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Sustainable Development of Education: An Empirical Study of China's Education Export

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Abstract. Education export is of great significance to the sustainable development of education in a country. The paper selects the panel data of China's education export to 76 countries from 2006 to 2018, and then it uses the stochastic frontier gravity model to study the export efficiency and potential of it, and next it uses a one-step method to analyze its influencing factors. The results show that: (1) The economic scale of China and the source country, the population size of the source country, China's FDI to the source country, the number of Chinese universities, the number of Confucius Institutes, and the mutual recognition of academic qualifications each has a significant role in promoting China's education export, although factors such as geographic distance and cultural distance that reflect the cost of studying abroad have a restraining effect. (2) From 2006 to 2018, China's education export only realized 62% of its export potential. Its export efficiency to seven countries including Qatar, the United Arab Emirates, and Kuwait was relatively low, with only less than 40% of the export potential being realized. (3) Although the overall efficiency of China's education export to non-Belt and Road countries is higher than that of countries along the Belt and Road, after The Belt and Road Initiative was put forward in 2013, China's education export to countries along the Belt and Road has seen a rapid rise in efficiency.

Keywords: Sustainable Development of Education; Education Export; Export Potential; Stochastic Frontier Gravity Model

1. Introduction

In November 2015 in Paris, the 184 UNESCO member states adopted the 2030 Education Action Framework, in which the sustainable development goal 4 (SDG 4), namely to "ensure inclusive and fair quality education, allowing lifelong learning opportunities", is a comprehensive, ambitious, and universally applicable agenda to meeting both national and global education challenges. First, the internationalization of education gives people in backward countries the opportunity to share the world's advanced education(Lin and Long, 2020; Yin and Zong, 2022); after they return to their home country, they form an important human capital accumulation for the sustainable development of both education and the economy(Baker etc, 2014; Dai and Xu, 2017; Benjamin, 2021). Second, education export is an important part of the economy of developed countries(Schatz, 2015; Novikova,2021); it can bring them huge economic income(Stadler, 2015; Guichon, 2019; Shahbaz etc, 2019). Moreover, some international students who choose to stay in the local areas after graduation also become important human capital(Urban and Palmer, 2014; Koenings etc,2021). Third, the internationalization of education will promote people-to-people exchanges between countries, will enhance understanding and tolerance among different cultures(Finn etc, 2021; Zhu and Bresnahan, 2022), will reduce the possibility of conflicts(Oda etc, 2015), and will create a favorable environment for the sustainable development of the world economy(Bozionelos etc, 2015; Bourassa etc, 2022).

In recent years, with the continuous improvement of China's education opening up to the world, the education service trade has developed rapidly, and China has become the world's largest exporter of international students as well as the largest destination country to study abroad in Asia. However, the education service has been in a deficit for a long time, and the deficit is constantly expanding. Therefore, identifying the influencing factors of China's education export, expanding the export potential, and improving its export efficiency are topics that are very worthy of our attention.

Compared with existing research, areas for innovation in this paper are mainly reflected in the following three aspects: first, regarding the influencing factors of China's education export, some studies have paid more attention to China's own factors(Gu and Schweisfurth, 2015; Pan, 2015; Lien and Miao, 2018; Wei etc, 2019). This paper, however, will focus not only on China's own factors, but also on the characteristics of the country of origin (Liu and Lin, 2016), as well as on the bilateral characteristics of China and the country of origin. Second, this paper will use the time-varying stochastic frontier gravity model to analyze the influencing factors, which can include the factors not observable in the general gravity model. This can improve the accuracy of the trade potential estimation. Finally, this paper will study the problem of the relatively backward development of China's education export from the perspective of market structure(Brunton and Jeffrey, 2014; Melikyan, 2018), and it will calculate the countries with "insufficient trade" or "excessive trade" through an empirical analysis, so as to provide reference for the market layout of China's education export.

The structure of the paper continues in this way: the second part explains the research design, which mainly introduces the model construction, the selection of variables and samples and explaining the data; the third part uses the stochastic frontier gravity model to analyze the influencing factors of China's educational export and to measure the export potential and efficiency; the fourth part is the conclusion and enlightenment of the article.

2. Study Design

Model Setting and Variable Description

The stochastic frontier approach was mainly used to analyze input-output problems. The approach is used in gravity models, with the decomposition of random interference terms into random error terms and trade non-efficiency terms, while the neglected trade resistance factors into the trade non-efficiency term. The stochastic frontier model for panel data is generally expressed as:

$$T_{ijt} = f(x_{ijt}, \beta)\exp(-\mu_{ijt})\exp(v_{ijt}) \quad (1)$$

$$T^{*}_{ijt} = f(x_{ijt}, \beta)\exp(v_{ijt}) \quad (2)$$

$$TE_{ijt} = \frac{T_{ijt}}{T^*_{ijt}} = \exp(-\mu_{ijt}) \quad (3)$$

T_{ijt}, T^*_{ijt} and TE_{it} indicate the actual amount of trade, the potential trade volume, and the trade efficiency between country i and country j, respectively. x_{ijt} is the core factor affecting the actual trade volume, β is the parameter vector, v_{ijt} is the random error term indicating the unobservable factors affecting trade and obeying the normal distribution. μ_{ijt} is independent of v_{ijt}, and represents the trade non-efficiency term, indicates the degree of trade effectiveness, and contains the main human factors affecting trade. In the early stage, it was assumed that the time-invariant model, in which the trade non-efficiency term μ did not change over time, would be affected by a longer time dimension, so Battese and Coelli (1992) proposed the time-varying stochastic frontier model:

$$\mu_{ijt} = \{\exp[-\eta(t-T)]\}\mu_{ijt} \quad (4)$$

According to Armstrong (2007), the trade flow is determined by natural factors that will not change in the short term, such as the economic scale, the geographical distance, the boundary, and the language of the two countries. Then, combined with the characteristics of the educational service trade, we establish a model suitable for measuring the potential of China's educational export:

$$LnEX_{ijt} = \beta_0 + \beta_1 LnGDP_{it} + \beta_2 LnGDP_{jt} + \beta_3 LnPOP_{jt} + +\beta_4 LnDIS_{ij} + \beta_5 BOR_{ij} + \beta_6 LANG_{ij} + v_{ijt} - \mu_{ijt} \quad (5)$$

EX_{ijt} shows China's education export to country j during the period t. GDP_{it} represents China's GDP during the period t. The larger the scale of China's economy, the stronger the education export capacity, so the expected effect is positive. GDP_{jt} shows the GDP of country j during the period t, measuring the economic scale of the source countries of international students is expected to have a positive effect. POP_{jt} indicates the population size of country j reflecting the size and potential of the source country; it is expected to have a positive impact. DIS_{ij} shows the geographical distance between China and country j, reflecting the cost of transportation. The farther the distance, the higher the cost of studying in China, and the greater the cultural differences, so it is expected to have a negative impact. BOR_{ij} is a dummy variable indicating whether China has a common boundary with country j. A common boundary indicates a close distance; cultural differences may be small, and a positive effect is expected. $LANG_{ij}$ is a dummy variable indicating whether China and country j have a common language. The common language would make the students' experience something similar to China's cultural background, so communication would be more convenient. This will promote students to study in China and is expected to have a positive impact.

After obtaining trade efficiency estimates, the trade non-efficiency model is needed to study the influence of various factors on trade non-efficiency. The early study mainly used a "two-step method" to measure the efficiency first, and then to analyze other influencing factors. However, this method has inconsistent assumptions. In the first step, the trade non-efficiency term μ is independent and identically distributed. In the second step, the non-efficiency term is analyzed against factors as explained variables, which means that it is not independent and identically distributed, contradicting to the hypothesis in the first step. Therefore, Battese and Coelli (1995) propose a "one-step approach" to regressing trade non-efficiency terms and their influencing factors simultaneously in a stochastic frontier model. Among these, z_{ijt} represents the exogenous variables affecting non-efficiency of trade, δ the parameter to be estimated, and ε_{ijt} the random perturbation term.

$$\mu_{ijt} = \delta z_{ijt} + \varepsilon_{ijt} \quad (6)$$

As for the factors affecting the export efficiency of education service, Gu and Qiu (2017) found that international students in China can significantly promote China's foreign direct investment. On the contrary, China's foreign direct investment and trade will also affect the size of the population of international students. Tang (2019) pointed out that China's economic changes, the number of Chinese higher education institutions representing education development, and the number of Confucius Institutes, as well as the number of government scholarships, have all played a significant positive role in overseas students coming in China. Zhuang etc (2019) believe that cultural identity is an important

factor influencing international students coming to China. Therefore, on the basis of existing research, this paper builds the following non-efficiency model of China:

$$\mu_{ijt} = \delta_0 + \delta_1 LnTRADE_{ijt} + \delta_2 LnOFDI_{ijt} + \delta_3 LnEXCH_{ijt} + \delta_4 LnNCU_t + \delta_5 CI_{jt} + \delta_6 LnCD_{ij} + \delta_7 LnPNS_{jt} + \delta_8 CER_{ijt} + \varepsilon_{ijt} \quad (7)$$

For formula (7), the meaning of the various explanatory variables, the theoretical explanation and their possible impact on China's export of educational services are shown in Table 1.

Table 1. Meaning and expected symbol of each variable in the non-efficiency model

Independent Variable	Implications	Theoretical Explanation	Expected Symbol
$TRADE_{ijt}$	bilateral trade volume	The greater the trade volume and FDI between the two countries, the closer the economic and trade exchanges, the greater the demand for mutual languages and professionals, and the greater the motivation to study in China.	+
$OFDI_{ijt}$	China's FDI in country j		+
$EXCH_{ijt}$	Exchange rate level between China and country j	The exchange rate reflects the cost of studying in China. The higher the cost, the greater the resistance.	-
NCU_t	Number of higher institutions in China	The larger the scale of higher education in China, the stronger the ability to receive overseas students.	+
CI_{jt}	Number of Confucius Institutes in country j	The number of Confucius Institutes may attract more international students to study in China. There is also the possibility that overseas students can meet their needs by studying at Confucius Institutes and no longer need to study extra in China.	unsure
CD_{ij}	Cultural distance between China and country j	The greater the cultural distance, the higher the time cost and effort that overseas students expend to study in China, the weaker their willingness to study in China.	-
PNS_{jt}	The proportion of China offering scholarships to country j	It reflects the situation of students in the country receiving scholarship support. The more they get scholarship support, the more willing they are to study in China.	+
CER_{ijt}	Whether China and country j have signed a mutual recognition agreement on academic qualifications	With mutual recognition, international students' education can be recognized by their own country, thus enhancing their willingness to study in China.	+

Sample Selection

This paper calculates the export potential of Chinese educational service trade based on the setting of the stochastic frontier gravity model described above. In order to ensure that the conclusion would be reliable and steady, the paper first eliminated the overseas students data missing and any information from incoherent countries, and then screened the variable data of the remaining 90 countries, eliminated the countries with more than three missing pieces of data within a certain variable, used the interpolation method to complete the missing data in individual countries, and finally retained 76 countries with complete data.

These included 35 countries along the "Belt and Road": UAE, Pakistan, Philippines, Georgia, Kazakhstan, Kyrgyzstan, Cambodia, Qatar, Kuwait, Laos, Malaysia, Mongolia, Bangladesh, Myanmar, Nepal, Saudi Arabia, Sri Lanka, Tajikistan, Thailand, Turkey, Singapore, Iran, Israel, India, Indonesia,

Jordan, Vietnam, Egypt, Belarus, Poland, Russia, Czech Republic, Romania, Ukraine, and Hungary. In 2018, a total of 425,991 international students came to study in China from these 76 countries, accounting for 86.55% of the number of Chinese international students. Therefore, the data of these 76 countries is strongly representative to use in analyzing the export of China's education service.

Data Description

The export data are from the number of students coming to China in the 2006-2018 Brief Statistics published by the Ministry of Education of China. GDP and population size data are obtained from the World Bank. The exchange rate uses the RMB against the source country currency data, and the original data is from the World Bank. The information about the geographical distance between the two countries and whether there are common boundaries and language comes from the official website of the French Centre for International Economic Research (CEPII).

Bilateral trade with China and its partner countries comes from the China Statistical Yearbook, 2006-2018. China's FDI data in other countries comes from the China's Foreign Direct Investment Statistical Bulletin, 2006-2018. Since China's FDI data in some countries are not continuous, the paper refers to the formula of Busse and Hefeker (2007) to transform and to handle the investment data with negative and zero values. The number of ordinary Chinese institutions of higher learning comes from the National Bureau of Statistics. The number of Confucius Institutes is from the official website of the National Han Affairs Office. Cultural distance refers to the six-latitude measurement formula, the original data is from Hofstede's official website.

$$CD_j = \frac{\sum_{i=1}^{6}\left[(I_{ij} - I_i)^2 / V_i\right]}{6} \tag{8}$$

I_{ij} represents the cultural distance values of country j in the dimension i. I_i is the score of the parent country in the dimension i. V_i is the variance of all sample countries in the dimension i. The proportion of scholarship students is calculated through the ratio of the number of scholarship students and the total number of students from the country to study in China. The scholarship data is from the Brief Statistics of Overseas Students in China. The academic mutual recognition agreement is from the Chinese Ministry of Education government portal.

Main statistical indicators and correlations for each variable are shown in Tables 2 and 3.

Table 2. Summary statistics

Variable	Observation	Mean	Standard Deviation	Minimum	Maximum
$EXPORT_{ij}$	988	3909.93	8379.365	1	70540
GDP_i (ten thousand USD)	988	816026503	336577399.9	275213177.3	1360815186
GDP_j (ten thousand USD)	988	76234501.24	204839506.3	0	2054434346
POP_j (ten thousand)	988	6365.08	15097.31	102.27	135261.73
DIS_{ij} (kilometers)	988	7572.09	3500.9	955.65	16948.04
BOR_{ij}	988	0.14	0.35	0	1
$LANG_{ij}$	988	0.03	0.16	0	1
$TRADE_{ij}$ (ten thousand USD)	988	3406960.88	7012733.2	3429	63351900
$OFDI_{ij}$ (ten thousand USD)	988	35459.91	112442.16	-321206	1698081
$EXCH_{ij}$	988	159.01	566.1	0.0269	6176.63
NCU	988	2386.31	242.96	1867	2663
CI_{ij}	988	11.79	51.74	0	629
CD_{ij}	988	4.31	1.34	1.78	7.61

PNS_j	988	0.16900	0.170	0.0028	1
CER_j	988	0.39	0.49	0	1

Table 3. Correlation coefficients

	GDP_i	GDP_j	POP_j	DIS_{ij}	BOR_{ij}	$LANG_{ij}$	$TRADE_{ij}$	$OFDI_{ij}$	$EXCH_{ij}$	NCU	CI_{ij}	CD_{ij}	PNS_j	CER_j
GDP_i	1													
GDP_j	0.034	1												
POP_j	0.019	0.295	1											
DIS_{ij}	0	0.082	-0.103	1										
BOR_{ij}	0	-0.078	0.273	-0.491	1									
$LANG_{ij}$	0	-0.039	-0.051	-0.148	-0.068	1								
$TRADE_{ij}$	0.125	0.868	0.261	-0.106	-0.067	0.091	1							
$OFDI_{ij}$	0.177	0.487	0.090	-0.014	-0.008	0.218	0.511	1						
$EXCH_{ij}$	0.074	-0.066	0.038	-0.192	0.191	-0.046	0.012	0.006	1					
NCU	0.927	0.034	0.018	0	0	0	0.119	0.166	0.066	1				
CI_{ij}	0.122	0.841	0.161	0.089	-0.053	-0.031	0.732	0.605	-0.052	0.114	1			
CD_{ij}	0	-0.127	-0.149	0.211	-0.076	-0.041	-0.179	-0.116	-0.171	0	-0.065	1		
PNS_j	-0.245	-0.226	-0.171	0.209	-0.067	-0.132	-0.295	-0.169	0.033	-0.247	-0.133	0.209	1	
CER_j	0.081	0.012	-0.108	-0.125	0.037	-0.028	0.058	0.045	-0.078	0.087	0.024	-0.05	-0.231	1

3. Empirical Analysis

Model Suitability Test

Before regression analysis, in order to ensure the correctness of the equation of the stochastic frontier gravity model, the paper first uses the likelihood ratio test to verify the applicability of six models, including the trade non-efficiency term existence test, the trade non-efficiency term time-varying test, whether to introduce China's GDP variable, whether to introduce the GDP variable of the origin country and the population scale variable, and whether to introduce the geographical distance, boundary and language variables. As shown in Table 4, the test results all reject the null hypothesis that no trade non-efficiency and trade non-efficiency do not change over time, indicating that the time-varying stochastic frontier gravity model is applicable.

Economic size, population size, and geographic distance variables are also rejected, but the null hypothesis of common boundaries and common language variables are accepted. This may be because most of the countries bordering China are located in the west and the south of China's multi-plateau mountainous areas, and the land transportation is inconvenient, so it has little impact on studying in China (Lu and Zhao, 2010). Singapore and Malaysia are the only countries with a common language with China, which is not enough to have a significant impact on international students studying in China. Thus, after excluding the common boundaries and language variables, formula (5) is adjusted to:

$$LnEX_{ijt} = \beta_0 + \beta_1 LnGDP_{it} + \beta_2 LnGDP_{jt} + \beta_3 LnPOP_{jt} + +\beta_4 LnDIS_{ij} + v_{ijt} - \mu_{ijt} \quad (9)$$

Table 4. Results of the likelihood ratio test for the stochastic frontier gravity model

Null hypothesis	H0	H1	LR	Degree	1% Critical value	Test conclusion
No trade non-efficiency	-1366.80	-461.81	1809.98	3	11.34	reject
Trade non-efficiency does not change	-532.82	-461.81	142.00	2	9.21	reject
No China's GDP	-479.72	-461.81	35.81	3	11.34	reject
No source country's GDP	-488.64	-461.81	53.66	3	11.34	reject
No population scale	-545.76	-461.81	167.90	3	11.34	reject
No geographical distance	-484.65	-461.81	45.67	3	11.34	reject

No common boundary	-462.88	-461.81	2.04	3	11.34	accept
No common language	-465.51	-461.81	7.32	3	11.34	accept

Model Estimation and Analysis

To compare the robustness of the results, the paper compares the estimates of the OLS, time-invariant, and time-varying models, as shown in Table 5. □ represents the proportion of the trade non-efficiency terms in the compound error where both the time-invariant and time-varying models are significant above 0.9, further demonstrating that a stochastic frontier gravity model should be used. The □ value of the time-varying model is significantly greater than 0, indicating that trade non-efficiency decreases with time; that is, trade resistance is decreasing, further demonstrating that the time-varying stochastic frontier gravity model is more applicable.

Table 5. Comparison of the results for the OLS, time-invariant and time-varying models

Variable	OLS			time-invariant model			time-varying model		
	Coefficient	Standard error	t value	Coefficient	Standard error	t value	Coefficient	Standard error	t value
β_0	-11.166***	1.4616	-7.6395	-9.8492***	0.8440	-11.6695	4.8137***	1.3966	3.4467
ln GDP$_i$	1.1115***	0.0669	16.6265	1.0634***	0.0264	40.2862	0.4855***	0.0563	8.6235
ln GDP$_j$	0.1489***	0.0209	7.1394	0.2422***	0.0353	6.8674	-0.3324***	0.0429	-7.7495
ln POP$_j$	0.5628***	0.0292	19.2525	0.6593***	0.0662	9.9537	0.8896***	0.0532	16.7144
ln DIS$_{ij}$	-1.2930***	0.0585	-22.0908	-1.4120***	0.0769	-18.3582	-0.7419***	0.0573	-12.9393
σ^2	1.0565			1.7661***	0.4989	3.5398	1.1857***	0.2255	5.2588
γ				0.9305***	0.0197	47.3002	0.9157***	0.0162	56.4941
μ				1.1956***	0.3677	3.2513	1.9247***	0.1726	11.1535
η				-	-	-	0.0405***	0.0021	18.8921
Log Likelihood	-1426.5353			-538.3956			-466.492		
LR				1776.2793			1920.0866		

* significant at 10%; ** significant at 5%; *** significant at 1%.

After determining model applicability, the export panel data of China with 76 countries from 2006-2018 were estimated, and the results are shown in Table 6. According to Table 6, the economic scale variables are significant at the 1% level, and they have a positive coefficient, indicating that the economic scale of both sides has a positive impact on China's education export. The larger the scale China's economic scale, the more important its position in the world economy and the more attractive it is to international students. The higher the economic level of the source country of overseas students, the larger the export market of China's education, so that the economic scale will promote China's education export, in line with expectations. The coefficient of POPj is significantly positive. The larger the population of the country, the more diverse its educational needs will be. The larger the domestic market that overseas students need to serve, the higher the expected income of studying abroad, and the stronger their willingness to study in China, in line with the expectation. The coefficient of DISij is significantly negative, indicating that the transportation cost will become an obstacle to choosing to study in China.

Table 6. Empirical results of the time-varying stochastic frontier gravity model

	Variable	Coefficient	Standard error	t value
SFF	β_0	-6.8664***	0.9996	-6.8694
	ln GDP$_i$	0.9677***	0.0472	20.5105
	ln GDP$_j$	0.1946***	0.0178	10.9077

	$ln\ POP_j$	0.3875***	0.0269	14.3932
	$ln\ DIS_{ij}$	-1.3042***	0.0440	-29.6588
TIM	δ_0	8.7981***	3.1109	2.8282
	$lnTRADE_{ij}$	0.0507	0.0803	0.6311
	$lnOFDI_{ij}$	-0.0960***	0.0196	-4.9063
	$lnEXCH_{ij}$	-0.5500***	0.1108	-4.9648
	$lnNCU$	-2.9841**	0.8026	-3.7179
	CI_j	-0.0192***	0.0010	-19.7546
	$lnCD_{ij}$	7.9689***	1.4433	5.5213
	$lnPNS_j$	0.3310***	0.1081	3.0632
	CER	-2.8938***	0.5039	-5.7425
	σ^2	4.1699***	0.4345	9.5959
	γ	0.8946***	0.0153	58.6179
	LR		1261.5562	
	$Log\ Likelihood$		329.9582	

As to trade non-efficiency factors, the trade volume between the two countries has a positive, but not significant impact; this may be due to fact that the United States, Japan, Germany, Australia and other developed countries are our main trading partners, and that students from these countries prefer to choose the US and Europe as the target countries for their study. China's FDI has a significant negative impact on trade non-efficiency; that is, the more China invests in the country, the more the country will learn from China's advanced technology, equipment, management experience and organizational ability, and the more this will attract international students to study in China, in line with the expectation. The coefficient of EXCHij is significantly negatively related with trade resistance, contrary to the expectation. This may be due to data defects; this paper uses the nominal exchange rate to reflect the spending cost of international students. However, after the 2008 financial crisis, China implemented a prudent monetary policy, while many foreign countries carried out a lot of quantitative easing. This resulted in the RMB's actual exchange rate decline, and it relatively reduced the expenditure cost of studying in China, thus attracting more international students and reducing the non-efficiency of export. The number of colleges and Confucius Institutes has a significant negative impact on trade non-efficiency. The more colleges in China, the stronger the ability to undertake foreign students, the more the number of Confucius Institutes will expand the influence of Chinese culture, attracting more students to study in China, so as to promote the export of education service in China. The coefficient of CDij has a significant positive impact on the trade non-efficiency. The farther the cultural distance, the more difficult it is to overcome the cultural differences to learning; so that the greater the resistance to trade, the stronger the obstacle effect on the export of China's education service. The coefficient of PNSj shows a significant positive correlation for trade non-efficiency, contrary to the expectation. This conclusion shows that China's existing scholarship policy does not play a good role in attracting international students; this may be related to the implementation of free tuition, free accommodation, and other forms of government subsidies, which are not reflected in the actual scholarships. This further shows that China should rely on its own international political and economic strength and its cultural influence to attract international students to voluntarily pay for study, rather than rely on scholarships and other external means. The coefficient of CER is significantly and negatively related to the trade non-efficiency. After signing the mutual recognition agreement, the degree obtained in China can be recognized by the parent country, which plays a role in promoting the export of China's education service and is in line with the expectation. The γ value is 0.8946 and significant at the 1% level, indicating that these trade non-efficiency factors can explain more than 89%

of the failure of trade potential.

4. Export Efficiency and Potential Measure of China's Education Service

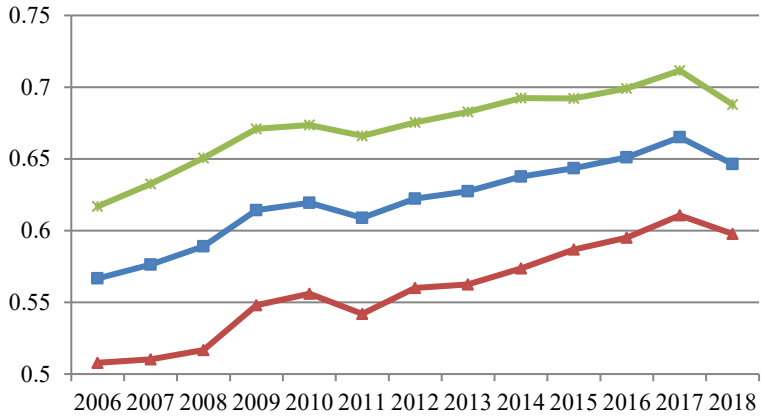
Based on the estimation of the time-varying stochastic frontier gravity model and the trade non-efficiency model, and dividing these markets into countries along the "Belt and Road" and non-"Belt and Road" countries, the export efficiency and the potential of China's educational services in different markets can be measured. The export efficiency formula is: $TE_{ijt} = \exp(-\mu_{ijt})$, where μ> 0, so the export efficiency is between 0 and 1, and greater μ means greater export resistance and lower export efficiency. Export potential is the part where export efficiency does not reach 1, that is, the maximum level of export of trade services without any other trade resistance. The specific potential value can be calculated from formula (3) to the following formula: $T^*_{ijt} = T_{ijt}/TE_{ijt}$

Table 7 lists the top 10 countries, respectively, in the average efficiency and potential of Chinese education export from 2006 to 2018. It can be seen that China's education exports to all countries are "insufficient trade." The country with the highest export efficiency is the United States, with an efficiency value of 0.85. Besides the United States, Germany, and South Korea, six of the top 10 countries are countries along the "Belt and Road": Laos, Thailand, Kazakhstan, Vietnam, Indonesia, and Singapore. China's education export potential to Qatar is the highest, reaching 0.98. Its export efficiency to the United Arab Emirates, Kuwait, Georgia. and other West Asian countries is relatively low and has great export potential. This shows that China has a very large space for the market development of education exports to West Asia.

Table 7. Top 10 countries in the average export efficiency and potential of China's education service in 2006-2018

Average Efficiency	Rank	Country	Average Potential	Rank	Country
0.8556	1	USA	0.9829	1	Qatar
0.8193	2	Germany	0.9567	2	UAE
0.8176	3	South Korea	0.9509	3	Kuwait
0.8164	4	Laos	0.7792	4	Georgia
0.8163	5	Thailand	0.6825	5	Romania
0.8114	6	Kazakhstan	0.6587	6	Bangladesh
0.8098	7	Vietnam	0.6039	7	Egypt
0.804	8	Indonesia	0.5971	8	Saudi Arabia
0.8016	9	Canada	0.5712	9	Poland
0.7985	10	Singapore	0.563	10	Mozambique

Figure 1 shows the changes in the export efficiency of Chinese education service in different markets from 2006-2018. It can be seen that the export efficiency of China's education service is rising, on the whole, and that the efficiency level of non-"Belt and Road" countries has increased from 0.6 to above 0.7, which has been higher than the countries along the "Belt and Road." This may be due to that China has had very close economic and trade exchanges with non-"Belt and Road" developed countries such as the United States and Germany, while along the "Belt and Road", there are many countries like Qatar and Georgia with small economic scale and fewer educational and cultural exchanges with China. Moreover, the "Belt and Road" initiative is still relatively short enough to bridge the gap between economic and cultural exchanges with developed countries. However, it can be seen from the figure that China's export efficiency of education to countries along the "Belt and Road" has increased rapidly after the "Belt and Road" initiative was proposed in 2013, indicating that it has effectively promoted the export of China's education and that it has attracted more students to study in China.



■: all countries; ▲: "Belt and Road" countries; ★: non- "Belt and Road" countries

Fig.1: Change of average export efficiency of China's education service

Tables 8 and 9 specify the export efficiency and the potential of Chinese education service in countries along the "Belt and Road" and non-"Belt and Road" countries in 2018. In 2018, China's average export efficiency to countries along the "Belt and Road" was 0.6 and the average export potential was 0.4, which is higher than the average export potential of 0.31 in non-"Belt and Road" countries. Therefore, China has greater potential for education export to countries along the "Belt and Road".

Table 8. List of export efficiency and potential of China's education to countries along "Belt and Road" in 2018 (Unit: Person)

Country	Export efficiency	Export potential	Actual value	Potential value	Country	Export efficiency	Export potential	Actual value	Potential value
Laos	0.8599	0.1401	14645	17031	Belarus	0.6223	0.3777	1048	1684
Thailand	0.8246	0.1754	28608	34693	Jordan	0.5756	0.4244	978	1699
Kazakhstan	0.8030	0.1970	11784	14675	Egypt	0.5951	0.4049	2247	3776
Kyrgyzstan	0.7724	0.2276	4614	5974	Poland	0.5955	0.4045	1926	3234
Russia	0.7840	0.2160	19239	24540	India	0.6214	0.3786	23198	37332
Pakistan	0.7987	0.2013	28023	35086	Hungary	0.6235	0.3765	587	941
Tajikistan	0.7485	0.2515	4007	5353	Turkey	0.4559	0.5441	1854	4067
Singapore	0.7697	0.2303	4718	6130	Czech	0.6385	0.3615	611	957
Malaysia	0.7575	0.2425	9479	12514	Iran	0.5252	0.4748	2044	3892
Mongolia	0.7609	0.2391	10158	13350	Georgia	0.3343	0.6657	301	900
Nepal	0.7682	0.2318	6986	9094	Israel	0.4303	0.5697	449	1043
Indonesia	0.7811	0.2189	15050	19268	Romania	0.3908	0.6092	594	1520
Cambodia	0.7683	0.2317	4047	5267	Philippines	0.3563	0.6437	2786	7819
Myanmar	0.7762	0.2238	8573	11045	Saudi Arabia	0.2401	0.7599	783	3261
Sri Lanka	0.7113	0.2887	3290	4625	Kuwait	0.0553	0.9447	76	1374
Vietnam	0.7664	0.2336	11299	14743	UAE	0.0432	0.9568	78	1806
Ukraine	0.6852	0.3148	3090	4510	Qatar	0.0117	0.9883	13	1111
Bangladesh	0.6666	0.3334	10735	16104	Average	0.5976	0.4024	6798	9441

Table 9. List of export efficiency and potential of China's education to non- "Belt and Road"

countries in 2018 (Unit: Person)

Country	Export efficiency	Export potential	Actual value	Potential value	Country	Export efficiency	Export potential	Actual value	Potential value
USA	0.8567	0.1433	20996	24508	Netherland	0.7013	0.2987	2393	3412
Zambia	0.8490	0.151	4342	5114	Spain	0.6893	0.3107	2650	3844
Tanzania	0.8364	0.1636	5673	6783	Denmark	0.6888	0.3112	1122	1629
Sierra Leone	0.8273	0.1727	983	1188	Uganda	0.6869	0.3131	1570	2286
Ghana	0.8139	0.1861	6475	7956	Ireland	0.6738	0.3262	717	1064
Germany	0.8095	0.1905	8079	9980	Panama	0.6572	0.3428	738	1123
Rwanda	0.8074	0.1926	2660	3295	Mali	0.6254	0.3746	788	1260
UK	0.7983	0.2017	6415	8036	Austria	0.6177	0.3823	517	837
Canada	0.7901	0.2099	4322	5470	Peru	0.6049	0.3951	502	830
Ethiopia	0.7796	0.2204	5532	7096	Sweden	0.5958	0.4042	1080	1813
Australia	0.7718	0.2282	4058	5258	Switzerland	0.5909	0.4091	884	1496
Namibia	0.7706	0.2294	675	876	Mozambique	0.5798	0.4202	659	1137
Italy	0.7669	0.2331	5386	7023	Columbia	0.5739	0.4261	879	1532
South Korea	0.7667	0.2333	50600	65997	Belgium	0.5601	0.4399	1502	2682
South Africa	0.7638	0.2362	2981	3903	Algeria	0.5563	0.4437	1036	1862
France	0.7625	0.2375	10695	14026	Brazil	0.5549	0.4451	1463	2637
Kenya	0.7565	0.2435	2553	3375	Japan	0.5441	0.4559	14230	26153
New Zealand	0.7501	0.2499	767	1023	Norway	0.4957	0.5043	813	1640
Nigeria	0.7499	0.2501	6845	9128	Finland	0.4723	0.5277	585	1239
Senegal	0.7281	0.2719	797	1095	Mexico	0.2573	0.7427	499	1939
Morocco	0.7229	0.2771	2612	3613	Average	0.6879	0.3121	1036	6223

5. Discussions and Implications

Through the empirical analysis of the determinants of education export and the measure of the potential and efficiency of education export, this paper offers the following policy implications for the education export:

First, a country should strive to improve the development level of its economy, trade, and foreign investment. Education export is closely related to the development level of its economy, trade, and investment. The higher the level of economic development, the more important the position in the international economy; the deeper the integration into the global value chain, the more it will attract the attention of other countries, so as to improve its education export level.

Secondly, a country should increase investment to improve the level and the quality of education. The quality of a country's education has a significant role in promoting its education export, so it should increase its investment in education(Cho and Yu, 2014; Jongbloed and Vossensteyn, 2016), improve the teaching and research level of the teaching staff(Shalka, 2017), improve the quality of talent training, create distinctive majors(Straker1, 2016; Sun and Soden, 2021), and improve the international reputation of the country(Wen etc, 2018; Tukur etc, 2022).

Third, we should optimize and improve the education export structure and promote the diversification of the education export market. For the export market that has been excessive trade, we should reasonably control its development scale, and for those markets that have insufficient trade and still have potential, we should vigorously explore. In addition, because geographical distance and cultural distance have a significant inhibitory effect on education export(Singh etc, 2014), we should

also give priority to the adjacent markets with small cultural differences, and then we should consider other distant markets with large cultural differences.

Fourth, we should vigorously promote the mutual recognition of academic qualifications and academic degrees between countries. Mutual recognition of academic qualifications and degrees is of great significance for promoting the communication among students(Yan and Guo, 2017), teachers, and researchers from various countries(Ding, 2016; Deuchar, 2022), deepening the recognition and the understanding of citizens of different cultures(Phan etc, 2019), strengthening the cooperation between higher education(Kobayashi, 2015), and realizing the sharing of educational resources. Educational organizations and universities should actively expand international cooperation and exchanges(Moskal, 2017; Qadeer etc, 2021), and they should draft and reach agreements to promote the flow of students and the mutual recognition of degrees and degrees as soon as possible.

6. Conclusions

This paper uses the panel data from 2006 to 2018 to conduct an empirical study on the export potential of China's education service trade by using the time-varying stochastic frontier gravity model. The main conclusions are as follows: (1) Many important factors have a significant positive impact on China's education exports, such as he GDP of the two countries, the population size of the source country, China's direct investment in the source country, the number of Chinese universities, the number of Confucius Institutes, and mutual recognition agreements. The geographical distance, cultural distance, and scholarship ratio between the two countries have all become negative obstacles. (2) By measuring the export potential of different countries, it is found that the average export efficiency of China's education services from 2006 to 2018 is 0.62, and countries basically present a state of "trade shortage", and the market development space is still large. The countries with the highest export efficiency include the United States, Germany, and South Korea, all with efficiency values above 0.81. The export efficiency to the United Arab Emirates, Kuwait, and Georgia is the lowest, and the export potential is above 0.95, among which the West Asian market has the greatest development potential. (3) The overall export efficiency to non-"Belt and Road" countries is higher than those of "Belt and Road" countries.

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