The Impact of Infrastructure Quality on China's OFDI: A Study Based on RCEP Partners

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Abstract

Infrastructure plays a crucial role in facilitating economic development and attracting foreign direct investment (FDI) in a country. With the implementation of the Regional Comprehensive Economic Partnership (RCEP) Agreement, trade and investment ties between China and its RCEP partners have been further strengthened. This study investigates the influence of host country infrastructure development on China's outward FDI (OFDI) within RCEP partners. By analyzing China's OFDI to RCEP partners and the infrastructure characteristics of member countries, we explore the impact of host country infrastructure quality on China's OFDI. Using panel data on China's direct investment stock in 12 RCEP countries from 2008 to 2020, in conjunction with host country infrastructure quality indicators, we apply a fixed-effect regression model to examine the effects of different types of infrastructure quality on China's OFDI. Our results reveal that transportation, communications, and energy infrastructure in host countries significantly promote Chinese OFDI. Furthermore, we find that a larger market size, population, and higher trade openness in the host country effectively attract FDI from China. Based on these empirical findings, we provide recommendations to optimize the capital flow and enhance the efficiency of China's OFDI.

Keywords: China, OFDI, Infrastructure Quality, RCEP Partners

1. Introduction

Since China's accession to the World Trade Organization (WTO), it has increasingly integrated into the global market, prompting a surge in outward investment by Chinese enterprises. Furthermore, with the introduction of the "Belt and Road" initiative, Chinese enterprises have demonstrated a more open approach to global markets. When selecting investment destinations abroad, enterprises conduct comprehensive evaluations of various aspects, taking into account the market conditions of the host country. Among these considerations, the quality of infrastructure emerges as a crucial factor.

Infrastructure refers to the engineering facilities that provide public services for regional production and livelihoods. It comprises an essential public service system that ensures the smooth operation of socio-economic activities within a region (Huang et al., 2018). The World Bank (1994) classifies infrastructure into economic and social categories. Economic infrastructure directly serves economic activities and involves capital invested in the production process, including transportation and digital communications. Social infrastructure, on the other hand, enhances living standards and productivity, encompassing education, healthcare, and more. Well-established infrastructure is of paramount importance for the steady development of local economies, as it reduces transportation and communication costs, enabling local businesses to maximize profits. Multinational enterprises, driven by profit-maximization goals, are more likely to invest in and establish factories within markets that possess well-developed infrastructure.

The Regional Comprehensive Economic Partnership Agreement was officially signed in 2020 and came into force on January 1, 2022. As of June 2023, it has entered into full force for the 15 signatory countries. Existing research on the factors influencing outward foreign direct investment (OFDI) primarily focuses on indicators such as economic levels and resource endowments, with limited attention given to the impact of infrastructure. Furthermore, no research has yet explored the influence of infrastructure on China's investment in RCEP partner countries, particularly with regard to the distinct effects of different infrastructure types on outward investment. This article aims to contribute to the existing literature by examining this unexplored aspect and providing insights to guide Chinese enterprises in selecting investment locations within RCEP partner countries, ultimately improving investment efficiency. Previous studies have highlighted the positive impact of infrastructure quality in host countries on attracting OFDI (Sahoo et al., 2009; Zhang & He, 2019; Rehman et al., 2019; Shen et al., 2021; Wang et al., 2021). Iqbal et al. (2019) investigated the factors influencing China's outward direct investment and found that infrastructure development in the host country positively affects FDI attraction, albeit to a relatively low degree. Cui and Yu (2017) and Qin et al. (2019) explored the threshold effect of infrastructure quality on FDI inflows, revealing a positive correlation between infrastructure quality and increased FDI inflows. However, they also observed that when infrastructure quality is low, improvements in infrastructure exert a greater attraction on China's FDI. Yet, beyond a certain threshold, the impact of infrastructure enhancements on FDI inflows diminishes.

While domestic literature has extensively investigated the factors influencing China's OFDI, much of the research is centered on countries along the "Belt and Road." However, little attention has been paid to the impact of infrastructure in RCEP partner countries on China's OFDI. This article aims to address this research gap and contribute to the existing literature in this specific context.

2. Current Situation of China's OFDI to RCEP Partners

From 2003 to 2020, China's OFDI flows and stocks to the fourteen RCEP partners are on an overall upward trend. The OFDI flows rose from US$0.31 billion in 2003 to US$18.34 billion in 2020, while the OFDI stocks rose from about $1.37 billion in 2003 to $176.17 billion in 2020, an overall increase of nearly 126 times. Table 1 shows the total flows and stocks of China's OFDI to RCEP partners from the year 2003 to 2020.

Table 1. Flow and Stock of China's OFDI to RCEP Partners from 2003 to 2020 (Unit: Million US$)

	OFDI Flows	OFDI Stocks
2003	314.1	1372.38
2004	371.1	2184.91
2005	960.2	2911.71
2006	493.7	3782.22
2007	1593.8	7220.76
2008	4542.5	11271.96
2009	5492.8	17439.03
2010	5786.4	24119.95
2011	9589.6	35637.31
2012	9520.5	47086.25
2013	11618.4	57518.38
2014	13051.7	77795.8
2015	19918.7	99034.78
2016	16863.8	115498.37
2017	20062.3	136861.82
2018	17439	154028.96
2019	16357.4	161190.68
2020	18340.8	176171.51

Source: Statistical Bulletin of China's Outward Foreign Direct Investment (2003-2020).

In terms of proportion, the proportion of China's OFDI to RCEP partners in the total amount of China's OFDI in one year fluctuates. In terms of OFDI flows, as is shown in Figure 1, the share was only 2.33% in 2006, and once reached 13.67% in 2015, the highest proportion in recent years, after which it was in oscillation. Data shows that China's OFDI flows in RCEP partners accounted for 11.93% of China's total OFDI flows in 2020. As for China's OFDI stocks to RCEP partners, its share in China's total OFDI stocks rose from 4.13% in 2003 to 9.02% in 2015, and showed a slow downward trend afterwards, with the share in 2020 being 6.83%. But in general, it is still in a rising trend.

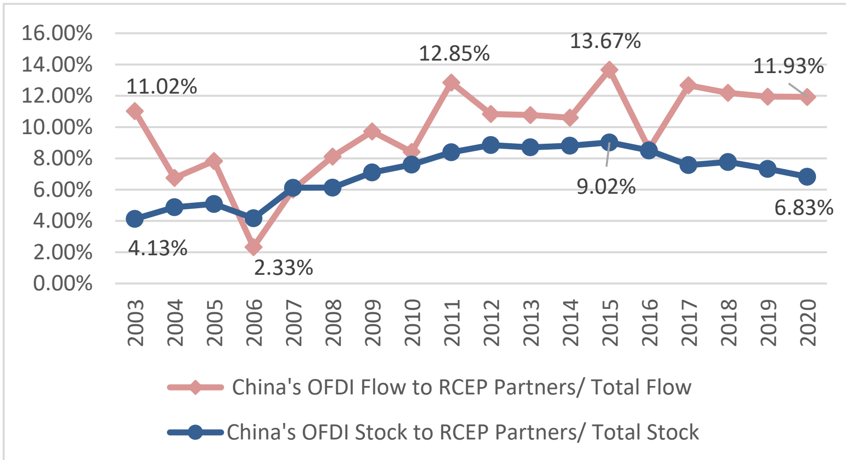

Figure 1. The Proportion of China's OFDI Flows and Stocks to RCEP Partners in Total OFDI

Source: 2020 Statistical Bulletin of China's Outward Foreign Direct Investment

From the perspective of countries, RCEP partners have always been important destinations for China's OFDI. Taking data in 2020 as an example, 8 RCEP partners are in the list of the top 20 countries and regions for China's OFDI flows, namely Singapore, Indonesia, Thailand, Vietnam, Laos, Malaysia, Australia and Cambodia. In terms of OFDI stocks, the top 20 countries and regions include 7 countries in RCEP such as Singapore, Australia, Indonesia and so on, which shows RCEP partners' importance in China's OFDI. The following section describes the trend of China's OFDI in RCEP partners over the years.

3. Infrastructure Quality of RCEP Partners

Infrastructure is the material basis for enterprises to engage in production and operation as well as for residents to live a prosperous and comfortable life, and it is also a public service system that guarantees the smooth running of regional socio-economic activities. According to the definition of the World Bank (1994), economic infrastructure mainly includes transportation infrastructure, such as road and railway construction; communications infrastructure, such as base stations and server construction; and energy infrastructure, such as the popularization of the national power grid. Scholars usually use the capacity that the above infrastructure can carry or the amount of loss in the transmission process as the measure of infrastructure quality. Based on data availability, this paper focuses on the impact of infrastructure quality on FDI absorption in RCEP partners from 2008 to 2020, and the relevant data for Myanmar and Laos are excluded from the sample due to their data incompleteness.

RCEP partners include developed economies such as Japan, Singapore, and Australia, which have an early industrial start and well-developed infrastructure, as well as developing economies such as Malaysia, Indonesia, and the Philippines, which fall behind in terms of infrastructure quality. In the following section, the infrastructure quality of RCEP countries will be discussed from the perspective of transportation, communications, and energy infrastructure.

3.1 Transportation Infrastructure

Transportation is a fundamental sector of national economy and an important basis for international trade and investment. Transportation infrastructure improvement can reduce the cost of goods transportation and labor movement, which is extremely essential for improving the efficiency of production and life and bringing convenience to our daily life. However, the quality of transportation infrastructure varies from country to country within RCEP. Transportation infrastructure is usually divided into three types which are maritime, air, and railroad transportation and the measurements of their quality are different. Container port traffic is usually used to measure the quality of maritime infrastructure and the volume of products or passengers to be carried is used to measure the quality of air and railroad infrastructure.

Among the ten ASEAN countries, only Vietnam, Laos, and Myanmar share land borders with China, so most of the trade transport between China and ASEAN are realized through maritime transport (Wei & Li, 2017), and maritime transport plays an important role in China- ASEAN trade development. Among the RCEP partners, except for Laos, which is a landlocked country, all of them have coastlines, and the development of their harbors contributes to their improvement of maritime transport capacity, and the increase of container port traffic also reflects the development of a country's economy. As is shown in Table 2, the container port traffic of 12 RCEP partners showed an increasing trend during 2007-2019, with Singapore's always ranking the first. And with the continuous development of maritime infrastructure, South Korea and Malaysia surpassed Japan which originally ranked second, and ranked second and third respectively from the year of 2011. The two fastest growing countries are Vietnam and Brunei, with growth rates of more than 200% over the past thirteen years.

Table 2. Container Port Traffic of RCEP Partners during 2007-2019 (Unit:1000 TEU)

	2007	2010	2013	2016	2019
Singapore	28768	29147	33388	31688	37195
Korea, Rep.	17086	18520	23445	26373	28312
Malaysia	14829	16843	21138	24570	26859
Japan	19165	18966	20522	20319	22277
Indonesia	6583	9010	11718	12432	14764
Vietnam	4009	6430	8452	11086	13659
Thailand	6339	6819	8363	9983	10756
Philippines	4351	5589	5826	7421	8818
Australia	6290	6372	7250	7629	8799
New Zealand	2312	2331	2867	3162	3229
Cambodia	253	286	312	482	779
Brunei	90	93	122	125	282

Source: World Bank Database.

The quality of air transport infrastructure in the RCEP partners has changed in different directions over the thirteen years, with five countries experiencing a decrease in the volume of air cargo transported and seven other countries experiencing an increase. Australia, Cambodia, Malaysia, Singapore, and Thailand all experienced decreases in air transport volume over the thirteen-year period. On the contrary, air transport cargo volume of Brunei, Indonesia, Japan, South Korea, the Philippines, New Zealand, and Vietnam in 2019 was larger than that in 2007, with Vietnam experiencing the highest growth rate, increasing from 258.5 million ton-kilometers in 2007 to 1022.8 million ton-kilometers in 2019. Among the remaining six countries, Indonesia and the Philippines had growth rates of more than 100%. Air traffic in Japan and South Korea showed an overall upward trend during 2007-2019, but there was a significant decline from 2009 to 2011. But in general, when comparing among the twelve countries mentioned above, we will find that the top three countries in terms of the volume of air cargo transported are South Korea, Japan and Singapore. It is evident that although air traffic of Japan, South Korea and Singapore had a declining phase during this period, they still have a high quality and advantage due to the pre-development and accumulation of their air transport infrastructure.

In addition, the level of railroad and road infrastructure varies significantly among RCEP partners. Due to the relatively small size of the country, some of the ten ASEAN countries do not build railroads or have very few railroads. For example, Cambodia has only two railroads (Yang and Ning, 2018), while the total railroad mileage of Brunei is not included in the World Bank database. By comparing the rail freight volumes, we find that only Australia and Indonesia have significantly increased the volume of rail cargo transported during 2007-2019, with the figures in 2019 being 1.3 and 2.5 times higher than those in 2017, respectively. Other countries such as Japan, South Korea, Malaysia, New Zealand, Thailand, and Vietnam saw their rail freight volumes remain the same as or decline slightly from that in 2007.

3.2 Communications Infrastructure

Communications infrastructure includes infrastructure related to information transmission, such as broadband, fixed telephones, and mobile communication networks and so on. This paper includes the above three infrastructures in the scope of discussion, and describes the current level of communications infrastructure in RCEP partners in terms of the number of fixed broadband, fixed telephone, and cell phone subscription per 100 people, respectively.

Table 3. Fixed Broadband Subscription per 100 People during 2007-2019

	2007	2010	2013	2016	2019
Korea, Rep.	30.00	34.70	37.22	40.32	42.76
New Zealand	20.15	24.99	29.12	32.85	34.72
Australia	24.92	24.87	25.72	30.39	34.54
Japan	22.03	26.53	28.77	31.16	33.50
Singapore	20.22	26.08	27.38	28.16	25.91
Vietnam	1.52	4.17	5.68	9.72	15.35
Thailand	1.95	4.84	7.62	10.47	14.52
Brunei	3.10	5.58	6.81	8.60	12.51
Malaysia	3.87	7.44	9.97	8.86	9.28
Philippines	0.55	1.87	2.60	2.88	5.48
Indonesia	0.34	0.94	1.29	2.00	3.80
Cambodia	0.06	0.25	0.22	0.62	1.12

Source: World Bank Database.

As is shown in Table 3, from 2007 to 2019, South Korea has always enjoyed the highest number of fixed broadband subscription per 100 people, with its number rising from 30 to 42.76 in thirteen years. By contrast, Cambodia has the lowest number of fixed broadband subscription per 100 people among RCEP partners, with its number rising from just 0.06 in 2007 to about 1.12 by the end of 2019. From 2007 to 2019, fixed broadband subscription in 12 countries is on an upward trend, with Cambodia and Indonesia enjoying the fastest growth, whose subscription number in 2019 were about 18 times and 10 times higher than that in 2007, respectively.

With the decline of production costs and prices of cell phones, its popularity has increased. And due to the high overlap between the functions of fixed telephones and cell phones, their subscription data from 2007 to 2019 mostly changed in the opposite direction.

As is shown in Table 4, the country with the highest number of fixed telephone subscription per 100 people from 2007 to 2018 was always South Korea; however, in 2019, with the overall decline in the number of fixed telephone subscription, Japan overtook to become the first. The number of fixed telephone subscription per 100 people trended downward in all 12 countries except for Malaysia and Cambodia, which had growth rates of about 42% and 24%, respectively. Among them, Vietnam has the largest decline, from 13.1 in 2007 to 3.8 in 2019, a drop of 70%. Indonesia also experienced the second largest decline rate at nearly 60%, and Australia the third, declining from 46.7 to 24.6, with a decline rate of about 47%.

Table 4. Fixed Telephone Subscription per 100 People during 2007-2019

	2007	2010	2013	2016	2019
Japan	39.87	51.05	49.89	50.19	49.46
Korea, Rep.	46.92	57.61	60.25	54.99	48.27
New Zealand	41.27	43.02	40.94	37.77	37.11
Singapore	40.66	38.90	36.07	35.35	32.93
Australia	46.66	47.96	44.51	34.95	24.60
Malaysia	16.28	16.34	15.39	15.76	23.18
Brunei	21.22	20.56	17.63	17.68	19.98

Thailand	10.61	10.17	8.89	6.82	7.78
Philippines	4.41	3.55	3.18	3.65	3.94
Vietnam	13.07	16.34	7.41	5.98	3.79
Indonesia	8.40	16.93	12.20	4.11	3.57
Cambodia	0.27	2.51	2.80	1.44	0.34

Source: World Bank Database.

In contrast to the decline in the number of fixed telephone subscription, the number of cell phone subscription per 100 people has increased in 12 RCEP partners. As is shown in Table 5, Singapore enjoyed the highest number of cell phone subscription per 100 people before 2015. But Thailand, with its rapid increase, became the country with the highest number of cell phone users during 2015-2019, growing from 80.04 to 186.16 over the period, and the annual growth rate was 7.4%. Among RCEP partners, Cambodia enjoyed the highest growth rate, jumping from 18.88 to 129.92 with an annual growth rate of as much as 20%.

Table 5. Cell Phone Subscription per 100 People during 2007-2019

	2007	2010	2013	2016	2019
Thailand	80.04	106.74	137.72	173.51	186.16
Singapore	129.39	143.92	154.72	149.65	155.65
Philippines	64.14	88.49	104.00	115.85	154.76
Japan	83.54	95.91	115.25	130.60	147.02
Vietnam	52.71	126.83	136.34	128.79	141.23
Malaysia	87.38	120.03	145.93	141.65	139.60
New Zealand	100.43	107.78	105.48	130.92	134.93
Korea, Rep.	90.49	102.47	108.61	120.23	134.49
Brunei	97.65	111.95	115.92	124.69	132.66
Cambodia	18.88	56.95	134.86	126.32	129.92
Indonesia	40.19	87.37	124.39	147.42	126.11
Australia	101.64	101.56	107.25	109.43	109.25

Source: World Bank Database.

The rapid development of communications infrastructure and the improvement of its quality have greatly reduced communication costs and information collection costs, and increased efficiency in both production and daily life, which has contributed to making more trade and attracting more foreign direct investment.

3.3 Energy Infrastructure

The World Bank defines energy infrastructure as equipment for the production and transmission of energy. Energy, as an indispensable resource in modern life, is an essential accelerator to improve the people's living standards and increase production efficiency. Among RCEP partners, developing economies account for a large proportion and therefore, some countries are not yet well developed in terms of energy infrastructure. This paper regards basic standards such as access to electricity and electricity consumption per capita as indicators to measure the quality of energy infrastructure in the host country.

As is shown in Table 6, only five developed countries (Japan, South Korea, Singapore, Australia and New Zealand) and Brunei reached 100% electricity popularization rate in 2007. Among other RCEP partners, Malaysia enjoyed the highest electricity popularization rate at 99.3% and the electricity popularization rate in Cambodia was the lowest at 35.09% in 2007.

Table 6 also indicates that in 2019, after more than a decade of infrastructure development, the access to electricity of all countries has increased significantly, with Malaysia reaching 100% and the rest of the countries exceeding 95%

except Cambodia. As for Cambodia, the proportion of total population who have access to electricity has increased from 35.1% in 2007 to 93% in 2019.

Table 6. Electricity Popularization Rate during 2007-2019

	2007	2010	2013	2016	2019
Australia	100	100	100	100	100
Brunei	100	100	100	100	100
Japan	100	100	100	100	100
Korea, Rep.	100	100	100	100	100
New Zealand	100	100	100	100	100
Singapore	100	100	100	100	100
Malaysia	99.3	99.28	99.92	100	100
Thailand	94.24	99.7	99.43	99.85	99.9
Vietnam	93.25	97.43	98.54	99.2	99.4
Indonesia	91.1	94.15	96.46	97.62	98.85
Philippines	82.06	85.4	87.5	92.05	95.63
Cambodia	35.09	31.1	54.89	76.63	93

Source: World Bank Database.

Table 7 shows the specific figures of electricity consumption per capita of RCEP partners during the period of 2007-2019. As is shown in the table, most countries have enjoyed an increase to varying degrees. Combining with the increase of electricity popularization rate in all the developing economies in RCEP, it implies that the energy infrastructure in these countries has become more developed. Among the countries with increasing electricity consumption per capita, Cambodia and Vietnam are in the leading position in terms of growth rate, both with annual growth rates of more than 10%.

While most countries have shown an upward trend in terms of electricity consumption per capita, Australia and New Zealand experienced significant decreases and Japan experienced a small decrease. In 2007, electricity consumption per capita in Australia, New Zealand and Japan ranked top three respectively among all 12 RCEP partners, but after a decade, they were surpassed by others. Among these three countries with decreasing electricity consumption per capita, New Zealand experienced the largest decrease, a decline at about 12% during 2007-2019, while the decline rates in Australia and Japan are both about 10%.

Table 7. Electricity Consumption Per Capita during 2007-2019（Unit: kWh per capita）

	2007	2010	2013	2016	2019
Korea, Rep.	8462	9716	10385	10600	10900
Brunei	8614	8810	9874	9600	10200
Australia	10973	10727	10221	9900	9900
Singapore	8707	8680	8681	9000	9450
New Zealand	9641	9602	9090	8600	8400
Japan	8710	8595	7989	8100	7900
Malaysia	3273	4146	4520	4700	5100
Thailand	2080	2308	2515	2800	2870
Vietnam	728	1022	1277	1800	2320
Philippines	582	638	683	800	888.4

Indonesia	546	636	774	400	640
Cambodia	101	144	222	400	600

Source: World Bank Database.

Electricity is a public service product, and it plays the role of the basis and driving force for the smooth and stable development of modern society. Without sufficient and stable electricity and energy supply, it is difficult for a country to achieve industrialization and modernization. The improvement of energy infrastructure not only benefits the individuals, but also brings great convenience to enterprises that try to proceed its production activities, so the improvement of energy infrastructure is conducive to the host country's own economic development and can become an important influence factor to attract OFDI.

4 Empirical Analysis on the Impact of Infrastructure Quality on China's OFDI

4.1 Model Construction

Based on the research from Xiang (2018) and Pan and Yang (2020), this paper constructs the following regression model, uses the panel data of quality of infrastructure of different types in 12 RCEP partners and carries out the empirical analysis.

$$lnOFDI_{it} = \alpha + \beta_1 lnInfra_{i,t-1} + \beta_2 lnGDP_{i,t-1} + \beta_3 lnOpen_{i,t-1} + \beta_4 lnPop_{i,t-1} + \mu_{i,t-1} \quad (1)$$

Where, i denotes RCEP partners, t denotes years, ranging from 2008 to 2020, μ is the random error term. lnInfra is the core explanatory variable and lnGDP, lnOpen, lnPop are control variables. β_1, β_2, β_3 and β_4 are the regression coefficients of explanatory variables and control variables.

4.2 Variable Selection and Data Sources

RCEP partners have different levels of infrastructure development, and some countries have many missing data. Considering data availability, this paper is going to exclude two countries which have incomplete data, namely Laos and Myanmar, and analyze the impact of infrastructure quality of twelve RCEP partners, namely Australia, Brunei, Cambodia, Indonesia, Japan, South Korea, Malaysia, New Zealand, the Philippines, Singapore, Thailand, and Vietnam, on China's decision on where to carry out OFDI. The time span of the infrastructure quality data is from 2007 to 2019. Since the volume of China's OFDI in RCEP partners in the current period is influenced by the quality of infrastructure in the host countries in the previous period, the time span of Chinese OFDI stock (dependent variable) is from 2008 to 2020.

4.2.1 Dependent Variable

The dependent variable (lnOFDI) in this paper is the data of China's OFDI stocks in RCEP partners (host countries). Since OFDI flows are more responsive to changes in the current year, flows may have negative values due to changes of the host country's political and investment environment. While the figure of OFDI flows is very unstable, figure of OFDI stocks has the advantage of data stability, and besides, part of OFDI stocks has already had an impact on the host country's economy, so it has higher validity if we use OFDI stocks data. Therefore, this paper selects OFDI stocks as the dependent variable and logarithmically processes the original data. The time span of the OFDI stocks is from 2008 to 2020, and the data source is the Statistical Bulletin of China's Outward Foreign Direct Investment in the past years.

4.2.2 Explanatory Variables

This paper focuses on the impact of host country's infrastructure quality on China's OFDI, so the following variables are chosen as explanatory variables, and we are going to take the natural logarithm of these data. The time span of explanatory variables is all from 2007 to 2019.

Overall infrastructure quality of the host country (lnInfra). It is used to examine the impact of the overall infrastructure quality on the host country's ability to absorb FDI, the source of the data is the Global Competitiveness Report published by the World Economic Forum. The Global Competitiveness Report measures the quality of overall infrastructure on a scale of 1 to 7, with a score of 1 indicating that the country's overall infrastructure is extremely poor in the world, and a score of 7 indicating that the country's overall infrastructure is extremely developed in the world.

Container port traffic of the host country (lnSea). It is calculated as the natural logarithm of container port traffic, and it is used to examine the impact of the level of maritime infrastructure in the host country on China's OFDI. Container port traffic measures the flow of containers transported by land to sea or vice versa, and a larger value indicates more developed maritime infrastructure. The source of the data is World Bank database.

The quality of air and rail infrastructure in the host country (lnAirRail). It is calculated as the natural logarithm of the sum of million ton-kilometers of freight transported by air and rail, and it is used to examine the impact of air and rail transport infrastructure on OFDI absorption, The source of the data is World Bank and ASEAN database.

The host country's electricity consumption per capita (lnEnergy). It is calculated as the natural logarithm of electricity consumption per capita, and is used to examine the impact of the host country's energy infrastructure quality on the absorption of China's OFDI, and the data source is World Bank database. Electricity is the most widely used energy source and has a great impact on production and daily life, so the indicators related to electricity can be a good proxy for the level of energy infrastructure. At the same time, the calculation of electricity consumption per capita removes the power loss in the process of power transmission and distribution, and uses the actual consumption instead of power generation as the raw data, which can better measure the quality and efficiency of power supply in the host country.

Host country communications infrastructure quality (lnCommu). It is calculated as the logarithm of the sum of fixed broadband subscription, fixed telephone subscription, and mobile phone subscription per 100 people, and is used to examine the impact of the level of communications infrastructure on the host country's ability to attract China's OFDI, and the sources for all the above data are World Bank database.

4.2.3 Control Variables

The control variables in this paper include three variables: market size, total population, and trade openness of the host country.

The market size of the host country (lnGDP) is measured by GDP. Higher GDP indicates that the market size in the host countries is larger and the economy is more developed. The source of the data is World Bank database.

Host country's total population (lnPop). Companies tend to carry out OFDI in countries or regions with higher population. The source of the data is World Bank database.

The trade openness of the host country (lnOpen) is calculated as lnOpen= ln((imports + exports)/GDP). The higher the share of imports and exports in its GDP is, the higher the trade openness is in the host country. The source of the data is World Bank database.

Descriptive statistics of the dependent variables, explanatory variables, and control variables are shown in Table 8.

Table 8. Results of Descriptive Statistics of Each Variable

Variable	Obs	Mean	Std. Dev.	Min	Max
lnOFDI	156	12.2527	1.704177	6.47851	15.6049
lnInfra	156	4.239201	0.225308	3.670469	4.561255
lnSea	156	15.55887	1.628708	11.35717	17.43686
lnAirRail	156	6.308619	3.099718	-2.943841	9.979129
lnEnergy	156	8.069763	1.27316	4.611005	9.305651
lnCommu	156	6.32207	1.7797	2.955955	11.71746
lnGDP	156	5.663515	1.665176	2.156314	8.743908
lnPop	156	17.07474	1.729664	12.83459	19.41625
lnOpen	156	4.57685	1.567555	6.448138	11.12956

4.3 Empirical Analysis

4.3.1 Unit Root Test

Although the panel data may reduce data's non-stationarity to some extent, there may still exist unit roots which make the data non-stationary. To make sure the stationarity of the panel data used and the validity of the regression model, we first carry out unit root test on each of the selected variables before we perform the regression. According to the rules of performing unit root test, panel data with more years than countries should apply the Levin-Lin-Chu unit root test (LLC test). Therefore, we performed LLC test on the variables to observe whether the panel data is stationary or not. The results of LLC test are shown in Table 9.

Table 9. Results of LLC Test

Variable	Adjusted t*	p-value	
lnOFDI	-9.7052	0.0000	Stationary
lnInfra	-4.4161	0.0000	Stationary
lnSea	-3.9078	0.0000	Stationary
lnAirRail	-4.1346	0.0000	Stationary
lnEnergy	-7.7960	0.0000	Stationary
lnCommu	-4.9775	0.0000	Stationary
lnGDP	-4.1337	0.0000	Stationary
lnPop	-3.9137	0.0000	Stationary
lnOpen	-2.7437	0.0030	Stationary

Results of LLC test show that the p-value of every selected variable is below 0.01, which indicates that the original hypothesis that the panel data contain unit roots has been rejected at the 1% significance level and confirms that the panel data is stationary.

4.3.2 Empirical Results

According to econometric theory, the regressions using random effects model and fixed effects model produce different results. In order to decide which model to use, this paper performs Hausman test. The original hypothesis of the Hausman test is that the random effects model should be adopted, while rejecting the original hypothesis indicates that the fixed effects model is more effective and should be applied. The results of the Hausman test are shown in Table 10, and given that the p-value is 0.00, the original hypothesis is rejected and the fixed-effects model will be adopted in the following regression.

Table 10. Results of Hausman Test

	Coeff.
Chi2(4)	108.94
p-value	0.00

By performing fixed effects regression model on overall infrastructure quality, transportation infrastructure quality (including maritime and air and railroads), electricity consumption per capita and communications infrastructure quality, respectively, we obtain the results from model (1)-(4) in Table 11.

In general, the signs of the regression coefficients of the explanatory variables and control variables are in line with theoretical expectations, the coefficients of all types of infrastructure are positive, and among the control variables, the coefficients of the host country's market size (GDP), total population and the host country's trade openness are also positive.

Table 11. Results of Fixed Effects Regression Model

Variable	(1)	(2)	(3)	(4)	(5)
lnInfra	1.51** (2.15)				
lnSea		0.84*** (3.50)			0.75*** (3.51)
lnAirRail		0.004 (0.13)			
lnCommu			0.29*** (6.50)		0.28*** (6.11)
lnEnergy				0.17*** (2.77)	0.03 (0.48)
lnGDP	0.63** (2.12)	0.59** (2.16)	0.86*** (3.72)	0.87*** (3.38)	0.54** (2.29)
lnPop	14.21*** (10.94)	12.16*** (8.55)	7.40*** (4.69)	14.49*** (11.28)	5.78*** (3.47)
lnOpen	0.11*** (3.24)	0.10*** (3.14)	0.02 (0.63)	0.07* (1.87)	0.02 (0.55)
_cons	-240.77*** (-11.43)	-212.19*** (-9.63)	-120.82*** (-4.63)	-241.70*** (-11.59)	-103.26*** (-3.84)
R-squared	0.7829	0.7941	0.8278	0.7874	0.8433

*** $p<0.01$, ** $p<0.05$, * $p<0.1$.

According to the results of model (1), the regression coefficient of overall infrastructure quality is 1.51, which passes the 5% significance level test, and the model fitting (R-Squared) is 0.7829. It indicates that for every 1% increase in the overall quality of host country's infrastructure, China's OFDI stocks to the host country will increase by 1.51%, and the results also confirm that overall infrastructure quality has a significant positive effect on attracting FDI. The regression results are elaborated separately for different types of infrastructure in the following section.

Model (2) uses container port traffic and air and rail transportation volume as explanatory variables in a fixed effects regression to examine the impact of maritime and air and rail transportation infrastructure on attracting OFDI, respectively. The results show that the regression coefficient of maritime infrastructure is 0.84 at 1% significance level, while the regression coefficients of air and rail transportation infrastructure are only 0.004, which is extremely small and fails to pass the significance level test. These results indicate that the improvement of maritime infrastructure in RCEP partners can attract more FDI from China, while air and rail transport infrastructure are not effective factors in explaining the location choice of China's OFDI in RCEP partners. Among the 14 RCEP member countries (excluding China), there are ten countries from ASEAN and the stocks and flows of China's OFDI to ASEAN rank second among China's total OFDI, second only to HKSAR. And maritime transport is the main way for China and ASEAN to carry out international trade (Wei and Li, 2017), so the improvement of maritime infrastructure quality contributes more to RCEP member countries' attracting China's OFDI. What is more, except for New Zealand and Australia, which are in Oceania, the rest of the member countries are in East Asia or Southeast Asia. And the only countries bordering China among the RCEP partners are Vietnam, Laos and Myanmar, but since 2003, the volume of China's OFDI stocks in the above three countries accounts for a very low proportion in China's total OFDI stocks in that year (only 0.88% in 2020), and accounts for only 12.82% in the stocks of China's OFDI to RCEP partners in 2020. Therefore, the impact of the upgrading of air and railroad infrastructure in RCEP countries on the absorption of FDI from China is low.

Model (3) regards communications infrastructure quality as explanatory variable which is mainly measured by fixed broadband, fixed telephone and cell phone subscription per 100 people. The coefficient turns out to be 0.29 at 1%

significance level, indicating that every 1% increase in the quality of communications infrastructure quality in RCEP partners will bring 0.29% increase of China's OFDI to the host country. It shows that in a modern society with ever-developing communications infrastructure, the reduction of the cost of information communication and collection may have a significant positive impact on attracting OFDI.

Model (4) performed a fixed effects regression by regarding electricity consumption per capita as explanatory variables and the results show that the coefficient of electricity consumption per capita is 0.17 at 1% significance level. It indicates that every 1% increase in electricity consumption per capita will contribute to 0.17% increase of China's OFDI, which illustrates the positive impact of electricity on modern production and daily life.

Model (5) in Table 11 regards the three explanatory variables which have passed the significance level test in model (2)-(4) (i.e. container port traffic, communications infrastructure and electricity consumption per capita) as explanatory variables and performed fixed effects regression once again. The results turn out that the coefficient for container port traffic is 0.75 at 1% significance level, indicating the significant positive impact of maritime transport infrastructure on attracting China's OFDI; coefficient for communications infrastructure is 0.28 at 1% significance level, indicating the significant positive impact of communications infrastructure; and the coefficient for electricity consumption per capita is 0.03 and it fails to pass the significance level test, indicating that among the above three infrastructure, energy plays a less important role in attracting China's OFDI. In addition, the model fitting (R-Squared) is 0.8433 in model (5). The above results imply that three kinds of economic infrastructure all contributes to the host countries' attractiveness to China's OFDI, with the impact of maritime transport infrastructure being the most significant.

As for the control variables, in the results of model (1)-(5), the coefficients for all three control variables which are market size, total population and trade openness in the host country are positive and are consistent with the theoretical expectation. Market size (GDP) has significant positive impact on attracting China's OFDI, which is in line with one of the OFDI motivation to seek larger markets. The result indicates that a larger market in the host country contributes to higher OFDI absorption. Larger population in the host country has a positive impact on host country's ability to attract OFDI as well. Besides, trade openness in the host country is positively related to attracting China's OFDI, implying that when the proportion of international trade in GDP is higher in RCEP partners, China will make more direct investment in the host country.

4.4 Robust Test

In order to test whether the above empirical analysis is robust, a robust test is carried out by changing the measurements of core explanatory variables. Model (5) above is used to show the relationship between maritime, communications, and energy infrastructure quality and China's OFDI, and the following part is going to apply another measurement of the above three kinds of infrastructure to study the impact of infrastructure quality of RCEP partners on China's OFDI.

Maritime infrastructure quality is measured by liner shipping connectivity, and the source is UNCTAD. It captures how well countries are connected to global shipping networks, showing the extensiveness and capacity of its seaports. Communications infrastructure is measured by number of Internet servers, and the source is World Bank Database. With the coverage of the Internet, it has helped us lower the communication costs and saved us much time and has become indispensable in production and life. Energy infrastructure is measured by the proportion of ore and metal exports in total exports, referred to Pan and Yang (2020), and the source is World Bank Database. All the control variables are the same as those in model (5).

Fixed effects model is used to conduct the regression and the results are showed in Table 12. Model (5) shows the results acquired using the original measurements and model (6) shows the results using the new measurements of explanatory variables.

Table 12. Results of the Robust Test

Variable	Original Measurements Model (5)	New Measurements Model (6)
lnSea	0.75*** (3.51)	0.67** (2.28)
lnCommu	0.28*** (6.11)	0.14*** (3.36)
lnEnergy	0.03 (0.48)	0.008 (0.54)
lnGDP	0.54** (2.29)	0.55** (2.05)
lnPop	5.78*** (3.47)	10.02*** (6.30)
lnOpen	0.02 (0.55)	0.09*** (2.65)
_cons	-103.26*** (-3.84)	-164.88*** (-6.25)
R-squared	0.8433	0.8036

**** p<0.01, ** p<0.05, * p<0.1.*

Model (6) shows that maritime and communications infrastructure quality of the host country is significantly related to attracting China's OFDI, while the coefficient of energy infrastructure quality is quite small and fails to pass the significance test. The results of model (6) are similar to those in model (5) and can well confirm the validity of the original results.

When using the new measurements of the core explanatory variables, the coefficient of maritime and communications infrastructure quality is smaller than those in the original model. Nevertheless, it confirms that maritime infrastructure quality in the host country is of the most significance than the other two kinds of economic infrastructure in attracting China's OFDI, the importance of communications infrastructure ranks the second and energy infrastructure the least important.

5. Conclusions and Suggestions

5.1 Conclusions

This paper focuses on the impact of infrastructure quality of host countries on China's OFDI. To start with, we review the theories related to OFDI, and select the infrastructure quality as the core explanatory variable based on the previous literature, and then describe and analyze the current situation of China's OFDI and the domestic infrastructure quality of RCEP partners. Finally, data of China's OFDI stocks to 12 RCEP partners from 2008 to 2020 are selected, and panel data is used to combine qualitative analysis and quantitative research to conduct an empirical study on the impact of infrastructure quality in RCEP partners on China's OFDI through a fixed effects regression model. This paper studies infrastructure of three major types, transportation infrastructure, communications infrastructure and energy infrastructure, conducts empirical studies separately, and obtains the following conclusions.

First, by analyzing the data of China's OFDI over the years, we find that both flows and stocks of China's OFDI are rising with China's economic development. And after studying the countries which China's OFDI flows to, we find that China is more inclined to make foreign direct investment in developed countries and when it comes to developing countries, China will invest more in Asian countries. Over the past few years, the stocks of China's OFDI in RCEP partners account for about 7% in China's total OFDI stocks in that year.

Second, the overall quality of infrastructure in RCEP partners plays a significant role in attracting China's OFDI. As the overall infrastructure quality of the host country rises, the host country becomes more attractive as a destination country for OFDI. China's willingness to invest in that host country will be higher, and the stocks of China's OFDI will be higher as well. The fixed effects regression model shows that for every 1% increase in overall infrastructure quality, the stocks of OFDI from China will rise by 1.51%.

Third, the economic infrastructure that is closely related to production and life, namely transportation infrastructure, communications infrastructure and energy infrastructure, have different effects on attracting OFDI in China. By conducting fixed effects regression model for each of these three types of infrastructure, the study finds that all three types of infrastructure have a significant positive effect on attracting OFDI from China. Among the variables that passed the significance level test, the largest coefficient was found for maritime transportation infrastructure, followed by communications infrastructure, and the smallest one was found for energy infrastructure. The similar results are obtained when regressing all three types of infrastructure at the same time which leads us to the conclusion that China prefers countries with high levels of maritime transport infrastructure and, to a lesser extent, countries with more developed communications infrastructure when making OFDI to RCEP partners.

Finally, among the control variables in the paper, the variable GDP, which is used to refer to the market size of the host country, has a significant promotion effect on OFDI absorption, which well confirms the market-seeking motivation of China's OFDI. In addition, the variable population shows a significant positive effect on OFDI absorption, because countries with larger population may lead to more socio-economic activities and can attract more OFDI than those accommodating fewer people. It indicates that China tends to make OFDI to countries with more labor supply as well. The regression results for the control variable of host country's trade openness also suggest that the higher the trade openness of the host country is, the more willing China is to make OFDI to it.

5.2 Suggestions

The signing of the RCEP will promote China's economic development and enhance its international influence, as well as strengthen the ties between China and countries in the Asia-Pacific region and lay the foundation for Chinese enterprises to explore overseas markets. RCEP's coming into force in 2022 will enable Chinese enterprises to improve productivity, increase profits and handle the wave of reverse globalization. In order to promote China's regional as well as industrial layout of OFDI, combined with the findings obtained from the empirical analysis in this paper, the following suggestions are made.

First, Chinese enterprises should take the overall infrastructure level of the host country into consideration when deciding where to invest. Both economic and social infrastructure can bring about convenience to the construction and operation of companies afterwards. More developed infrastructure facility in the host country can provide Chinese enterprises with a good production environment, reduce the inconvenience resulted from host country's infrastructure imperfections to Chinese investors, and thus serve the purpose of reducing production costs and improving investment efficiency.

Second, among economic infrastructure, Chinese enterprises should pay more attention to maritime and communications infrastructure. Chinese companies should first choose countries with developed maritime transport infrastructure for OFDI, followed by countries with more developed communications infrastructure. As the most common mode of international trade transportation, maritime transport boasts the advantages of large capacity and low transportation cost. In the preliminary stage of OFDI, a large amount of equipment and raw materials are needed for the construction of factories and therefore, need to be transported from home country to the host country for preparation. Developed maritime infrastructure can provide favorable conditions for international transportation, reduce the transport cost, and improve the transportation efficiency. Communications infrastructure also plays an important role in the highly informationized 21st century. Well-developed communications infrastructure can reduce the cost of information collection and communication, which can improve the operational efficiency and profitability of the company in the modern life with a faster pace of work.

Third, Chinese enterprises may invest in the infrastructure construction industry in the host countries to help them improve infrastructure level. China has always put emphasis on domestic infrastructure construction and has made achievement and earned the reputation of infrastructure powerhouse both at home and abroad. For instance, China's high-speed railway has the longest mileage worldwide and communications network has also developed a lot over the years. Chinese enterprises boast advanced technology and practical skills related to infrastructure construction and therefore, foreign companies seek for cooperation in infrastructure construction with us. Chinese enterprises should make full use of such advantage and invest in RCEP partners to improve their level of different kinds of infrastructure, which can not only help host countries gain economic development, but can also offer other Chinese investors better business and production environment, reduce the negative impact of imperfect infrastructure, and improve investment efficiency. In return, higher infrastructure quality and higher investment efficiency can attract more Chinese investors to invest in various industries in RCEP partners.

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