

Article

Features of Geo-Economic Network between China and Countries along the 21st Century Maritime Silk Road

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Abstract: The countries along the 21st-Century Maritime Silk Road (MSRCs) are important geo-economic spaces for China. The implementation of the Belt and Road initiative is drawing a new geo-economic network of the Maritime Silk Road. Based on trade and investment flows, this study uses social network analysis to examine the characteristics and structure of trade and investment networks between China and the MSRCs. The results show that the MSRCs' trade network is approximately an irregular quadrilateral, the node weighted degree distribution follows the law of long-tail distribution, and the trade network has shifted from the tripartite confrontation of China, Japan, and South Korea to China's single-core dominance. The MSRCs' trade group has changed greatly, and the trade cohesion of China, Japan, and South Korea is strong. The MSRCs' investment network is not fully developed and the network connections are sparse. China, Japan, and Singapore are its core nodes. The weight degree of the MSRCs' investment inflow network first increased and then decreased, and the weight degree of the MSRCs' investment outflow network increased. The MSRCs' investment network followed the "core-peripheral" structure. The cohesive subgroup of the investment inflow network did not have significant regional characteristics, and the cohesion of the core subgroups in the MSRCs' investment outflow network was strong. To promote the development of geo-economic relations between China and the MSRCs, China should focus on regional powers, upgrade the investment network of MSRCs, and implement differentiated geo-economic cooperation strategies.

Keywords: geo-economic; geo-economic network; social network analysis; China; the 21st-Century Maritime Silk Road (MSRCs)



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1. Introduction

In the geo-economic era of globalization, the circulation, transformation, and interaction of geo-economic elements are constantly reshaping new geo-economic networks. As the Belt and Road initiative gradually becomes a geo-economical practice, the linkage between China and those countries along the route of the 21st-Century Maritime Silk Road (MSRCs) has been further strengthened. In 2020, the total import and export of goods between China and MSRCs reached 12,624 hundred million dollars. Singapore, Indonesia, Vietnam, Laos, Malaysia, Saudi Arabia, and other MSRCs play a significant role in foreign investment and contracted projects of Chinese enterprises. MSRCs have become a key region that covers many of China's geo-economic interests. Analyzing the geo-economic network between China and MSRCs is vital to better understand the spatial evolution of China's geo-economics and the characteristics of China's international geo-economic relations.

The concept of geo-economics was proposed in 1990 by Edward Luttwak, who believed that economic power and economic means are two significant aspects that can affect national

games and power distribution [1]. In contrast to the logic of the territorial and spatial control of geopolitics, geo-economics emphasizes that national interests can be realized through the control of economic elements such as resources, markets, and finance [2]. Geo-economics has different connotations when interpreted from different perspectives. Being considered a way for countries to obtain and exercise power under their references to each economic factor, geo-economics is considered a means to practice political purposes by using the means of economics [3]. As a means to develop regional resources, geo-economics involves the politics of controlling and developing regional resources [4]. A geo-economy is the result of the effect of geographical conditions on the economy itself [5]. As a narration of those places or spaces strategically sold in a globalized economy, geo-economics has created new economic spaces and places [6].

It is not difficult to find that the connotation of geo-economics is constantly expanding. Geo-economics is an economic relationship, such as cooperation, complementarity, competition, and opposition, which is formed based on factors such as geographical location, resource endowment, and economic structure [7,8]. The regional potential difference caused by the spatial differentiation of geo-economic elements promotes the global flow of geo-economic elements, resulting in various geo-economic flows such as trade flows, investment flows, and tourism flows. Therefore, geo-economics is not only a certain type of economic relationship from the perspective of conflicting logic but also a collection of trade flow, investment flow, tourism flow, and other types of geo-economic element flows from the perspective of “flow space” [9]. With the support of modern information and transportation technology, the circulation of geo-economic elements is getting faster, and the shaping function of geo-economic flow towards geo-economic relations is deeply strengthened. More importantly, the flow of geo-economic elements between countries has formed a geo-economic network composed of flows, nodes, and channels, interpreting cooperation, competition, confrontation, win-win, and other geo-economic interactions.

A geo-economic network is an economic network that links countries together due to the circulation and conversion of various geo-economic factors such as trade, investment, transportation, and resources among countries. Compared with the ordinary economic network, the geo-economic network emphasizes the network formed by the interaction between countries brought about by geographical proximity, economic spaces expansion, and political communication. As the “flow space” form of geo-economic exchanges [10], the geo-economic network has attracted much attention from related research on its spatial pattern, connection effect, and network structure [11]. At the level of globalization, the hierarchy of trade flow networks has increased significantly over time [12], and the scale-free characteristics of commodity trading networks have gradually weakened [13]. On the one hand, at the regional level, the US strengthened its regional trade ties with its American neighbors, West Germany, and its EU partners from 1968 to 1992. On the other hand, Japan expanded and deepened its export ties with out-of-region partners [14]. India’s continued growth in demand for oil has led to increasing economic ties between India and GCC countries, which are reshaping the geo-economic landscape of the Indian Ocean [15]. At the national level, geo-economic linkages manifest as a great power agglomeration effect and the geographic proximity effect [10], and geo-economic cooperation and competition are always the main forms of geo-economic relations [16]. The world energy trade network continues to expand and gradually evolves into a stable, orderly, and integrated energy system [17]. The capacity of the world energy trade network continues to expand, and stable trade relations are gradually formed between countries, gradually evolving into a stable, orderly, and integrated system [18]. The structure of the global intellectual property trade network has gradually changed. With the rapid increase in technology development in East Asian and European countries such as Japan, China, and Germany, the global intellectual property trade pattern has gradually changed from a monopoly centered on the US to a multi-polar pattern [19]. In the changing process of the global economy from “place-space” to “flow-space,” geo-economic connections are upgraded by the “flow-space” shaped by geo-economic flows to geo-economic network connections. It is more important

to describe the vector characteristics of the geo-economic relations between countries from the geo-economic network than to analyze the connection strength of a single geo-economic element. More importantly, geo-economic network analysis can not only analyze the characteristics of the connection structure, spatial structure, and topology structure of geo-economic element flows but can also reveal the interaction of geo-economic exchanges among countries.

In the process of geo-economic globalization and the construction of the Belt and Road, trade flow, transportation flow, resource flow, and other geo-economic element flows are creating a brand new geo-economic network in MSRCs. At the infrastructure level, the construction of connectivity infrastructure along the Maritime Silk Road will reduce transportation distance and transportation time, and strengthen the connectivity of countries along the route [20]. Sustainable development is promoting the evolution of the port network along the Maritime Silk Road. Ports in Southeast Asia and South Asia are expected to become the core nodes in the network, while the status of China's ports in the network will decline significantly [21]. At the trade level, the trade dependence of ASEAN countries on China is constantly increasing [22]. The maritime network reconfiguration resulting from the implementation of the 21st century Maritime Silk Road will have an important impact on the maritime connectivity of the selected countries, especially significantly improving China's export values with some developing countries [23]. At the energy level, the 21st century Maritime Silk Road is conducive to ensuring China's maritime energy supply chain across the Indian Ocean region and South China Sea [24]. At the investment level, the construction of the 21st century Maritime Silk Road gives both the Chinese state and Chinese capital strong incentives and pressure to actively engage in a "spatial fix" by reconfiguring its geographic vision in order to further capital accumulation and expansion on a larger spatial dimension [25]. At the value chain level, institutional forces and multiple governance modes are key determinants of value chain integration in MSRCs [26].

To sum up, most of these studies describe geo-economic linkages from the size of element flow or the strength of element linkages but do not analyze geo-economic interactions based on the interaction of geo-economic flows, nor do they analyze the characteristics of geo-economic relations based on geo-networks. Therefore, there is an urgent need to integrate geo-economic flows and networks to explore the evolution of geo-economic relations. In terms of geo-economic network research between China and MSRCs, these issues need to be addressed urgently: (1) How has the geo-economic network between China and MSRCs changed? (2) What are the structural characteristics of the geo-economic network between China and MSRCs? (3) How to analyze the evolution of geo-economic relations through the geo-economic network between China and MSRCs? In this study, the analysis of the geo-economic network between China and MSRCs will address these questions. It is worth noting that Keohane and Nye believe that the interdependence of countries stems from international economic exchanges brought about by the flow of economic factors such as capital, commodities, people, and information [27]. The circulation and transformation of geo-economic factors such as trade, investment, and resources are not only international economic exchanges but also a reflection of national economic interdependence among countries. However, the interdependence relationship emphasizes the sensitivity and vulnerability of one party to the other, while the geo-economic network emphasizes the state of interdependence formed by the interconnection of countries and cannot directly reveal the degree of interdependence. Therefore, the geo-economic network analysis in this study mainly focuses on the structural characteristics of the geo-economic network of MSRCs rather than the interdependence of MSRCs. Trade and investment flows play a central role in the structure of geopolitical exchanges, making them the most direct reflection of international geo-economic interactions. Based on the perspectives of geo-economic flow, this study analyzes the characteristics of the geo-economic network between China and MSRCs from the perspective of trade flow and investment flow, and then interprets the characteristics of the geo-economic relations between China and MSRCs.

The structure of the paper is arranged as follows. In Section 1, the research background is introduced and the relevant literature is reviewed. In Section 2, the research method and research data are introduced. In Section 3, the structural characteristics, node changes, and cohesive subgroup effects of the geo-economic network between China and MSRCs are analyzed. In the last section, the conclusions and discussion are presented.

2. Methods and Data

2.1. Geo-Economic Network Construction

Social network analysis is a typical analysis method for analyzing network morphology, characteristics, and structure. Using social network analysis can not only analyze the evolution of the morphology, characteristics, and structure of the MSRCs geo-economic network but also reveal the evolution characteristics of the MSRCs geo-economic relations. Social network analysis believes that any individual or unit can be regarded as a node, and the connections between nodes produce various relationships [28]. The network is a collection of nodes and node relationships. According to social network analysis, countries are nodes in a geo-economic network, and flows of various geo-economic elements between nodes form a geo-economic network. Therefore, this study takes China and 39 countries in the study area as nodes, and takes mutual trade flows and mutual investment flows as edges, and uses Gephi software to build weighted trade networks of MSRCs and weighted investment networks of MSRCs.

Specifically, this study uses $V = \{v_1, v_2, v_3, \dots, v_n\}$ to represent the set of countries, and n represents the number of countries. In this study, R_{ij} is used to represent the trade flows connection or investment flow connection between country i and country j , and a trade flow matrix or investment flow matrix R_{ij}^t is constructed.

$$R_{ij}^t = \begin{bmatrix} R_{11} & \cdots & R_{1n} \\ \vdots & \ddots & \vdots \\ R_{n1} & \cdots & R_{nn} \end{bmatrix} \quad (1)$$

where R_{ij}^t represents the directed weighted trade network or investment network between n countries, R_{ij} represents the trade flow or investment flow from country i to country j , and t represents the year. If there is a trade or investment connection between country i and country j , then $R_{ij} \neq 0$. If there is no trade or investment connection between country i and country j , then $R_{ij} = 0$.

2.2. Indicators of Social Network Analysis

Indicators such as centrality, density, and clustering coefficient in social network analysis can effectively analyze the evolution of geo-economic network characteristics caused by changes in the size of geo-economic element flows and spatial distribution changes of geo-economic element flows. Therefore, based on the perspective of geo-economic flow, this study uses the centrality, density, clustering coefficient, and cohesive subgroups of social network analysis to analyze the evolution law of the pattern and structure of trade flow networks and investment flow networks between China and MSRCs. Centrality, density, clustering coefficient, and cohesive subgroups are measured by Gephi software.

2.2.1. Centrality

Centrality reflects the connection strength between a node and other nodes in the network. The greater the centrality of the node, the greater the possibility that the node will contact other nodes, and the stronger the centrality of the node in the network. Because the unweighted network cannot describe the node interactions, and the weighted network can reflect the node interactions, this study uses the weighted node degree to measure the node

centrality of the geo-economic network between China and MSRCs. The formula for node weighted degree is as follows:

$$D_i = w_{ij} \quad (2)$$

where w_{ij} is the weighted degree of node i .

2.2.2. Density

Density reflects the overall tightness of the nodes in the network. The greater the density of the geo-economic network, the closer the group connections in the network, and the smoother the geo-economic element flow.

$$M = \frac{2L}{g(g-1)} \quad (3)$$

where L is the number of lines in the network and g is the number of nodes in the network.

2.2.3. Clustering Coefficient

The clustering coefficient reflects the degree of agglomeration of the connections between a node and neighboring nodes in the network [29]. The greater the clustering coefficient of the geo-economic network, the greater the clustering degree of the network nodes. The overall clustering coefficient of the network is the average of the local clustering coefficients of all the nodes.

$$CC = \frac{1}{N} \sum_{i=1}^N \frac{E_i}{k_i(k_i-1)} \quad (4)$$

where N is the number of nodes and E_i represents the number of edges between all k_i adjacent nodes of node i .

2.2.4. Cohesive Subgroups

Cohesive subgroup analysis is a kind of social network analysis tool. Cohesive subgroup analysis can determine the number of cohesive subgroups in the network and which members each cohesive subgroup contains, helping us to identify the community structure of the network. A cohesive subgroup is a subset of nodes with relatively direct and close relationships in the network. The nodes within the same subgroup have stronger connections, and the changes in the cohesive subgroup reflect changes in the cohesion of the nodes and the structure of the community. In the MSRCs' trade network and the MSRCs' investment network, each subgroup is a subset of countries with relatively direct and close connections. Referring to related studies [27], this study uses k-core in social network analysis to divide the MSRCs' trade network cohesive subgroups and the MSRCs' investment network cohesive subgroups.

2.3. Study Area and Data Source

As an open cooperative initiative, the Maritime Silk Road has neither absolute spatial boundaries nor a precise spatial scope [30]. The ancient Maritime Silk Road shipping routes mainly include shipping routes in the East China Sea, shipping routes in the South China Sea, and shipping routes in North America and South America [31], and most countries in North America and South America have not yet signed the "Belt and Road" cooperation agreement or memorandum with China. Therefore, the coastal countries in Southeast Asia, South Asia, West Asia, the Balkan Peninsula, and the east coast of Africa, which are involved in the shipping routes in the East China Sea and shipping routes in the South China Sea, constitute the main study areas.

Referring to the Ancient Maritime Silk Road and related research [32,33], this study selected 39 MSRCs, such as Japan, the Philippines, and India, as the research area (Figure 1). To facilitate the analysis, Japan, South Korea, and North Korea are divided into three East Asian countries; Indonesia, Thailand, Malaysia, Vietnam, Singapore, the Philippines, Myanmar, Cambodia, and Brunei are divided into nine Southeast Asian countries; India,

Bangladesh, Pakistan, and Sri Lanka are divided into four South Asian countries; Saudi Arabia, the United Arab Emirates, Oman, Iran, Turkey, Israel, Kuwait, Iraq, Qatar, Jordan, Lebanon, Bahrain, Yemen, and Syria are divided into fourteen West Asian countries; Greece, Slovenia, Croatia, Albania, and Cyprus are divided into five Balkan countries; and Egypt, Kenya, Tanzania, and Sudan are divided into four African countries.

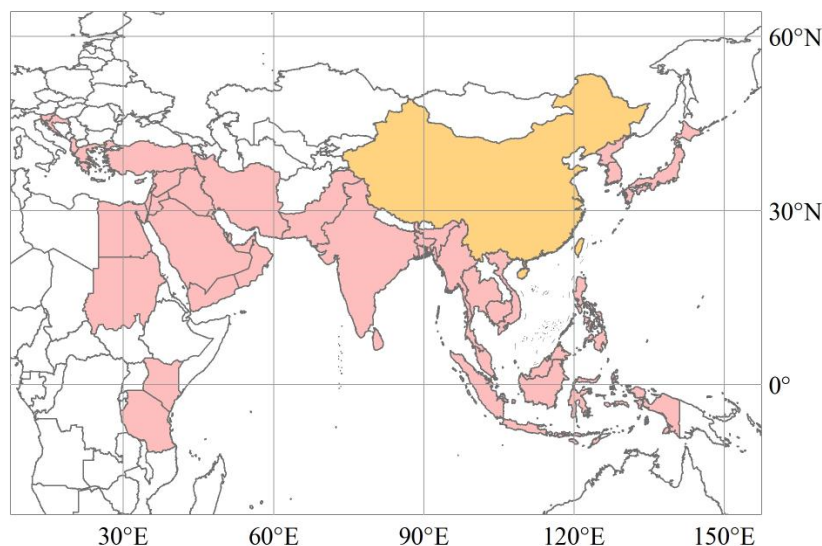


Figure 1. Study areas.

The analysis of trade network and investment network between China and MSRCs needs import and export data of goods and investment inflow and investment outflow data. The import and export data of goods are from the UN Comtrade database (<https://comtrade.un.org/data/> (accessed on 5 September 2022)). In order to facilitate comparison, the trade data of 2006, 2010, 2014, and 2017 were selected as time nodes, specifically including 5112 items of import and export data of goods of China and 39 countries in the study area. The investment inflow and investment outflow data are from the UNCTAD website (<https://unctad.org/topic/investment> (accessed on 5 September 2022)), the World Investment Report (<https://worldinvestmentreport.unctad.org/> (accessed on 5 September 2022)), and the Statistical Bulletin of China's Outward Foreign Direct Investment (<http://hzs.mofcom.gov.cn/article/date/201512/20151201223578.shtml> (accessed on 5 September 2022)). Since the investment data in the UNCTAD database is only updated to 2012, and the investment data of MSRCs after 2013 cannot be obtained, this study does not analyze the investment network between China and MSRCs from 2013 to 2017. The investment data of 2006 and 2012 are selected as time nodes, specifically including 438 items of investment inflow data and 438 items of investment outflow data for China and 39 countries in the study area.

3. Results

3.1. China and MSRCs' Trade Network

3.1.1. The Trade Network of MSRCs Is Approximately an Irregular Quadrilateral

According to social network analysis, by linking the trade flows of MSRCs and visualizing them with Gephi software, the MSRCs' trade network can be obtained (Figure 2). From 2006 to 2017, the density of the MSRCs' trade network remained stable, and the trade flows between countries were closely linked. From the perspective of trade network density, the MSRCs' trade network densities in 2006, 2010, 2014, and 2017 were 0.824, 0.844, 0.809, and 0.799, respectively, and the network density was close to 1, indicating that MSRCs' trade activities were frequent and trade ties between countries were close. From the perspective of the average weighted degree of the network, the average weighted degree of the MSRCs' trade network in 2006, 2010, 2014, and 2017 was 3.51×10^{10} ,

5.28×10^{10} , 6.60×10^8 , and 5.98×10^{10} , respectively. The overall upward trend was obvious, and the strength of MSRCs' trade linkage gradually increased. The clustering coefficients of the MSRCs' trade network in 2006, 2010, 2014, and 2017 were 0.845, 0.856, 0.832, and 0.829, respectively. The overall network clustering coefficient is extremely high, which further shows that the MSRCs' trade is closely linked. From a regional perspective, the trade flow between China, Japan, and South Korea is much larger than that between the three countries and other MSRCs, and the trade networks of the three countries are most closely connected. Egypt, Kenya, Tanzania, and Sudan have weak trade flows, and there is no obvious regional trade network. The trade flows between the five Balkan countries, nine Southeast Asian countries, and four South Asian countries were relatively large, forming a dense area in the northwest-southeast direction in the MSRCs' trade network. From the perspective of network shape, the MSRCs' trade network is approximately an irregular quadrilateral, and China, Indonesia, Tanzania, and Greece are the four vertices of the quadrilateral (Figure 2). It is worth noting that China has trade linkages with all the MSRCs. However, owing to the trade imbalance between China and India, the large overlap of trade commodities between China and India, Indian trade protectionism, the trade linkage between China and India is relatively weak.

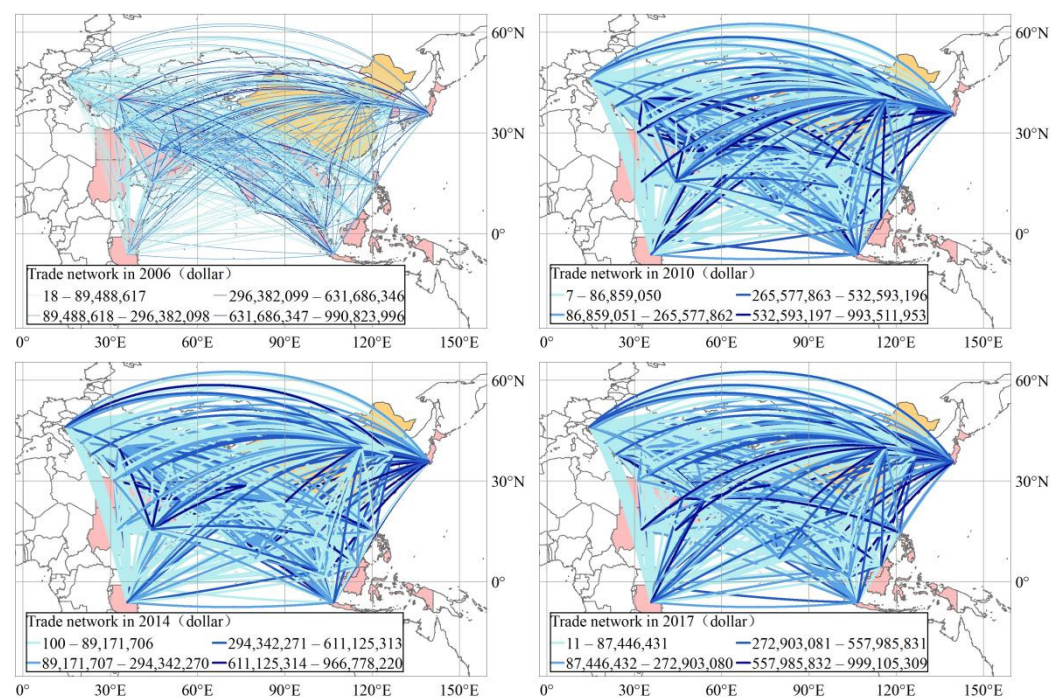


Figure 2. The trade network in MSRCs from 2006 to 2017.

3.1.2. The Weighted Degree Distribution Follows the Long-Tail Distribution Law

According to the weighted degree measurement of trade network weighted degree from 2006 to 2017, the weighted degree of most countries in the MSRCs trade network showed an upward trend, and the average weighted degree increased from 7.03×10^{10} to 1.20×10^{11} (Table 1). The node centrality is positively correlated with trade flow. The trade flows of China, Japan, and South Korea are much larger those that of other countries, which makes the node weighted degree of China, Japan, and South Korea always in the top three. In 2006, Japan had the largest centrality, and its trade flow with MSRCs was the largest. With the advancement of China's economic development and the construction of the Maritime Silk Road, the trade flow between China and MSRCs has continued to increase, driving China's node weighted degree in the MSRCs' trade network to continue to rise. From 2006 to 2017, China's node weighted degree in the MSRCs' trade network increased from 4.98×10^{11} to 9.81×10^{11} surpassing Japan to become the country with the highest node centrality in the MSRCs' trade network and the core of the MSRCs' trade network.

South Korea and Japan have developed economies with high economic extroversion and large trade flows. The node weighted degree of the two countries was ranked second and third from 2010 to 2017, becoming central in the MSRCs' trade network, second only to China. It is worth noting that the gap between South Korea's centrality and that of Japan is constantly narrowing. In 2006, South Korea's centrality was 62.75% of Japan's, and South Korea's centrality was 90.92% of Japan's in 2017. This shows that the trade flow between South Korea and MSRCs was growing rapidly, which promoted the rapid improvement of South Korea's centrality in the MSRCs' trade network.

Table 1. The variation of weighted degree of trade network in MSRCs from 2006 to 2017.

Ranking	2006	2010	2014	2017
1	Japan	5.10×10^{11}	China	8.06×10^{11}
2	China	4.98×10^{11}	Japan	6.63×10^{11}
3	South Korea	3.20×10^{11}	South Korea	4.59×10^{11}
4	Singapore	2.07×10^{11}	Singapore	2.74×10^{11}
5	Malaysia	1.68×10^{11}	India	2.49×10^{11}
6	Thailand	1.49×10^{11}	Malaysia	2.48×10^{11}
7	Saudi Arabia	1.48×10^{11}	Thailand	2.18×10^{11}
8	India	1.22×10^{11}	Saudi Arabia	1.98×10^{11}
9	United Arab Emirates	1.13×10^{11}	United Arab Emirates	1.95×10^{11}
10	Indonesia	1.13×10^{11}	Indonesia	1.94×10^{11}
11	the Philippines	6.78×10^{10}	Iran	9.28×10^{10}
12	Iran	5.10×10^{10}	the Philippines	7.91×10^{10}
13	Kuwait	4.42×10^{10}	Vietnam	6.94×10^{10}
14	Vietnam	3.79×10^{10}	Qatar	6.21×10^{10}
15	Qatar	3.71×10^{10}	Kuwait	5.90×10^{10}
16	Turkey	3.52×10^{10}	Turkey	5.78×10^{10}
17	Oman	2.62×10^{10}	Oman	4.15×10^{10}
18	Pakistan	2.10×10^{10}	Pakistan	3.12×10^{10}
19	Greece	1.80×10^{10}	Egypt	2.72×10^{10}
20	Israel	1.32×10^{10}	Iraq	2.52×10^{10}
21	Egypt	1.28×10^{10}	Israel	1.96×10^{10}
22	Yemen	9.25×10^9	Bangladesh	1.87×10^{10}
23	Bangladesh	9.21×10^9	Greece	1.84×10^{10}
24	Iraq	7.80×10^9	Yemen	1.20×10^{10}
25	Jordan	7.78×10^9	Jordan	1.09×10^{10}
26	Sri Lanka	7.17×10^9	Sudan	1.05×10^{10}
27	Brunei	7.07×10^9	Sri Lanka	9.80×10^9
28	Bahrain	6.45×10^9	Bahrain	9.76×10^9
29	Syria	5.82×10^9	Brunei	9.13×10^9
30	Sudan	5.77×10^9	Myanmar	8.91×10^9
31	Slovenia	4.66×10^9	Kenya	7.23×10^9
32	Kenya	4.35×10^9	Syria	6.75×10^9
33	Croatia	4.20×10^9	Lebanon	6.48×10^9
34	Myanmar	4.08×10^9	Slovenia	5.94×10^9
35	Lebanon	3.97×10^9	Tanzania	5.65×10^9
36	Cyprus	3.22×10^9	Croatia	4.82×10^9
37	Tanzania	3.09×10^9	Cyprus	4.78×10^9
38	Cambodia	1.88×10^9	Cambodia	3.29×10^9
39	North Korea	1.35×10^9	North Korea	1.59×10^9
40	Albania	9.61×10^8	Albania	1.57×10^9
			China	1.04×10^{12}
			Japan	6.88×10^{11}
			South Korea	5.90×10^{11}
			Singapore	3.15×10^{11}
			India	3.09×10^{11}
			Saudi Arabia	2.94×10^{11}
			Malaysia	2.86×10^{11}
			United Arab Emirates	2.62×10^{11}
			Thailand	2.51×10^{11}
			Vietnam	2.28×10^{11}
			Indonesia	2.28×10^{11}
			Vietnam	1.36×10^{11}
			Qatar	1.14×10^{11}
			Iran	8.86×10^{10}
			Kuwait	8.55×10^{10}
			Turkey	8.38×10^{10}
			the Philippines	7.99×10^{10}
			Iraq	6.93×10^{10}
			Oman	6.34×10^{10}
			Egypt	3.58×10^{10}
			Pakistan	3.55×10^{10}
			Myanmar	3.33×10^{10}
			Greece	2.54×10^{10}
			Israel	2.54×10^{10}
			Bahrain	2.02×10^{10}
			Jordan	1.56×10^{10}
			Yemen	1.43×10^{10}
			Sri Lanka	1.41×10^{10}
			Sudan	1.06×10^{10}
			Brunei	1.06×10^{10}
			Tanzania	9.33×10^9
			Slovenia	8.61×10^9
			Cambodia	7.30×10^9
			Lebanon	7.21×10^9
			Croatia	5.59×10^9
			Sudan	5.11×10^9
			Bangladesh	5.06×10^9
			Cyprus	4.36×10^9
			North Korea	3.09×10^9
			Kenya	1.90×10^9
			Albania	1.70×10^9
			Syria	9.30×10^8
			China	9.81×10^{11}
			Japan	5.95×10^{11}
			South Korea	5.41×10^{11}
			India	2.79×10^{11}
			Singapore	2.75×10^{11}
			Malaysia	2.62×10^{11}
			Thailand	2.46×10^{11}
			United Arab Emirates	2.35×10^{11}
			Vietnam	2.27×10^{11}
			Indonesia	2.04×10^{11}
			Saudi Arabia	2.01×10^{11}
			the Philippines	1.02×10^{11}
			Turkey	8.71×10^{10}
			Iran	7.67×10^{10}
			Qatar	6.16×10^{10}
			Kuwait	5.63×10^{10}
			Iraq	4.56×10^{10}
			Oman	4.38×10^{10}
			Egypt	3.45×10^{10}
			Pakistan	3.42×10^{10}
			Israel	2.55×10^{10}
			Greece	2.45×10^{10}
			Myanmar	2.09×10^{10}
			Bahrain	1.70×10^{10}
			Sri Lanka	1.43×10^{10}
			Jordan	1.17×10^{10}
			Sudan	9.80×10^9
			Slovenia	9.46×10^9
			Kenya	9.35×10^9
			Lebanon	7.83×10^9
			Tanzania	7.10×10^9
			Brunei	6.67×10^9
			Croatia	6.60×10^9
			Bangladesh	6.02×10^9
			Cambodia	5.54×10^9
			Cyprus	5.02×10^9
			Yemen	2.19×10^9
			North Korea	1.83×10^9
			Albania	1.59×10^9
			Syria	6.22×10^8

Comparing the centrality rankings in 2006 and 2017, we find that, except for South Korea, Indonesia, Qatar, Croatia, and Cyprus, which remain unchanged, the centrality rankings of the remaining 35 countries have changed. Among them, the centrality ranking of 17 countries has decreased, while that of 18 countries has risen, and the centrality pattern of the MSRCs trade network has changed greatly. Myanmar had the fastest increase in centrality rankings. The advancement of democratic reforms and the reduction of external economic sanctions have created a good environment for Myanmar's economic develop-

ment. Its economic development thus entered a period of rapid growth. Furthermore, its import and export trade flows with China, Thailand, Japan, and other countries increased rapidly, and the centrality ranking increased by 11 places. Yemen, Syria, and Bangladesh had the greatest decline in centrality. Yemen and Bangladesh are among the least developed countries in the world. Backward industrial development and a single industrial structure have led to a slow growth in Bangladeshi imports and exports. The civil war in Syria and Yemen severely damaged the economic development, imports, and exports of the two countries, leading to the rankings of Yemen, Syria, and Bangladesh falling by 15, 11, and 11, respectively.

In terms of regions, Egypt, Tanzania, Kenya, and Sudan have increased their centrality in the MSRCs' trade network. The four South Asian countries, except Bangladesh, have experienced a significant increase in the centrality of the MSRCs' trade network, while the five Balkan countries have changed their centrality slightly in the MSRCs' trade network, and the trade network centrality rankings of Southeast and West Asian countries have both experienced upward and downward trends. This further indicates that the trade centrality of the regions along the Maritime Silk Road is not stable and that the centrality pattern of the trade network fluctuates significantly. In addition, the power function fitting analysis was carried out on the weighted degree distribution of the MSRCs' trade network, and it was found that the top 25% of node weighted degrees accounted for more than 80% of the total weighted degree in 2006, 2010, 2014, and 2017 (Figure 3). The fitting relationship coefficients of the trade network weighted degree and power function were all greater than 0.8. The weighted degree of a few nodes is very high, and the weighted degree of most nodes is very low, indicating that the distribution of the nodes' weighted degree in the MSRCs' trade network follows the long-tail distribution law, and the scale-free characteristics are significant.

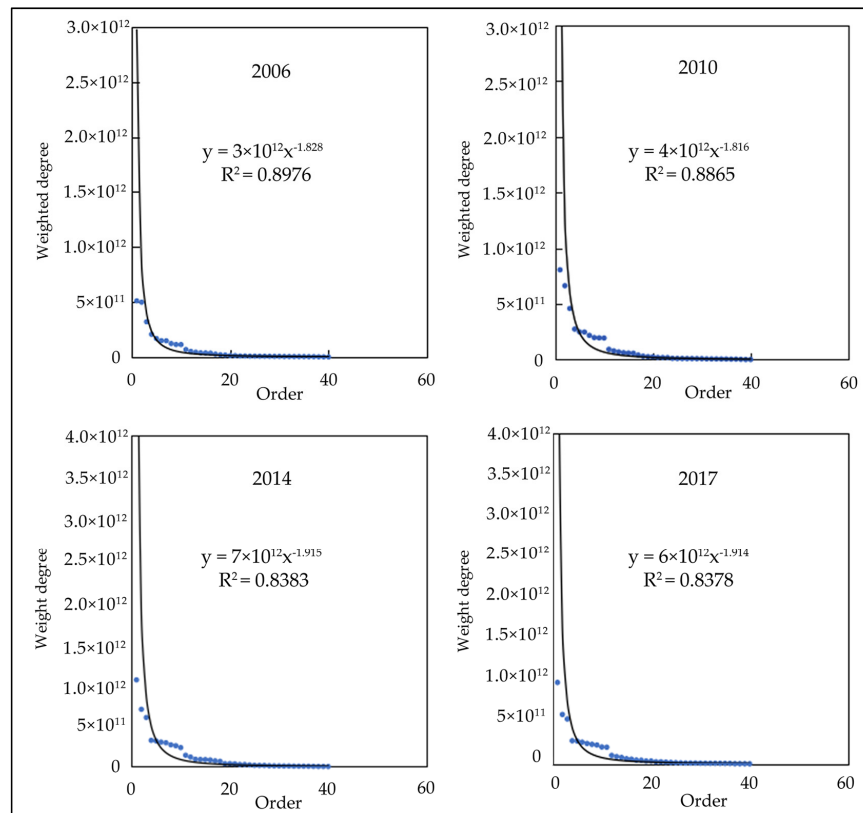


Figure 3. The weighted degree distribution of the trade network in MSRCs from 2006 to 2017.

3.1.3. The Trade Network Has Shifted from the Triad of China, Japan, and South Korea to China's Single-Core Dominance

Gephi software was used to analyze the topological structure of the trade network, and the topological structure maps of the MSRCs trade network were obtained (Figure 4). In 2006, China, Japan, and South Korea, the top three countries in the weighted degree of the trade network, accounted for 17.71%, 18.15%, and 11.39% of the total weighted degree of all MSRCs, respectively. There is little difference in the centralities of the three countries in the MSRCs' trade network. During this period, the MSRCs' trade network exhibited a tripartite pattern for China, Japan, and South Korea (Figure 4). In 2010, the trade network weighted degree of Japan and South Korea decreased in proportion to the total weighted degree of all MSRCs, while the trade network weighted degree of China increased in proportion to the total weighted degree of all MSRCs. In 2014, the proportion of China's weighted degree in the total weighted degree of all MSRCs continued to rise, and the proportion of South Korea's weighted degree in the total weighted degree of all MSRCs increased to 13.04%, while the proportion of Japan's weighted degree in the total weighted degree of all MSRCs further decreased. In 2017, the weighted degrees of China, Japan, and South Korea accounted for 20.52%, 12.45%, and 11.31%, respectively, of the total weighted degree of all MSRCs. Although the weighted degree of China's in 2017 was lower than that in 2014. China's centrality in the MSRCs' trade network is much higher than that of Japan and South Korea, and it is becoming the core country in the MSRCs' trade network (Figure 4). From 2006 to 2017, China's total import and export trade volume increased by 2.37 times, the centrality of the trade network continued to increase, and the centrality advantages of Japan and South Korea continued to expand, which promoted the MSRCs' trade network from a tripartite confrontation of China, Japan, and South Korea to China's single-core dominance. It is worth noting that the node weighted degree of a country is not only a reflection of the country's position in the trade network, but also a reflection of the country's influence on other countries. The strengthening of China's dominance of the MSRCs' trade network indicated that China's trade influence on MSRCs was increasing.

3.1.4. The Cohesion of MSRCs Trade Network Is Weak

Cohesive subgroup analysis was performed on the MSRCs' trade network, and ArcGis software was used to visualize it to obtain the MSRCs' trade network cohesive subgroup maps (Figure 5). In 2006, 2010, 2014, and 2017, the trade network investment was divided into three subgroups. According to the cohesive subgroups analysis, the MSRCs' trade communities have changed significantly, and the trade network cohesion is weak. In 2006, the division of the MSRCs' trade network into cohesive subgroups and regional divisions overlapped greatly, and geographically adjacent countries were mostly in the same subgroup (Figure 5). Vietnam, Cambodia, Malaysia, and Singapore belonged to subgroup 1. China and Japan, North Korea, South Korea, Indonesia, Thailand, the Philippines, Myanmar, Brunei, and Sudan are in subgroup 2. Fourteen West Asian countries, four South Asian countries, and five Balkan countries, Egypt, Kenya, and Tanzania, are in subgroup 3. Because the number of countries in subgroup 1 is very small, and subgroup 2 and subgroup 3 occupy dominant positions. In 2010, the number of countries in subgroup 2 increased. Subgroup 1 is clustered in Southeast Asia, and Indonesia, the Philippines, Singapore, and Malaysia are in the same subgroup. Vietnam, Cambodia, Iran, Oman, and North Korea have transferred from subgroup 1 and subgroup 3 to subgroup 2, which China is located in, indicating that the influence of the cohesive subgroups that China belongs to has expanded.

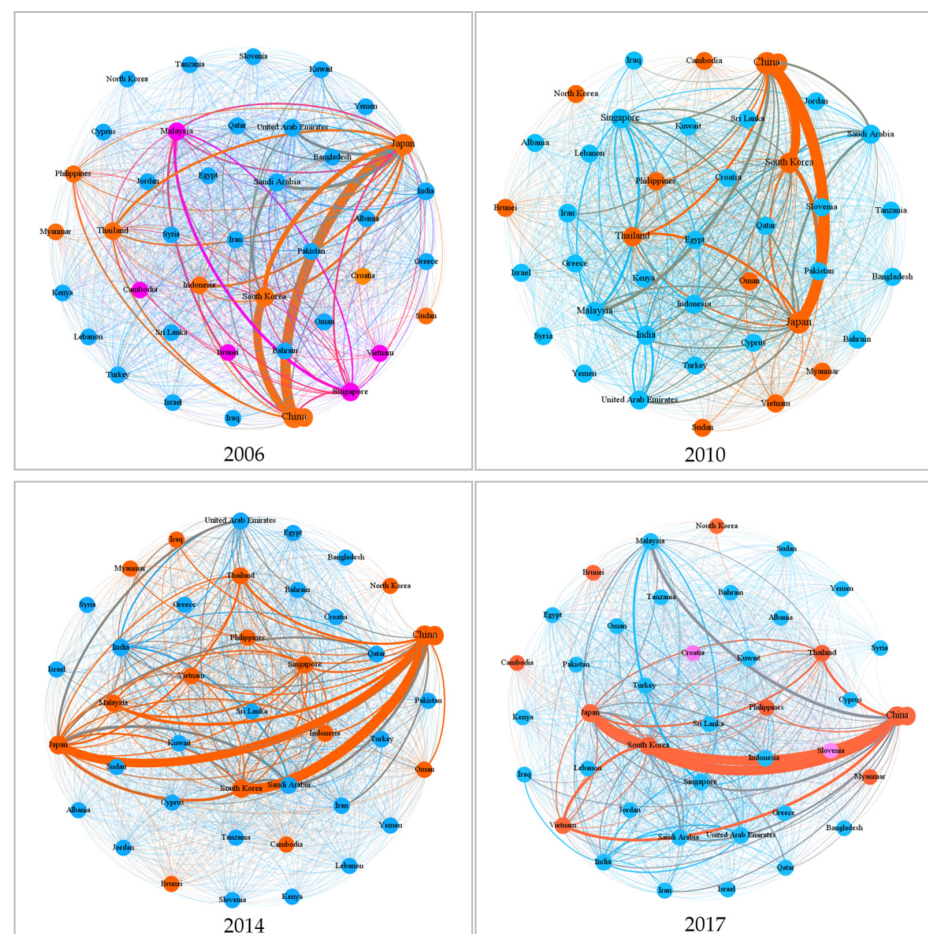


Figure 4. The topological structure maps of the trade network in MSRCs from 2006 to 2017.

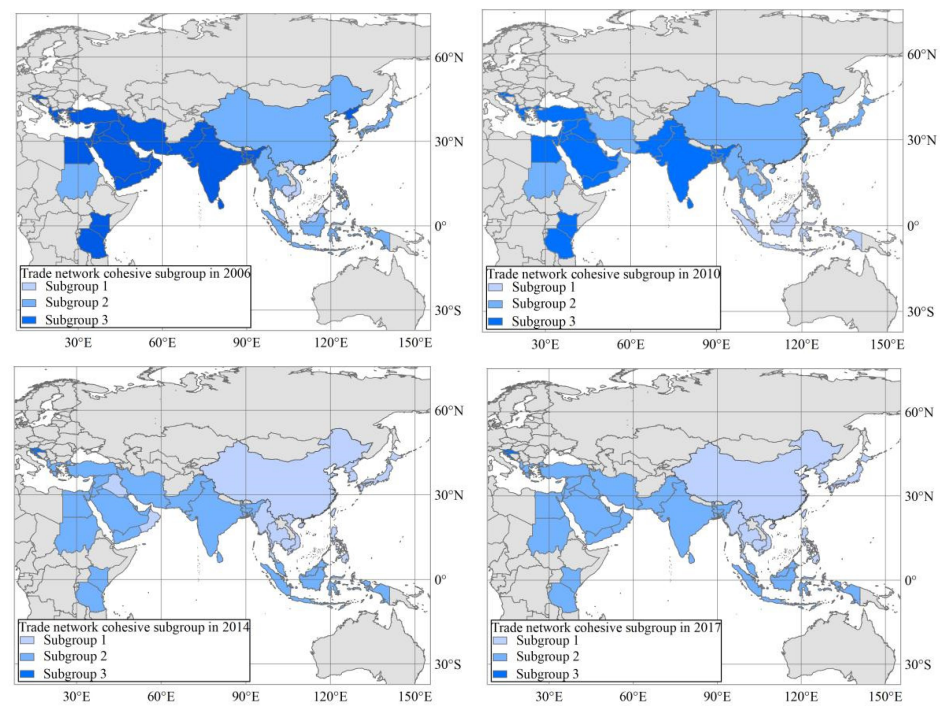


Figure 5. The cohesive subgroup maps of the trade network in MSRCs from 2006 to 2017.

In 2014, the number of countries in subgroup 3 decreased significantly, leaving only Croatia and Slovenia. Except for four South Asian countries, Singapore, Malaysia, and Indonesia, the MSRCs around China are in the same subgroup with China. Most countries in West Asia, four African countries, and four South Asian countries, as well as Indonesia, Malaysia, Singapore, Greece, Albania, and Cyprus are in subgroup 2. In 2017, the regional characteristics of trade cohesive subgroups became more obvious. Fourteen West Asian countries, four South Asian countries, and four African countries, Greece, Albania, Cyprus, Malaysia, Singapore, and Indonesia constitute subgroup 2. China, Japan, North Korea, South Korea, Myanmar, Thailand, Cambodia, Vietnam, and the Philippines constituted subgroup 1. Since there are still only Croatia and Slovenia in subgroup 3, subgroup 1, and subgroup 2 are in a confrontational situation. From the perspective of trade flow and trade scale, whether it is in subgroup 1 or subgroup 2, China is the core of the community. China, Japan, and South Korea belong to the same subgroup. Nine Southeast Asian countries gradually joined the subgroup that is dominated by China. Four South Asian countries, fourteen West Asian countries, four African countries, and China are in different subgroups most of the time (Figure 5). On the whole, China, Japan, and South Korea have strong trade cohesion, and China's trade influence is mainly concentrated in Southeast and East Asia.

3.2. China and MSRCs Investment Network

3.2.1. The Investment Network of MSRCs Is Insufficiently Developed and Network Connections Are Sparse

According to social network analysis, by linking the investment inflow and investment outflow and visualizing them with Gephi software, the MSRCs' investment inflow network and the MSRCs' investment outflow network can be obtained (Figures 6 and 7). From the perspective of the investment inflow network, in 2006 and 2012, MSRCs' investment inflow had network edges of less than 200, a network average degree of less than 5, a network density of less than 0.15, and a maximum node degree of more than 30. Investment inflows in various countries are relatively sluggish, and connections are sparse (Figure 6). Although the number of edges, average degree of nodes, network density, and maximum node degree of the investment outflow network in 2006 and 2012 were slightly larger than those of the investment inflow network, these index values were still small, and the investment outflows in different countries were relatively small. The outflow network node connection system was weak (Figure 7). Based on the average length of the path, the length of the investment inflow and outflow networks in each year was greater than two. The accessibility of the investment network nodes was poor, and the investment flow had not yet achieved large-scale, high-frequency, and efficient circulation. Obviously, compared with the trade network of MSRCs, the investment network of MSRCs is insufficiently developed and the network connections are sparse. In addition, from 2006 to 2012, the average degree and density of the investment inflow network and the investment outflow network showed a slight upward trend, and the average path length showed a downward trend, which meant that the connection strength of MSRCs' investment network nodes slowly increased.

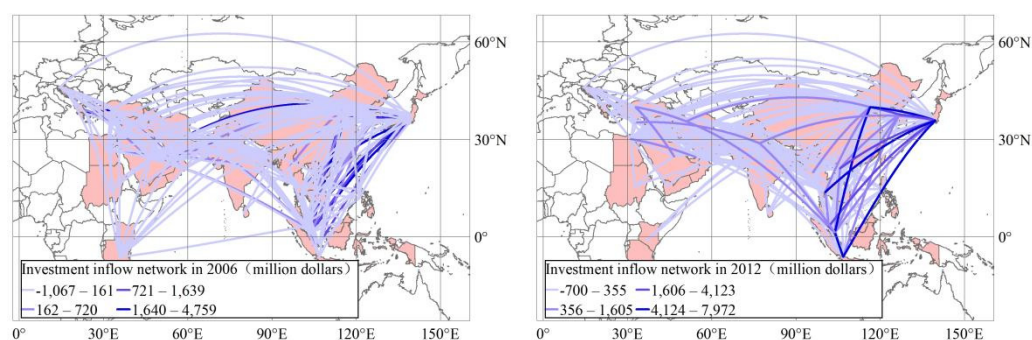


Figure 6. The investment inflow network in MSRCs from 2006 to 2012.

In the investment network, China, Japan, South Korea, and Singapore occupied important positions. The investment inflows of Japan, Singapore, South Korea, and Indonesia are much larger than those of other countries (Figure 6), and the investment outflows of China, Japan, and Singapore are much larger than those of other countries (Figure 7). Southeast Asian countries with adjacent geographical locations, rapid economic development, and favorable investment environments, and energy-rich Saudi Arabia and the United Arab Emirates environments have attracted a large amount of investment from China, Japan, and South Korea, thus establishing a relatively stable regional investment network. Kenya, Tanzania, and Sudan, which are economically backward and have poor investment environments, had very few investments and weak investment linkages with MSRCs. With rapid economic development and huge economic volume, China is attracting a large amount of foreign investment and increasing foreign investment. It is an important investment destination and a source country in the MSRCs' investment network. In 2012, China invested 8.639 billion dollars in MSRCs, and 39 MSRCs invested 17.8 billion dollars in China. This makes the node degree of China rank third in the investment inflow network of MSRCs and the node degree of China rank first in the investment outflow network of MSRCs, becoming a core node country in the investment network along the Maritime Silk Road. With the continuous advancement of the "Belt and Road Initiative", China's investment in MSRCs increased to 17.894 billion dollars in 2017, and countries along the route have further increased their dependence on China's investment. Japan, South Korea, and Singapore are the most developed economies along the Maritime Silk Road, with strong capital and active overseas investments. They have also attracted a capital inflow from many developing countries.

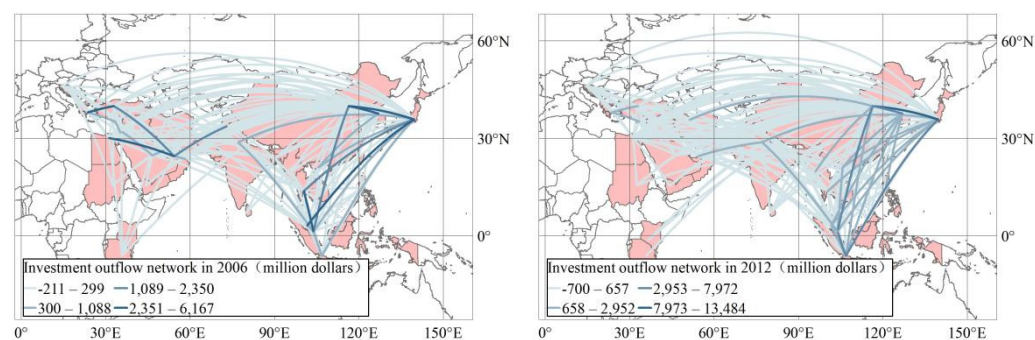


Figure 7. The investment outflow network in MSRCs from 2006 to 2012.

3.2.2. China, Japan, and Singapore Are the Core Nodes of the Investment Network along the Maritime Silk Road

According to the weighted degree measurement of the investment inflow network and the investment outflow network from 2006 to 2012, the network weighted degree of the MSRCs' investment inflows first increased and then decreased. The average weighted degree of the MSRCs' investment inflow network increased from 1360.50 in 2006 to 2297.50 in 2010 and then dropped to 1788.92. This shows that in the post-financial crisis period, MSRCs' investment was sluggish and recovery was slow. From the node weighted degree rankings, Japan, Singapore, and China were the three countries with the highest weighted degree of investment flows in most years, and their centrality in the network of investment flows was higher than that of the other countries (Table 2). The investment inflows of Saudi Arabia, South Korea, the United Arab Emirates, and Indonesia were highly weighted and had a high central position in the investment inflow network. From 2006 to 2012, the centrality of investment inflows in Indonesia, Vietnam, Myanmar, and Cambodia in Southeast Asia increased by 6, 29, 6, and 7, respectively. The centrality and attractiveness of the investment inflows increased significantly. The construction of the China-ASEAN Free Trade Area has promoted a rapid increase in China's investment in Southeast Asian countries. Japan and South Korea are shifting their industries to Southeast Asia, leading to

a rapid increase in the centrality of investment inflows from Indonesia, Vietnam, Myanmar, and Cambodia. Affected by the impact of the financial crisis, the Syrian war, and the “crowding-out effect” brought about by the increasing investment attractiveness of Southeast Asian countries, the weighted investment inflows of oil countries such as Saudi Arabia, the United Arab Emirates, and Syria have dropped by 10, 11, and 5, respectively. Thus, investment attractiveness has declined.

Table 2. The variation of weighted degree of the inflow network in MSRCs from 2006 to 2012.

Ranking	2006		2008		2010		2012	
1	Japan	21,233	Saudi Arabia	22,694	Singapore	29,513	Japan	33,439
2	Singapore	16,776	Singapore	18,490	China	26,197	Singapore	21,404
3	China	15,187	Japan	17,166	Japan	21,658	China	20,332
4	South Korea	7038	United Arab Emirates	15,941	Myanmar	13,470	Indonesia	17,272
5	United Arab Emirates	6662	China	15,176	South Korea	12,082	South Korea	11,524
6	Saudi Arabia	6573	Kuwait	9702	Indonesia	11,768	Thailand	7782
7	Thailand	6123	India	8686	Saudi Arabia	10,836	Vietnam	5740
8	Malaysia	5456	South Korea	6988	India	10,348	Malaysia	5733
9	Turkey	4652	Indonesia	6188	Thailand	9341	India	4645
10	Indonesia	3571	Malaysia	4979	United Arab Emirates	8775	Turkey	2142
11	Egypt	3352	Thailand	4659	Malaysia	7673	Egypt	1259
12	Greece	3177	Turkey	3388	Kuwait	5744	Myanmar	1094
13	Pakistan	1943	Egypt	3371	Turkey	2411	Cyprus	1037
14	India	1937	Cyprus	2165	Egypt	1524	Cambodia	989
15	Oman	703	Pakistan	2117	Qatar	1512	United Arab Emirates	734
16	Kuwait	682	Greece	1594	Cyprus	1455	Iran	712
17	Jordan	587	Oman	1067	Sri Lanka	1304	Saudi Arabia	684
18	Myanmar	530	Jordan	1010	Greece	1192	Lebanon	425
19	Cyprus	379	Qatar	982	Pakistan	657	Greece	390
20	the Philippines	355	Myanmar	959	Lebanon	657	Bangladesh	379
21	Cambodia	319	Cambodia	624	Croatia	648	Kuwait	351
22	Bangladesh	295	Bangladesh	616	the Philippines	606	the Philippines	285
23	Yemen	244	the Philippines	501	Iran	583	Pakistan	261
24	Lebanon	163	Slovenia	385	Jordan	540	Sri Lanka	191
25	Croatia	139	Syria	379	Cambodia	536	Iraq	171
26	Israel	118	Lebanon	359	Oman	398	Croatia	171
27	Slovenia	112	Croatia	312	Slovenia	389	Qatar	134
28	Tanzania	92	Yemen	250	Syria	331	North Korea	109
29	Iran	87	Iran	183	Vietnam	298	Kenya	83
30	Albania	86	Vietnam	142	Bahrain	268	Jordan	54

Table 2. Cont.

Ranking	2006		2008		2010		2012	
31	Qatar	72	Israel	111	Kenya	195	Albania	26
32	Sudan	57	Albania	67	Bangladesh	194	Slovenia	25
33	Syria	38	Kenya	42	Iraq	150	Oman	24
34	Bahrain	26	North Korea	41	Brunei	139	Yemen	17
35	Kenya	17	Sudan	34	Tanzania	134	Bahrain	12
36	Vietnam	13	Iraq	23	Yemen	127	Brunei	10
37	North Korea	11	Brunei	21	Albania	78	Israel	2
38	Sri Lanka	7	Sri Lanka	20	Sudan	39	Sudan	2
39	Brunei	2	Tanzania	19	Israel	18	Syria	1
40	Iraq	1	Bahrain	2	North Korea	12	-	-

From 2006 to 2012, the network weighted degree of the MSRCs' investment outflows showed an increasing trend, but the growth momentum was insufficient (Table 3). In 2006, 2008, 2010, and 2012, the average weighted degrees of the MSRCs' investment outflow network were 1159.45, 2243.21, 2134.05, and 2101.80, respectively. The 2008 financial crisis was an important node in weighted changes in the investment network. Before the 2008 financial crisis, investment outflows grew rapidly, and the weighted degree of investment outflows increased rapidly. After the 2008 financial crisis, the overseas investment of MSRCs recovered slowly, and the weighted degree of investment outflows stagnated. China, Japan, and Singapore are the most important foreign investment countries in MSRCs. The outflow of investment from these three countries is much larger than that of other countries, and they are growing rapidly. From 2006 to 2012, due to the substantial growth of investment abroad, the investment outflow weighted degree of Japan, China, and Singapore increased by 2.18 times, 2.31 times, and 2.74 times, respectively, and their centrality in the MSRCs' investment outflow network continued to strengthen. Comparing the changes in investment weighted degree rankings in 2012 and 2006, it is found that the rankings of investment outflow weighted degree of 20 countries have fallen, and more than half of the countries have tightened investment abroad. Oman, Pakistan, and Jordan have experienced the largest decline in investment outflow centrality, and the centrality of investment outflows from Myanmar, Iran, and Sri Lanka has risen the fastest. Owing to the limited growth of overall investment outflows, the centrality of MSRCs' investment outflows is slowly increasing.

Table 3. The variation of weighted degree of the outflow network in MSRCs from 2006 to 2012.

Ranking	2006		2008		2010		2012	
1	Japan	15,402	Japan	23,360	Singapore	34,485	China	33,594
2	China	12,780	Singapore	21,718	Japan	21,677	Japan	29,705
3	Singapore	10,550	Saudi Arabia	19,588	China	21,641	Singapore	28,869
4	United Arab Emirates	8440	China	18,127	India	12,191	Indonesia	15,726
5	Thailand	5667	United Arab Emirates	14,942	Malaysia	10,677	South Korea	10,820
6	South Korea	5205	Malaysia	10,613	Indonesia	9316	Malaysia	9515
7	Turkey	4726	India	10,091	Saudi Arabia	8952	India	9142

Table 3. Cont.

Ranking	2006		2008		2010		2012	
8	Pakistan	3661	Kuwait	9722	United Arab Emirates	8639	Thailand	5749
9	Egypt	3600	Indonesia	8217	South Korea	7586	Vietnam	5191
10	Malaysia	3551	South Korea	7339	Thailand	7373	Turkey	3127
11	Greece	3304	Thailand	6088	Kuwait	5795	United Arab Emirates	2230
12	Indonesia	2733	Vietnam	3351	Vietnam	2367	the Philippines	2068
13	Saudi Arabia	2359	Egypt	3128	Turkey	1712	Greece	1817
14	India	1420	Pakistan	3071	Bahrain	1676	Myanmar	1391
15	Cyprus	1356	Turkey	2475	Cyprus	1485	Egypt	1306
16	Vietnam	1152	Myanmar	1906	Egypt	1483	Cyprus	1265
17	Bahrain	1052	Bahrain	1871	the Philippines	1443	Cambodia	1147
18	Israel	1028	the Philippines	1378	Pakistan	1342	Saudi Arabia	1009
19	Oman	823	Oman	1095	Greece	1319	Lebanon	865
20	Kuwait	729	Jordan	1010	Myanmar	1310	Iran	713
21	the Philippines	727	Bangladesh	932	Sri Lanka	1304	Pakistan	504
22	Jordan	586	Cambodia	927	Lebanon	1269	Bangladesh	379
23	Lebanon	326	Cyprus	923	Oman	1087	Kuwait	360
24	Bangladesh	268	Greece	796	Cambodia	936	Bahrain	257
25	Yemen	244	Lebanon	673	Iran	586	Israel	256
26	Cambodia	179	Syria	379	Jordan	540	Iraq	247
27	Myanmar	179	Yemen	250	Croatia	521	Sri Lanka	209
28	Croatia	143	Iran	184	Bangladesh	460	Tanzania	120
29	Slovenia	130	Slovenia	151	Syria	331	Qatar	117
30	Tanzania	88	Croatia	137	Slovenia	296	Croatia	105
31	Iran	87	Israel	136	Kenya	195	Kenya	83
32	Albania	86	Qatar	86	Iraq	150	Jordan	54
33	Sudan	57	Albania	67	Yemen	127	Yemen	52
34	Qatar	46	Brunei	58	Israel	118	Brunei	43
35	Syria	38	Kenya	54	Tanzania	117	Slovenia	37
36	Kenya	17	Tanzania	50	Brunei	78	Oman	36
37	Brunei	9	Sudan	34	Albania	77	Albania	26
38	Sri Lanka	7	Iraq	23	Sudan	39	North Korea	7
39	Iraq	1	Sri Lanka	20	Qatar	23	Sudan	3
40	-	-	-	-	North Korea	1	-	-

3.2.3. The Investment Network of MSRCs' Space Structure Follows the "Core-Periphery" Circle Structure

Gephi software was used to analyze the topological structure of the investment network, and the topological structure maps of the MSRCs' inflow network and the MSRCs' outflow network were obtained (Figures 8 and 9). The spatial structure of the MSRCs' investment inflows has obvious core-periphery structural characteristics (Figure 8). South Korea, Saudi Arabia, Malaysia, Thailand, the United Arab Emirates, Indonesia, India, Turkey, and Vietnam are the sub-core nodes in the investment inflow network. Lebanon, Greece, Bangladesh, Kuwait, Sri Lanka, Qatar, and Croatia are edge nodes in the investment inflow network. Take the weighted degree of investment inflows as an example, the sum of the weighted degrees of investment inflows in China, Japan, and Singapore accounted for 53.91% of the total weighted degree of all MSRCs in 2012, and the investment attractiveness of the three countries is far greater than that of other countries.

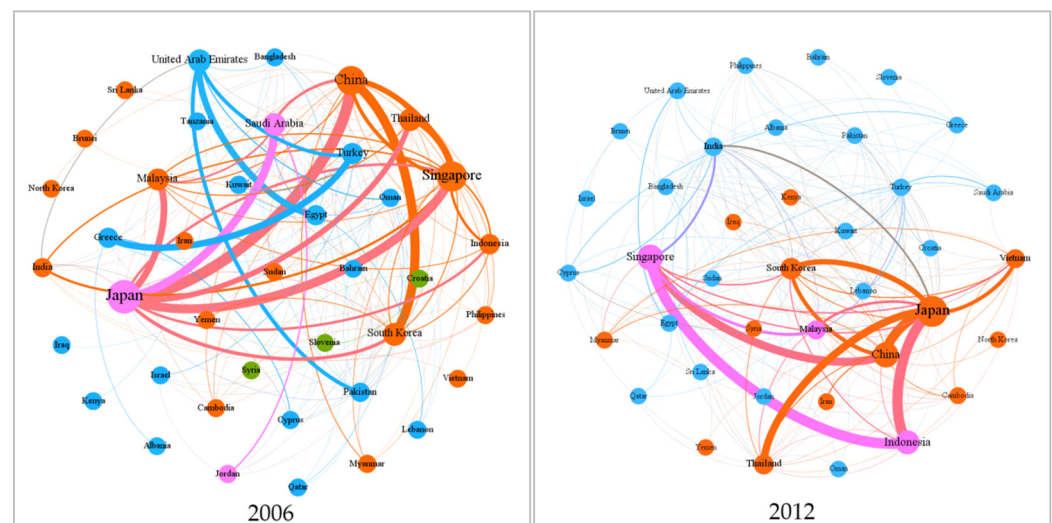


Figure 8. The topological structure maps of the inflow network in MSRCs from 2006 to 2012.

The spatial structure of the MSRCs' investment outflow also has a significant “core–periphery” structural feature (Figure 9). China, Singapore, and Japan are the core investment outflow countries in the MSRC investment outflow network. China, Singapore, and Japan are not only the countries with the largest investment abroad in MSRCs, but also important investment partners of each other. In 2012, China, Singapore, and Japan invested 8.378 billion dollars, 19.195 billion dollars, and 27.580 billion dollars in MSRCs, respectively. In 2012, Japan invested 7.352 billion dollars and Singapore invested 6.305 billion dollars in China. At the same time, China invested 1.519 billion dollars in Singapore and 211 million dollars in Japan. This indicates that China, Singapore, and Japan have a huge impact on the outflow of investment from MSRCs. Indonesia, South Korea, Malaysia, India, Thailand, and Vietnam constitute the sub-core countries in the MSRCs' investment outflow network. Cambodia, Saudi Arabia, Iran, and Kuwait constitute the sub-peripheral countries in the MSRCs' investment outflow network. Yemen, Brunei, Slovenia, and Sudan constitute the most marginal countries in the MSRCs' investment outflow network. It is worth noting that the rapid rise in South Korea and Indonesia's node status in the investment outflow network from 2006 to 2012 has had a certain impact on the core status of China, Japan, and South Korea.

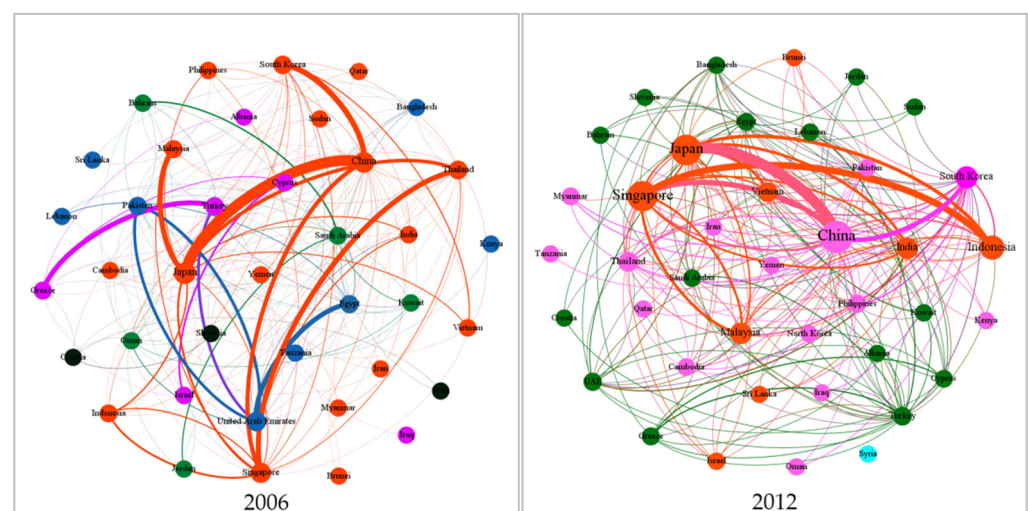


Figure 9. The topological structure maps of the outflow network in MSRCs from 2006 to 2012.

3.2.4. The Cohesion Subgroup of Investment Inflow Network of MSRCs Does Not Have Significant Regional Characteristics, and the Investment Outflow Network Core Subgroup Has Strong Cohesion

Cohesive subgroup analysis was performed on the MSRCs' investment network, and ArcGis software was used to visualize it to obtain the MSRCs' investment inflow network and the MSRCs' investment outflow network cohesive subgroup maps (Figures 10 and 11). The investment inflow network of MSRCs' cohesive subgroups does not have significant regional characteristics, and most countries in the same region are in different subgroups (Figure 10). In 2006, the investment inflow network was divided into four subgroups. Japan, Saudi Arabia, and Jordan were in subgroup 1, and Slovenia, Croatia, and Syria constituted subgroup 2. Albania, Greece, Cyprus, Lebanon, Israel, Egypt, Kenya, Tanzania, Iraq, Kuwait, Bahrain, Qatar, the United Arab Emirates, Oman, Pakistan, and Bangladesh constituted subgroup 3. China, North Korea, South Korea, Southeast Asian countries, Sri Lanka, India, Iran, Yemen, and Sudan constituted subgroup 4. Subgroup 4, in which China is located, is the most widely distributed and constitutes the most dominant community in the investment inflow network of MSRCs. In 2012, the investment inflow network was divided into 3 subgroups. The number of cohesive subgroups of MSRCs' investment inflow network decreased. The scope of subgroup 3 was replaced by subgroup 1 and subgroup 2, and the scope of subgroup 4 shrank significantly. China, North Korea, South Korea, Japan, Myanmar, Thailand, Vietnam, Cambodia, Iran, Iraq, Yemen, Syria, and Kenya constituted subgroup 1; Malaysia, Singapore, and Indonesia constitute subgroup 4; and other countries constitute subgroup 2. It is worth emphasizing that from 2006 to 2012, the subgroup in which China is located split into three subgroups after the financial crisis, and the pattern dominated by the four subgroups before the financial crisis was broken.

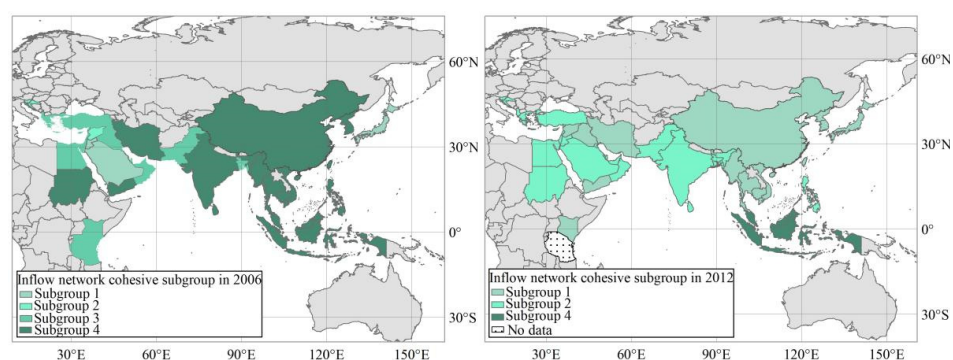


Figure 10. The cohesive subgroup maps of the inflow network in MSRCs from 2006 to 2012.

The investment outflow network of MSRCs has many cohesive subgroups with a miscellaneous distribution and strong cohesion of core subgroups (Figure 11). In 2006, the investment outflow network was divided into five subgroups. Pakistan, Bangladesh, Sri Lanka, Kenya, Tanzania, Egypt, Lebanon, and the United Arab Emirates constituted subgroup 1. Syria, Slovenia, and Croatia constituted subgroup 2, and Turkey, Greece, Albania, Cyprus, Israel, and Iraq constituted subgroup 3. Saudi Arabia, Jordan, Kuwait, Bahrain, and Oman formed subgroup 4, and other countries formed subgroup 5. The number of countries in subgroup 5, in which China was located, accounted for more than half, occupying a dominant position. Affected by factors such as geopolitics, differences in national economic development levels, and the investment environment, the fourteen West Asian countries belong to five different subgroups, and the investment outflow communities are highly fragmented. In 2012, the cohesive subgroups of the investment outflow network were reduced to four subgroups. The five Balkan countries, along with Turkey, Lebanon, Jordan, Saudi Arabia, the United Arab Emirates, Bahrain, Kuwait, Egypt, Sudan, and Bangladesh, constituted subgroup 1. The Syrian War caused a substantial reduction in its foreign investment, and subgroup 2 was reduced to one country in Syria. Comparing the changes of cohesive subgroups in 2006 and 2012, it is found that the

subgroup 5 countries that occupied a dominant position in 2006 have strong cohesion, and most of them joined the new subgroup 3 in 2012, and continued to occupy an absolute dominant position.

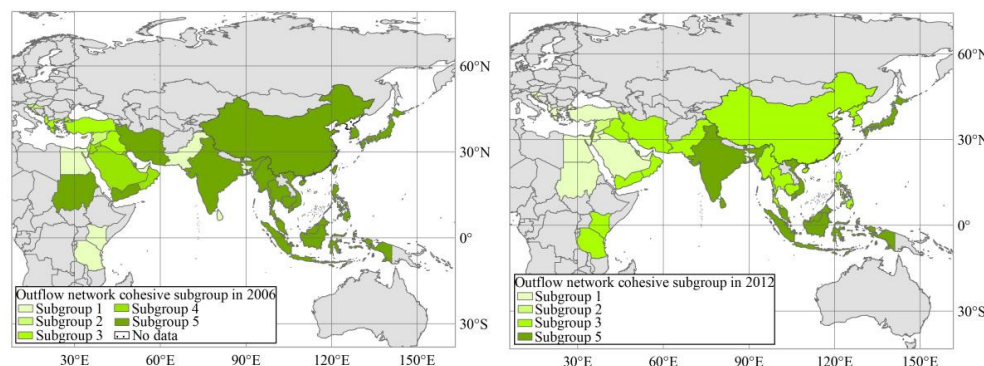


Figure 11. The cohesive subgroup maps of the outflow network in MSRCs from 2006 to 2012.

Overall, the temporal changes of the cohesive subgroups of investment inflows and outflows change greatly in MSRCs; economic development changes, international financial market fluctuations, and investment policies affect the change of investment communities. A geopolitical game is a geopolitical interaction in which countries engage in competition, conflict, containment, cooperation, and alliance based on geographical conditions, resource endowment, historical geography, and other factors in order to safeguard their own interests [5]. However, geopolitical games are not the main reason for the change of investment communities most of the time.

4. Conclusions and Discussion

The flow of geo-economic elements connects the MSRCs to a close geo-economic network. Countries have different statuses and structural characteristics in a geo-economic network. Based on trade and investment flows, this study uses social network analysis to analyze the characteristics of the geo-economic network between China and MSRCs. The MSRCs' trade network is approximately an irregular quadrilateral, and the strength of the trade network connection is constantly increasing. The density and agglomeration coefficients of the MSRCs' trade network are relatively large, and the average weighted degree is constantly increasing. Further, trade ties between countries are close. The weight distribution of the MSRCs' trade network follows the long-tail distribution law and a few countries play a leading role in the operation of the trade network. In terms of spatial structure, the MSRCs' trade network has shifted from the three pillars of China, Japan, and South Korea to a single core dominated by China, and China's centrality in the MSRCs' trade network has been increasing. Unlike the "Belt and Road" trade network [34], the MSRCs' trade network has weak cohesion and changes in trade groups. The trade subgroups of countries constantly change with trade development. The trade cohesion among China, Japan, and South Korea is strong, and China's trade influence is mainly concentrated in Southeast Asia and East Asia. Insufficient development of MSRCs' investment networks, small investment inflows and outflows, poor accessibility of investment network nodes, and sparse investment connections among countries. China, Japan, and Singapore are the core node countries of the MSRCs' investment network, and Southeast Asia has the most frequent investment transactions with China, Japan, and South Korea. Affected by geographic location, investment environment, and financial crisis, the weighted degree of the MSRCs' investment inflow network first increases and then decreases. The weighted degree of the MSRCs' investment outflow network showed an increasing trend, and countries along the route increased their dependence on investments in China and Japan. Similar to the structure of the world's transnational investment network, the spatial structure of the MSRCs' investment network also has the characteristics of a "core-periphery" circle structure, and the three countries of China, Japan, and South Korea have a solid core

position in the MSRCs' investment network. The MSRCs' investment inflow network cohesive subgroups do not have significant regional characteristics, and countries in the same region are mostly in different subgroups. The investment outflow network has many cohesive subgroups, while the core subgroups have strong cohesion and always occupy a dominant position.

Analyzing the characteristics of the geo-economic network between China and MSRCs is of great significance for advancing geo-economic cooperation between China and MSRCs. Firstly, deepening the geo-economic relations between China and MSRCs should focus on regional powers. The centrality analysis of trade and investment networks shows that regional powers such as Japan, South Korea, Singapore, Saudi Arabia, and Indonesia all occupy a more important position in the network. Regional powers have a greater say in regional geo-economic affairs. Only by attaching importance to regional powers can we better promote the development of geo-economic relations between China and MSRCs. Secondly, improving investment efficiency and strengthening financial cooperation to upgrade the investment network of MSRCs should also be focused on. The trade flow of MSRCs is much larger than the investment flow, and the smaller investment inflow and investment outflow make the MSRCs' investment network insufficiently developed, and the investment connections are sparse between China and MSRCs. Upgrading the geo-economic network of MSRCs should make up for the shortcomings of the investment network, and upgrading the investment network of MSRCs by improving investment efficiency and strengthening financial cooperation. Thirdly, give full play to China's pivotal role in the MSRCs' geo-economic network and implement differentiated geo-economic cooperation strategies. The structural analysis of the trade network and the investment network shows that China is an important core node in the trade network and investment network of MSRCs and has different trade and investment influences on different countries. As a hub in the MSRCs' geo-economic network, China should play its role as a connection and bridge to strengthen the mutual benefit and win-win between China and MSRCs. According to the differences in trade and investment connections between China and MSRCs, China should implement differentiated geo-economic cooperation strategies, continue to strengthen economic linkage with core node countries in the geo-economic network of MSRCs, and increase the enthusiasm of edge-node countries in the geo-economic network of MSRCs to participate in geo-economic cooperation.

The geo-economy is not only a collection of "geopolitics" and "economy," but also a collection of geo-economic elements flows [35]. Analyzing geo-economic relations should not only pay attention to the competition and cooperation of the geo-economy but also to the geo-economic flow and the geo-economic network shaped by it. Geo-economic flow is the flow of trade, finance, tourism, resources, population, information, and other geo-economic elements that circulate and transform between geo-entities for geographic proximity, geographical differences, and geo-entities' interactions [10]. In the era of globalization and "flow space", the status of geo-economic flows in geo-economic relations between countries has risen further. The empirical analysis of the geo-economic network between China and MSRCs proves that geo-economic flows, such as trade flows and investment flows, are the key to shaping geo-economic relations. Whether it is a geo-economic interaction, geo-economic pattern, or geo-economic network, geo-economic flow is the core variable. This study analyzes the geo-economic network between China and MSRCs based on trade flow and investment flow, and does not integrate the geo-economic element flows with different attributes of trade flow, investment flow, traffic flow, and tourism flow into a unified geo-economic flow, nor does it describe the overall structure and geo-economic effect of geo-economic "flow space". Therefore, geo-economic research in the future should pay more attention to the comprehensive description of the geo-economic flow elements of different attributes, focusing on the functional expression of geo-economic flow, the "flow space" structure of geo-economic flow, and the geo-economic effects brought by geo-economic flow.

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