Agricultural Products Trade between China and Five Central Asian Countries under the Belt and Road Initiative: Empirical Study by Trade Gravity Model

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ABSTRACT

According to the monthly import and export report by the Ministry of Commerce of PRC, China, a higher degree of market concentration is in a trade deficit with the five Central Asian countries in agricultural products trade. Among the five countries, Uzbekistan is an important importer and exporter of agricultural products for China, while Kazakhstan is the largest importer. The thesis, by establishing the gravity model of agricultural products trade between China and five Central Asian countries as well as, using the panel data of 2006 to 2015 found that the economic scale and population size could facilitate bilateral trade. It is noteworthy to mention that effects by the economic scale are greater than that by the population size. Agricultural products trade between China and the five Central Asian countries is fit to Linder’s “demand similarity theory” which proves that the huger the bilateral differences of per capita GDP, the poorer the development of the agricultural products trade. “The Belt and Road Initiative” strategy promotes the development of the agricultural products trade between China and the five Central Asian countries. It, however, does not exert a very significant effect on that so far.

Key words: The Belt and Road Initiative, five Central Asian countries, agricultural products trade, gravity model, demand similarity theory.

INTRODUCTION

In 2013, along with the implementation of the strategic conception of “the Belt and Road Initiative”, it has been exerting a significant impact on the economic development of China and countries lying along the Belt and Road. Serving as a hub in Eurasian continent, the five Central Asian countries are the pivots for exchanges and communications between China and countries along the road. In this sense, the five Central Asian countries act as the core areas in the Silk Road Economic Zone. From the perspective of geopolitical strategy as well as trade exchanges, the five Central Asian countries are the keys to ensuring the smooth flow of trade (Hu et al., 2014). Besides, they also serve as the main carrier for the development of the Silk Road Economic Zone (Feng et al., 2015).

LITERATURE REVIEW

There are several researches on the agricultural products trade between China and the five Central Asian countries such as: agricultural products trade model (Chen et al., 2014), factors influencing the export of agricultural products (Gong et al., 2014), potential of agricultural products trade (Tan, 2016), complementarity of agricultural products trade (Li et al., 2011). As the five Central Asian countries are traditional agricultural countries, agricultural products trade, a vital cooperation field, not only enjoys a sound foundation in their bilateral trade with China, but also serves as an important engine facilitating the construction of the Silk Road Economic Zone.
By analyzing the existing research literature, the author found that there were few papers analyzing the agricultural products trade between China and the five Central Asian countries in a quantitative manner from the empirical perspective. In addition, the data used was out of date. Against the backdrop of “the Belt and Road Initiative”, this paper, starting from the agricultural products trade data from 2006 to 2015 between China and the five Central Asian countries, focuses on studying the bilateral trade of agricultural products by means of the gravity model.

Analysis on the current situation of agricultural products trade between China and the five Central Asian Countries

In recent years, the development trend of agricultural products import and export between China and the five Central Asian countries shows sharp differences (Figure 1). The export of agricultural products from China to the five Central Asian countries, on the whole increased yearly except a slight decline in 2009 and 2015. China’s imports of agricultural products from the five Central Asian countries, however, showed a trend of fluctuation in general. The trade volume of imports at the peak amounted to 618 million dollars in 2006, after which it turned out to subsequently decline on a yearly basis.

In 2009, it reached the minimum value with 250 million dollars. It once again reached the peak in 2010 with 814 million dollars. One year later, the trade volume of imports decreased to 608 million dollars, but it reached the peak in 2012 with 854 million dollars. Then, it showed a trend of decreasing yearly and in 2015 reached a trough with 507 million dollars. In addition, the development trend of the trade volume of agricultural products import and export between China and the five Central Asian countries appeared to be the same as that of China’s import from the five Central Asian countries.

Factors affecting the agricultural products trade between China and the five central Asian countries

Along with further implementation of “the Belt and Road Initiative” strategy, there is a huge market potential for the agricultural products trade between China and the five Central Asian countries. The way to better tap the market potential is to further analyze the influence factors of agricultural products trade between China and the five Central Asian countries as well as to provide feasible policies and recommendations to optimize bilateral agricultural products trade.
Table 1: The distance between the capital of China and that of the five Central Asian countries (Unit: km).

<table>
<thead>
<tr>
<th>Country</th>
<th>Dist cap</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uzbekistan</td>
<td>3944</td>
</tr>
<tr>
<td>Kyrgyzstan</td>
<td>3472</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>3656</td>
</tr>
<tr>
<td>Tajikistan</td>
<td>4053</td>
</tr>
<tr>
<td>Turkmenistan</td>
<td>4940</td>
</tr>
</tbody>
</table>

Source: French International Centre for prediction studies (CEPII).

Table 2: GDP of China and the five Central Asian countries (Unit: billion dollars).

<table>
<thead>
<tr>
<th>Country</th>
<th>2006</th>
<th>2010</th>
<th>2014</th>
</tr>
</thead>
<tbody>
<tr>
<td>Uzbekistan</td>
<td>170</td>
<td>393</td>
<td>626</td>
</tr>
<tr>
<td>Kyrgyzstan</td>
<td>28</td>
<td>48</td>
<td>74</td>
</tr>
<tr>
<td>Kazakhstan</td>
<td>810</td>
<td>1480</td>
<td>2122</td>
</tr>
<tr>
<td>Tajikistan</td>
<td>28</td>
<td>56</td>
<td>92</td>
</tr>
<tr>
<td>Turkmenistan</td>
<td>103</td>
<td>221</td>
<td>479</td>
</tr>
<tr>
<td>Five Central Asian countries' average GDP</td>
<td>228</td>
<td>440</td>
<td>679</td>
</tr>
<tr>
<td>China</td>
<td>217657</td>
<td>408903</td>
<td>635910</td>
</tr>
</tbody>
</table>

Source: Data in 2010 and 2014 is from National Bureau of the Statistics of the PRC and in 2006 from the World Bank.

Being an important tool to study the decision model of trade volume, gravity model was originally used in the international trade analysis by Tinbergen (1962) and Poyhomen (1963) and was later been widely used around the world at large. The original form of this model was in the formula: \( F_{ij} = R \times \frac{M_i M_j}{D_{ij}} \), in which \( F_{ij} \) refers to the total bilateral trade volume, \( R \) to proportional constant term, \( M_i \) and \( M_j \) to country I’s and country J’s GDP respectively and \( D_{ij} \) to the geographical distance between I and J. According to the gravity model, the economic scale and distance between the two countries are the main factors deciding their bilateral trade.

In accordance with the production factor endowment and regional economic integration theory, both physico-geographical and socio-geographical factors have significant effects on the international trade. Afterwards, a series of exogenous variables were introduced into the model with the change of application environment and deepening of the research (Gu, 2001; De, 2010), which mainly included population size, preferential trade agreement, trade limited measures, colonial relationship, languages, per capita income, exchange rate, national consumption standards as well as, whether having common boundaries and belonging to the same economic organization.

There are several factors affecting the agricultural products trade between China and the five Central Asian countries. They are outlined as:

**Geographical distance**

Although Kazakhstan, Kyrgyzstan and Tajikistan, as one party, are neighboring with the west of China, they are far away from China geographically due to the vast territory of China as well as underdeveloped transportation in the five Central Asian countries (Table 1). The average distance reaches 4013 km from Beijing, capital of China, to the respective capitals of the five Central Asian countries by measuring the distance between them. Table 1 shows that Turkmenistan is the farthest from China with 4940 km and Kyrgyzstan is the nearest with 3472 km.

The natural environment exerts a great impact on agricultural products in such links as production, storage, transportation and marketing and the transportation distance has an important influence on the scale and variety of agricultural products trade in particular. In addition, China is far from the five Central Asian countries, which means to some extent, there are differences in the resource endowments of the production of agricultural products, thus, the comparative advantages of agricultural products in bilateral trade also appears in different ways.

**Economic scale**

There are huge economic scale gap between China and the five Central Asian countries in terms of GDP (Table 2). The average GDP of the five Central Asian countries enjoyed a fast growing pace, increasing from 22.8 billion dollars in 2006 to 67.9 million dollars in 2014. It is, however, only equal to 0.11% of China’s GDP. Kazakhstan boasts the highest GDP in the five Central Asian countries, but its GDP is only equal to 0.3% of that of China. Compared with 2006 and 2010, the GDP gap between China and the five Central Asian countries is also increasingly expanding, which shows that the differences of the potential supply and
demand capabilities between the two sides are also more and more significant.

Population size

Uzbekistan has the largest population (Table 3). In 2014, Uzbekistan had a population of 30.74 million, which was much less than that of China. On the whole, populations in the five Central Asian countries were all growing from 2006 to 2014. However, compared with that of China whose population increased 45.26 million at the same period, their growing was still in a smaller margin. Measured by the population size and population growth rate, the agricultural products consumption market in the five Central Asian countries is far smaller than that of China.

In addition, most residents in the five Central Asian countries believed in Islam, which means that their religious beliefs, customs, culture and eating habits are different from that in China. On this regards, the consumption structure of agricultural products between the two sides is of great difference.

Demand structure

There were sharp demand differences between China and the five Central Asian countries in terms of per capita GDP (Table 4). The per capita GDP gap between China and the five Central Asian countries expanded from 691 dollars in 2006 to 3082 dollars in 2014 under the condition of not taking inflation into account. The gaps between China on one side and the five respective Central Asian countries on the other were also different. China's per capita GDP was less than that of Kazakhstan, Turkmenistan and Tajikistan, especially of Kazakhstan and Turkmenistan. However, China's per capita GDP is more than that of Uzbekistan and Kyrgyzstan, especially of Uzbekistan.

Institution, policy and infrastructure

“The Belt and Road Initiative” strategy is of great importance to the development of both China and the five Central Asian countries and it will exert great influences on such aspects as politics, economy, trade and culture. However, the five Central Asian countries may require different processes to accept the “the Belt and Road Initiative” strategy, for there are a lot of significant differences in their politics, economy, infrastructure, economic development pattern as well as, agricultural production and consumption structure.

Construction of gravity model of agricultural products trade between China and the five Central Asian countries

Model construction

It often uses the logarithmic form in the empirical study to
analyze the factors affecting trade flow through the gravity model. The relationships among the factors in economic life are mostly in geometric form rather than the arithmetic form. In this sense, the logarithmic form can not only make the gravity formula linear-oriented, reducing the outliers in the data, but also avoid the abnormal distribution and the different variance of the residual data. The general equation of the trade gravity model is given as:

\[ 
\text{Ln}F_{ij} = R + \alpha\text{Ln}M_i + \beta\text{Ln}M_j - \theta\text{Ln}D_{ij} + \sigma\text{Ln}X_{ij} + \varepsilon_{ij} 
\]  
(1)

In the equation, \( F_{ij} \) refers to the bilateral trade volume between country \( i \) and country \( j \); \( M_i \) and \( M_j \) to the two countries’ GDP respectively; \( D_{ij} \) to the geographical distance between the two countries; \( X_{ij} \) is a vector set of other variables that affect bilateral trade between the two countries, including population size, language and national policies; \( R \) is a constant term, \( \alpha, \beta, \theta \) and \( \sigma \) are parameters to be estimated; \( \varepsilon_{ij} \) is a random disturbance.

In order to investigate the effects of economic scale, geographical distance and “the Belt and Road Initiative” strategy on agricultural products trade between China and the five Central Asian countries, three gravity models for quantitative research were constructed.

**Gravity model of agricultural products trade between China and the five Central Asian countries**

To estimate the overall impacts of the economic scale, population size and geographical distance on agricultural products trade between China and the five Central Asian countries, it designs the following gravity model (Zhang, 2008):

\[ 
\text{Ln}F_{ij} = \alpha\text{Ln}(M_i * M_j) + \beta\text{Ln}(P_i * P_j) + \theta\text{Ln}D_{ij} + \varepsilon_{ij} 
\]  
(2)

In the model, \( i=1 \) which refers to China; \( j=1,2,\ldots,5 \), which refers to the five Central Asian countries; \( F_{ij} \) to agricultural products trade volume between China and the five Central Asian countries; \( M_i \) and \( M_j \) to the GDP (unit: million dollars) of China and the five Central Asian countries respectively; \( P_i \) and \( P_j \) respectively to the population size (unit: ten thousand persons) of the two sides respectively, \( D_{ij} \) to their capitals’ geographical distance (unit: km) of the two sides.

**Influences of demand similarity on agricultural products trade between China and the five Central Asian countries**

In the empirical analysis, the absolute value of the differences of per capita GDP is used to test Linder’s “demand similarity theory”. While explaining the contradiction between the industrial products trade and traditional factor endowments theory (H-O theory) among major developed industrial countries after World War II, Linder, a Swedish economist, proposed the “demand similarity theory” which held the idea that the demand structure of a country depends on the per capita GDP of the country. The closer the per capita GDP of two countries, the more similar the demand structures and the greater needs for mutual demands, thus, the bilateral trade volume will enjoy a greater increase margin. Therefore, if the coefficient of per capita GDP differences is negative and statistically significant, it will show that demand similarity has a significant impact on the bilateral trade volume. Based on this, formula 2 is expanded as:

\[ 
\text{Ln}F_{ij} = \alpha\text{Ln}(M_i * M_j) + \beta\text{Ln}(P_i * P_j) + \theta\text{Ln}D_{ij} + \gamma\text{Ln}DG_{ij} + \varepsilon_{ij} 
\]  
(3)

In the aforementioned formula, \( DG_{ij} \) represents the per capita GDP differences between China and five Central Asian countries.

**Influences of “the Belt and Road Initiative” strategy on agricultural products trade between China and five Central Asian countries**

In 2013, China reached cooperation agreements with Kazakhstan and Uzbekistan on “the Belt and Road Initiative” strategy and achieved a great number of important fruits in various cooperation areas. In order to investigate the effect of “The Belt and Road Initiative” strategy, the action whether the five Central Asian countries respond to the initiative of building Silk Road Economic Belt can be introduced into the gravity model as a dummy variable. Then, here comes model (4) as follows:

\[ 
\text{Ln}F_{ij} = \alpha\text{Ln}(M_i * M_j) + \beta\text{Ln}(P_i * P_j) + \theta\text{Ln}D_{ij} + \eta BR_{ij} + \varepsilon_{ij} 
\]  
(4)

In model (4), \( BR_{ij} \) represents whether they respond to the initiative of building the Silk Road Economic Zone. If they did in 2013, the assignment was 1, whereas the assignment was 0.

**Data sources**

Models 2 and 3 are estimated based on panel data from 2006 to 2015. Data regarding the agricultural products trade between China and the five Central Asian countries is from the monthly import and export statistics report by Ministry of Commerce of PRC, Department of Foreign Trade from 2006 to 2015; the geographical distance between China and the five Central Asian countries is from...
the CEPII; data about GDP, per capita GDP and population is from the National Bureau of the Statistics of PRC from 2006 to 2015 while some comes from the World Bank. In addition, model 4, mainly considering the effects of “The Belt and Road Initiative” strategy on agricultural products trade between China and the five Central Asian countries adopts the relevant data from the year 2010 to 2015.

**Empirical results and analysis**

The estimated results of the gravity model of agricultural products trade between China and the five Central Asian countries are dealt with Stat 12.0 software and here are the final results (Table 5) given as:

1) Economic scale, population size and geographical distance have important influence on the agricultural products trade between China and the five Central Asian countries. The goodness of fit of model (2) was 0.842, which showed a better fitting degree of the model. The regression coefficients of the three explanatory variables all passed the significant tests of the level of 10% and above. Among them, the regression coefficient of economic scale was 1.34 and passed the test of the 1% significant level, which showed that the economic scale facilitates and has a significant impact on agricultural products trade between China and the five Central Asian countries. However, the regression results showed that once the difference of per capita GDP between China and the five Central Asian countries increased by 1%, it will promote bilateral agricultural product trade volume by 0.68%.

2) The agricultural products trade between China and the five Central Asian countries conforms to Linder’s “demand similarity theory”. The goodness of fit of model 3 was 0.915, which showed that the model fits very well. With exception of the geographical distance, other variables were all passed the significant test of the level of 5% and above. The coefficient of per capita GDP difference was negative, which showed that agricultural products trade between China and the five Central Asian countries is in accordance with Linder’s “demand similarity theory”. The greater the per capita GDP difference between China and the five Central Asian countries is, the greater the difference in demand and the more unfavorable to the development of bilateral agricultural trade. Regression results showed that once the difference of per capita GDP between China and the five Central Asian countries was greater than 1%, it will promote bilateral agricultural product trade volume decrease by 0.68%.

3) “The Belt and Road Initiative” strategy is favorable to the development of agricultural products trade between China and the five Central Asian countries, but its effect is not currently significant. The goodness of fit of model 4 was 0.788, which showed that the model fits quite well. Most variables passed the significant test of the level of 10% and above. The coefficient of BR and dummy variable is positive, which showed that “The Belt and Road Initiative” strategy promoted the development of agricultural product trade between China and the five Central Asian countries. However, the regression results showed that the BR variable was not statistically significant, which demonstrated that its impact was not significant enough at the present. The main reasons are as follows: firstly, “The Belt and Road Initiative” strategy was launched in 2013 and the five Central Asian countries need some time to accept and respond. In addition, systems, policies, trade structures and the production of agricultural products concerned are also under adjustment, which means that “The Belt and Road Initiative” strategy has not fully played its role; secondly, the data testing the effects of “The Belt and Road Initiative” strategy is selected from the year 2010 to 2015. However, the five Central Asian countries participated in the construction of the Silk Road Economic Zone in different periods with different development levels; for instance, Turkmenistan was not a co-founder of the Asian

<table>
<thead>
<tr>
<th>Variable</th>
<th>Regression model (2)</th>
<th>Regression model (3)</th>
<th>Regression model (4)</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Coefficient</td>
<td>Value of t</td>
<td>Coefficient</td>
</tr>
<tr>
<td>Ln(M*M)</td>
<td>1.34</td>
<td>8.11***</td>
<td>1.77</td>
</tr>
<tr>
<td>Ln(Pi*Pi)</td>
<td>0.57</td>
<td>2.04***</td>
<td>0.13</td>
</tr>
<tr>
<td>LnDij</td>
<td>-2.36</td>
<td>-7.52*</td>
<td>-1.02</td>
</tr>
<tr>
<td>LnDGij</td>
<td>-</td>
<td>-</td>
<td>-0.68</td>
</tr>
<tr>
<td>BRij</td>
<td>-</td>
<td>-</td>
<td>-</td>
</tr>
<tr>
<td>R²</td>
<td>0.842</td>
<td>-</td>
<td>0.915</td>
</tr>
</tbody>
</table>

Note: *, ** and *** represents the significant level of 10, 5 and 1% respectively.
Investment Bank. On this regards, the strategy exerted influences on the five Central Asian countries with varying degrees.

RESULTS AND DISCUSSION

In recent years, China, on the whole, is in the deficit with the five Central Asian countries in terms of agricultural products trade, but the volume of unfavorable balance of trade is reducing yearly. China’s exports to the five Central Asian countries are increasing yearly, while the amount of imports is in fluctuation. The market concentration degree of the bilateral trade is high, for instance, Uzbekistan is an important agricultural products importer and exporter for China and Kazakhstan is the largest agricultural importer from China.

Economic scale, population size, geographical distance, demand structure as well as, policy and system are important factors influencing agricultural products trade between China and the five Central Asian countries. An empirical study based on three gravity models shows that economic scale and population size can promote the agricultural products trade between China and the five Central Asian countries and the impact of economic scale is greater than that of the population size. Although geographical distance also has some effects, it is not quite significant. “The Belt and Road Initiative” strategy promotes the agricultural products trade between China and the five Central Asian countries; however, its function has not been quite significant. Research also shows that agricultural products trade between China and the five Central Asian countries is fit to Linder’s “demand similarity theory”.

In addition, the differences of per capita GDP also affects the demand structure between China and the five Central Asian countries, which is not conducive to the development of bilateral agricultural products trade.

With further implementation of "The Belt and Road Initiative" strategy, China will conduct closer economic and trade cooperation with the five Central Asian countries, which will also affect their bilateral trade in agricultural products.

Based on the differences of agricultural products production and consumption structure as well as, the existing market concentration degree between China and the five Central Asian countries, the two sides need to focus on the following aspects in their future cooperation. Firstly, they have to promote bilateral agricultural products trade in an all-round way by making full use of “The Belt and Road Initiative” strategy. Secondly, they should, on the one hand, continue to strengthen the development of such key markets as Uzbekistan and Kazakhstan, on the other hand, promote the growth of such underdeveloped markets as Tajikistan and Turkmenistan. Thirdly, they ought to accelerate the development of the infrastructure to fuel bilateral trade, especially the traffic, transportation and logistics in the five Central Asian countries. Only by promoting bilateral connectivity and communication can they reduce the adverse impacts on agricultural products trade posed by geographical distance.

REFERENCES