**2018**	**2021**
Australia	0.254	0.195	0.210	0.251
Brunei	0.017	0.010	0.008	0.009
China	0.590	0.621	0.616	0.628
Indonesia	0.186	0.152	0.155	0.154
Philippines	0.076	0.104	0.112	0.126
South Korea	0.413	0.420	0.436	0.381
Japan	0.486	0.440	0.421	0.382
Cambodia	0.012	0.016	0.024	0.030
Laos	0.005	0.006	0.006	0.006
Malaysia	0.187	0.186	0.169	0.194
Myanmar	0.018	0.029	0.027	0.022
Singapore	0.238	0.234	0.208	0.203
Thailand	0.178	0.173	0.172	0.182
Vietnam	0.126	0.227	0.264	0.311
New Zealand	0.027	0.026	0.031	0.035

5. CONCLUSION

With the globalization of the world, trade networks have intensified and this has brought about various economic integration practices. Especially in the last century, countries that want to increase their commercial activities and dominance have effectively used free trade agreements, which are a result of global competition. Free trade agreements eliminate tariffs, quotas, and other barriers to specific groups of goods or services traded between countries that are parties to the agreement. Free trade agreements create effects that facilitate trade for the parties and at the same time increase the level of economic income and welfare.

On the other hand, free trade agreements may have a great impact on world trade by removing practices that hinder trade between countries. The RCEP agreement, which is the subject of the study, is the world's most comprehensive free trade agreement in terms of global trade and GDP. In the study, an attempt was made to establish a relationship between the changes in the trade network of RCEP countries, centrality criteria and the roles of the agreement actors in three-year periods (2012, 2015, 2018 and 2021).

In the analysis results, it was observed that China ranked first in all centrality measurements in trade between RCEP countries for four years. During this period, China's most important trade partners were Japan and South

Korea. Apart from these three countries, it has been determined that the countries that attract the most attention in terms of centrality measurements within the group are Australia, Singapore, Indonesia, Malaysia and Thailand. On the other hand, Vietnam came to the fore with the development of its trade in this period, and it was determined that Vietnam's most important trade partner was China. This finding emphasizes the importance of trade relations with the country that plays a key role in the network (China).

The scope of this study is limited to commercial relations between RCEP countries. However, in future studies on the subject, trade between RCEP countries and Türkiye may be examined and the impact of the agreement on Türkiye may be evaluated. Or, trade between India and RCEP countries, which withdrew from the agreement at the last minute, may be examined and the impact of the agreement on India may be evaluated.

AUTHORS' DECLARATION

This paper complies with Research and Publication Ethics, has no conflict of interest to declare, and has received no financial support.

AUTHORS' CONTRIBUTIONS

Conceptualization, writing-original draft, editing – **FGA** and **MY**, data collection, methodology, formal analysis – **FGA** and **MY,** Final Approval and Accountability – **FGA**

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