# A Study on the Trade Potential between Northeast China and Countries along the Northeast Passage of the Arctic

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**Abstract:** The navigation of the Arctic Channel has brought certain impact on the traditional international trade environment. Northeast China is the closest to the Arctic, so it is of great significance to study whether the future navigation of the new Arctic channel will have a positive impact on the cargo trade and transportation in Northeast China. This paper uses the panel data from 2010-2020, uses the expanded trade gravity model to conduct empirical tests, analyzes the influencing factors of the bilateral trade between the Northeast China and the countries of the Arctic Northeast Passage, and compares the trade potential of the Suez Canal Passage and the Arctic Northeast Passage. The results show that there is a significant negative relationship between shipping distance and trade volume; the opening of the Arctic Northeast Channel will increase the export potential and import potential of the Northeast China to the countries from the channel by 30.76% and 31.52% on average. Our results shed light on government policies aiming to improve the level of foreign trade in Northeast China.

## 1. Introduction

Under the effect of "Arctic anti-amplification effect", the melting of Arctic glaciers has accelerated, and the possibility of commercial navigation of the Arctic channel has been widely concerned by countries around the world, especially Arctic countries and near-Arctic countries. The Arctic Channel consists of three channels, namely, the Northeast Channel, the Northwest Channel and the Central Channel. The Northeast Channel has the best navigation conditions among the three channels, and has achieved seasonal navigation at present.

China's participation in Arctic affairs can be traced back to *the Treaty of Spitsbergen Islands* in 1925. The 2018 *White Paper on China's Arctic Policy* clearly mentions that China will participate in the development. Compared with the traditional China-Europe shipping route through the Suez Canal, the shipping distance of the Northeast Arctic route has been significantly reduced. At present, the traditional route has problems such as rising costs, congestion, piracy and geopolitical conflicts affecting the navigation safety. The Northeast Arctic route can be used as a substitute or supplement for the traditional route.

At present, the research on the Arctic Northeast Passage is mainly focused on two aspects: first, study its airworthiness and economy by comparing the new and old routes. Shou and Feng (2015)[1] established a shipping technical and economic cost analysis model, and compared and analyzed the container transport costs of different ship types through the Arctic Northeast Channel. Wang and Fan (2011)[2] compared the economy of the traditional China-Europe channel with the Arctic channel in terms of navigation mileage and ship cost. Yang (2016)[3] studied the navigation conditions of the Arctic Northeast Channel from the perspective of natural conditions, and evaluated China's participation in the development and utilization of the Northeast Channel.

The second is to study the trade development potential. Trade potential is the ability to achieve expected value exchange in import and export trade. The greater the trade potential, the greater the space for trade improvement. After the opening of the Arctic channel, Zhang and Yang (2021)[4] found that the export trade potential between China and the Arctic countries increased by 25% on average using the expanded trade gravity model. Zhu (2015)[5] drew the conclusion that China's export potential to the Arctic countries increased by 9% - 11% and its import and export trade potential increased by 15% - 17% by applying the stochastic frontier gravity model. Wei (2022)[6] and others used gravity model to conduct quantitative analysis on trade growth and study its impact on the trade of goods through Dalian Port. Li and Li (2020)[7] selected the relevant data of trade between Northeast China and waterway countries from 2010 to 2018 to conduct a quantitative analysis of the trade intensity and trade complementarity, and providing suggestions and basis for the external development of Northeast China.

However, when studying the trade development potential, scholars mostly take the country as the research object to study the trade development between China and the countries along the waterway and the Arctic countries,

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or take the Northeast China as the research object to study the trade development potential between China and various trading partner countries. There is little research on the development of trade between Northeast China and shipping countries, which is lack of pertinence and reference. Therefore, based on the panel data from 2010 to 2020, this paper uses the expanded trade gravity model to conduct empirical tests, analyzes the factors affecting the bilateral trade between the Northeast China and the countries of the Northeast Arctic Channel, estimates and compares the trade potential, and gives corresponding development suggestions.

As China's traditional old industrial base, Northeast China has a good industrial base, and is also an important area of northern China's opening up. In 2020, the foreign trade volume of the three provinces was 112.277 billion yuan, an increase of 19.9% over the previous year. However, the regional transportation conditions limit the economic development of Northeast China. Of the three provinces, only Liaoning has maritime ports, and the foreign trade volume between Heilongjiang and Jilin, which have no sea ports, is less than one third of that of Liaoning Province in recent years. The navigation of the Arctic Northeast Passage has greatly shortened the trade distance between Northeast China and Europe, and has made it possible to reverse the regional disadvantage of Northeast China. Therefore, we should seize the new opportunity of the construction of the "Ice Silk Road", actively adjust the regional industrial structure, increase trade exchanges with countries along the Arctic Northeast Passage, and accelerate the promotion of the Northeast revitalization strategy.

## 2. Current situation of trade

### 2.1. Changes in trade growth

From 2010 to 2020, the volume of bilateral trade between the Northeast China and the countries along the Northeast Passage of the Arctic increased slightly, and the total import and export volume increased from 24.5 billion US dollars to 33.6 billion US dollars. However, there are three distinct stages of change: (1) From 2014 to 2015, the domestic economic growth slowed down, and the Russian economy was greatly impacted, resulting in a sharp decline in import and export trade. (2) The bilateral trade volume began to grow in 2017 and continued to accelerate in 2018. The reason is that the price of energy commodities rose by nearly 24% in 2017, and the second line of China-Russia crude oil pipeline was officially put into operation in 2018, and Heilongjiang increased its energy import to Russia. (3) The decline in trade from 2019 to 2020 is mainly due to the impact of the COVID-19 on global trade.

### 2.2 Trade structure and direction

On the whole, there is an obvious trade deficit between the Northeast China and the countries along the Arctic Channel, which has been expanding year by year. The trade deficit reached the largest US $27.58 billion in 2018. In addition, there are obvious country differences in bilateral trade. Among the seven countries, Russia is the largest trading partner in Northeast China, with the bilateral trade volume accounting for more than 40% of the total trade volume between Northeast China and countries along the waterway all the year round, and Germany ranks second, with the average bilateral trade volume accounting for 35.6% in the past decade. The bilateral trade with Russia and Germany plays a decisive role in the foreign trade performance of Northeast China to countries along the waterway.

### 2.3. Trade commodity structure

On the whole, the foreign trade structure of Northeast China is relatively simple. Crude oil, mechanical and electrical products and high-tech products are the main types of goods imported and exported in Northeast China. In 2020, the trade volume of these three types of goods accounted for 61.5% of the foreign trade volume of Northeast China in that year.

From the perspective of provinces, crude oil is the most important import commodity of Heilongjiang Province. In 2020, crude oil imports accounted for 45.2% of the total imports of Heilongjiang Province. Capital intensive commodities are the main target of foreign trade of Heilongjiang Province. The foreign trade of Jilin Province is mainly composed of mechanical and electrical products, high-tech products and automobile related industrial products. In 2020, the total import and export of mechanical and electrical products in Jilin Province accounted for 61.6% of the foreign trade. Mechanical and electrical products and high-tech products are the main foreign trade commodities of Liaoning Province, accounting for 49.9% of the foreign trade volume of that year. At the same time, Liaoning Province has a huge demand for crude oil. In 2020, crude oil imports accounted for 26.3% of the total imports.

## 3. Model building

### 3.1. Trade gravity model mechanism

In the study of international trade, Tinbergen (1962)[8] and Pöyhönen (1963)[9] first introduced the gravity model to analyze bilateral trade flows. More scholars set different explanatory variables in the model according to their research focus, form an expanded trade gravity model, analyze the size and direction of the impact of different factors on the scale of bilateral trade, and further calculate the potential of bilateral trade. As shown in formula (1), trade gravity model established by Tinbergen:

$$X_{\mathrm{ij}} = K\frac{\left(Y_i\right)^{a}\left(Y_{\mathrm{j}}\right)^{\mathrm{b}}}{\left(1+\mathrm{e}D_{\mathrm{ij}}\right)^{\mathrm{f}}} \tag{1}$$

$X_{\mathrm{ij}}$ - the total export of country i to country j, $Y_i$ and $Y_{\mathrm{j}}$ -the GNP of country i and country j, $D_{\mathrm{ij}}$ the

distance between country i and country j，K，e-constants，a、b-parameters。The formula shows that the size of the total amount of countries i go abroad to j or the volume of trade between countries i and j is directly proportional to the total national income of countries i and j, and inversely proportional to the distance between the two countries. Poyhonen is different from the simplified form adopted by Tinbergen, which is compatible with the time series data and technology. In the study, the section data is used.

Linnemann(1966)[10] added demographic variables to the original trade flow measurement model, and modeled them in logarithmic form, revealing the reasons affecting export trade from a macro perspective. As shown in formula (2).

$$\ln X_{ij} = \partial_0 + \partial_1 \ln Y_i + \partial_2 \ln Y_j + \partial_3 \ln D_{ij} + \partial_4 \ln P_{ij} \quad (2)$$

Berstrand(1989)[11] went further, replacing the population index with per capita income.

### 3.2 Model construction

This paper studies the trade potential of the three northeastern provinces and the seven countries along the Arctic Northeast Passage, and introduces the economic scale and shipping distance of the two sides into the model from the gravity model. The economic scale is expressed by the per capita GDP of the three northeastern provinces and the seven countries. For the selection of shipping distance, since most of the goods in the northeast region are transported through Dalian Port, the distance from Dalian Port to the main ports of each country is selected as the shipping distance. On this basis, based on the trade characteristics of the Northeast China and the countries along the Northeast Channel, this paper adds the real effective exchange rate index, container terminal throughput, and trade facilitation policies.

(1) $GDPP_{it}GDPP_{jt}$ - in the period t, the product of the per capita GDP of Northeast China and the per capita GDP of the country j. The greater the value, the stronger the trade capacity of the two countries, and the expected relationship is positive.

(2) $DIST_{ij}$ -the distance (in kilometers) from Dalian Port, via the Suez Canal route, to the national port j, including Antwerp Port in Belgium, Hamburg Port in Germany, Copenhagen Port in Denmark, London Port in the UK, Amsterdam Port in the Netherlands, Murmansk Port in Russia and Stockholm Port in Sweden. The greater the value, the more unfavorable the bilateral trade, and the expected relationship is negative.

(3) $RE_{jt}$ is the real effective exchange rate index of country j in the period t. The real effective exchange rate index not only considers the currency situation of a country's trading partners, but also excludes the inflation factor, which can truly reflect the external value of a country's currency. The expected relationship of the export trade model is positive, the expected relationship of the import trade model is negative, and the direction of the bilateral trade model is unknown.

(4) $TFP_{jt}$ -dummy variable， indicating whether country j and China had trade facilitation policies in the period t. yes=1， no=0。The expected relationship is positive. Considering that only Russia and Northeast China have borders and there is no common language research between the country and China, some dummy variables commonly used in the trade gravity model, such as whether there is a common language, whether there is territorial border, and cultural differences, are not included in the model.

(5) $CPT_{jt}$ - the container terminal throughput of country j in the period t, which is the most important indicator to measure the size of the port, so it can also better reflect the port infrastructure construction of a country. The expected relationship is positive.

### 3.3 Data source and processing

The data of trade volume and per capita GDP of Northeast China with seven countries come from the provinces. The data comes from the Statistical Yearbook of Heilongjiang, Jilin and Liaoning from 2010 to 2020; The actual effective exchange rate and container terminal throughput data are from the World Bank database; The distance between Dalian Port and other countries is from Searates website (http://www.searates.com).

## 4. Empirical analysis

### 4.1. Regression results

For the panel data, mixed regression, fixed effect regression and random effect regression were made respectively, and the final empirical method was determined through F test, LM test and Hausman test. According to the results, we select random effect model for regression.

(1) GDP per capita is an important factor affecting trade volume. The results show that, at the level of 1% significance, every 1% increase in the product of GDP per capita of country i and country j in Northeast China will lead to an increase of 0.555% in bilateral trade and 0.85% in import trade, with a higher significance in import trade. Although the conclusion of positive impact can be drawn, the scope of growth driven by it is very limited, especially for exports, which may be due to the fact that the trade between Northeast China and relevant

**Table 1** Regression results of random effect model

| | Bilateral trade model | Export trade model | Import trade model |
|---|---|---|---|
| $\ln GDPP_{it}GDPP_{jt}$ | 0.555*** (0.211) | 0.343* (0.202) | 0.85*** (0.282) |
| $\ln DIST_{ij}$ | -14.081*** (2.073) | -8.617*** (2.685) | -18.522*** (2.572) |
| $\ln RE_{jt}$ | -3.453*** (0.456) | 0.096 (0.836) | -5.304*** (0.632) |

| | | | |
|---|---|---|---|
| $lnCPT_{jt}$ | 1.684*** (0.37) | 1.11*** (0.215) | 1.925*** (0.47) |
| $TFP_{jt}$ | -0.147** (0.061) | 0.185*** (0.036) | -0.387*** (0.1) |
| _cons | 119.327*** (12.799) | 65.159*** (17.566) | 159.464*** (19. 214) |

Note: Significance indicated by (10%)*, (5%)** , and(10%)***. Standard errors are in parentheses.

countries accounts for a small proportion of the economic volume of the other countries.

(2) The shipping distance between Dalian Port and the representative ports of seven countries has a negative relationship with the trade volume, and has a greater impact on the import of Northeast China. At the significance level of 1%, for every 1% increase in distance, bilateral trade will decrease by 14.081%, exports from Northeast China to 7 countries will decrease by 8.617%, and imports from Northeast China to 7 countries will decrease by 18.522%. The opening of the Northeast Channel and the shortening of the shipping distance will have a positive effect on the increase of bilateral trade volume.

(3) The exchange rate level has a significant impact on the bilateral trade volume and import trade volume, both showing a negative relationship; In the export trade model, there is a positive relationship, but it is not significant. It can be seen that this variable has a greater impact on the import trade in Northeast China. The elasticity of trade between China and the Arctic countries to the exchange rate changes of different currencies is different, which may also have a certain impact on the return results.

(4) The throughput of container terminals can clearly report the volume of containers transported by land to sea. For each 1% increase in container terminal throughput, the bilateral trade volume increased by 1.684%, and the export trade volume of Northeast China to seven countries increased by 1.11%, and passed the significance test at the 1% level. It can be seen that improving port infrastructure construction and improving port throughput will promote the development of bilateral trade.

(5) In the export trade model, the direction of the regression results is consistent with the expectation and very significant; in the import trade model, the result is opposite, which because Russia is the only country that has signed a trade agreement. This opposite result also can be used as a research direction in the future.

### 4.2. Calculation results of trade potential of new and old channels

On the basis of the gravity model, select the actual data of the import trade volume and export trade volume of 2020, replace the original variable with the distance through the Northeast Channel, estimate the predicted import and export trade volume calculate the trade potential respectively, as shown in the table2.

According to the size of the ratio, the trading partners are divided into three categories: the ratio of actual bilateral trade volume to predict trade volume is greater than or equal to 1.2, which is potential reshaping; the ratio between 0.8-1.2, which is potential development; and the ratio less than 0.8, which is huge potential. The analysis results are as follows:

**Table 2** Estimation of trade potential

| County | Original channel | Northeast channel | Change rate |
|---|---|---|---|
| | Export trade potential | | |
| Belgium | 0.527 | 0.369 | 29.99% |
| Germany | 1.119 | 1.003 | 10.35% |
| Denmark | 1.182 | 0.648 | 45.21% |
| Britain | 1.768 | 0.884 | 49.97% |
| Netherlands | 1.170 | 1.104 | 5.66% |
| Russia | 1.136 | 0.372 | 67.26% |
| Sweden | 0.699 | 0.651 | 6.87% |
| | Import trade potential | | |
| Belgium | 0.484 | 0.239 | 50.55% |
| Germany | 3.934 | 3.606 | 8.35% |
| Denmark | 0.725 | 0.367 | 49.33% |
| Britain | 2.229 | 0.773 | 65.34% |
| Netherlands | 0.272 | 0.259 | 4.76% |
| Russia | 0.436 | 0.296 | 32.12% |
| Sweden | 1.146 | 1.029 | 10.19% |

The export trade and import trade between the Northeast and Belgium are of great potential. If the Northeast Channel is selected, the trade potential will increase by 29.99% and 50.55% respectively. The two sides still have large trade space, and need to fully consider various factors and give full play to the potential trade potential.

If the traditional route is used, the UK's export trade and import trade are potential reshaping, and the space for trade potential development is limited, so it is necessary to find new trade growth points; If the Northeast Channel is selected, the trade potential will be greatly improved.

Germany has reshaped its export trade potential and import trade potential, indicating that its export potential to Germany has not been fully exploited and there is still room for growth; If the Northeast Channel is used, the import trade potential will not be significantly improved.

Denmark and Russia are two countries with huge import trade potential. After selecting the new channel, the export trade potential has changed from a pioneering type to a huge one. The Netherlands has huge export trade potential and import trade potential, and Sweden has huge export trade potential and import trade potential. The change of channel has not significantly improved the trade between the two countries and the Northeast, but there is still room for the import and export trade between the Northeast and these countries.

In general, the opening of the Arctic Northeast Channel will increase the export potential and import

potential of the three provinces to the countries benefiting from the channel by 30.76% and 31.52% on average. Compared with the traditional Suez Canal channel, after selecting the new channel, the trade potential of Northeast China with Germany, the Netherlands and Sweden is limited, but there is still a lot of room to improve the trade potential of other countries in the Arctic Northeast Channel. In addition, Iceland and Norway, which are not included in the sample due to the lack of trade data, may have greater trade potential with China: Iceland is the first European country to sign a free trade agreement with China; Since the normalization of bilateral relations between China and Norway in 2016, the negotiation process of free trade agreement has also been accelerated in recent years. It can be seen that on the basis of the new channel, it can promote the deeper cooperation between the Northeast China and the European countries along the line.

## 5. Conclusions and suggestions

The opening of the Northeast Passage of the Arctic has a significant impact on international trade, as well as political and military aspects; as the nearest region to the Arctic Channel in China, Northeast China is bound to seize this development opportunity. This paper uses the expanded trade gravity model to analyze the influencing factors of the bilateral trade between the Northeast China and the countries along the Northeast Passage of the Arctic, calculates the trade potential of the traditional Suez Canal Passage and the Northeast Passage, and compares them, thus reflecting the impact of the opening of the new route on international trade.

The empirical results show that: first, per capita GDP, container terminal throughput and import and export trade volume show a significant positive correlation, and the impact on import trade is greater than export trade. Second, the shipping distance between Dalian Port and the representative ports of seven countries is negatively related to the trade volume; The level of exchange rate has significantly affected the bilateral trade volume and import trade volume, both showing a significant negative relationship, both of which have a greater impact on the import of Northeast China; Third, if the partner countries and China have an agreement to promote trade facilitation, it will be more conducive to the export of Northeast China. Fourth, the opening of the Arctic Northeast Channel will increase the trade potential of the three provinces to the countries benefiting from the channel by an average of 31%, including Denmark, Britain and Russia; from the perspective of the type of trade potential, the export and import with Belgium, Denmark and Russia are of huge trade potential. Therefore, the opening of the Northeast Passage of the Arctic is of great significance for China's northeast region to enhance its foreign trade capacity.

Based on the research conclusion, the following suggestions are put forward:

1. Northeast China should rely on a sound industrial system and rich resources, reasonably allocate production factors, increase scientific and technological research and innovation, and increase the proportion of trade volume of high-tech products in regional economic development. Especially for Heilongjiang Province, it should strive to change the current situation of relying on energy commodities and agricultural trade to promote foreign trade, strive to innovate independently, and optimize the trade structure. While promoting foreign trade, Northeast China should pay attention to expanding domestic demand to ensure the stable development of regional economy.

2. Actively participate in the development and construction of the Arctic Northeast Channel. The navigation of the Northeast Channel has reduced the shipping distance and improved the trade development potential of both sides. We should also strengthen exchanges and cooperation with neighboring countries, seek the possibility of signing free trade agreements and the formulation of various policies, and facilitate trade development and economic cooperation between the two sides.

3. To improve port infrastructure construction, improve port throughput, increase investment in science and technology, rely on the Internet of Things, big data, etc., make port construction develop towards automation and intelligence, and comprehensively improve port operation efficiency. At the same time, we will attract professionals related to port and logistics, and comprehensively improve the port's carrying capacity and service level from the aspects of infrastructure and talent introduction and training.

4. In addition to strong economic exchanges with Russia and Germany, there is still a lot of room for trade improvement with other countries. Northeast China should strengthen economic exchanges with these countries, fully tap the trade potential of both sides, formulate corresponding policies and foreign trade development strategies for different countries, give full play to their respective advantages, and promote the development of interregional trade.

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