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### 4.2.1 Construction of time-varying stochastic frontier gravity model

On the basis of the above analysis, this paper selects the export value of cultural products between China and South Korea as the dependent variable, and selects the gross domestic product, whether there is a common language with China and South Korea, population, geographical distance and whether to sign a free trade agreement as independent variables to construct Model. In the model, all variables except dummy variables were logarithmically processed to ensure dimensional consistency.

$$\ln EXP_{ijt} = \beta_0 + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 \ln POP_{it} + \beta_4 \ln POP_{jt} + \beta_5 \ln Dis\ tan\ ce_{ij} + \beta_6 LAN_{ij} + v_{ijt} - u_{ijt}, u_{ijt} \geq 0 \quad (6)$$

In formula (6), i and j represent the exporting country and the importing country, respectively. A description of each indicator is shown below.

(1) GDP represents the total GDP of exporting countries or trading partners of cultural products in year t. It is generally believed that GDP plays an active role in promoting the export scale of cultural products. From the perspective of the supply side, the higher the GDP of the exporting country (region), the higher the level of economic development, and the exporting country will have more capital to invest in the development of cultural industries. From the perspective of demand, the higher the country's GDP, the greater the demand for culture.

(2) POP represents the population size of the cultural product exporting country or its trading partners in year t. Population size affects not only the supply of a country's cultural products but also the demand.

(3) Distance represents the geographical distance between the exporting country of cultural products and the trading country (region). It refers to the distance between the capitals or regional centers of two countries. The increase of geographical distance will lead to the increase of logistics cost, which is not conducive to the development of trade. In addition, the length of geographical distance will also affect the degree of cultural exchanges between the two countries.

(4) LAN indicates whether the exporting country and importing country (region) of cultural products have a common language. This variable takes into account the language similarity between China and South Korea as a whole with their trading partners. The closer the language, the higher the acceptance of cultural products and the greater the demand for cultural products. This variable is a dummy variable, if the language similarity is large, it is marked as 1. If the language similarity is weak, the flag is 0.

### 4.2.2 Construction of trade inefficiency model

Based on the above analysis, this paper selects the cultural distance between China and South Korea,

government efficiency, whether to sign free trade agreements with trading partners and trade freedom as explanatory variables, and constructs the following model.

$$u_{ijt} = \alpha_0 + \alpha_1 FTA_{ijt} + \alpha_2 GULD_{ijt} + \alpha_3 GE_{ijt} + \alpha_4 TF_{ijt} + \varepsilon_{ijt} \quad (7)$$

In formula (7), *i* and *j* represent the exporting country and the importing country, respectively, and the explanation of each variable is as follows.

(1)  $FTA_{ijt}$  represents whether the exporting and importing countries (regions) of cultural products have signed a Free Trade Agreement (FTA) in year *t*. If the two countries (regions) signed a free trade agreement, the variable value is 1, otherwise it is 0. Signing a free trade agreement can reduce the restrictions on the trade of products between the two countries, thereby promoting the trade of cultural products.

(2)  $GULD_{ijt}$  represents the cultural distance between the exporting country and the importing country (region) of cultural products in year *t*. Similar cultures can promote the residents of the exporting country to accept the cultural products of the exporting country, thereby promoting the trade of cultural products between the two countries.

(3)  $GE$  stands for Government Efficiency. The development of a country's trade depends to some extent on the efficiency of its government. Generally speaking, the better the government efficiency, the better the trade growth between the two countries (regions).

(4)  $TF$  represents the degree of freedom of trade. It refers to the degree of openness of a country or region to imported goods or services. Export trade efficiency increases with the degree of trade facilitation in importing countries.

#### 4.2.3 Sample selection and data sources

This paper includes the trade data from 2002 to 2019 of 25 countries or regions that trade more cultural products with China and South Korea. 25 countries are China, South Korea, Japan, the United States, Italy, India, Singapore, Malaysia, the Netherlands, Spain, Canada, the United Kingdom, Germany, France, Brazil, the Philippines, Vietnam, Saudi Arabia, the United Arab Emirates, Thailand, Indonesia, Mexico, Russia, South Africa and Hong Kong.

The export value of cultural products of China and South Korea to trading partners is from the UN Comtrade Database. The GDP of the trading countries and the population of the trading countries are from the WDI database. Whether China uses a common language with other countries (regions) comes from the CEPII database. In this paper's trade inefficiency model, the data on whether the two countries have signed a free trade agreement come from the China Free Trade Zone Service website. The cultural distance data comes from the official Hofstede website. Data on trade freedom comes from the Economic Freedom

website. Government efficiency data comes from the World Data Atlas.

### 4.3 Hypothesis Testing

Whether to introduce a trade inefficiency term and use a time-varying stochastic frontier gravity model requires an LR test. First, this paper needs to test whether the trade inefficiency term exists. Assuming that the trade inefficiency term does not exist, if the original hypothesis is rejected, it means that the value of  $\gamma$  is relatively close to 1, and  $u_{ijt}$  accounts for a high proportion of the random error term, so it is more reasonable to use the stochastic frontier gravity model. Conversely, the reason for the actual export inefficiency is  $v_{ijt}$ .

In this paper, the value of  $LR=-2[\ln(H0)-\ln(H1)]$  is compared with the critical value of 1% of the chi-square distribution. The test results are shown in the following TABLE VII:

**TABLE VII. Hypothesis Test of Stochastic Frontier Gravity Model**

Null Hypothesis	Constraint Model	Unconstrained Model	LR Statistic	P-value	Test Results
$U_{ijt}$ does not exist (China)	-1149.12	-62937	1039.49	0.0000	reject
$U_{ijt}$ time-invariant (China)	-913.13	-531.21	763.84	0.0000	reject
$U_{ijt}$ does not exist (South Korea)	-756.59	-648.19	216.79	0.0010	reject
$U_{ijt}$ time-invariant (South Korea)	-324.67	-231.25	186.84	0.0000	reject

According to the hypothesis test results, it can be found that the empirical research effect of using the time-varying stochastic frontier gravity model is better for South Korea and China.

### 4.4 Empirical Results

The data of cultural products trade from 2002 to 2019 in China and South Korea for 25 countries or regions were regressed, and the results are shown in TABLE VIII.

**TABLE VIII. Time-varying Stochastic Frontier Model Results for China and South Korea**

Variable	Export of Chinese Cultural Products		Export of Korean Cultural Products	
	Stochastic Frontier Gravity Model	Trade Inefficiency Model	Stochastic Frontier Gravity Model	Trade Inefficiency Model
$\ln GDP_{it}$	1.2055*** (0.309)		-11.6809 (14.000)	
$\ln GDP_{jt}$	0.9875*** (0.045)		16.6904*** (2,266)	
$\ln POP_{it}$	•18.2210** (8.699)		-3.7742 (5.560)	
$\ln POP_{jt}$	-0.5265*** (0.040)		-0.1295 (0.090)	
$\ln Distance_{ij}$	-0.4333*** (0.069)		-1.0670*** (0.073)	

LAN <sub>ij</sub>	0.0999***		-0.0000	
	(0.109)		(0.000)	
GE <sub>ijt</sub>		-5.4860***		-0.2035*
		(4.286)		(0.110)
GULD <sub>ijt</sub>		8.4426***		-0.0467
		(1.777)		(0.074)
TF <sub>ijt</sub>		11.9164		-1.0149**
		(8.497)		(0.421)
FTA <sub>ijt</sub>		-1.8267*		-0.1952**
		(1.920)		(0.134)
Constant	353.1275**	-144.4157***	79.8440	5.5699
	(173.949)	(34.400)	(65.637)	(28.212)
u	2.3746***		0.2473***	
	(0.312)		(0.488)	
v	-0.2867***		0.3669***	
	(0.074)		(0.392)	
γ	0.8346***		0.3124***	
	0.027***		0.009***	
η				
Observations	450	450	450	450

Data source: STATA 17 calculation and finishing

#### 4.4.1 Analysis of results

In China's time-varying frontier gravity model for 25 countries (regions), the coefficients of China's GDP to 25 countries (regions) are all positive. Compared with other factors, the estimated coefficients of both are relatively large and both pass the 1% significance test. The higher the level of China's economic development, the more funds China invests in the development of the cultural industry, and the stronger its ability to export to the outside world. At the same time, the improvement of China's economic strength is conducive to foreign countries' understanding of China and enhance their understanding and recognition of Chinese culture. In contrast, the estimated coefficient of  $\text{LnGDP}_{it}$  is 0.218 larger than that of  $\text{LnGDP}_{ji}$ . This shows that China's own GDP growth has a stronger impetus for its cultural product exports. In Korea's time-varying frontier gravity model for 25 countries (regions), the coefficients of Korea's GDP to 25 countries (regions) are inconsistent. Korea's GDP coefficient fails the significance test. The  $\text{LnGDP}_{jt}$  coefficient of the trading countries (regions) is very large, which means that the larger the GDP of the trading countries (regions), the greater the demand for Korean cultural products. This shows that the Korean cultural product trade is more competitive with China.

For the indicator geographic distance  $\text{LnDistance}$ , the coefficients of China and South Korea are negative and significant. This shows that with the development of productive forces, the logistics level of various countries has been greatly improved, but the geographical distance is still an important factor hindering the trade of cultural products between the two countries. The absolute value of the  $\text{LnDistance}$  coefficient of South Korea is larger than that of China, which indicates that geographical distance has a greater impact on the export of Korean cultural products.

In terms of population factors, in China's model results for 25 countries (regions), the coefficients of  $\text{LnPOP}_{it}$  and  $\text{LnPOP}_{jt}$  are -18.2210 and -0.5265, respectively, and are significant at the 5% and 1% confidence levels, respectively. This may be due to the increase in demand caused by the growth of China's population. The consumption of cultural products gives priority to domestic demand. In South Korea's model results for 25 countries (regions), the coefficients of  $\text{LnPOP}_{it}$  and  $\text{LnPOP}_{jt}$  are not significant. This may be due to the fact that South Korea has a small population and it is difficult to form a scale effect.

The results of the indicator LAN are only significant in China's time-varying stochastic frontier gravity model for 25 countries (regions). This shows that language exchange between the two countries (regions) is conducive to promoting the export of Chinese cultural products. Although the popularity of the Internet and the development of economic globalization have lowered the barriers to language communication, language factors still have a great impact on cultural trade.

#### 4.4.2 Analysis of trade inefficiency model results

As shown in TABLE VIII, the values of the Y coefficients for China and Korea are 0.8346 and 0.3124, respectively. China's Y coefficient is close to 1, which shows that trade inefficiency is the main reason for hindering trade exports. The Y coefficient of South Korea is smaller than that of China, which indicates that South Korea's trade inefficiency level is lower than that of China.

Among the coefficients of the indicator  $\text{GE}_{ijt}$ , the model coefficients of China and South Korea for 25 countries (regions) are -5.4860 and -0.2035, respectively, and are significant at the 1% and 10% confidence levels. This shows that government efficiency has played a role in promoting the export of cultural products between China and South Korea. China's government efficiency index model coefficient is very large, which shows that the improvement of government efficiency will greatly improve China's cultural product exports. The improvement of government efficiency is less of a boost for South Korea.

The coefficient of Chinese cultural distance index  $\text{GULD}_{ijt}$  is 8.4426, which is relatively large. This means that the cultural distance between China and the importing country is an important factor hindering the export of cultural products. The large cultural distance between the two countries indicates that the cultural differences between the two countries are relatively large, which is not conducive to the understanding of the exporting country's culture by importers and exporters.

The trade freedom index  $\text{TF}_{ijt}$  is only significant in South Korea's model results for 25 countries (regions), and its coefficient is -1.0149. This shows that the improvement of trade freedom can improve the foreign trade efficiency of Korean cultural products. For China, trade freedom has a weaker role in promoting the export of Chinese cultural products.

In terms of the indicator  $\text{FTA}_{ijt}$ , the coefficients of China and South Korea are -1.8267 and -0.1952, respectively, and are significant at the 10% and 5% confidence levels, respectively. This shows that the

signing of FTAs between trading countries can effectively reduce trade inefficiencies. The signing of free trade agreements can effectively reduce trade costs.

## **V.CONCLUSION**

Comparing the import and export scale and structure of cultural products between China and South Korea, it is found that the import and export scale of Chinese cultural products is relatively large. However, exports are mainly low value-added products, and the structure of cultural products needs to be improved. The import and export scale of cultural products in South Korea is relatively small, but the export is mainly high value-added products, and the international competitiveness is relatively strong. Using MS, TC, and RCA indices to quantitatively compare the competitiveness of cultural products in China and South Korea, it is found that the international competitiveness of cultural products trade between China and South Korea is relatively high, but the competitiveness of China's cultural products improves slowly. China should seize the opportunity to strengthen the development of the digital cultural industry and further enhance the international competitiveness of cultural products.

From 2002 to 2019, the overall efficiency of China's cultural products export trade was relatively high. However, compared with South Korea, the export of Chinese cultural products is greatly affected by the inefficiency of trade, and there is a lot of room for improvement. However, the export efficiency of Korean cultural products is relatively high, and the development has been relatively stable. There is little room for improving the level of trade exports by improving the inefficiency of trade. The factors affecting South Korea's foreign trade exports are mainly affected by other unexpected factors.

From the perspective of the factors affecting the export of cultural products between China and South Korea, the size of the GDP of both sides of the trade has a greater impact on the export of cultural products. The export of Korean cultural products is mainly driven by the GDP of the trading country, and is less affected by the GDP of the country. besides. Whether there is a common language with the exporting country is also an important factor in promoting the trade of cultural products. Although the logistics cost of import and export is decreasing with the development of productivity, geographical distance is still an important factor restricting export.

From the perspective of the influencing factors of the trade non-efficiency item, the cultural differences, trade freedom, government efficiency and whether to sign a free trade agreement between the two countries have different effects on the export of cultural products between China and South Korea. Among them, the improvement of government efficiency has a great effect on reducing the inefficiency of trade in China.

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