Analysis on the structural characteristics of global cotton trade network

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Abstract: cotton is an important raw material for textiles, and the change of cotton export structure will affect the cost of downstream industries. Therefore, based on the world cotton trade data from 2010 to 2020 in the United Nations commodity trade statistics database, this paper constructs the world cotton trade network with the help of social network analysis methodThe three dimensions of point degree centrality and core edge characterize the overall network and individual network of the existing world cotton trade, providing an analytical basis for the evolution of the world cotton trade network in the future.

Key words: cotton; Trade network; network analysis

1. Introduction

Cotton is an important strategic material different from chip and communication technology. It is also a major agricultural product with the longest industrial chain and high commercialization rate, and occupies an important position in the international trade of agricultural products. Since the late 1980s, the cotton industry center has gradually transferred from the powerful countries in North America and Europe to the developing countries. However, the developing countries do not have a say in the production links and production standards of the cotton industry, and the traditional cotton industry has gradually shown the characteristics of multipolar separation.

In recent years, affected by many factors such as geographical climate, domestic subsidies and national political relations, the cotton trade relationship between countries has become increasingly complex. This paper uses the world cotton trade data in the United Nations commodity trade database to explore the characteristics of the cotton trade network pattern from the perspectives of the overall network and the individual network with the help of network analysis method, so as to assist in future prediction.

2. Construction and analysis index of world cotton trade network

2.1 Data source and processing

The data in this paper is mainly from the United Nations commodity trade statistics database, and the HS code of cotton is 52. This paper selects the dynamic data of cotton import and export trade in the world from 2010 to 2020 as the statistical analysis object.

Because the cotton trade involves many countries' trade exchanges, and the calculation and processing are complicated, this paper uses the social network analysis method, and uses UCINET software to binarize the trade data from 2010 to 2020 with the mean value of the data in each network as the critical point to construct a binarization matrix.

2.2 Trade network analysis indicators

1. trade network density

The density of the whole network refers to the ratio of the actual number of trade relations in the whole network to the theoretical maximum number of trade relations, which can provide the connection degree of the relevant groups of a product trade network in the whole world. The density value is between 0 and 1. The larger the value, the closer the relationship between actors in the network, the higher the cohesion of the whole group, and the more active the behavior. The calculation formula of network density is $\rho = M/N(N\text{-}1)$ Where ρ Is the network density, M represents the number of actual relationships contained in the network, and N represents the number of trading countries.

2. the point centrality of the trade network

Point degree indicates the number of connections a node has, which can be divided into the out degree and in degree of nodes. The point out degree in the calculation results corresponds to the number of exporting countries of a country, while the point in degree is the opposite.

Point out degree is defined as: $K_h^{out}(t) = \sum_{j=1}^{N(t)} C_{hj}(t)$

Penetration is defined as: $C^w(k) = \dfrac{1}{s(k)} \sum_{k_i = k} C_i^w$

Where n (T) refers to the total number of countries with no right to trade in a product in the world in the T year, C_{hj} Indicates the value of the unweighted adjacency matrix of whether country h exports products to country j in year t, where $C_{hj} \in [0,1]$, $J \in [1, n(T)]$, C_{jh} Is the value of the weighted network adjacency matrix of whether country h imported products from country j in year t, $C_{jh} \in [0,1]$, $J \in [1, n(T)]$. The larger the point size of a country, the more countries trade with it, and the more it can reflect its trade status.

3. core periphery of trade network

In the trade network, there are generally countries with higher status and greater influence, which are called "core countries". On the contrary, countries with lower status and less influence are called "marginal countries".

According to the measurement method of the core periphery structure level, the trade participating countries are generally divided into three levels, of which the countries with a core degree greater than 0.1 are core countries, those between 0.01-0.1 are semi core countries, and those less than 0.01 are peripheral countries.

4. individual network of trade network

A node is extracted from the whole trade network, and then the connection between the node and other nodes in the network is analyzed to form an individual network. By analyzing a group of actors connected with this node extracted from the individual network, we can judge the status change of this node in the individual network.

3. Analysis of the characteristics of the world cotton trade network

3.1 Analysis of cotton trade network density

According to the calculation, the density of the world cotton trade network has not fluctuated much since 2010, but has been showing a slow decline trend. In 2010, with the improvement of the world economic situation, the domestic and foreign sales of textiles and clothing gradually recovered, and the corresponding cotton market also showed a hot situation. However, since 2012, the cotton market has been affected by the growth of global production and the continued downturn of the world economy, and the trade volume has been declining. From 2013 to 2017, the network density of cotton remained around 0.008. Affected by the Sino US trade dispute in 2018, cotton futures prices fell sharply as a whole, market demand shrank significantly, and cotton network density showed a slight decline trend. In 2020, the downstream demand will be reduced, and the network density will further drop to 0.0071.

3.2 Analysis of point degree centrality of cotton trade network

From the point of view, countries with more cotton export trade partnerships in the world include China, India, the United States, Pakistan, Brazil, Indonesia, Germany, Vietnam, Greece and Spain. Among them, the number of China's export related countries from 2010 to 2020 is in the range of 59-73, which is in the leading position. The number of India's associated countries is in the range of 38-48, second only to China. The number of the United States has not changed significantly in the past decade, hovering in the third place. The ranking of Turkey, Pakistan and the United States fluctuated alternately in the past decade, and that of Brazil and Indonesia fluctuated alternately. Italy is declining, Vietnam is rising, and its influence is increasing.

From the perspective of penetration, countries with more cotton import trade partnerships in the world include China, Vietnam, Indonesia, Bangladesh, Turkey, Pakistan, Germany, Italy, Thailand and Malaysia. From 2010 to 2020, the number of cotton export related countries in China remained in the range of 23-35, also in the leading position. It is worth noting that the number of Bangladesh is increasing, while the number of Germany is decreasing.

3.3 Core periphery analysis of cotton trade network

The core countries remained unchanged from 2010 to 2013. In 2016, Hong Kong and Egypt withdrew and Japan joined. In 2019, Thailand withdrew and Egypt and Greece joined. In 2020, Germany and Malaysia withdrew and Thailand joined. In the past decade, 11 countries including Bangladesh, Brazil, China, India, Indonesia, Italy, Pakistan, South Korea, Turkey, the United States and Vietnam have been in the core region. From 2010, the cotton export trade volume of the 11 core countries accounted for about 72% of the total global cotton exports, reaching 80% in 2020. Among them, the export trade volume of China, Italy, Pakistan and South Korea continued to decline. On the contrary, Brazil, Turkey, the United States and Vietnam continued to rise, and Brazil's growth rate was as high as 398%. Cotton trade is gradually shifting to low-cost countries such as Southeast Asia, Core countries are decreasing.

3.4 Individual network characteristics of cotton trade network

China, the United States and India, the top three core countries of the world cotton trade network in 2010, 2913, 2016, 2019 and 2020, were selected as the research objects.

First, analyze China. From 2010 to 2019, China maintained the number of about 70 partner countries, and the core degree increased year by year. The cotton trade showed diversified development. However, in 2020, the number of countries dropped sharply to 60, but China's intermediary centrality remained the highest.

Specifically, China's major export countries in 2010 were the United States, Spain, Indonesia, Turkey, Mexico, Italy, India, Brazil, Guatemala, Malaysia, Vietnam, Benin and Thailand. In 2013, China's main export countries were Spain, Turkey, India, Indonesia, the United States, Italy and Germany. In 2016, China's main export countries were Turkey, India, Indonesia, Spain, Pakistan, Vietnam, Malaysia, Germany and the United States. In 2019, China's main export countries are Turkey, Italy, India, Germany, Spain, Pakistan, Vietnam and the United States. In 2020, China's main export countries are Turkey, Italy, Pakistan, India, Germany, Vietnam and the United States.

Overall, the number of major trading countries in China's cotton trade network has gradually decreased, the cotton trade relationship with the United States and India has declined, and the trade relationship with Turkey, Italy and Pakistan has increased.

Secondly, it analyzes the United States. The core degree of the United States has been stable and rising year by year, surpassing India. The number of major trading countries has decreased year by year from 33 countries in the world in 2010 to 29 countries in 2020. In 2010, the main export countries of the United States were China, Italy, Mexico, Bangladesh, China, Hong Kong, Pakistan, Indonesia, India and Turkey. The main exporting countries in 2013 were China, Indonesia, Vietnam and India. In 2016, the main export countries were Turkey, China, Italy, Pakistan, India, Vietnam and Indonesia. The main export countries in 2019 are China, Turkey, India, Vietnam and Pakistan. In 2020, the main exporting countries are China, Turkey, Vietnam, India and Indonesia.

In the U.S. individual network, there is little difference between the intermediary centrality of China and the United States, especially in 2019, the intermediary centrality of the two countries is getting closer and closer. Compared with China and India, the number of trading partners in the U.S. individual network is small and decreasing year by year. In recent years, the Czech Republic has been added as a cotton importer, and the partner countries have not changed significantly. The United States has a relatively simple and stable cotton trade network in the network.

Finally, India. In 2010, India's major export countries were China, the United States, Spain, Italy, Turkey, Indonesia, Pakistan, Benin, Thailand, Hong Kong, Vietnam, Bangladesh, Egypt, and Germany. In 2013, India's major export countries were China, Spain, Turkey, Italy, Germany, Indonesia, Hong Kong, and the United States, In 2016, the main export countries were China, Turkey, Spain, Pakistan, Indonesia, the United States, Italy, Vietnam and Germany. In 2019, the main export countries were China, Turkey, Spain, Italy, Vietnam, Germany, Pakistan and the United States. 2020 will be China, Turkey, Vietnam, Italy, the United States and Spain. On the whole, China is India's largest trader, but the relationship between India and the United States has started to rise steadily in recent years.

4. Conclusion

Using the network analysis method and the cotton export trade volume data of 229 countries from 2010 to 2020, this paper studies the overall layout of the cotton trade network and the trade characteristics of important nodes. The research shows that the overall network density of world cotton trade shows a slow downward trend from 2010 to 2020, but the cotton trade association between countries remains relatively stable.

From the point of view of the degree of centrality, the export of each country is greater than the import, and the top countries such as China, India and the United States remain basically stable. There are obvious changes in the number of import trading partners of each country compared with the number of exporting countries. The import countries that a country can choose are not in a fixed and stable state, and the value of import and export is constantly decreasing.

From the core edge analysis, the core countries have basically not changed much, and the overall cotton trade network is changing slowly, but the number of core countries has decreased slightly, and the cotton trade is gradually transferring to the low-cost countries in Southeast Asia led by India. In the future, we should pay attention to the role of Bangladesh, Brazil, China, India, Indonesia, Italy, Pakistan, South Korea, Turkey, the United States and Vietnam in promoting the cotton trade pattern.

From the perspective of the intermediary centrality of individual networks, China has a high degree of intermediary centrality in the individual networks of the United States and India. Any change in China's policies or cotton supply and demand will have a huge impact on the trade pattern of the two countries. China has a large number of trading countries and has a high degree of overlap with the trading countries of the United States and India. The cotton trade competition between China and the United States and India is high. In addition, Turkey's competitiveness also deserves attention.

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