Spatial and Industry Cluster of Agricultural FDI into China: Evidence from 13165 Foreign Firms’ Choices

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Abstract: Based on the adding up of panel data from 13165 agricultural firms in 1998 and 2013, use the fixed effect estimation within controlling the fixe effects of year, cities and industry links, we find four robustness conclusions. Firstly, Chinese agricultural FDI has significant spatial agglomeration and industrial cluster phenomenon. Secondly, the fixed effect of the year is remarkable which means China's agricultural FDI is affected by macroeconomic fluctuations significantly. Thirdly, the fixed effect of city is not significant which means the local regional agricultural FDI management diversity does not resulted in significant differences of effectiveness in the extent of practice. Fourthly, the fixed effect of industry link is significant, of which agricultural products processing industry has a higher probability of industrial agglomeration while comparing with the planting industry. Afterwards, based on the four conclusions, we put forward two policy recommendations for "how to more effectively utilize agricultural FDI into China".

Keywords: Agricultural Foreign Direct Investment; Spatial Cluster; Industry Cluster

INTRODUCTION

In the new century, China’s foreign direct investment (FDI) into agriculture sector has developed rapidly. In 2000 the actual amount of Agricultural FDI used in China was only US $676 million, while in 2015 it reached US $1534 million, with an average compound growth rate of 5.6% in the 15 years. With the expansion of Agricultural FDI in China, there were many empirical studies on the development of agricultural FDI, however, only few literatures focused on the spatial and industrial cluster of Agricultural FDI into China. Moreover, mostly they used macro-level data to implement the empirical test [1, 2, 3], which leads to two short boards.

To sum up, previous studies on the agglomeration effect of Chinese agricultural FDI have proved that there is indeed a spatial agglomeration effect in Chinese agricultural FDI, but due to the use of provincial panel data in previous studies, there are also two limitations that need to be improved. Firstly, due to the weighted average processing effect of macro data, after adding control variables such as regional economic development and agricultural development level, the endogenous effects of FDI on local economic growth and agricultural development promotion cannot be effectively eliminated, thereby making the estimation results biased and invalid. Secondly, the macro-data test of space and industry agglomeration effects cannot reflect the space and industry agglomeration effects represented by corporate behavior in the real market. It is likely that a large amount of investment in a single agricultural FDI project in a certain area will result in the test results obtained in this area and adjacent areas show that there is an agglomeration effect, but this is not in line with the original intention of discussing the behavior of corporate groups when discussing industrial agglomeration.

In order to overcome these two limitations, we used the fixed effects panel data model to test whether there was spatial agglomeration and industrial agglomeration of agricultural FDI in China based on the samples of 13,165 agricultural enterprises that had FDI behaviors in China from 1998 to 2013. The beginning of this article is the introduction, introducing the research background and starting point. The
first part is a literature review that briefly explains the theoretical sources of FDI space and industrial agglomeration effects. The second part is the data description that describes the current distribution of enterprises that carry out agricultural FDI in China. The third part discusses the empirical model and the results. The fourth part is summary and policy recommendations.

LITERATURE REVIEW

The concept of industrial agglomeration was first proposed by Porter in his theory of national competition[4, 5], also known as Porter agglomeration or competitive agglomeration, including spatial agglomeration of enterprises with a certain type of common characteristics and spatial agglomeration of different links in the industrial chain. Subsequently, Krugman incorporated the economic theoretical basis related to this proposition into the framework of his new geographic economics and became the basis for discussing industrial agglomeration in the field of international economics[6, 7]. According to the theory of industrial agglomeration, the space of enterprise and industry agglomeration main motivation comes from two aspects: first, in the same industry companies usually for raw materials, labor, market environment and transportation condition. They have similar preferences, which enables enterprises to cluster in certain regions with the above external environmental advantages. Second, industries in different links of the industrial chain tend to cluster in adjacent regions to strengthen economic ties and technology spillovers among enterprises, so as to fully save transaction costs, information costs and innovation costs; and take advantage of economies of scale and shared innovation.

It can be seen from the reference that the spatial and industrial agglomeration effects of Chinese agricultural FDI should also come from three main factors: First, according to the neoclassical international direct investment theory hypothesis represented by John Dunning’s Eclectic Paradigm of International investment theory, enterprises develop FDI would choose the better of the host country for the enterprises to carry out the international industrial transfer and location for investment, because of the same industry enterprises in the international industrial transfer in the concrete location choice exists on similar preferences, and thus when it into the same host country exists in space and industrial agglomeration phenomenon. Second, the first entry of FDI can drive local industry development and economic growth in the host country, creating favorable conditions for further space and industrial agglomeration in the local area. Third, from the perspective of China's national conditions, local governments are targeting foreign direct investment with their own different preferential conditions and management systems for investment promotion. Greenfield companies will choose the most suitable location according to their own needs. At the same time, foreign companies often invest in the same industry in China when they enter the Chinese market. Other foreign companies understand the information, which may agglomeration at the same location.

From the literature on the spatial agglomeration effect of China's overall FDI, most previous international and domestic studies have confirmed that China's FDI has a significant spatial agglomeration effect.

Internationally, Belderbos and Carree used the information of FDI projects carried out by Japanese electronics manufacturing companies in China from 1990 to 1995, and adopted Logit estimation to find that Japanese companies' investment in China has a significant spatial agglomeration phenomenon[8]. Thompson based on a quantitative survey of Hong Kong garment companies that invest in manufacturing in mainland China. Found that there were significant spatial agglomeration characteristics[9]. Ng and Tuan found that manufacturing foreign direct investment enterprises will follow the gravity model when making location selection in his empirical study on the location selection of manufacturing foreign direct investment after China's entry into the WTO and the relationship described is more likely to choose spatial agglomeration in areas that are getting farther and farther from the core location[10]. Tuan and Ng further extended their research to test the location choice of foreign direct investment in the wider region of China, based on the city level Panel data found that China's FDI has significant spatial agglomeration characteristics[11], and this phenomenon of spatial agglomeration has a significant promotion effect on the investment in local regional economic development[12]. Kang and Lee found that South Korean companies conducting FDI in China have spatial agglomeration when selecting locations, based on corporate-level data of Korean subsidiaries invested in China, and this agglomeration phenomenon can be explained by the regional differences in economic development, labor quality, transportation infrastructure and government policies[13].

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In China, Han, Pan and Xu used mixed panel estimation to find that the location selection of foreign capital from the agglomeration effect has a significant impact on the use of FDI enterprise data in Jiangsu Province from 1992 to 2003[14]. Zhao and Zhang[14] adopted the panel data model with spatial Gini coefficient, and find that China's manufacturing FDI can be divided into high agglomeration and low agglomeration industries, only the high agglomeration industry agglomeration effect is significant, and there is a nonlinear relationship between FDI and industry agglomeration based on the data of FDI penetration and regional agglomeration of 20 manufacturing industries in China from 1999 to 2003. Based on the FDI data of nine prefecture level cities in the Pearl River Delta from 1992 to 2003, Li and Ding[16] adopted a dynamic local adjustment model, and found that the FDI of Guangdong Province can be explained by the characteristics of each prefecture and the agglomeration effect. Su and Hu[17] adopted spatial econometric model to find that compared with the traditional factors of attracting FDI, the role of agglomeration effect is increasingly prominent based on the provincial panel data of 1986-2005. Jiang and Lai[18] adopted spatial econometric model to find that spatial agglomeration effect is the primary factor affecting the location choice of foreign capital, so that the attractiveness of a city's foreign capital mainly depends on its location conditions by the use of FDI data of 244 prefecture level cities in China in 2006. Zhao and Luo[19] adopted spatial econometric model to find that the spatial concentration of FDI in China is very significant by the data of the per capita FDI and spatial location coordinate data of 601 county-level cities.

In summary, we can infer that agricultural FDI in China should also have similar spatial and industrial agglomeration effects. However, for this research topic, no empirical studies have been conducted using panel data from the national enterprise level in previous literatures. This article can provide a new literature contribution.

DATA ILLUSTRATION

In order to avoid the limitation of using macro-panel data in the future, we use the panel data from 1998-2013 in the database of industrial enterprises in China, which is from the foreign direct investment level. The database of industrial enterprises in China contains detailed basic information, financial data and operating activities of enterprises over the past years. In the cleaning process of the data, we removed the duplicate statistical samples and the data samples of the key variables such as the lack of information on the region and the industries to which they belong, the final available data sample is a none equilibrium panel of 66,683 observations from 13,165 firms of foreign direct investment between 1998 and 2013, data on the number of enterprises in different agricultural sectors in 237 cities from 1998 to 2013 were obtained by classifying and adding them by year, city and foreign direct investment. The number of agricultural enterprises in foreign direct investment is shown in figure 1.

Figure 1-Annual number of agricultural foreign direct investment firms into China (1998-2013)

Source: China Industrial Enterprise Database
It can be seen that the number of Chinese agricultural FDI enterprises has experienced a development process of first growth and then decline from Figure 1. Intuitively, the first growth is mainly due to the impact of China's accession to WTO, and the subsequent decline was affected by the subprime mortgage crisis and the decline in global agricultural investment. Observing the color depth in Figure 2, we can see that China's agricultural FDI shows a three-step decreasing distribution from east to west, and the eastern region is still far more attractive to foreign direct investment in agriculture than the central and western regions. Showing imbalance characteristics.

**EMPIRICAL METHOD**

**Spatial aggregation estimation equation:**

In order to test whether there is spatial agglomeration effect of agricultural FDI in China, we construct the estimation equation (I) as:

\[ afd_{ikt} = \beta_0 + \beta_1 subafdi_{iikt} + \beta_2 cityid_i + \beta_3 year_t + e_{iit} \]

Among them, \( i \) is the identification ID of the city, \( t \) is the identification ID of the year.

\( afd_{ikt} \) is the number of agricultural enterprises in the city in foreign direct investment; \( subafdi_{iikt} \) is the cumulative number of agricultural enterprises in the city by the end of foreign direct investment; \( cityid_i \) is the city ID variable, \( year_t \) is the year identifier variable, we added these two to control the fixed effect. Different cities may adopt different policies to attract investment due to their different economic development level, industrial environment and human geographical conditions, so it is necessary to control their fixed effects. As the foreign direct investment is affected by the macroeconomic environment, it is also necessary to control the fixed effects of the year variables and eliminate the effects of time trends.

At the same time, we use \( subafdi_{iikt-1} \), the cumulative number of foreign direct investment enterprises in a city as an instrumental variable of \( subafdi_{iikt} \), to estimate the robustness of the test. The significance of the estimation equation is intuitive, that is, if there is spatial agglomeration of FDI in China's agriculture, the estimation of the parameters \( \beta_1 \) should be significant.

**Industry agglomeration estimation equation:**

Similar to the spatial agglomeration equation, in order to test whether there is an industrial agglomeration effect in Chinese agricultural FDI, an estimation equation (II) is established:

\[ afdli_{ikt} = \beta_0 + \beta_1 subafdi_{iikt} + \beta_2 cityid_i + \beta_3 year_t + \beta_4 indstry_{ik} + \epsilon_{iikt} \]

Among them, \( i \) is the id of the city, \( k \) is the id of the industry and \( t \) is the id of the year.

\( afdli_{ikt} \) is the number of enterprises in the city \( i \) in the year \( t \) of the foreign direct investment in the agricultural industry; \( subafdi_{iikt} \) is the cumulative number of enterprises with foreign direct investment in the agricultural industry in the cities as of the end of the second year; Similar to the spatial agglomeration estimation equation, we added the city id variable \( cityid_i \), Year id variable \( year_t \), and id identification variable \( indstry_{ik} \) of the industry link to control the effects of fixed effects. The reasons for controlling the fixed effects of cities and years are similar to the above. And the reason for controlling the fixed effects of industrial link variables is that some industrial links may have a higher tendency to agglomerate enterprises due to their production conditions and environmental requirements.

Similar to the robust estimation of the spatial agglomeration equation, we use \( subafdi_{iikt-1} \), the cumulative number of foreign direct investment in an industry in a certain city as of the end of last year as the instrumental variable of \( subafdi_{iikt} \) to estimate the robustness. Similarly, if there is industrial agglomeration in China's agricultural FDI, the estimation result of the parameter \( \beta_1 \) should be significant.

**Two points about the estimation equation:**

First of all, the number of foreign direct investment in agricultural enterprises is used instead of the amount of foreign direct investment as the dependent variable, because the spatial agglomeration and industrial agglomeration are usually discussed in order to describe the convergent behavioral model of many enterprises, plus a very large sample of investment amounts may give a biased impact, the use of the number of enterprises is more appropriate.

In addition, it is clear that the cumulative number of foreign direct investment in agricultural enterprises at the end of the previous year is highly correlated with the cumulative number of foreign direct investment in agricultural enterprises that year, and because of the sequence in the time
series, this instrumental variable satisfies both correlation and exogenous claim. At the same time, there is no abnormal phenomenon that "the cumulative number of companies as of the end of the year" is less than the "accumulated number of companies as of the end of the previous year", so the effect of local average treatment effects (LATE) in instrument variables can be ignored, so as to the unbiasedness and validity of the instrumental variable as a robustness test are guaranteed.

ESTIMATION RESULTS

Spatial clustering estimation results:
The estimated results of the spatial agglomeration equation (I) are shown in Table 1:

|                | (1)   | (2)   |
|----------------|-------|-------|
| afdi           |       |       |
| subafdi        | 0.108*** |       |
|               | (27.90) |       |
| cityid         | -0.407 | -0.560 |
|               | (-0.66) | (-0.77) |
| year           | -7.746*** | -8.741*** |
|               | (-5.76) | (-5.15) |
| L.subafdi      |       |       |
|               | 0.112*** |       |
|               | (22.59) |       |
| Constant term  | 15573.7*** | 17587.7*** |
|               | (5.78) | (5.17) |
| Observed value | 495   | 464   |

Three conclusions can be drawn from Table 1: First, from the fact that the coefficients of subafdi and L.subafdi are both significantly positive, it is clear that there is a significant spatial agglomeration phenomenon in China's agricultural FDI. Second, the year variable has a significant fixed effect. It can be inferred that there were no significant differences in the investment invitation policies for agricultural FDI in China in 237 cities.

Industrial agglomeration estimation results:
Because the dependent variable in the industry agglomeration equation represents the number of foreign direct investment enterprises in a certain agricultural industry link in a certain year, it is classified according to three dimensions: year, city, and industry link. Therefore, before using the panel data model for estimation, it is necessary to generate a new serial number according to the "city × industry link" and build the panel data model together with the year. The estimated results of the industrial agglomeration equation (II) are shown in Table 2:

|                | (1)   | (2)   |
|----------------|-------|-------|
| Afdii          |       |       |
| subafdi        | 0.129*** |       |
|               | (176.63) |       |
| cityid         | 0.0110 | 0.0136 |
|               | (1.89) | (1.77) |
| year           | -0.437*** | -0.546*** |
|               | (-34.31) | (-30.16) |
| idstry         | -0.000625*** | -0.000826*** |
|               | (-8.25) | (-8.17) |
| L.subafdi      |       |       |
|               | 0.138*** |       |
|               | (135.22) |       |
| Constant term  | 878.5*** | 1097.5*** |
|               | (34.38) | (30.22) |
| Observed value | 14328 | 12002 |

Four conclusions can be drawn from Table 2: First, from the fact that the coefficients of subafdi and L.subafdi are both significantly positive, it is clear that there is a significant industrial agglomeration phenomenon in China's agricultural FDI. Second, the year variable has a significant fixed effect. It can be concluded that China’s agricultural FDI was significantly affected by the macroeconomic situation of the year. Third, the city's fixed effect is not significant. Fourthly, it is obvious that there is an idstry coefficient estimation result, and there are significant fixed effects in different agricultural industry links, that is, different agricultural industry links have different probability of agglomeration tendency. Because the ranking of the agricultural industry identification variables in the Chinese industrial enterprise database is based on the order of planting to processing, it can be inferred that in Chinese agricultural FDI, the agricultural processing industry has a higher probability of agglomeration tendency than the planting industry. In fact, this inference is consistent with intuition in actual observation. The plantation
industry depends on natural geographical conditions, so it is
difficult to produce industrial agglomeration. The
agricultural product processing industry depends more on
social convenience such as the convenience of transportation
and the labor market environment. Conditions, it is easy to
form the phenomenon of industrial agglomeration where
these elements focus.

**CONCLUSION AND IMPLICATION**

This paper uses the aggregated panel data based on the
micro-enterprise level for the first time to conduct an
empirical test on the spatial agglomeration and industrial
agglomeration of Chinese agricultural FDI. Based on the
aggregated panel data of 13,165 foreign direct investment
agricultural enterprises from 1998 to 2013, Panel data on the
number of agricultural FDI companies by city and industry
link over 15 years. By controlling the fixed-effect model of
the three variables of year, city and industry link, and
introducing effective instrumental variables for robustness
estimation, four-point robust estimation results are obtained.

First, China's agricultural FDI has significant spatial and
industrial agglomeration phenomena. Second, the year's
fixed effect is significant, and it can be inferred that China's
agricultural FDI is significantly affected by macroeconomic
fluctuations. Third, the fixed effects of the cities are not
significant. It can be inferred that there is no significant
difference in the practical effects of the investment promotion
policies of foreign direct investment in agriculture in China's
diversecities. Fourth, the industrial sector has a fixed effect.
According to the characteristics of the database, it can be
inferred that the agricultural product processing industry has
a higher probability of industrial agglomeration than the
plantation industry.

Based on the above conclusions, two policy suggestions are
proposed for "how to use agricultural foreign direct
investment more effectively in China" as follow:

First, foreign capital should be actively encouraged to carry
out agricultural direct investment in China, support should be
given to areas that have already formed agricultural FDI or
industrial agglomerations. Agricultural FDI industrial parks
should be actively constructed. Changing the uneven
distribution of China's agricultural FDI development
Conditions to promote faster agricultural development in
mainland China by regulating organized contacts and
interoperability, strengthening the virtuous circle of existing
advantages in agglomerated areas, and guiding foreign
capital to spread more toward central and western regions.

Second, it should be combined with the advantages of China's
agricultural production and industrial layout, it should be
focused on strengthening the industrial advantages in various
areas to support related industries and industry sectors to
courage foreign direct investment policy, it is necessary to
make full use of the natural industrial agglomeration
tendency of agricultural FDI to further enhance the
industrialization level and brand advantage of each industry
advantage area.

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