The Impact between GDP of RCEP Member Countries and CHINA's Smartphone Business Exports: Based on Gravity Model Analysis

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Abstract
The Regional Comprehensive Economic Partnership (RCEP) has brought closer economic and trade ties among its members, and also brought closer supply chains and upstream and downstream ties among member country in electronics, technology equipment, etc. Smartphones are an indispensable necessity in today's world and a major component of electronic products. In the circulation among RCEP member country, the production and trade of smartphones are particularly important. The theory used in this article is the gravitational model, and some adjustments are made on the basis of the gravity model to analyze the trade volume of smartphones between RCEP member country and CHINA. This paper uses the econometric method of the least squares estimation (OLS) method, uses the smartphone panel data of CHINA and its 14 trading country for regression analysis, and measures the export potential between CHINA and other RCEP member country, which can provide relevant reference for CHINA's trade system and strategy.
Keywords: RCEP Member Country, Gravity Model, Smartphone Business, International Trade, Economic Integration

Introduction
Background of the Topic
RCEP was launched in 2011, lasted for nearly 9 years, and officially came into effect on November 15, 2020. As one of the world's largest and most influential free trade zones, RCEP covers almost 3 billion people, and its overall GDP accounts for more than 30% of the world, fully demonstrating its important position in the global economy. The signing of RCEP will further promote regional economic integration, promote complementary advantages and resource sharing among member country, expand new market opportunities, promoting sustainable economic development in East Asia, and provide new impetus for industrial upgrading and economic transformation of country in the region.

As a major producer and exporter of the global smartphone industry, CHINA's economic status and influence in the RCEP region are particularly prominent. As an important trade product between CHINA and RCEP country, smartphones have a huge trade scale and economic impact. Since RCEP was officially launched on January 1, 2022, the agreement has greatly reduced trade barriers between member country, and the tariffs and non-tariff barriers of smartphone products have been gradually reduced, which has promoted the growth of market demand in RCEP member country and provided new opportunities for the export of Chinese smartphone products. Chinese smartphone products can not only enter the RCEP market more easily, increase market share, but also further promote the optimization and improvement of the industrial chain. However, the market competition between CHINA and other country in the RCEP region is becoming increasingly fierce, especially Japan, South Korea and some Southeast Asian country, which have strong competitiveness in technological innovation and brand influence in the smartphone industry.

To this end, this paper not only conducts a detailed analysis of the export competitiveness of Chinese smartphones in the RCEP region but also proposes a calculation of future development potential and provides policy for the cooperative development of the smartphone industry between CHINA and RCEP member country.

Research Significance
By analyzing the competition of CHINA's smartphone industry under this background, this study can enrich Regional Economic Integration and International Trade, reveal the impact of free trade agreements on the competition pattern and market flow between industries, and further improve the theoretical framework of global supply chain, market expansion and cross-border competition.

Studying the export competitiveness of Chinese smartphone products in the RCEP region can help Chinese companies better identify market opportunities and challenges, optimize export strategies and market positioning, and enhance product competitiveness. In the context of market penetration, how to use the RCEP agreement for reducing trade barriers and increase market spending is an important issue facing Chinese smartphone companies. The research results provide theoretical reference and practical guidance for the international layout and long-term development of CHINA's smartphone industry.

Literature Review
Gravity Model
The gravity model was originally derived from Newton's gravity equation and is used to explain the distribution of international trade flows. Bhardwaj (2021) mentioned that economists borrowed this physical formula to describe trade flows between country or regions, believing that trade flows are affected by the size of the two economies (such as GDP) and the distance between them (or other relevant obstacles). The introduction of this model marks a new stage in international trade flows in economics. With the deepening of research, scholars have continuously expanded and improved the gravity model, and gradually formed a multi-level and multi-dimensional analysis tool. Van Bergeijk and Brakman (2010) pointed out that the gravity model is not only used to analyze the distribution of international trade flows but also can be used to describe stable relationships in ecological economics. For example, the model shows that the interaction between small economic clusters is weaker

than that between large economies, and economic clusters. People who are geographically close are more attractive than those who are geographically far away. In other words, trade flows are not only affected by market size and distance, but also by other complex economic, political and geographical factors.

In the past, the gravity model has achieved empirical success in explaining trade between country, but it lacks a solid theoretical foundation. The traditional gravity model still varies according to the origin in the previous sense, and the results obtained are relatively inaccurate. Jeffrey H (1985) pointed out that the traditional gravity model ignores certain variables. The traditional gravity model is only a general form of a partial equilibrium subsystem with nationally differentiated products. This paper will add a new independent variable to the gravity model, such as population and trade development level.

The gravity model has a wide range of uses in practical applications. It is used to analyze and predict trade flows, helping economists and policymakers understand the trade potential and trends between different country. Through this model, researchers can more accurately predict and explain changes in international trade, thereby providing theoretical support and empirical basis for stability and global economy.

RCEP Member Country
Shimizu K (2021) ASEAN leads economic integration amid global economic change. Since its establishment in 1967, ASEAN has been committed to regional economic cooperation, and in 2015, the ASEAN Economic Community (AEC) was formally established, becoming the most developed economic integration project in East Asia. ASEAN has also led the East Asia Cooperation Initiative (e.g., ASEAN+3, ASEAN+6) and the RCEP negotiations. In November 2020, the RCEP, the first large-scale free trade area in East Asia, was signed, further consolidating ASEAN's core position in economic integration.

Li Q (2018) analyzes the impact of trade among RCEP members by using a computable general equilibrium model. The results show that CHINA's accession to RCEP has significantly increased the trade volume between CHINA and South Korea. according to related trade benefits, CHINA will increase its revenue by $214 billion, and South Korea will also receive a revenue increase of about $30 billion. Therefore, it can be seen that the trade barriers between RCEP member country are weakened, and the trade volume between RCEP member country will continue to rise in the future.

Business Research on Smartphones
In recent years, scholars' research on smartphones has focused on competitive advantage, patents, and consumer behavior. In the study of competitive advantage and patents, Paik and Zhu (2016) explored for the first time the impact of heterogeneity in national patent systems on firms' global strategy formulation through empirical evidence, providing a perspective for firms to develop more balanced strategies under different patent systems. On the other hand, the study of consumer behavior has gradually attracted attention. Miyauchi et al. (2021) further revealed the potential of smartphones in monitoring economic issues such as residents' activities and consumption behavior by combining user location data with service agency location data to record users' daily activities at five-minute intervals for commuter

traffic. These studies put forward more scientific solutions for the multi-field application of smartphones, and provide strong support for policy formulation and corporate strategy.

Methodology

Gravity Model Construction

Based on the idea of gravitational modeling, which originated from the law of gravity, economists have used gravitational modeling in international trade to analyze the factors affecting the trade between two country. The trade gravity model equation is as follows:

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

where A is a constant, T_{ij} is bilateral trade between country i and j. Y_j represents the level of economic development of country i, Y_j represents the level of economic development of country j, and D_{ij} represents the distance between the two country. Other things being equal.

$$EX_{ij} = \frac{A\left(Y_i Y_j\right)}{D_{ij}}$$

EX_{ij} denotes the export volume from exporter i to importer j. In this paper, it denotes CHINA's export volume of smartphones and its related business to other RCEP member country.

The trade gravity model is a common method to measure the trade volume between two country. In the continuous research and application of the trade gravity model, scholars have added many new variables such as the population of the trading country, trade complementarity, and whether they belong to the same economic organization. Based on the original model, this study added explanatory variables such as the total population of the trading country, the trade openness of the trading country, and the direct investment flow of CHINA to the trading country, and established the following model:

$lnEX_{ijt}=\beta_0+\beta_1 lnGDP_{jt}+\beta_2 lnPOP_{jt}+\beta_3 lnDIST_{ijt}+\beta_4 OPEN_{ijt}+\beta_5 FDI_{ijt}+\beta_6 BORDER_{ijt}+\beta_7 LANG_{ijt}+u_{ijt}$

Variable Selection and Explanation

Table 1

Descriptions of the Variable

Variable	Economic implications	Data Source
Dependent Variable		
EX_{ij}	The total trade volume of CHINA's exports of smartphone products to the RCEP member country	Un Comtarde Database
Independent Variable		
GDP_j	GDP of each RCEP member country	World Bank
POP_j	Total domestic population of each RCEP member country	World Bank
$DIST_{ij}$	The absolute distance between CHINA and RCEP member country (distance to capital or important ports)	CEPII

OPEN$_{ij}$	The degree to which a country is open to trade is expressed as a share of GDP.	World Bank
FDI$_{ij}$	Represents CHINA's outward direct investment flow to RCEP country .	Statistical Communiqué of CHINA's Outward Direct Investment
Border$_{ij}$	A dummy variable indicating whether there is a common border between the two country. If there is a common border between the two country, the value is 1, otherwise the value is 0.	World Bank
LANG$_{ij}$	A virtual variable indicating whether there is a common language between the two country. If there is a common language between the two country, the value is 1, otherwise the value is 0.	World Bank

Finding

Descriptive Statistics

This paper uses stata17 to perform descriptive statistics on the variables in the model. Through calculation, we obtain the results shown in Table 4.1.

Table 4.1
Descriptive Statistics

	(1)	(2)	(3)	(4)	(5)
VARIABLES	Obs	Mean	Std. dev.	Min	Max
LNEX	210	20.45	1.988	15.41	23.70
LNFGDP	210	9.086	1.471	6.483	11.32
LNFPOP	210	17.05	1.646	12.86	19.43
OPEN	210	1.035	0.797	0.00170	4.373
LNDIST	210	8.178	0.583	6.856	9.309
LNFDI	210	10.53	1.763	4.595	13.86
POLICY	210	0.767	0.424	0	1
BORDER	210	0.214	0.411	0	1
LANG	210	0.143	0.351	0	1

As can be seen from Table 4.1, the total amount of data in this article is 210*9=1890; result of each variable are shown in Table 4.1.

Unit Root Test
Table4.2
Unit Root Test Result

variable	Levin, Lin&Chut	ADF-fisher chi-squared	Stationarity Analysis
LNEX	-3.0467(0.0012)	73.0862(0.0000)	steady
LNFGDP	-5.7627(0.0000)	85.9182(0.0000)	steady
LNFPOP	-11.2643(0.0000)	278.8128(0.0000)	steady
LNFDI	-6.2541(0.0000)	118.2667(0.0000)	steady
OPEN	-4.0709(0.0000)	98.7802(0.0000)	steady

According to the unit root test results in Table 4.2, the p-values of the explained variable EX and the explanatory variables FGDP, FPOP, FDI and OPEN are all less than 0.01, which indicates that these variables have no unit root and are stable. Other variables are dummy variables and do not participate in the unit root test.

Correlation Analysis
Table4.3
Correlation analysis

	LNEX	LNFGDP	LNFPOP	LNDIST	OPEN	BORDER	LANG	LNFDI	POLICY
LNEX	1								
LNFGDP	0.229***	1							
LNFPOP	0.725***	-0.352***	1						
LNDIST	-0.324***	0.242***	-0.317***	1					
OPEN	0.108	0.189***	-0.305***	-0.02	1				
BORDER	-0.166**	-0.581***	0.072	-0.230***	-0.073	1			
LANG	0.182***	0.278***	-0.168**	0.152**	0.729***	-0.213***	1		
LNFDI	0.550***	0.05	0.360***	0.058	0.256***	0.036	0.290***	1	
POLICY	-0.185***	-0.175**	-0.184***	0.202***	0.200***	0.123*	0.129*	0.103	1

From the data in the correlation analysis in Table 4.3, we can know that the correlation coefficients between all variables are below 0.95, and the correlation between variables is not high. At the same time, the significance of the correlation coefficient between LNFGDP, LNFPOP, LNDIST, BORDER, LANG, LNFDI, POLICY and LNEX is very high (p value is less than 0.01), and the correlation coefficient between OPEN and LNEX is not significant (p value is greater than 0.1).

Multicollinearity Test
Table4.4
Multicollinearity test

Variable	VIF	1/VIF
OPEN	2.820	0.355
LANG	2.480	0.403
LNFPOP	2.210	0.452
LNFGDP	2.090	0.479
BORDER	1.710	0.585
LNFDI	1.660	0.604
LNDIST	1.420	0.703
POLICY	1.240	0.804
Mean	VIF	1.950

According to the multicollinearity test in Table 4.4, we can see that the VIF between the explanatory variables is less than 10 and the average VIF value is 1.95, which is less than 10, there is no multicollinearity between these explanatory variables.

Regression Results Analysis
Table4.5
Hausman test result

VARIABLES	(1) Hausman
LNFGDP	0.892***
	(0.090)
LNFPOP	1.153***
	(0.080)
LNDIST	-0.530**
	(0.214)
OPEN	0.746***
	(0.158)
BORDER	0.550
	(0.338)
LANG	-0.303
	(0.430)
LNFDI	0.143***
	(0.036)
POLICY	0.177*
	(0.104)
Constant	-5.477**
	(2.778)
Observations	210
Number of id	14
chi2	10.206
Prob > chi2	0.070

Standard errors in parentheses,*** $p<0.01$, ** $p<0.05$, * $p<0.1$

The null hypothesis of the Hausman test is that the model is suitable for the effect model. In this table, the 2 of the Hausman test is equal to 10.206, and the p value is 0.07. Therefore, the null hypothesis is rejected and the model is suitable for the fixed effect.

Table4.6
Regression results analysis

	OLS LNEX	Random LNEX	Fixed LNEX
LNFGDP	0.802***	0.892***	0.940***
	(21.386)	(9.91)	(4.16)
LNFPOP	1.087***	1.153***	3.414***
	(31.504)	(14.34)	(3.57)
LNDIST	-0.608***	-0.530**	
	(-7.782)	(-2.48)	
OPEN	0.565***	0.746***	0.806***
	(7.028)	(4.73)	(3.59)
BORDER	0.374***	0.550	
	(3.083)	(1.62)	
LANG	-0.010	-0.303	
	(-0.056)	(-0.70)	
LNFDI	0.159***	0.143***	0.125***
	(5.713)	(4.02)	(3.09)
POLICY	0.243**	0.177*	-0.027
	(2.418)	(1.69)	(-0.21)
_cons	-2.920***	-5.477**	-48.431***
	(-2.693)	(-1.97)	(-3.16)
N	210	210	210
R^2	0.926	0.9231	0.7609
F	313.905	431.65	33.79

***p<0.01", "**p<0.05", "*p<0.10

According to the regression results, the explanatory variable FGDP has a significant positive impact on CHINA's smartphone business exports to RCEP member country, which is in line with the previous expected assumptions. The main reason is that the higher the per capita GDP of the importing country, that is, the higher the economic level, the higher the consumption level will naturally be, thus promoting the demand for CHINA's smartphone business.

FPOP has a significant positive impact on CHINA's smartphone business exports to RCEP member country, which is in line with the previous expected assumptions. The main reason is that the larger the population of RCEP country, the greater the demand for smartphones and related businesses, thus promoting the export of CHINA's smartphone business.

DIST significantly inhibits CHINA's smartphone business exports to RCEP member country, which is in line with the previous expected assumptions. The reason is that as the distance between the two country increases, the transportation cost will also increase, so the distance will inhibit CHINA's smartphone business exports to RCEP member country.

OPEN has a significant positive impact on CHINA's smartphone business exports to RCEP member country. This is consistent with the previous expected assumptions because the

greater the trade openness of RCEP member country, the more conducive it is to CHINA's smartphone business exports, thereby promoting CHINA's smartphone business exports to RCEP member country.

BORDER has a significant positive impact on CHINA's smartphone business exports to RCEP member country. This is consistent with the previous expected assumptions, mainly because trade between CHINA and RCEP member country with common borders is more convenient, and the existence of common borders promotes the export of CHINA's smartphone business to neighboring RCEP member country.

LANG has no significant impact on CHINA's smartphone business exports to RCEP member country. This shows that even if some RCEP member country use Chinese as a second language, it will not directly affect CHINA's smartphone business exports.

FDI has a significant positive impact on CHINA's smartphone business exports to RCEP member country. The previous expected signs are uncertain under the analysis of different scholars, but in this regression analysis, CHINA's direct investment in RCEP member country will have a significant positive impact on CHINA's smartphone business exports.

Discussion and Implications
Discussion
By using gravity models to analyze smartphone trade among RCEP member country and searching for a large amount of relevant data between RECP country. Taking CHINA as an example, the volume of smartphone trade with RECP country. Based on the results of regression analysis, it can be concluded that CHINA's gross domestic product has a significant impact on the export of smartphone products by RCEP member country. The independent variable FGDP has a better impact on CHINA's smartphone product exports to RCEP member country. The results of FPOP are not significant, indicating that CHINA's population does not significantly affect the export trade of smartphones. FPOP has a significant positive impact on CHINA's exports of smartphone products to RCEP member country. DIST_ij significantly suppressed CHINA's exports of smartphone products to RCEP member country. The significance of indicates that the degree of trade openness of RCEP member country will have a positive impact on CHINA's export of smartphone products. In addition, the calculation of export quantity potential between CHINA and RCEP country. The smartphone trade between CHINA and six country including Australia, Malaysia, Singapore, Cambodia, Vietnam, and Thailand is relatively stable, and there is still room for expansion. CHINA conducts smartphone trade with eight country including the Philippines, Japan, South Korea, Laos, Brunei, Indonesia, New Zealand, and Myanmar. CHINA has distant relations with these country in terms of smartphone export trade, but the potential is enormous. It is necessary to resolve trade barriers between both sides, eliminate conflicts, and expand CHINA's smartphone export trade.

Implications
First of all, investment should be increased in improving the trade facilitation level of RCEP member country, especially in accelerating the optimization of the business environment and giving full play to its key role in trade. On the one hand, it is necessary to improve domestic border management measures, accelerate the development of paperless trade, optimize the

financial environment, strengthen intellectual property protection, and improve labor rights and environmental protection levels. On the other hand, the reform of state-owned monopoly enterprises should be accelerated to comprehensively improve the level of trade facilitation. As the benefits of the last round of trade policies gradually fade away, we should seize the opportunity to unleash the potential of a new round of trade facilitation and inject new momentum into deepening cooperation with RCEP member states.

Secondly, we must actively participate in the negotiations of free trade zones, especially the consultation of free trade zones. From the actual situation, the signing of free trade zone agreements has promoted the development of China's export trade. In addition, the current free trade zone negotiations are no longer limited to border measures such as reducing tariffs but pay more attention to the coordination and improvement of domestic policies. Free trade zones have become the mainstream trend of future negotiations.

Third, from a geographical perspective, when promoting trade facilitation cooperation with RCEP country, CHINA should formulate differentiated strategies based on the characteristics of each region and highlight the focus of cooperation. For country in East Asia, Southeast Asia and South Asia, we should focus on strengthening the collaborative construction of the business environment, focusing on optimizing the investment environment, improving market openness, promoting paperless trade and digital economic cooperation, and reducing cross-border trade costs. Cooperation with Oceania country should focus on strengthening border management, promoting the standardization and efficiency of customs procedures, and improving the level of mutual recognition of inspection and quarantine, rules of origin, etc. At the same time, we can explore the establishment of more convenient cooperation mechanisms in the trade of resource-based products such as agriculture and mining and actively expand trade cooperation in green economy and clean energy to jointly build a stable and sustainable trade partnership. By formulating cooperation priorities tailored to local conditions, CHINA can better improve the level of trade facilitation with RCEP member states, enhance the depth and breadth of regional economic integration, and lay the foundation for mutual benefit and win-win results.

Conclusion and Recommendations
Conclusion
First, from the perspective of export trade scale and export markets, CHINA's smartphone business trade with RCEP country is large and growing, with Japan and South Korea being CHINA's largest export markets. During the period from 2008 to 2022, CHINA's export market share to Japan showed a trend of first increasing and then declining and remaining stable; CHINA's export market share to South Korea showed. There is a trend of rising first and then falling; for the five country of Australia, Malaysia, Philippines, Vietnam, Thailand, and Indonesia, the trend has been rising.

Second, judging from the results of the regression analysis, the per capita GDP, population, absolute distance between the two country, degree of trade development, common border, foreign direct investment and bilateral trade policies of RCEP member states will all contribute to CHINA's smartphone business exports have a significant impact. The coefficient of FGDP is 0.802, which shows that when the per capita GDP of RCEP member states increases by 1%, CHINA's smartphone business exports will increase by 0.802%; the coefficient of FPOP is

1.087, which shows that when the population of RCEP member states increases every 1% will increase CHINA's smartphone business exports by 1.087%; the coefficient of DIST is -0.608, which shows that when the absolute distance between CHINA and other country increases by 1%, CHINA's smartphone business exports will decrease by 0.698%; OPEN The coefficient of FDI is 0.565, which indicates that a 1% increase in the trade openness of RCEP member states will increase CHINA's smartphone business exports by 0.565%; the coefficient of FDI is 0.159, which indicates that a 1% increase in CHINA's direct investment in RCEP member states It will increase CHINA's smartphone business exports by 0.159%.

Third, the potential coefficient of CHINA's smartphone trade with Australia, Malaysia, Singapore, Cambodia, Vietnam and Thailand is between 1 and 2, indicating that CHINA's smartphone export trade in these country has a relatively stable performance and has occupied a certain market share. market share. However, the market demand in these country is still growing, especially the demand for mid-to-high-end smartphones and smart ecological products is gradually increasing, indicating that there is still room for further expansion of CHINA's smartphone exports. By strengthening brand building, optimizing product structure and improving service levels, we can better meet the diverse needs of these markets, while consolidating and expanding our market share in these country. On the other hand, the potential coefficient of smartphone trade between CHINA and eight country: the Philippines, Japan, South Korea, Laos, Brunei, Indonesia, New Zealand and Myanmar is less than 1, indicating that CHINA's current smartphone exports to these country are relatively weak and the market Pioneering is still in its infancy. However, the economic development and increasing consumption power of these country mean that their market potential is huge. In order to expand the export trade of Chinese smartphones in these country, it is necessary to focus on solving the trade barriers between the two sides, including institutional obstacles such as tariffs, technical standards, and product certification. In addition, it is necessary to strengthen coordination with these country in terms of policies, industrial chains and technical standards to reduce possible contradictions and conflicts and create more favorable conditions for bilateral trade.

Recommendations

According to the research results, under the RCEP framework, Chinese smartphone products have shown a relatively stable trade advantage in Australia, Malaysia, Singapore, Cambodia, Vietnam and Thailand. This shows that Chinese smartphones have successfully entered the markets of these country and have a certain degree of competitiveness. However, with the upgrading of consumption and technological innovation, the demand for high-end smartphones and smart ecosystems in these country is growing rapidly, and CHINA still has a lot of room for market expansion. By further optimizing product structure, strengthening brand building and improving after-sales service capabilities, we can consolidate market share on the basis of existing advantages and open up more potential customer groups. At the same time, the potential coefficient of smartphone trade between CHINA and eight country, namely the Philippines, Japan, South Korea, Laos, Brunei, Indonesia, New Zealand and Myanmar, is less than 1, indicating that the current export trade potential has not yet been fully released. Although CHINA's export performance in these country is relatively limited at this stage, the market potential is huge. To expand smartphone exports to these country, it is necessary to focus on solving trade barriers. For example, in view of restrictions such as tariffs, technical standards, and certification procedures, promote the deepening of bilateral and

multilateral agreements; through cultural exchanges and market promotion, enhance the recognition of Chinese smartphone brands; customize diversified products according to the consumption characteristics of different country to meet localized needs. In addition, CHINA should further strengthen cooperation with these country in the fields of digital infrastructure construction, 5G network promotion, mobile payment ecology, etc., and provide more cost-effective and technologically innovative solutions to drive smartphone exports. By improving the trade environment, eliminating conflicts and strengthening cooperation and mutual trust, the market share of CHINA's smartphone business in these country is expected to grow steadily, promoting the further prosperity of regional trade under the RCEP framework.

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