Research on Factors Affecting Export Trade Between China and Countries Along"the Belt and Road Initiative"-taking Electromechanical Products as an Example

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Abstract:

Driven by global economic integration and the "Belt and Road"initiative, China's economic and trade cooperation with countries along the route is becoming increasingly close. The export of mechanical and electromechanical products holds a significant role. This paper focuses on studying the export trade of electromechanical products between China and key trading nations participating in the Belt and Road Initiative. It employs the trade gravity model to assess how factors like GDP, geographical distance, population size, and official exchange rate influence the export of electromechanical products. The findings of the empirical analysis indicate a strong positive relationship between economic size and export volume, a negative correlation between geographical distance and export volume, a positive influence of population size on exports, and a detrimental effect of exchange rate fluctuations on exports. This paper proposes recommendations that include enhancing market penetration in high GDP countries, refining the logistics system, and bolstering exchange rate risk management. These suggestions offer theoretical backing for China to refine the export structure of electromechanical products and boost its global competitiveness.

Keywords: The belt and road initiative; electromechanical products; export trade; trade gravity model.

1. Introduction

In the context of global economic integration, international trade, as an important engine of economic growth, has attracted much attention for its trends and influencing factors. China's economic and trade collaboration with countries along the Belt and Road Initiative route has strengthened, with a significant boost in the export of mechanical and electrical products. Investigating the factors that influence the

export of mechanical and electrical products is crucial for market expansion, structural optimization, and competitiveness enhancement. Zhang Yujia's study uncovered that China's trade reliance on countries part of the Belt and Road Initiative is significant, particularly in East Asia, Southeast Asia, and the Middle East, while being comparatively lower in Central and Eastern Europe [1]. China's economy has proliferated, and exports of mechanical and electrical products have expanded, making it one of the world's major exporters. The Belt and Road Initiative creates fresh opportunities and boosts demand in the countries along its route. Zuo Linlin used the trade gravity model to analyze the factors affecting the export trade of Chinese Mechanical and electrical products to countries along the Belt and Road and put forward suggestions on exploring international markets and implementing a diversification strategy [2].

2. Literature Review

2.1 Current Status of Foreign Research

Foreign scholars have conducted extensive research on the export trade of electromechanical products under the framework of international trade theory. The focal point of Krugman and Obstfeld's International Economics is the significance of the theory of comparative advantage [3]. The study also explored the complementary and competitiveness between China and the Belt and Road countries in the trade of electromechanical products, as well as the impact of macroeconomic, policy, geographical, and cultural factors [3]. In addition, some studies pay special attention to policy barriers, such as tariffs and non-tariff measures that restrict exports. Meng Xia's research points out that the implementation of the "Belt and Road" trade framework will promote the export of Chinese mechanical and electrical products, especially the reduction of technical trade barriers, which will have a positive impact [4].

2.2 Domestic Research Status

Scholars in the domestic sphere have recognized the strategic importance of the"Belt and Road"initiative for the export of electromechanical products. The initiative will bring new markets for China's export of electromechanical products, alleviate overcapacity, and promote industrial upgrading.Simultaneously, it has advanced economic growth and infrastructure development in nations along the route, fostering mutual benefits and win-win outcomes.Since 1995, mechanical and electrical products have outstripped textiles to become China's top export product. Its proportion in total domestic exports contin-

ues to rise. This significant change not only consolidates the position of the mechanical and electrical industry in the international market but also Strongly promotes the prosperity and development of global international trade. Liu Qi highlighted that the export of electromechanical products not only encouraged the involvement of other industries in the global market but also fostered the accelerated growth and technological advancements within the electromechanical sector, thereby strengthening its presence on the international platform [5].

With the introduction of China's "One Belt, One Road" international trade strategy, some trade problems have also emerged. Wang Fang revealed the inequality in the trade network of countries along the route and emphasized that China's leading position in infrastructure construction provides a natural advantage for foreign trade enterprises, including the export of mechanical and electrical products [6]. Zhou Jialing further analyzed the trade pattern under the background of the"Belt and Road Initiative"and pointed out that the import and export trade demand from Southeast Asia and the Middle East to China is crucial to the export of mechanical and electrical products [7].

Domestic scholars have proposed numerous constructive opinions in terms of countermeasures and suggestions. Here is a revised version of the sentence For instance, enhancing brand development and elevating product value; refining export framework and fostering technological advancement; bolstering global partnerships and accessing varied markets; enhancing policy backing and cutting export expenses for businesses. Si Zhibin utilized the BACI database to investigate how the"One Belt, One Road"initiative influenced the export quality of the industry. The study revealed a substantial enhancement in export quality driven by the promotion of the"export competition effect"and the"OFDI reverse spillover effect"due to the initiative. Particularly in low-tech sectors, the positive impact of the initiative on price competition was notably pronounced [8]. Liu Zuankuo conducted a study on how logistics performance influences China's export of mechanical and electrical products. He found that the quality of logistics services, capabilities, and infrastructure have a crucial positive impact on exports. Furthermore, he analyzed potential risks associated with the Maritime Silk Road and suggested enhancing basic transportation facilities, minimizing transportation costs, and implementing other strategies to achieve mutually beneficial and sustainable development [9]. Additionally, Li Fang highlighted the insufficient technical capabilities of mechanical and electrical products and the shortcomings in transportation infrastructure, emphasizing the need for specific improvements [10].

A review of relevant literature shows that research on

the export of mechanical and electrical products between China and the countries along the Belt and Road Initiative has made progress, but there are still limitations. Existing research may not be comprehensive and accurate in terms of data and models, and lacks analysis of specific factors such as cultural differences and trade facilitation. To adapt to international trade, it is necessary to find solutions to the export problems of mechanical and electrical products from within. In addition to product and transportation issues, through the "Belt and Road" policy, this article deeply explores the direct and specific factors affecting the export of mechanical and electrical products.

To sum up, "Research on Export Trade Factors of Mechanical and Electrical Products between China and Major Trading Countries along the Belt and Road"is a topic with important practical significance and academic value. By deeply analyzing the mechanism and policy effects of various influencing factors, this paper provides strong support for relevant policy formulation and corporate decision-making.Simultaneously, it is imperative to consistently monitor academic frontiers and practical advancements and promptly adapt research directions and priorities to foster ongoing depth and progress in the field of study. Therefore, starting from a spatial distance, population size, GDP, and other data, this paper explores the relevant factors affecting the export trade of mechanical and electrical products of countries along the "Belt and Road", aiming to provide theoretical support and policy recommendations for further optimizing China's mechanical and electrical product export structure and enhancing national competitiveness.

3. Analyzing China's Export Trade of Mechanical and Electrical Products to Key Trading Countries Involved in the Belt and Road Initiative Through Empirical Studies

3.1 Model Overview

The gravity model is one of the key theories in international trade research, explaining the changes and patterns of trade flows between countries. The statement is founded on two premises nations with bigger economies contribute a greater portion to trade, and countries in close proximity engage in more frequent trade.The gravity model offers a quantitative prediction of trade flows, underscoring the significance of distance in trade dynamics. The formula is as follows:

$$T_{ij} = \frac{A\left(Y_i Y_j\right)}{D_{ij}} \tag{1}$$

Where Tij is the total bilateral trade volume; Yi is the GDP of country i; Yj is the GDP of country j; Dij is the distance between country i and country j; A is the proportionality constant. Using the gravity model, people have deeply analyzed the complex trade relations between countries, thereby gaining a better understanding and grasp of international trade phenomena. Based on this model, this paper analyzes and predicts trade flows between different countries based on economic size and distance.

3.2 Indicator Selection

In order to thoroughly analyze the interaction between China and key trading partners in the export of mechanical and electrical products as part of the"Belt and Road"initiative, this paper must establish a set of relevant evaluation indicators. These indicators will enable an indepth analysis of trade ties between the two countries. This paper examines the factors influencing Mechanical and electrical products based on the research conducted by Liu Zuankuo [9]and Huang Hong [11]. The study selects the export volume of mechanical and electrical products as the dependent variable, while GDP, official exchange rate, population size, and spatial distance are considered as independent variables. This section elaborates on these selected indicators.

(1)Mechanical and electrical product export value The value of exported mechanical and electrical products serves as a crucial metric for assessing trade activities. This article focuses on the export of mechanical and electrical products between my country and countries along the"Belt and Road", explores its export trade status, and provides data support for analyzing the economic relations between my country and these countries.

(2)GDP(Gross Domestic Product): GDP is a core indicator to measure the economic strength and scale of a country or region. This article compares China's GDP with the GDP of major trading countries along the Belt and Road Initiative to assess the economic strength and trade potential of both sides.

(3)OR(Official Rate): The official rate is an important factor affecting international trade. This article analyzes the changes in official rates between China and major trading countries along the Belt and Road Initiative, reveals its impact on trade activities, and provides a reference for policy making.

(4) PS (Population size): Population size is an important indicator of regional population density and affects the scale and structure of trade demand. This article will compare the population size of China and other "Belt and

Road" countries and analyze its impact on the export trade of mechanical and electrical products.

Spatial distance, as a geographic factor, influences international trade. This paper examines the variations in physical distance between China and key trading nations along the Belt and Road Initiative, investigates how it influences trade and investment patterns, and anticipates a diminishing impact of regional economic integration on spatial separation.

In this section, this paper chosen a set of indicators to thoroughly and objectively assess China's performance and competitiveness in exporting mechanical and electrical products to key trading partners within the Belt and Road Initiative. These selected indicators will lay a solid foundation for building subsequent models and conducting data analysis while ensuring the accuracy and credibility of the research results.

3.3 Model Settings

This paper first establishes a static benchmark regression model to investigate the correlation between the export volume of mechanical and electrical products and various factors. The model considers variables such as GDP, national distance, and population size within the trade gravity framework. Additionally, a fixed effect model is utilized to validate the findings.

$$Y_{it} = \beta_0 + \beta_1 GDP + \beta_2 PR + \beta_3 OR + \beta_4 SD + \beta_{5_{it}} + \alpha_i + \lambda_t + \varepsilon_{it} \qquad (2)$$

In year t, Y signifies the export volume of mechanical and electrical products of country i;while GDP signifies the gross domestic product, PR signifies the population, OR represents the official exchange rate, and SD represents the spatial distance of country i. The model also incorporates individual-specific fixed effects α_i and year-specific fixed effects λ_t. To mitigate the impact of outliers, this paper applied prioritization to all continuous variables.

3.4 Data Source

To fully understand the status of trade in mechanical and electrical products between China and countries along the "Belt and Road", this paper conducted extensive information collection and data integration. Through authoritative institutions such as the World Bank, the United Nations Statistics Division, and the General Administration of Customs of China, this article obtained key economic indicators including GDP, population ratio, official rate, etc., providing a multi-dimensional background for the analysis. In addition, the economic data obtained from these national statistical bureaus further enhance the depth and breadth of this paper's research.

This paper constructs the gravity model by making the export volume of mechanical and electrical products between China and the major trading countries along the Belt and Road the dependent variable, and choosing economic factors like GDP, population ratio, official rate, geographical distance, and weighted average tariff of each country as independent variables.

By considering these factors, this article can more thoroughly reveal the evolution and future trends of the mechanical and electrical products trade, thereby providing more solid and reliable research support for policymakers, entrepreneurs, and academia.

3.5 Analysis of Empirical Results

3.5.1 Descriptive statistical analysis

Descriptive statistics summarize a data set by calculating statistics, including central tendency(such as mean, median, and mode)and dispersion(such as range, inter quartile range, variance, and standard deviation).

These metrics can clearly show the central location and dispersion of the data, laying the foundation for in-depth analysis and data mining. The data are shown in Table 1.

Table 1. Descriptive Statistics

Variables	N	mean	sd	min	max
export	132	30,394	37,844	0.00367	171,399
distcap	132	10,608	2,215	7,538	14,254
people	132	179,898	342,224	16,322	1380004
gdp	132	1462062	1188314	49,766	3974443
rate	132	391.5	1,468	0.608	10,054

This study conducted a thorough analysis of key indicators such as export volume, geographical distance, national population, GDP, and exchange rate based on data collected from 132 observation points spanning the 11-year period from 2010 to 2020.

The average export value was US$30,394 million, but it

fluctuated greatly, with a standard deviation of US$37,844 million, reflecting the complexity of international trade. The average geographical distance is 10,608 km, with a standard deviation of 2,215 km, indicating the extensiveness and diversity of the spatial distribution of the research objects. The average national population is 179.898 million, but the standard deviation is as high as 342.224 million, reflecting the extreme differences in population distribution.

The average GDP of US$1,462,062 million and a standard deviation of US$1,188,314 million highlight the varied nature of the global economic landscape.

The mean exchange rate is 391.5, the standard deviation is 1468, and extreme changes affect international economic exchanges.

3.5.2 Correlation statistical analysis

Table 2. Correlation Statistics

	export	distcap	people	gdp	rate
export	1				
distcap	-0.436***	1			
people	0.0510	0.509***	1		
gdp	0.781***	-0.631***	0.200**	1	
rate	-0.193**	0.253***	-0.0990	-0.302***	1

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Based on Table 2, the correlation coefficient between the export volume of mechanical and electrical products and GDP is 0.781, indicating a strong and positive relationship between the two variables. In essence, as a country's GDP increases, the export volume of mechanical and electrical products also tends to rise. Furthermore, there is a strong negative correlation of-0.436 between export volume and distance. This indicates that the export volume tends to decrease as the distance increases, highlighting the inverse relationship between the two variables. Furthermore, the correlation coefficient of 0.051 suggests a weak relationship between population size and export volume. The recorded correlation coefficient of-0.193 between the official exchange rate and export volume suggests a modest negative relationship. This indicates that fluctuations in the official exchange rate could potentially affect export volume.

3.5.3 Multivariate regression statistical analysis

Table 3. Gravity Model Multiple Regression Statistics

Variables	m1	m2
	export	export
distcap	12.650***	12.650***
	(0.586)	(0.610)
people	-0.067***	-0.067***
	(0.005)	(0.005)
gdp	0.043***	0.043***
	(0.002)	(0.002)
rate	-1.337***	-1.337***
	(0.354)	(0.369)
2011.		-3,811.854***
		(261.604)
2012		-4,147.029***
		(231.076)
2013		-5,179.390***
		(332.273)
2014		-5,162.071***

		(377.936)
2015		3,334.437***
		(72.453)
2016		7,227.426***
		(81.129)
2017		11,442.936***
		(265.675)
2018		7,012.465***
		(474.905)
2019		7,673.676***
		(479.165)
2020		8,201.215***
		(401.397)
Constant	-154,329.687***	-156,747.125***
	(7,054.946)	(7,220.767)
Observations	132	132
R-squared	0.729	
Number of year	11	11

Robust t-statistics in parentheses
*** p<0.01, ** p<0.05, * p<0.1

Table 3 displays the influence of each variable in the model on export volume. Initially, the significant negative coefficient of distance suggests that as the distance increases, the export volume decreases, aligning with the fundamental premise of the gravity model that emphasizes the critical influence of distance factors on trade dynamics.

Secondly, the coefficients of population and GDP are both positive and significant, indicating that the larger the country's population and economic scale, the higher its export volume. This is consistent with the gravity model in which countries with larger economic scale have a greater proportion of trade activities. consistent with large assumptions.

In addition, the coefficient on exchange rate is negative and significant, which may indicate that exchange rate changes have a negative impact on exports.

In the model, year dummy variables (2011.year to 2020. year) are also added.

The coefficients of these variables are all positive and significant, indicating that over time, China's exports of mechanical and electrical products to countries along the"Belt and Road"have increased.The amount shows an upward trend. This could be connected to the swift development of China's economy and the increase in exports of mechanical and electrical goods.

Ultimately, the significant and negative coefficient of the constant term may indicate the influence of unaccounted factors on exports within the model.

The R-squared value of the model is 0.729, indicating that the model can explain 72.9% of the variation in export volume and has a good fit.

Overall, the main factors affecting the export trade of mechanical and electrical products between China and countries along the "Belt and Road" include GDP, distance, population and exchange rate.

Among the factors studied, both GDP and population display a noteworthy positive influence on export volume, whereas country distance and exchange rate show a notable negative impact.

The year factor also shows a significant impact, especially the significant growth in export trade after 2015.

Over time, China's exports of mechanical and electrical products to these countries have been steadily increasing, a trend closely linked to the enhancement of China's manufacturing capabilities and the implementation of the"One Belt, One Road"initiative.

4. Conclusion and Recommendations

4.1 Conclusion

Studies indicate a direct relationship between the size of an economy and the volume of exports, specifically demonstrating that countries with larger GDP's tend to have higher export levels of mechanical and electrical goods.This indicates that countries with sizable economies possess greater capacities in driving the export of mechanical and electrical products.Simultaneously, there is a notable inverse relationship between geographic distance and the volume of exports.

That is, the farther the geographical distance is from a country, the export volume of its mechanical and electrical products will be greatly suppressed due to limitations in logistics costs and time costs.

While the correlation between population size and export volume may be weak, there is still a discernible positive relationship between the two variables.Specifically, countries with larger populations tend to have higher market demands for mechanical and electrical products. Furthermore, the official exchange rate will also have an indirect impact on the export volume of mechanical and electrical products. The fluctuation in the exchange rate, particularly with a high exchange rate, will negatively impact the export of mechanical and electrical products by increasing export costs and consequently reducing export volume.

4.2 Recommendations

(1)Improve market penetration in countries with high GDP. For countries with larger economic scales, people should increase market development efforts and take advantage of their higher purchasing power to further increase the market share of mechanical and electrical products.

(2)Enhance export competitiveness by improving logistics and transportation systems. To mitigate the negative impact of distance on exports, it is advised to enhance logistic collaboration with countries along the"Belt and Road", boost transportation efficiency, cut down logistics expenses, shorten transit times, ultimately bolstering export competitiveness.

(3)Enhance market research in countries with large populations. It is important to intensify market investigation and tailor products to the needs of populous countries, leveraging their substantial population and creating mechanical and electrical goods that cater to local demands to boost export growth.

(4)Exchange rate risk management. It is recommended that enterprises establish a sound exchange rate risk management system and adopt financial instruments such as hedging to reduce the adverse impact of exchange rate fluctuations on exports.

(5)At the same time, they can consider settling with partner countries in local currency or stable currency to reduce the risks brought by exchange rate fluctuations.

Authors Contribution

Each author made an equal contribution, and their names were arranged in alphabetical order.

References

[1] Zhang Yujia, Zhang Xiaoping, Gong Zezhou. Analysis of trade dependence between china and countries along the „Belt and road". Economic Geography, 2017, 37(04).

[2] Zuo Lingling, Zhong Bingping. Research on china's exports of electromechanical products to countries along the „Belt and road" and its potential. Price Theory and Practice, 2021, (10).

[3] Krugman P, Obstfeld M. International economics. 11th ed. MIT Press, 2018.

[4] Meng Xia, Huang Chenliu, Zhang Xiao. The impact of RCEP on China's electromechanical exports — Based on GTAP simulation analysis. Asia-Pacific Economy, 2018, (04).

[5] Liu Qi. Empirical analysis of intra-industry trade of china's electromechanical products. Journal of Southeast University (Philosophy and Social Sciences Edition), 2002, (S2): 44-47.

[6] Wang Fang, Hu Qiuguang. Analysis of the trade network structure of electromechanical products in countries along the „Belt and road". Asia-Pacific Economy, 2019, (05): 49-58+150.

[7] Zou Jialing, Liu Chunla, Yin Guoqing, et al. Trade pattern between china and countries along the „Belt and road" and its economic contribution. Progress in Geography, 2015, 34(05): 598-605.

[8] Si Zhibin, Qin Fengming, Cheng Min. Industry export quality upgrading under the „Belt and road" initiative. Nankai Economic Studies, 2024, (05).

[9] Liu Zuankuo, Xin Li, Cao Feifei. The impact of logistics performance of the 21st century maritime silk road on china's electromechanical exports. East China Economic Management, 2018, 32(11).

[10] Li Fang, Ma Yuyao, Wang Yuanxi. Research on the influencing factors of china's electromechanical exports to ASEAN member states. Old Brand Marketing, 2024, (14): 33-35.

[11] Huang Hong, Chen Jun. Research on the influencing factors and potential of china's electromechanical exports to RCEP member countries. Price Monthly, 2023, (07): 62-69.