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A Computational Study of the Path of Cooperative Interaction of Small States in the Global Economic System - The Case of Malta

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ABSTRACT
Because of their inherent vulnerability, small States are in a relatively weak position in global economic relations. In order to survive and develop, regional cooperation is an important way for small countries to safeguard and promote their national interests. Taking Malta as an example, this paper utilizes the international trade data of some major countries along the "Belt and Road" from 2004 to 2018, and adopts the social network analysis method to construct the trade network of 37 countries in each year, and explores the formation of the trade network of the "Belt and Road" through the gravity model. The gravity model explores the major trade subgroups formed in the "Belt and Road" trade network and reveals the cooperation and interaction paths of small countries in the global economic system. Among them, Malta's position and role in the countries along the "Belt and Road", Malta still participated in global economic cooperation through Russia in 2004, and in 2018, in the more closely linked global economic network system, Malta strengthened its economic ties with China, which has a core degree of 0.897, further enhancing its own position in the global economic network. The economic scale and institutional differences between countries have different impacts on the trade of different products, and small countries have limited resources, so it is more important to formulate different economic development strategies according to different influencing factors and product types, and strengthen trade cooperation with neighboring countries.

Keywords: Social Network Analysis, Gravity Modeling, One Belt, One Road, Malta

1. Introduction

In today's era of globalization, international economic cooperation has become an indispensable part of the economic development of all countries [1]. Such cooperation is of particular significance and impact for small countries such as Malta, which is often in a relatively weak position in the international economic arena due to the relatively small size of its economy, limited resources and narrow market [2-5]. However, through active participation in international economic cooperation,

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small countries such as Malta are also able to access many opportunities for economic growth and development [6-7].

International economic cooperation can bring advanced technology and management experience to small countries, expand their market space, and promote their industrial upgrading and structural optimization [8-9]. In the process of cooperation with large countries or other economically developed countries, small countries can come into contact with cutting-edge production technology, innovative management concepts and efficient operation modes, and the introduction of these technologies and experiences can help to improve the productivity and competitiveness of small countries [10-13]. Usually the domestic market of small countries is usually more limited, which is difficult to support large-scale production and economic growth, through participation in international trade agreements, the establishment of free trade zones and other forms of cooperation, the enterprises of small countries can obtain broader market access opportunities to market their products and services around the world [14-17]. This can not only increase the sales and profits of enterprises, but also promote the scale development of industries and drive the prosperity of related industries [18-19]. In the international division of labor system, small countries can choose to participate in specific industrial segments or fields according to their own advantages and characteristics, and gradually improve their national status in the industrial chain through cooperation with other countries, expanding from low-end processing and manufacturing to high-value-added research and development and design, brand marketing and other links [20-23]. At the same time, international economic cooperation can also prompt small countries to adjust their industrial structure, develop new industries and service industries, and realize economic diversification and sustainable development [24-25].

Based on the data of the international import and export volume of the countries along the Belt and Road from 2004 to 2018, this paper uses social network analysis and gravitational model to analyze the evolution of trade network characteristics of countries along the Belt and Road, and reveals the cooperation and interaction path of small countries represented by Malta in the global economic system. In addition, the economic scale, openness, innovation ability, human capital, financial development level and other indicators are selected as explanatory variables to explore the impact of the above variables on the centrality of network nodes in the trade economic network. Finally, the influencing factors of the trade network of large and small countries are explained from three different perspectives: system, proximity relationship and economic scale.

2. Study area and methodology

2.1. Research methodology

This paper takes Malta as an example, and takes the selected countries along the “Belt and Road” including Malta as a node to explore the cooperation and interaction path of small countries in the global economic system.

2.1.1. Gravitational modeling to set correlations. In the field of economics the methods of determining economic relations between regions or countries are divided into two main types: vector autoregressive (VAR) models and gravity models [26]. The authors chose the gravitational model to determine the economic relationship between China and the countries along the "Belt and Road", mainly because the gravitational model not only solves the problem of the difference of the relationship with time and the collinearity of the index, but also integrates economic factors and geographical factors, which can avoid the error caused by the analysis of economic data such as GDP and comprehensively describe the relationship between the research objects.

In this paper, the traditional gravity model is modified. According to the international economic cycle theory, trade and investment are the main ways of economic ties between countries, so trade and

investment data are introduced into the gravity model to analyze the trade subgroups formed in the trade network of "Belt and Road". The specific formulas are as follows:

$$y_{ij} = k_{ij} \frac{\sqrt[3]{I_i T_i G_i}\sqrt[3]{I_j T_j G_j}}{(D_{ij})^2}, k_{ij} = (\frac{T_i}{T_i + T_j} + \frac{I_i}{I_i + I_j}) \tag{1}$$

In equation (1), i, j denote countries or regions; γ_i is the gravitational coefficient between country i and country j; T_i and T_j are the total import and export trade of country i, j to the world, respectively; and are the stock of total foreign investment at the end of year i, j for country i, j, respectively; G_i and G_j are the GDPs of countries i, j respectively; D_{ij} is the distance between countries i and j; k_{ij} is the contribution of country i to the trade linkage between countries i, j. From equation (1), the gravitational force between i and j countries is directed, which is mainly reflected in k_{ij}, and this relationship needs to be normalized by 0-1 when performing social network analysis. The critical value of the y_{ij} matrix is taken as its row average, and the element in each row takes the value of 1 if it is greater than the average value of this row, otherwise it takes the value of 0. Finally, the 0-1 normalized matrix is transposed to obtain the desired spatial economic linkage matrix.

2.1.2. Social network analysis. A network model is a collection of elements and the relationships between them, which can be called nodes. In network analysis, nodes are dynamic, and nodes are connected to each other by edges, and most of the network definitions include two parts: nodes and edges. Most network definitions include both nodes and edges. A social network is a collection of social actors and their relationships as nodes, in which actors are connected through a set of relationships.

Network density is the degree of interconnectedness and cohesion among the N elements in a network. The density measure for binary data is limited to 0 to 1, with 0 indicating that there is no connection between all the elements, and 1 indicating that there is a direct connection between all the elements; the higher the degree of connection between the elements of a network, the higher the density of the network, and the stronger the network's influence on the elements. For a directed graph, the network density is expressed as for:

$$D = \frac{L}{N(N-1)} \tag{2}$$

L is the size of the entire network i.e. the number of nodes in the network, and N denotes the actual number of relationships between nodes in the network.

Network centrality is also known as central potential, if the network density can show the level of cohesion of the nodes in the overall network, then the centrality is to portray the extent to which this cohesion can be centered around a certain point or certain centers, in other words, the centrality represents the overall centrality of the social network graph. The calculation method of network centrality is relatively complicated. For a network of size N, firstly, we should find the maximum value of the centrality of each element in the network; then we should calculate the difference between the centrality of each element and the centrality of the other elements in the network, so as to obtain multiple "differences", and then sum up the differences of the centrality of each element. Then sum up all the "differences", and finally divide the sum by the theoretical maximum possible value of the sum of the differences. In general, the expression for the central potential C:

$$C = \frac{\sum_{i=1}^{N}(C_{\max} - C_i)}{\max\left[\sum_{i=1}^{N}(C_{\max} - C_i)\right]} \tag{3}$$

$C_{\max}$ is the maximum centrality of an element in the network, and C_i is the pointwise centrality of

element i.

The point degree centrality can intuitively show the number of direct connections between the point and other points within the network, for a network model of size N, the maximum centrality is $N(N-1)$, which indicates that the node has the strongest correlation in the network model, and the higher the importance of the node, on the contrary, if the centrality of a node is 0, it means that the node is not connected to other nodes within the network. Then:

$$D_e = \frac{n}{N-1} \tag{4}$$

In addition, the degree of each node in a directed graph can be further categorized into point-in degree and point-out degree. The point-in degree is the number of associations that a particular node in the network can get directly, i.e., the number of nodes that have a direct influence on that node: the point-out degree is the number of associations that a particular node within the network sends out directly, i.e., the number of relationships that it can directly influence.

The concept of intermediate centrality can reflect the degree of control of an element in the network over the resources, also known as the intermediary centrality, as the name suggests, this indicator can reflect the size of the intermediary role of each element in the network, that is, the greater the intermediary centrality, the greater the intermediary role of the element in the social network, and therefore located in the center of the network's rights. The specific expression is as follows:

$$C_{RB_i} = \frac{2\sum_{j}^{N}\sum_{k}^{N} b_{jk}(i)}{n^2 - 3n + 2}, b_{jk} = \frac{g_{jk}(i)}{g_{jk}} \tag{5}$$

where g_{jk} denotes the number of shortcuts that exist between node j and node k, $g_{jk}(i)$ denotes the number of shortcuts that pass through the presence of a third point i between nodes j,k, and $b_{jk}(i)$ denotes the control that the third point i has over nodes j,k.

The proximity centrality of an element in a network is a measure for being uncontrolled by others. It measures the sum of the shortest distances between an element and other elements in the network. In general, the shorter the distance between an element and all the rest of the elements in a network model, the earlier its influence will be transmitted to the other elements, and the higher the centrality of that element will be. Some scholars measure proximity centrality based on the “distance” between elements, which is equal to the reciprocal of the sum of the distances between elements. If the “distance” between an element and other elements in a social network is very short, it is considered to have a high degree of proximity centrality in the network. The proximity centrality of an element in a network, $C_{AP_i}^{-1}$, is expressed as follows:

$$C_{AP_i}^{-1} = \sum_{j=1}^{N} d_{ij} \tag{6}$$

Where d_{ij} is the shortcut distance (i.e., the actual number of lines contained in the shortcut) between element i and element j.

The research object of the above conventional indicators are the direct correlation between nodes, in the complex network, many nodes can not be directly associated, but need to be accomplished through the transmission between nodes, at this time we need to consider the indirect correlation between the nodes, which need to take into account the power of the correlation matrix. The powers of the association matrix can be used to measure “influence” because they count the number of pathways of various lengths between any pair of points. Social networks are usually analyzed based on three major influence indices, the Katz, Huber, and Taylor indices. In this paper, we mainly use the Katz influence index, where the row sum represents the influence of a particular node on other nodes in the network, and the column sum represents the influence of other nodes in the network on that

node. Its calculation formula is as follows:

$$t = (\frac{I}{a} - c)^{-1} s \tag{7}$$

where I is the unit matrix, C is the adjoint moment transpose, S is the column vector consisting of the sum of the columns of the matrix C, and a is the "attenuation factor".

The network models constructed in this paper are all complex networks, which are based on the directed acyclic graph model to identify the causal relationship between variables in the same period, taking the typical countries of the "Belt and Road", including Malta, as the network nodes, and the economic growth correlation between these countries as the "edge", using the indicators of overall network density, centrality, centrality and influence of individual network nodes, to study the correlation degree of the overall network of the countries along the "Belt and Road" and China's influence in the network.

2.2. Study area and data sources

By the end of June 2023, 152 countries have signed the "Belt and Road" cooperation documents with China. Because the construction of a complete economic network [27] needs to ensure that the trade data between any two nodes exist, so under the premise of ensuring the availability of research data, excluding the countries with more missing data, and finally selecting 37 countries with more complete data as the analysis sample. In addition, considering the impact and influence of the new crown epidemic on global trade, this paper selects the international import and export value of goods from 2004 to 2018 to reflect the closeness of economic ties, and uses the social network analysis method to analyze the correlation network among the countries along the "Belt and Road". The import and export data between 37 economies of the countries along the Belt and Road, including Malta, are obtained from the UN Comtrade database. The data for each explanatory variable of the empirical test were obtained from the EPSDATA database. The data for each country and region were converted to standardized dollar counts.

2.3. Selection of variables

Combined with the existing studies, this paper selects economic indicators such as economic scale, openness, innovation capacity, human capital and financial development level as the explanatory variables to further test the influence of each variable on the centrality of network nodes in the economic linkage network among the countries along the "Belt and Road".

1) Economic scale (GDPit). Nominal GDP [28] is used to measure the economic scale of network members.

2) Degree of openness (Openit). The total import and export of a country as a share of GDP is used to measure the degree of openness of the country.

3) Level of technological development (RDit). The ratio of R&D investment to GDP is used to measure the level of technological development (RDit).

4) Human Capital (HCit). Measured by the ratio of the number of people in the labor force who have received secondary education.

5) Financial development (Financeit). Measured using the ratio of domestic credit provided by financial institutions to GDP.

3. Belt and Road trade network-related analysis

3.1. Characterization of the Belt and Road trade network

3.1.1. Analysis of the evolution of the “Belt and Road” trade network pattern. There are many countries along the "Belt and Road", with the continuous acceleration of the process of globalization and the increasing frequency of economic and trade cooperation in the region, the "Belt and Road" trade network structure is becoming closer, and it is difficult to observe some important characteristics of the network if the relationship between all sides is retained. Therefore, this paper simplifies the network diagram by filtering the edges and retaining only the trade relations that occupy an important position in the bilateral trade exchanges, so as to achieve a better analysis of the network characteristics. Specifically, only the countries along the Belt and Road will retain the largest trade flows among the 37 countries or regions along the Belt and Road and China. In this paper, we select the visualization maps based on the largest edge on two nodes in 2004 and 2018 to intuitively reflect the change of Malta's status in the network and the evolution of the "Belt and Road" trade pattern.

From the overall characteristics of the "Belt and Road" trade network, in 2004, before the "Belt and Road" initiative was formally proposed, China has become the central node of the regional trade network, directly connecting Thailand, India, Vietnam, Saudi Arabia, Egypt, Israel and other countries, forming a trade network with China as the core and hub-and-spoke characteristics. At the same time, in 2004, as a similar trade network core node countries of Russia connected including Turkey, Malta, Azerbaijan, Greece and other countries, in 2004 Malta accession to the European Union after receiving a large amount of aid, the government launched a series of reform measures, adjust the economic structure, macroeconomic conditions continue to improve, but it is still in the development stage, need to attract foreign investment and technical cooperation to enhance their competitiveness, and is not directly connected with the "Belt and Road" core network, Rather, it is through Russia that it will interact with the global economic system. Overall, the 2004 Belt and Road trade network formed a multi-core trade network, as shown in Figure 1. In 2004, some countries along the Belt and Road were still independent of the interconnected trade network system, such as Serbia and Montenegro, Slovakia and the Czech Republic, indicating that some countries along the Belt and Road were less integrated into the network and the trade network was more loosely connected.

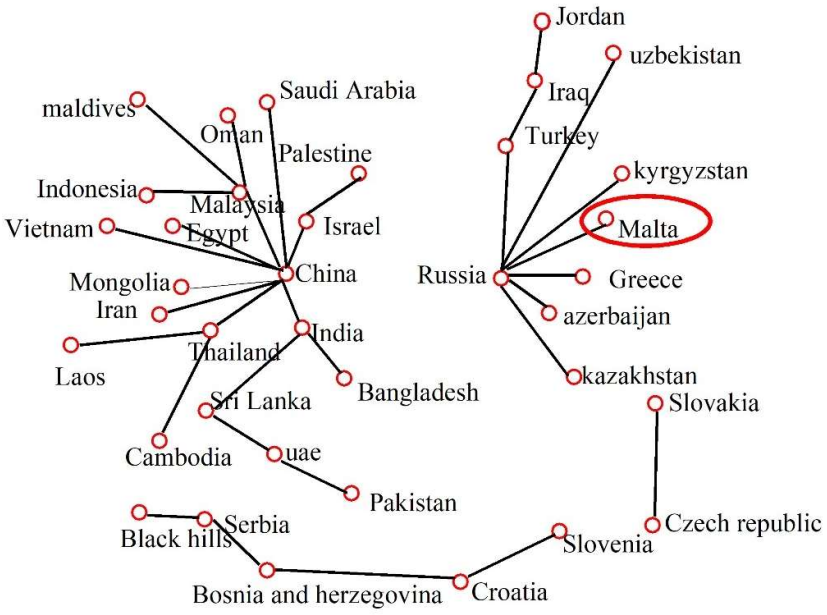

Fig. 1. Trade structure of countries along the road and road in 2004

Figure 2 shows that the Belt and Road trade network in 2018 shows that the Belt and Road trade pattern has undergone new changes: the multi-core pattern of the Belt and Road trade network has obviously changed to a single-core pattern with China as the core. As the core of the network, China directly connects most of the "Belt and Road" countries in Southeast Asia, South Asia, West Asia, and Northeast Asia, and the path between countries has been greatly shortened, and China's role as the network core and "broker" has been significantly enhanced. At the same time, the density of the CIS trade network with Russia as the core has declined, and the emergence of isolated local trade networks has also decreased, and only the largest trade relations of Slovenia, Croatia, Bosnia and Herzegovina are not directly connected to the core network of the "Belt and Road". China and Malta signed a Memorandum of Understanding on the Belt and Road Initiative, agreeing to promote common development and prosperity between the two countries under the framework of the Belt and Road Initiative. This is the main reason why the two sides have reached direct cooperation in many fields such as economy and trade, energy, infrastructure and culture.

Judging from the structural changes of the "Belt and Road" trade network in 2004~2018, China's "Belt and Road" initiative proposed in 2013 has a dual foundation of history and economy. China has established stable trade relations with most countries along the Belt and Road in 2004, and China is at the heart of the trade network, directly connecting some countries. In 2018, China's position in the "Belt and Road" trade network has been significantly improved, and the number of countries directly linked to trade with China has increased, and its direct impact is the improvement of the efficiency of the "Belt and Road" network, that is, goods can be circulated between countries at a faster speed and lower cost, which also means that the overall density of the "Belt and Road" network has increased, the economic and trade exchanges of countries along the route are closer, and more countries are more directly integrated into the "Belt and Road" trade network.

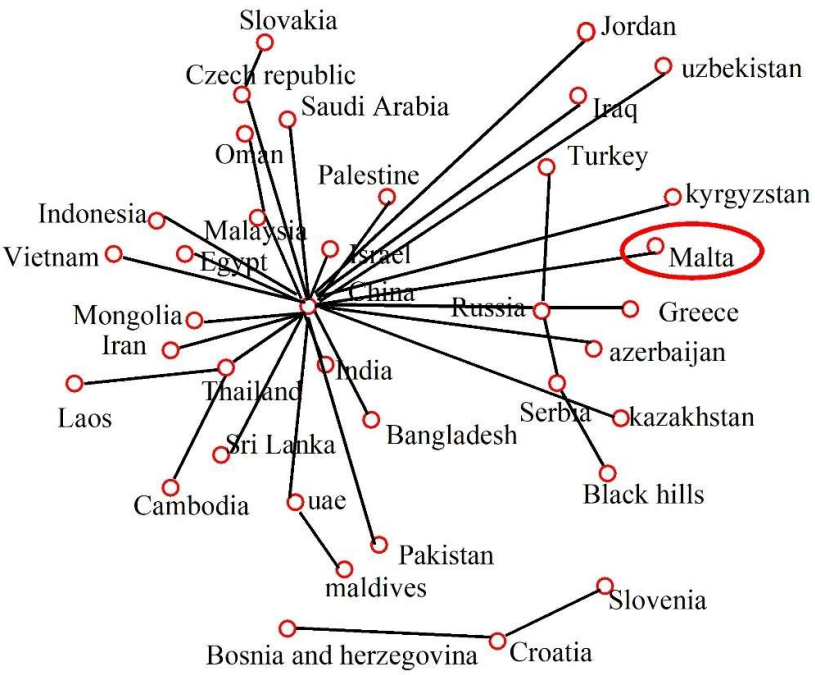

Fig. 2. Trade structure of countries along the road and road in 2018

3.1.2. Characterization of the Belt and Road trade network. Centrality analysis. This paper measured the PageRank index of countries along the “Belt and Road” from 2004 to 2018, and the larger the PageRank index, the stronger the centrality of the node in the network, and the stronger the influence and control of the network. Due to space limitations, this paper only shows the top ten countries in terms of PageRank value in 2018 as shown in Table 1.

As can be seen from Table 1, during 2004~2018, China's PageRank index has been ranked first and steadily increased, in 2004 China's PageRank index was 0.112, and in 2018, China's PageRank index rose to 0.179, ranking first among the countries along the "Belt and Road". It shows that during 2004~2018, China has always been the most important and influential country in the "Belt and Road" trade network, and it is also the country with the fastest growth in economic development and international influence in the "Belt and Road" trade network.

Table 1. The pagerank index of the road and road trading network

Region	2004	2007	2010	2013	2016	2018
China	0.112	0.123	0.153	0.149	0.175	0.179
India	0.045	0.053	0.063	0.068	0.055	0.058
Russia	0.085	0.084	0.075	0.074	0.058	0.056
Singapore	0.073	0.066	0.054	0.052	0.047	0.044
UAE	0.036	0.035	0.038	0.043	0.043	0.042
Malaysia	0.059	0.049	0.044	0.041	0.044	0.042
Thailand	0.044	0.043	0.038	0.039	0.042	0.038
Vietnam	0.016	0.011	0.019	0.023	0.032	0.034
Turkey	0.032	0.036	0.036	0.036	0.036	0.033
Indonesia	0.036	0.032	0.032	0.034	0.033	0.030

Core-Edge Analysis. Core-edge analysis is mainly analyzed from the position of the country in the network, the core node has a closer relationship with other nodes, and has a higher degree of core in the network, and is more important to the network.

According to the core degree, countries along the Belt and Road are categorized into core countries (with a core degree of more than 0.1), semi-core countries (with a core degree of between 0.1 and 0.01), and peripheral countries (with a core degree of less than 0.01). From the results of the analysis in Table 2, in 2004, China, Singapore, Russia and other countries were in the position of core nodes in the “Belt and Road” network, and there was not much difference in the degree of core of the above countries in the network. In 2018, the core degree of China was 0.897, and the other eight core countries were between 0.1 and 0.2. As analyzed earlier, the “Belt and Road” trade network has changed from a multi-core structure to a single-core structure with China as the core, and Malta is located in the Mediterranean region, and the core degree of its trade network has been influenced by the economic environment and trade pattern of the neighboring countries. Malta is located in the Mediterranean region, and the core degree of its trade network is influenced by the economic environment and trade pattern of neighboring countries. Malta has relatively close trade links with European and North African countries, but in the whole “Belt and Road” trade network, Malta's influence is relatively limited.

Table 2. "One belt and one road" trade network core - edge structure

Region	2004	2007	2010	2013	2016	2018
China	0.485	0.546	0.744	0.812	0.945	0.897
Singapore	0.685	0.631	0.365	0.265	0.146	0.194
India	0.115	0.196	0.255	0.218	0.119	0.166
Vietnam	0.075	0.078	0.098	0.094	0.093	0.144
Thailand	0.206	0.194	0.183	0.166	0.099	0.138
Russia	0.124	0.146	0.165	0.185	0.085	0.133
Malaysia	0.375	0.306	0.223	0.176	0.096	0.132
UAE	0.098	0.122	0.185	0.155	0.106	0.129
Indonesia	0.176	0.203	0.175	0.154	0.078	0.116

Societal analysis. Exploring the formation and evolution of trade sub-networks during the formation of the Belt and Road trade network will help to further understand the changes in China's position in the Belt and Road trade network and the relationship between countries along the route.

Three relatively stable trade subgroups are formed in the BRI trade network, which can be explained by the trade gravity model as a whole. According to the economic and geographical classification of the above three trade subgroups, they can be divided into China-Southeast Asia subgroup, South Asia-West Asia subgroup, and Central and Eastern Europe-Central Asia subgroup, and the main participating countries of the three subgroups are basically stable, reflecting the stability and continuity of the regional trade structure in the "Belt and Road" trade network.

3.2. Analysis of baseline estimation results

According to the correlation analysis reflects that the trade network may have a positive impact on regional economic growth, i.e., the higher the network centrality index, the higher the level of regional economic growth in OECD countries. In order to more accurately quantitatively analyze the relationship that exists between the relationship between trade networks and economic growth, this paper constructs a benchmark regression model for empirical testing.

Considering the possible endogeneity and multicollinearity problems, this paper eliminates the influence of certain common factors to a certain extent by controlling the double fixed effects of country and time. The test results are shown in Table 3, the values in parentheses are standard errors, and ***, **, and * indicate that they pass the 1%, 5%, and 10% significance tests, respectively.

The results show that the network centrality indicators are all significantly positive, indicating that trade network centrality has a significant role in promoting national economic growth.

The explanatory variables of the regressions from model 1 to model 5 are all GDP, and the core explanatory variables are network centrality indicators. Economic scale, trade openness, R&D investment, human capital and financial development level have a significant positive effect on the network centrality of an economy, and a developed financial system is the guarantee for the rational allocation of a country's resources, which can enhance the competitiveness of a country or region in international trade by reducing the cost of enterprise financing and transaction costs.

Table 3. Benchmark regression results

Interpretation variable	Model (1)	Model (2)	Model (3)	Model (4)	Model (5)
ln GDPit	0.427***(0.044)	0.47.***(0.034)	0.377***(0.025)	0.377***(0.026)	0.375***(0.026)
ln Openit		0.498***(0.115)	0.305***(0.094)	0.303***(0.096)	0.315***(0.092)
ln RDit			0.207***(0.068)	0.225***(0.073)	0.164***(0.053)
ln HCit				0.136*(0.075)	0.134*(0.075)
ln Financeit					0.063**(0.029)
_cons	0.556*(0.328)	0.255(0.287)	1.045***(0.174)	0.496(0.329)	0.184(0.345)
R-squared	0.685	0.782	0.828	0.844	0.859

3.3. Analysis of differences in impact factors

3.3.1. Analysis of differences in institutional factors. The greater the availability of products, the less likely that monopolies and trade barriers exist in trade between countries, and the freer the trade, the more likely that trade volume will increase due to the similarity of systems between countries. Some

countries have trade carried out, but the trade volume is too small will bias the results, so this paper filters out the countries whose trade volume accounts for the latter 1%, that is, the number of countries whose statistical trade volume accounts for 99% of the availability analysis, the smaller the number of countries involved in trade, it means that the availability is weaker, and vice versa, the stronger it is.2004-2018 Product Availability AnalysisAccording to Figure 3, agricultural products and resource and labor-intensive products are more available than the other 2 categories.

Only 10 of the countries along the Belt and Road are developed countries, the rest are developing countries, and 9 of them are among the world's least developed countries. One of the basic characteristics of developing countries is their high dependence on agricultural production. Many of the countries along the Belt and Road are populous countries, and the availability of agricultural products, resources and labor-intensive products is higher than that of capital- and technology-intensive products and energy products under the premise that the tertiary industry is weak and the primary and secondary industries are the main economic forces in developing countries.

Malta, on the other hand, has a small agricultural sector and limited land resources, and its investment sector focuses on technology-intensive and high-technology industries with a well-developed supply chain. The availability of capital- and technology-intensive products and energy products is therefore higher for Malta.

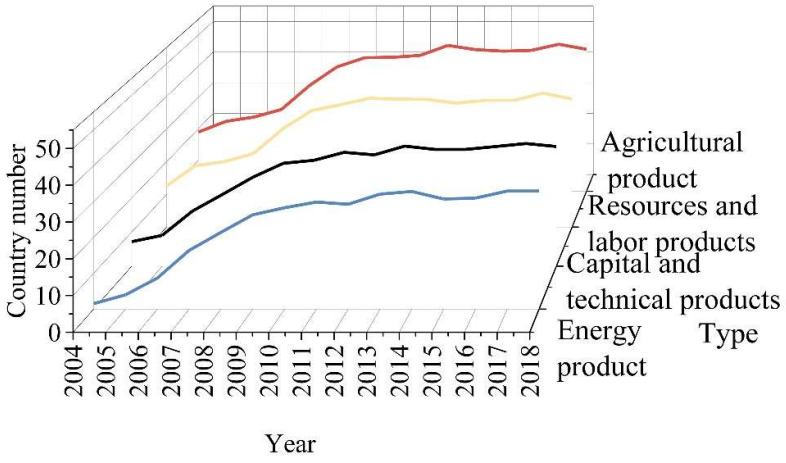

Fig. 3. 2004-2018 production availability analysis

The block model classification method is used to analyze the trade network of four types of products in the “Belt and Road” from 2004 to 2018 in a modular way. By choosing the maximum segmentation depth of 2 and the convergence criterion of 0.2, each category of products in each year can be analyzed to obtain four segments according to the block model. The normalized moment of inertia index (NMI) of each plate is calculated separately.

The stability analysis of the NMI index of the four categories of products from 2004 to 2018 is carried out, and the results are shown in Table 4, which is limited to space and only lists the relevant data for some of the more recent years. The product stability indexes of agricultural products in the five time stages are all above 0.8, and they are all greater than the stability indexes of the remaining three categories of products, indicating that the stability of agricultural products is higher than that of the other three categories of products.

Table 4. Change of trade network stability

Product type	2008-2009	2010-2011	2012-2013	2014-2015	2017-2018
Agricultural product	0.8002	0.8025	0.8456	0.9185	0.9168

Capital and technology-intensive products	0.5356	0.6784	0.4125	0.5964	0.7456
Resources and labor-intensive products	0.6985	0.4675	0.6654	0.8451	0.7125
Energy product	0.6825	0.7354	0.7125	0.6235	0.6985

3.3.2. Analysis of differences in proximity to countries. The results of the QAP analysis of trade network and country proximity for the four types of products from 2004 to 2018 are shown in Table 5.The values are the actual correlation coefficients,*** stands for P<0.01,** stands for P<0.05,* stands for P<0.1.It can be seen that trade is significantly correlated with country proximity (P<0.01), and trade closeness between neighboring countries is higher than that of non-neighboring countries closeness. Among them, the correlation coefficients between trade networks of agricultural products, resources and labor-intensive products and country proximity are larger than those of the other 2 categories, and the average correlation coefficients between trade networks of agricultural products, resources and labor-intensive products and country proximity are above 0.3.

Trade is more dependent on geographical location. At the same time, there is a clear correlation between the distance between countries and the differences in institutions, i.e., the closer the countries are, the more similar the institutions are, and the similarity of institutions between neighboring countries is higher than that between non-neighboring countries. The trade stability of agricultural products is higher than that of the other three categories of products, which is related to country proximity. Neighboring countries have similar systems and the trade in agricultural products is more dependent on geographic location, and at the same time, the higher the stability of trade, the smaller the related trade changes between countries. In other words, agricultural trade between neighboring countries is stable, which also confirms that the correlation between agricultural products and institutions is large. In addition, agricultural trade is closely related to safety issues. In order to ensure food safety, each country will introduce food safety laws, compared with the other three types of products, agricultural products trade substitution is less likely.

Table 5. QAP analysis of trade network and institutional differences

Year	QAP analysis of trade network and state proximity				QAP analysis of state proximity and institutional differences in countries
	Agricultural product	Capital and technology-intensive products	Resources and labor-intensive products	Energy product	
2004	0.345***	0.136***	0.274***	0.135***	-0.125***
2005	0.359***	0.175***	0.245***	0.123***	-0.133***
2006	0.357***	0.143***	0.306***	0.145***	-0.136***
2007	0.321***	0.184***	0.325***	0.149***	-0.136***
2008	0.344***	0.254***	0.345***	0.152***	-0.135***
2009	0.354***	0.241***	0.326***	0.163***	-0.134***
2010	0.359***	0.235***	0.384***	0.210***	-0.134***
2011	0.364***	0.246***	0.356***	0.202***	-0.132***
2012	0.635***	0.252***	0.354***	0.206***	-0.128***
2013	0.369***	0.265***	0.352***	0.221***	-0.123***
2014	0.374***	0.272***	0.322***	0.223***	-0.124***

2015	0.375***	0.249***	0.326***	0.219***	-0.121***
2016	0.377***	0.285***	0.345***	0.231***	-0.120***
2017	0.381***	0.244***	0.365***	0.236***	0.118***
2018	0.385***	0.265***	0.389***	0.238***	0.117***

3.3.3. Analysis of differences in economic size. In addition to capital- and technology-intensive products, the economic size gap has a significant effect on the trade of the other three types of products. Taking energy products as an example, there are big differences in the level of economic development and industrialization among the countries along the "Belt and Road", and the industrial development of the weaker countries tends to rely on the countries with large economic volume and higher level of industrialization. Agricultural products, resources and labor-intensive products can be explained by complementary trading.

The economic scale gap does not have a significant effect on the trade of capital- and technology-intensive products, which is reflected in the diversity of trade relations among countries in the trade network of the Belt and Road in this category of products. The total trade volume of different categories of products is shown in Figure 4. In the trade network of 4 categories of products from 2004 to 2018, the net density of agricultural products, capital- and technology-intensive products, and resource- and labor-intensive products is higher and the difference is not big, but the total trade volume of capital- and technology-intensive products is much higher than that of the other 3 categories in the weighted trade network, and its standard total trade volume reached 0.5 percent in 2018, and its standard total trade volume reached 0.5 percent in 2012. This indicates that in the trade of countries along the Belt and Road, the trade of these products is more related than that of the other 3 products, and is no longer limited to complementary trade between economic gaps.

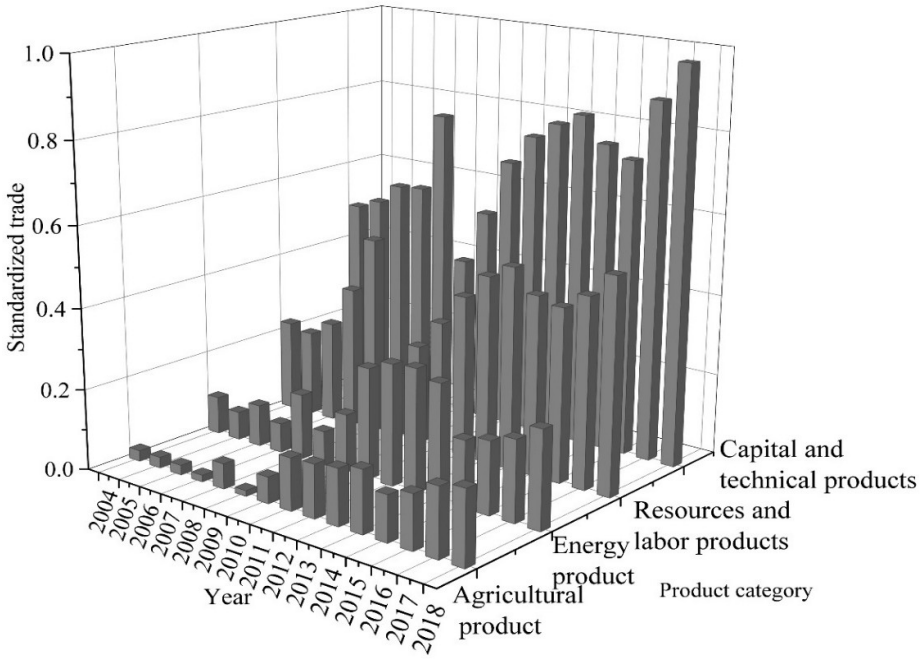

Fig. 4. 2004-2018 different categories of product trade

4. Conclusion

This paper constructs an economic network of 37 countries along the Belt and Road, including Malta, and analyzes the path of economic cooperation among the countries along the Belt and Road by using social network analysis and gravity model.

The "Belt and Road" trade network has gradually changed from a loose trade network in 2004 in which many countries were independent of the interconnected trade network system to a closely connected trade network system. In 2018, China's core degree reached 0.897, and Malta changed from indirectly connecting with the core network of the Belt and Road to directly cooperating with the core network of the Belt and Road, further enhancing its position in the global economic system. Malta's experience shows that small countries need to make full use of the advantages of social networks on the basis of traditional trade perspectives, actively integrate into the global economic network, and find a more suitable path for cooperation and interaction.

The five factors of economic size, trade openness, scientific research, human capital, and financial development all contribute significantly and positively to the network centrality of an economy. This also suggests that small countries need to strengthen these five aspects of economic construction to enhance their hub status in the global trade network.

The results of the variance analysis of the influencing factors show that trade links are easily generated between countries that are close to each other and not too different from each other. The wider the economic gap between countries, the more likely that trade in products other than capital- and technology-intensive products will occur, as the total trade in capital- and technology-intensive products is much higher than that in other products, and the total standard trade in this product in 2018 reached 0.97. This suggests that small countries with limited resources should focus on the development of advantaged industries with international competitiveness for the purpose of enhancing their economic resilience.

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