

Empirical Analysis of China - Eastern Europe Agricultural Trade: Gravity Model Approach

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Abstract: The China-Eastern Europe agricultural trade has undergone great changes in recent years. It is very necessary to take a deep look into the factors that influence the bilateral trade. The empirical research based on Gravity model demonstrates that the economical scale and the population size of both China and Eastern Europe have positive effects on agricultural trade, and the effect of economical scale is greater than that of population size on agricultural trade. While the geographical distance and EU enlargement have negative effects on agricultural trade between two sides. The research also demonstrates that the agricultural trade between China and Eastern Europe conforms to Linder's "demand similar theory". We also estimated potential of China-Eastern Europe agricultural trade.

Keywords: Eastern Europe; agricultural trade; Gravity model

1 Introduction

In recent years, the Eastern European economic and trade environment has undergone big changes. With the acceleration of the EU's eastward enlargement, Poland, Hungary, the Czech Republic, Slovakia, Slovenia joined the European Union in 2004. Bulgaria and Romania also joined the EU in 2007. Thus, it seem very necessary to take a deep look into the factors, which can impact the trade of agricultural products between China and Eastern Europe, and the development prospects after the EU's eastward enlargement in Eastern Europe.

At present, China domestic research on Eastern Europe mainly focus on the overall impact of the European Union's Eastward Expansion on economic and trade relations between China and European Union countries (Li,2004). The study of the impact on the agricultural trade between China and European Union countries after the EU's eastward enlargement is even fewer. Tinbergen(1962) and Poyhonen(1963) were the first authors to apply the gravity equation to analyze international trade flows. Since then, the gravity model has become a popular instrument in empirical foreign trade analysis. Some western scholars query on market systems of China and Eastern Europe countries, therefore, the empirical studies in these kind of economies based on gravity models is not so many. As a repre-

sentative case, Matthieu et al. (2005) calculated in the total GDP of Eastern European countries as well as the geographical distance between the capital cities which is supposed to has impact on bilateral investment flow, and finally found that bilateral investment flow is correlated with the total GDP and is negative related with distance. China domestic use of gravity model research mainly concentrated in China's foreign trade, exports of agricultural products, and the effects of technical barriers to trade, as well as the impact of regional economic integration in ASEAN and so on (Tian et al, 2005; Zhuang et al, 2007). There is no research making use of gravity model to estimate impacts of geographic, economic and policy factors on China-European countries agricultural trade, at present.

2 The Factors Influencing the China-Eastern Europe Agricultural Trade

China's imports of agricultural products from Eastern Europe mainly are animal products, other agricultural products, fruits and some aquatic products. In 2007, Animal products and other agricultural imports, respectively, account for 52% and 32% in China's total imports of agricultural products from Eastern Europe. In China's imports of animal products, other agricultural products, fruits and aquatic products from Eastern Europe, Poland has topped the list, and especially in aquatic products (see table 1). It can be seen that Poland, Romania and the

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Czech Republic and other countries enjoy relatively high market share in China's import and export of agricultural products in Eastern Europe.

Table 1. The main varieties of agricultural trade and market distribution in China and Eastern Europe in 2007 Unit: %

Varieties	The proportion of exports from China to Eastern Europe	Major export markets & market shares		
Animal products	24	Poland (72)	Romania (10)	Albania (8)
Aquatic products	19	Poland (79)	Slovakia (7)	Romania (5)
Vegetables	16	Romania (32)	Poland (30)	Czech Republic (12)
Other agricultural products	15	Romania (32)	Poland (30)	Hungary (8)
Varieties	The proportion of imports from Eastern Europe to China	Major import markets & market shares		
Animal products	52	Poland (57)	Czech Republic (33)	Hungary (8)
Other agricultural products	32	Poland (42)	Czech Republic (32)	Bulgaria (9)
Vegetable	11	Poland (77)	Bulgaria (19)	Serbia & Montenegro(4)
Aquatic products	5	Poland (91)	Bulgaria (8)	Croatia (1)

Source: Based on 2000 ~ 2007 Monthly Bulletin of Statistics, China Customs data processing, part of the data from the Ministry of Agriculture Trade Promotion Center.

What are the influencing factors of Chinese-Eastern European countries agricultural trade? After making a review of related literature on China's agricultural trade with Eastern European countries, we think the main infl-

Table 2. GDP of Eastern European countries & China (billion U.S. Dollars)

Nation/Area	1996	2006	Nation/Area	1996	2006
Poland	156.7	335.7	Serbia and Montenegro	19.4	35.9
Romania	35.6	121.6	Croatia	19.9	42.2
Hungary	46.4	112.0	Slovenia	20.5	36.9
Czech republic	62.0	141.2	Eastern Europe on average	43.5	101.2
Bulgaria	9.9	30.4	China	892.0	2666.8
Slovakia	21.4	55.1			

Source: Data of 1996 from the United Nations Conference on Trade (UNCTAD) Statistical Yearbook; Data of 2006 from World Bank.

uencing factors are as follows:

A. Economic scale. We can see from Table 2 that economic scales are quite different.

B. Population size. According to overall size of population, the consumer market of agricultural products in Eastern Europe is much less than that of China. Different religious beliefs and eating habits lead to different consumption structure(see table 3).

Table 3. Population size of Eastern European countries and China (thousand people)

Nation/Area	1996	2006	Nation/Area	1996	2006
Poland	3863	3810	Slovakia	537	540
Romania	2263	2160	Serbia & Montenegro	1077	950
Hungary	1027	1010	Croatia	437	440
Czech	1032	1030	Slovenia	191	200
Bulgaria	818	770	China	121755	131140

Source: Data of 1996 from Organization for Economic Cooperation and Development (OECD); Data of 2006 from the UN food and Agricultural Organization (FAO) database.

C. Geographical distance. The length of transport distance has important impact on the scale of agricultural trade and trade species. We can see from Table 4 that the distances between China and Eastern European countries are quite long.

Table 4. The distance between Chinese Beijing and other capitals of Eastern European countries Unit: kilometer

Nation/Area	Distance	Nation/Area	Distance
Poland	7364	Slovakia	7422
Romania	7686	Serbia & Montenegro	7723
Hungary	6948	Croatia	6372
Albania	7068	Slovenia	7616
Czech re-public	7347	Macedonia	7419
Bulgaria	7462	Bosnia-Herzegovina	7531

Source: French International Research Center forecast(CEPII)

D. Demand structure. From table 5, demand difference based on per capita GDP is very evident, and the level of per capita consumption of agricultural products in Eastern European countries is higher than that in China. Note that the difference between per capita GDP equals per capita GDP of a Eastern Europe country minus per capita GDP of China. The mean value of per capita GDP difference in one year equals the mean value of the dif-

ference in per capita GDP between China and Eastern European countries in that year.

E. Policy and institution. For Eastern European countries, policy changes brought by the EU's eastward expansion are great in politics, economy, trade and other aspects. Besides, different model and process of economic transition in Eastern European countries lead to quite obvious difference in economic institution.

Table 5. Per capita GDP gap of China and Eastern European countries Unit: Dollar

Nation/Area	1996	2006	Nation/Area	1996	2006
Poland	3323	6777	Slovakia	3246	8165
Romania	839	3595	Serbia & Montenegro	1072	1743
Hungary	3784	9055	Croatia	3812	7566
Czech	3221	11680	Slovenia	9959	16417
Bulgaria	478	1919	Per capita GDP on average	3304	7435

Note: the per capita GDP difference = per capita GDP of a Eastern European country - per capita GDP of China, and the mean value of per capita GDP difference in one year = the mean value of the difference in per capita GDP between China and Eastern European countries in that year.
Source: GDP data of 1996 from the United Nations Conference on Trade (UNCTAD) Statistical Yearbook; GDP data of 2006 from World Bank.

3 The Agricultural Trade Gravity Models

3.1 The Establishment of Models

The general logarithmic equation of the Trade Gravity Model are as follows:

$$\ln F_{ij} = R_j + \alpha \ln M_i + \beta \ln M_j - \theta \ln D_{ij} + \gamma \ln X_{ij} + \varepsilon_{ij} \quad (1)$$

In Formula (1), F_{ij} represents the bilateral trade volume between Country i and Country j ; M_i and M_j are the economic aggregates of the two countries; D_{ij} is the geographical distance between two countries, which is generally measured as either the space distance between the political or economical centers or the navigation distance between the major ports of the two countries; X_{ij} is the vector collection which helps explain some other variables of bilateral trade, including population, language barriers, regional economic organization, government policy and so on; R_j acts as a constant; α , β , θ , γ are parameters to be estimated;

ε_{ij} is the random perturbation item. This article has respectively established Gravity Models to conduct a quantitative assessment.

A. China-Eastern Europe Bilateral agricultural trade Gravity Model. In order to observe the overall scale of economy, population, space distance and so forth, the following Gravity Model equation is adopted.

$$\ln F_{ij} = \alpha \ln(Y_i \times Y_j) + \beta \ln(P_i \times P_j) + \theta \ln D_{ij} + \varepsilon_{ij} \quad (2)$$

In Formula (2), F_{ij} represents the bilateral trade volume between China and countries of Eastern Europe; Y_i and Y_j respectively stand for the GDP of China and Eastern European countries; P_i and P_j respectively stand for the population of China and Eastern European countries; while D_{ij} is the distance between the capitals of the two countries.

B. The effect of demand similarity on China-Eastern European Countries agricultural trade. The absolute value of difference of the GDP per capita between countries is frequently used to examine the effect of Linder's "demand similar theory". Formula (2) can be extended as follows:

$$\ln F_{ij} = \alpha \ln(Y_i \times Y_j) + \beta \ln(P_i \times P_j) + \theta \ln D_{ij} + \lambda \ln DG_{ij} + \varepsilon_{ij} \quad (3)$$

In Formula (3), DG_{ij} is the per capita GDP difference between China and a country of Eastern Europe.

C. The effect of EU enlargement on China-Eastern European Countries agricultural trade. To examine the effect of EU enlargement, the article brings it into the model as a dummy variable. Thus, Formula (4) is derived as follows:

$$\ln F_{ij} = \alpha \ln(Y_i \times Y_j) + \beta \ln(P_i \times P_j) + \theta \ln D_{ij} + \eta \ln EU_{ij} + \varepsilon_{ij} \quad (4)$$

In Formula (4), EU represents each Eastern European country that joined EU in 2004. $EU = 1$ if a country joined EU, 0 otherwise.

3.2 The Empirical Results and Analyses

The regression results of China-Eastern European countries agricultural trade gravity model is shown in Table 6.

Table 6. The regression results of China-Eastern countries agricultural trade gravity model

	Regression equation (2)		Regression equation (3)		Regression equation (4)	
	Coefficient	t value	Coefficient	t value	Coefficient	t value
$\ln(Y_i Y_j)$	1.12	10.23***	1.49	7.16***	0.78	3.14***
$\ln(P_i P_j)$	0.43	3.37***	0.04	0.16	0.41	1.93*
$\ln D_{ij}$	-2.10	-9.52***	-1.60	-4.98***	-1.44	-6.16***
$\ln DG_{ij}$	—	—	-0.37	-2.10**	—	—
EU_{ij}	—	—	—	—	-0.27	-0.94
Adj R ²	0.70		0.71		0.78	

Note: ***, **, * respectively represent the significant level of 1%, 5% and 10%.

A. The regression results in Equation (2) show the coefficient of each variable conforms to theoretical expectation, and all reach the significant level of 1%. The adjusted R² equal 0.70, displaying a much better model fitting (as shows in table 6).

B. The regression results in Equation (3) show each variable coefficient is in line with theoretical expectation, and the majority of variables are above 5% significant level, adjusted R² can reach 0.71 (see Table 6).

C. The results of equation (4) shows that the coefficients of all variables are consistent with the theoretical expectations, and the majority of the variables reach 10% significant level. The adjusted R² equals 0.78 that means the model fit better (see Table 6).

D. If the actual value of agricultural trade is lower than that of simulated value under ideal conditions, we regard it as "lack of trade", the opposite is called the "over-trading" (Zhuang, 2007). See the results in table 7.

According to ratio of actual value to simulated value, regional disparities can be divided into three types:

The first type is the great potential model. The ratio of actual value to simulated value is less than or equal to 0.80, which consist of Poland, Hungary, Romania, Czech Republic and Slovakia. The political, economic, social environment of this kind of Eastern European countries are of relatively stable and the level of agricultural development is similar to that of China.

The second type is the potential development model. The ratio of actual value to simulated value is among 1.20 to 0.80, which consist of Croatia, Serbia and Montenegro. These countries belong to former Yugoslav Republics. Although there is the complementary nature of economic structure between China and these countries, political instability of these countries has put restrictions on agricultural trade.

Table 7. Estimation of China-Eastern European Countries agricultural trade potential in 2006 (1000 U. S. Dollar)

Nation/Area	actual value	simulated value	actual value/ simulated value
Bulgaria	19787.1	10814.8	18.3
Croatia	11362.6	11562.3	9.8
Hungary	18980.8	52249.8	3.6
Poland	209145.4	353640.1	5.9
Romania	63214.3	86089.4	7.3
Serbia and Montenegro	12368.2	14004.6	8.8
Slovakia	8900.7	17703.7	5.0
Slovenia	17518.0	6803.2	25.7
Czech Republic	27230.3	66083.4	4.1

The third type is the potential remodeling model. The ratio of actual value to simulated value is more than or equal to 1.20, which consist of Bulgaria, Slovenia. Although the agriculture of Bulgaria has brought a higher level of development, these nations still lack a certain degree of stability.

4 The main conclusions

The empirical research of gravity models demonstrates that the economical scale and the population size of both China and Eastern European countries has positive effect on agricultural product trade, and the effect of economical scale is greater than population size on agricultural product trade. While the geographical distance and EU enlargement has negative effect on agricultural product trade between two sides. The research also demonstrates that the agricultural product trade between China and Eastern Europe conforms to Theory of Preference Similarity, namely the bilateral per capita national income level and demand structure's difference does not favor bilateral agricultural product trade. Considering the multilevel nature of the production and consumption of the agricultural product in Eastern European countries, the main tasks for future is to reinforce the coordination of economic policies & products quality standards, and to make stable markets.

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