Dynamic Relationship between Agricultural Trade and FDI in China

FEI Ping * , **XU Li-qing**

School of Food Science, Jiangnan University, Wuxi 214122, China

Abstract On the basis of time series data from 1984 to 2006, co-integration analysis and VAR model are used to carry out empirical analysis on the dynamic relationship between the foreign direct investment in agriculture and the variable volume of international trade of agricultural products. Result shows that there is long-term co-integration relationship between the two. But it is probable that foreign direct investment (FDI) has substituted for import in the short term and shows deviation from the long-run equilibrium relationship. Therefore, we put forward two policy proposals, which are improving market system and strengthening the import management of foreign-funded enterprises.

Key words Foreign direct investment; Agricultural products; International trade; China

Since the reform and opening up, government has gradually expanded the investment in agriculture, and has allowed the foreign investment in agriculture. Thus, agriculture has become one of the earliest industries using foreign direct investment (FDI). Foreign investment utilization of agriculture in China has experienced sustained growth since the 1990s. FDI has gradually become the main form of foreign capital utilization of agriculture in China, and accounts for 95.6% in the year 1995. Almost all the foreign investment in agriculture in recent years is in the form of FDI. According to the data from customs and the website data of the National Bureau of Statistics of China, total import and export of China's agricultural products in 2006 has reached 63.02 billion U. S. dollars, increasing by 12.88% compared with the last year. Among them, the export is 310.3 billion U. S. dollars with the growth rate of 14.16%; and the import of agricultural products is 319.9 billion U. S. dollars with the growth rate of 11.66%. Exports of agricultural products in foreign-invested enterprises have eventually taken the leading position. According to the data of the National Bureau of Statistics of China, contract price of FDI has increased from 2.276 billion U. S. dollars in the year 2003 to 3.199 billion U. S. dollars in the year 2006. FDI makes up for the lack of domestic capital, improves the agricultural production condition, promotes the development of agricultural science and technology, stimulates the exports of agricultural products, speeds up the reform and management of agricultural industrialization, and brings along the development of agricultural export-oriented economy.

1 Data and research method

Lu Li-cai and Huang Zu-hui (2006) carried out research on the FDI and the relationship between agricultural products and food trade in China. They argued that FDI had positive, long-

term stable, and equilibrium relationship with the total import and export volumes of agricultural and food products in China. That is to say, there is complementary relationship between the FDI and the trade of agricultural products and food in China[1]. Qi Jian-hong and Wang Ping (2007) conducted co-integration test on the effect of FDI on agricultural import and export trade based on the data of China from 1983 to 2004. Result shows that FDI is the reason that causes the changes of import and export of agricultural products, but the import and export of agricultural products is not the causation for the changes of FDI. FDI in agricultural department of China has substitution effect on agricultural import, and promotion effect on agricultural export[2]. This conclusion is in contradiction with the research result of Lu Li-cai and Huang Zu-hui (2006). Research on the relationship between FDI and agricultural products trade has offered strong evidence for the future study, and has also provided useful reference for the agricultural trade policy and foreign policy adjustments in China.

1.1 Data sources and description Agriculture in this paper includes agriculture, forestry, animal husbandry, fisheries and their service industry, which are the entire contents of primary industry according to industry classifications of the National Bureau of Statistics of China. Agricultural product is the primary products of agriculture, that is, the plants, animals, microorganisms and their products during agricultural activities.

According to the website data of FAO, WTO, UN Comtrade Database and the *China Statistical Yearbook*, considering the availability and consistency of statistical data, this paper uses the trade volume of SITC0, SITC1, SITC2 and SITC4 commodity in UN Comtrade Database, and discounts the metalliferous ores and metal scrap. FDI data only use the 1984 – 2006 agreement value of agriculture, forestry, animal husbandry and fisheries FDI in *China Statistical Yearbook*. This is because the actual amount of foreign investment announced by China is only since 1996. Variables in this paper include the agricultural products export (EX), import (IM), total volume of trade (TEI) and FDI. Logarithmic transformation will not

change the main characteristics of variables. Meanwhile, it can eliminate or reduce the heteroscedasticity that may exist in the data. Hence, the natural logarithm of variables EX, IM, TEI and FDI is obtained; and the new variable sequences of them are denoted as LnEX, LnIM, LnTEI and LnFDI.

1.2　Research method[3]　① This paper uses ADF (Augmented Dickey-Fuller) to carry out unit root test on the agricultural trade and FDI inflows. The optimal lag phase (P) in this paper is determined by AIC and SC criterion. And AIC and SC are selected as the minimum lag phase. ② Engle-Granger two-step test, namely EG method, is used to estimate the co-integration relationship among variables. The short and long-term relationship between variables in error correction model is established. ③ In order to explore the dynamic relationship between agricultural FDI and trade growth of agricultural products, vector autoregression (VAR) method put forward by Sims is used for variance decomposition and technique impulse response in order to study on the dynamic characteristics of model. Impulse response function describes the impact of a standard deviation from random disturbances (information) on the current and future values of variables in VAR model. It can more objectively reflect the dynamic interaction between variables and their effects. Variance decomposition is a further evaluation of the importance of different impact structures by analyzing the contribution degree of each structural impact on the change of endogenous variable (usually using variance).

2　Econometric test

2.1　Co-integration test　This paper uses Eviews 5.0 software to test the unit roots of LnEX, LnIM, LnTEI and LnFDI and to determine the stability of variables. According to the morphology of sequence, we adopt the test including intercept term and trend term. Test type of differential sequence is determined according to corresponding principles, test result of which is shown in Table 1.

Table 1　Result of ADF test

Variable	Test type (C,T,K)	ADF statistics	Critical value	Test result
LnEX	(C,T,0)	−1.827 0	−3.254 7 *	Non-stationary
ΔLnEX	(C,0,0)	−4.100 3	−3.788 0 **	Stationary
LnIM	(C,T,1)	−3.220 3	−3.261 5 *	Non-stationary
ΔLnIM	(C,0,1)	−4.632 3	−3.808 5 ***	Stationary
LnTEI	(C,T,0)	−1.905 7	−3.254 7 *	Non-stationary
ΔLnTEI	(C,0,0)	−3.740 0	−3.012 4 **	Stationary
LnFDI	(C,T,0)	−1.990 2	−3.254 7 *	Non-stationary
ΔLnFDI	(C,0,0)	−4.310 6	−3.788 0 ***	Stationary

Note: C in the test type means having constant term; T stands for having both constant term and trend term; K means the lag order adopted. *, * * and * * * mean significant at 10%, 5% and 1% levels, respectively.

Result shows that the original time-series data are non-stationary at 10% significant level with unit root. While the sequence after first order difference is stationary at no less than 5% significant level. In other words, the original time series are first-order integrated variables which are all I(1) sequence.

And there might have co-integration relationship among them.

The E-G two-step method can be used to test the co-integration relationship between two groups of time-series data having the same integrated order. LnEX, LnIM and LnTEI are used as explained variables and LnFDI as the explaining variable. After regression, stationary test on the residual terms is carried out. Hence, we have the regression equations by using Eviews5.0 software:

$$LnEX = 4.223\ 2 + 0.364\ 2LnFDI \tag{1}$$
$$(51.781\ 0)\ \ (10.196\ 6)\ \ R^2 = 0.832\ 0\ \ DW = 0.800\ 6$$
$$LnIM = 3.861\ 8 + 0.512\ 9LnFDI \tag{2}$$
$$(25.877\ 9)\ \ (7.847\ 3)\ \ R^2 = 0.745\ 7\ \ DW = 0.547\ 6$$
$$LnTEI = 4.743\ 1 + 0.441\ 4LnFDI \tag{3}$$
$$(43.578\ 8)\ \ (9.260\ 1)\ \ R^2 = 0.803\ 3\ \ DW = 0.620\ 5.$$

From the above equations, we can see that there might be a significant positive correlation among sequences. Stationary test of residual series in the model need to be carried out in order to determine whether the regression estimation model can be used to represent the long-run equilibrium relationship between the two variables or not.

Table 2 shows that the ADF test statistic of residual errors in equations (1) and (2) is significantly less than the critical value at 5% significant level. And the residual sequence is stationary series, that is I(0), indicating that the co-integration relationship in equations (1) and (2) is significant. According to the Granger theorem, it is bound to have certain kind of long-run equilibrium relationship among the variables if they are co-integration.

Table 2　Result of ADF test on residual series

Regression variable	Test type	ADF statistics	Critical value	Conclusion
LnEX and LnFDI	(N,0)	−2.108 7	−1.957 2 **	Stable
LnIM and LnFDI	(N,1)	−2.246 0	−1.958 1 **	Stable
LnTEI and LnFDI	(N,0)	−1.583 8	−1.608 2 *	Unstable

Note: Data in the table is calculated by Eviews5.0 software. N stands for the trend term without constant term. *, * * and * * * mean significant at 10%, 5% and 1% levels, respectively.

Table 3　Long-term relationship between agricultural FDI and agricultural trade

Dependent variable	LNEX	LNIM
Intercept term	4.223 2 ***	3.861 8 ***
Coefficient of LnFDI	0.364 2 ***	0.512 9 ***
R^2 after adjustment	0.832 0	0.745 7

Note: *, * * and * * * stand for significant at 10%, 5% and 1% levels, respectively.

As the extension of co-integration relationship, we establish the error correction model. The optimal lag order can be found out by AIC and SC. Meanwhile, considering the auto-correlation and heteroscedasticity factor, lag order of the vector error correction model (VEC) is second order. Table 4 reports that the symbols of parameter evaluation values of the explanatory variables are in accord with economic significance, though the fitting degree is low, which does not affect the general relationship between variables. Short-term fluctuation of FDI has no significant impact on export trade, but has a negative impact on the import of agricultural products. Correction term of import

equation is significant, indicating that import might deviate from the long-term equilibrium of FDI in the short term, and shows the short-term negative impact. However, the coefficient of correction term is −0.124 8, and the non-equilibrium degree in the

previous year is 12.48%, indicating that the adjustment speed from short-term non-equilibrium to long-term equilibrium is relatively fast.

Table 4 VEC between FDI and agricultural trade volume

ΔLnEX = −0.073 5	EC(−1) +0.379 3	ΔLnEX(−1) −0.313 8	ΔLnEX(−2) +0.002 7	ΔLnFDI(−1) +0.080 0	ΔLnFDI(−2) +0.064 6
(−0.493 1)	(1.709 7)*	(−1.405 7)* R^2 =0.355 3	(0.038 1)	(1.219 1)*	(1.807 9)**
ΔLnIM = −0.124 8	EC(−1) +0.346 3	ΔLnIM(−1) −0.443 1	ΔLnIM(−2) −0.134 5	ΔLnFDI(−1) +0.118 0	ΔLnFDI(−2) +0.138 0
(−0.796 0)*	(1.642 4)*	(−1.979 0)** R^2 =0.418 9	(−1.058 4)*	(0.895 2)*	(2.220 7)**

Note: *, ** and *** stand for significant at 10%, 5% and 1% levels, respectively.

2.2 Analysis of impulse response function and variance decomposition based on VAR model

In order to explore the dynamic relationship between FDI and growth in agricultural trade, vector autoregressive (VAR) technology put forward by Sims is used to carry out variance decomposition and technology impact reaction to study the model's dynamic characteristics.

Fig. 1 illustrates the simulated impulse response function based on VAR(3) and asymptotic analytical method. In the following diagrams, the transverse axis means the lag phase of impact action (unit: year); and the longitudinal axis is the response degree of dependent variable to explanatory variable. Solid line is the calculated values of impulse response function. Dotted lines on both sides are the deviation zone of double standard deviation of impulse response function value. The lag phase of impact action is set to be 10 years.

Fig. 1a shows an impulse response function of the changes in agricultural exports caused by the impact of a standard deviation in agricultural FDI. Fig. 1a indicates that there is a positive response in the growth of agricultural exports at the beginning of 1.0 to 4.5 years after giving one standard deviation impact on agricultural exports (increase in agricultural FDI). The positive response is the biggest at the third year, and then negative response comes into being. Eight years later, there is positive response again. Indication of the convergence of interactive response is stable and weak after 4.5 years. This phenomenon shows that agricultural FDI and the growth of agricultural exports have close and long-term relationship. In the short term, growth in agricultural exports shows a positive significant response to agricultural FDI. But in the long run, agricultural FDI has longer impact on the growth of agricultural exports with

weak intensity, which coincides with the result of co-integration analysis mentioned above. Its economic meaning is that foreign investment in agriculture is difficult to form a stable and expected income due to the restriction of investment environment of China's agriculture and the lack of effective agricultural support and protection system, which leads to the strong short-term behavior of agricultural FDI, and has significant promotion effect on the growth in agricultural exports. After a certain period of negative response, agricultural FDI plays a weak role in promoting the growth of agricultural exports in the long run. Therefore, when enlarging the scale of foreign investment, government should consider taking a long-term policy, and should guide the rational flow of foreign capital.

Fig. 1b illustrates an impulse response function of the changes in agricultural imports caused by the impact of a standard deviation in agricultural FDI. Fig. 1b shows that there is a negative response in the growth of agricultural imports at the beginning of 1.0 to 2.5 years after giving one standard deviation impact on agricultural imports (increase in agricultural FDI). The negative response is the biggest at the second year, following with a stronger positive response. Indication of the convergence of interactive response is stable and weak after 5 years. This phenomenon shows that agricultural FDI and the growth in agricultural imports have close and long-term relationship. In the short term, growth in agricultural imports shows a negative response to agricultural FDI, showing that FDI has substitution effect on the agricultural imports. And in the long run, impact of agricultural FDI on the imports growth of agricultural products is similar to that of exports.

(a) Response path of agricultural exports to agricultural FDI information

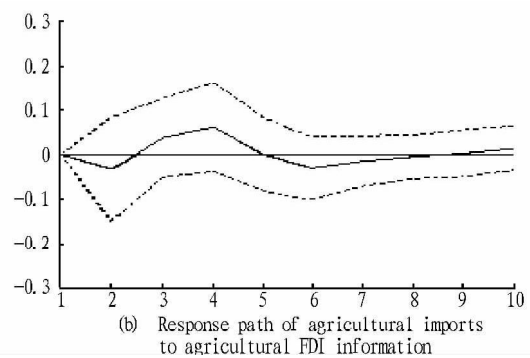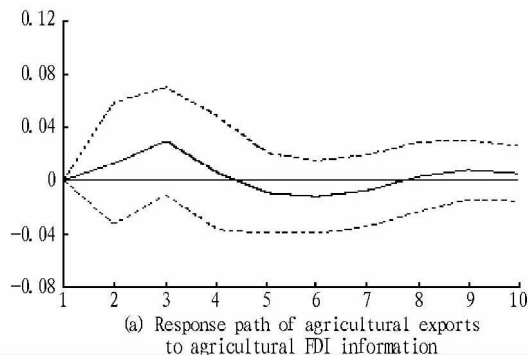(b) Response path of agricultural imports to agricultural FDI information

Fig.1 The curves of impulse response function

According to the result of predicated standard deviation,

fluctuations in the import and export volume of agricultural prod-

ucts at the first year are influenced only by fluctuations of their own. Impact of agricultural FDI on the agricultural exports (contribution rate of prediction error) appears only in the second year. However, its impact is relatively weak, accounting for 2.18% and 2.37% of the agricultural exports and imports, respectively. And the impact is basically stable after the sixth year. Fluctuations in the import and export volumes of agricultural products due to their own impact are gradually weakened. And the impact also tends to be stable after the sixth year. Ag-

ricultural FDI is affected by their own fluctuations at the first period, as well as the growth in the import and export volume of agricultural products. And the influence of agricultural FDI is greater than the growth in the import and export volume of agricultural products, followed by a decline effect of its own fluctuation on agricultural FDI. The impact becomes stable after the fifth year. This is basically the same with the analysis result of impulse response function mentioned above.

Table 5 Variance decomposition of $\triangle$LnFDI$_t$ and $\triangle$LnEX$_t$

Period	Variance decomposition of agricultural FDI			Variance decomposition of agricultural exports		
	Predicated standard deviation	$\triangle$LnFDI$_t$//%	$\triangle$LnEX$_t$//%	Predicated standard deviation	$\triangle$LnEX$_t$//%	$\triangle$LnFDI$_t$//%
1	0.337 983	97.119 97	2.880 027	0.083 992	100.000 00	0.000 000
2	0.387 307	82.285 15	17.714 85	0.087 445	97.820 00	2.180 001
3	0.409 989	73.738 88	26.261 12	0.092 237	88.076 60	11.923 40
4	0.425 265	74.044 29	25.955 71	0.092 624	87.815 72	12.184 28
5	0.441 236	75.654 71	24.345 29	0.093 674	87.076 84	12.923 16
6	0.441 603	75.621 51	24.378 49	0.094 536	85.649 47	14.350 53
7	0.447 334	75.424 57	24.575 43	0.094 910	85.123 19	14.876 81
8	0.451 943	75.842 59	24.157 41	0.094 998	85.056 62	14.943 38
9	0.452 976	75.801 49	24.198 51	0.095 352	84.520 20	15.479 80
10	0.453 943	75.742 76	24.257 24	0.095 487	84.281 21	15.718 79

Table 6 Variance decomposition of $\triangle$LnFDI$_t$ and $\triangle$LnIM$_t$

Period	Variance decomposition of agricultural FDI			Variance decomposition of agricultural exports		
	Predicated standard deviation	$\triangle$LnFDI$_t$//%	$\triangle$LnIM$_t$//%	Predicated standard deviation	$\triangle$LnIM$_t$//%	$\triangle$LnFDI$_t$//%
1	0.329 703	90.565 89	9.434 105	0.209 944	100.000 00	0.000 000
2	0.334 093	88.464 84	11.535 16	0.219 065	97.630 77	2.369 232
3	0.425 473	55.339 23	44.660 77	0.243 738	95.775 52	4.224 479
4	0.425 622	55.370 12	44.629 88	0.255 475	90.583 28	9.416 722
5	0.458 556	48.913 96	51.086 04	0.255 557	90.584 57	9.415 428
6	0.469 072	48.376 91	51.623 09	0.257 735	89.236 77	10.763 23
7	0.470 545	48.367 49	51.632 51	0.259 203	88.972 76	11.027 24
8	0.474 408	48.948 97	51.051 03	0.262 471	89.195 38	10.804 62
9	0.476 393	48.694 90	51.305 10	0.262 562	89.197 60	10.802 40
10	0.477 993	48.399 31	51.600 69	0.263 802	89.024 00	10.976 00

3 Result and conclusion

Empirical analysis is carried out based on the data of the years 1984 –2006. Result shows that there is long-term co-integration relationship between the agricultural FDI and agricultural import and export in China. In other words, each additional one percentage point of agricultural FDI will lead to the 0.364 2 percentage point increase in agricultural exports and 0.512 9 percentage point increase in agricultural imports. FDI might restrict the import trade in the short term, thus deviated from the long-term equilibrium relationship. But it will soon return to the long-run equilibrium state. Impulse response curve shows that agricultural import and export volume have long-term positive response to the agricultural foreign investment; but in the short term, agricultural import shows negative response to the agricultural FDI.

Though developed countries have technological advantages in export, their agricultural products mainly rely on natural resources and the input of labor force, reflected in the advantages of natural resources and labor force. Advantages of natural resources and labor force in China are difficult to be significantly

enhanced in short term. Therefore, the existence of long-term and stable relationship is reasonable. However, the above test results have also showed that the short-term fluctuation might deviated from the long-term equilibrium. According to the impulse response curve, China's agricultural export can be increased by attracting the FDI in short term. In recent years, export in foreign-invested enterprises has accounted for more than 40% of that of the agricultural products in China. After entering the agricultural fields, especially the processing industry of agricultural product, by using the advanced technology, management experience and sales network around the world, multinational corporations have effectively stretched the agricultural industry chain, have exerted the associated investment effect and the technology demonstration effect, have led to the rapid development of agricultural export-oriented economy in China, and have promoted China's exports of agricultural products.

Agricultural FDI and agricultural import have a complementary relationship of short-term substitution and long-term stability, which shows that the effect of agricultural FDI on import ta-

de can not be generalized. This is probably due to the restrictions and barriers for the agricultural import of China, though there is huge consumer market. Foreign capital has to invest in China so as to obtain market share. Accordingly, import of agricultural products from China is reduced. With the development of foreign-funded enterprises in China, they begin to use the cheap labor force and technological superiority to conduct deep processing of the raw materials and primary products from abroad, so as to achieve value-added agricultural products, and to promote China's agricultural import in a relatively long period of time.

4 Policy suggestion

4.1 Improving the market system Government should enhance the speed and strength of technology transfer of foreign-funded enterprises in China, reinforce the absorption technology and innovation capacity of China, and fundamentally improve the quality and level of Chinese export commodity. The continued technology transfer of foreign-funded enterprises to China is determined by the perfection and openness of China's market, and by the stability of policy for attracting foreign investment. Besides, policy support for technology transfer of foreign-funded enterprises is also important.

4.2 Strengthening the import management of foreign-funded enterprises Foreign-funded enterprises in China have exceeded the state-owned enterprises, and have become the biggest import and export entity of agricultural products. However, we should notice that many of the foreign-funded enterprises are mainly interested in the huge market in China. And their agricultural products are mainly sold in domestic china, supplemented with export. In order to occupy the high-end market in China, some foreign-funded enterprises have imported large quantities of raw materials and primary products from abroad. Low level of imported materials and equipment is bound to produce low-level exports, which is not conducive to the export of high value-added products, and weakens the overall competitiveness of Chinese industries and export products in international markets. This is contrary to the original intention of the use of foreign direct investment. In order to transfer from the labor-intensive products to high value-added or high-tech exports, government should pay great attention to the imported materials and parts, especially the imported second-hand equipment in the form of investment. Meanwhile, government should guide, adjust and improve the structure of imported goods in foreign direct investment enterprises, increase the import of capital-intensive goods and intermediate inputs of production type, which is conducive to update equipment, introduce new techniques, and enhance the competitiveness of exports.

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我国农业 FDI 与农产品国际贸易的动态关系研究

费平,徐立青 (江南大学食品学院,无锡 214122)

摘要 运用协整分析和 VAR 模型对农业外商直接投资与农产品国际贸易额变量之间的动态关系进行实证分析。FDI 数据以中国统计年鉴 1984 ~ 2006 年的中国农、林、牧、渔业外商直接投资的协议金额为基础,采用农产品出口(EX)、农产品进口(IM)、总贸易额(TEI)和外商直接投资(FDI)为变量,并通过对数化消除或减少可能存在的异方差,得到新的变量序列 LnEX,LnIM,LnTEI 和 LnFDI。笔者利用 Eviews5.0 软件,对这 4 个单位根进行检验,结果显示原有的时间序列都是一阶单整变量,它们之间存在着协整关系;再使用 EG 法进行检验,得到的回归模型显示协整关系是显著的,因此它们之间必然存在某种长期均衡关系。另外,笔者利用向量自回归 VAR 技术进行方差分解和技术冲击反应来研究模型的动态特征,脉冲响应曲线结果显示,农产品进出口对农业 FDI 存在长期的正向响应,但在短期内 IM 对农业 FDI 呈现负向响应,预测方差分解的结果与脉冲响应函数分析的结果基本上是一致的。因此,其结论为农业 FDI 与我国农产品进出口增长存在长期的协整关系,但在短期内可能发生 FDI 对 IM 的替代而偏离长期均衡关系的想象。最后,笔者针对农业 FDI 对农产品出口额具有促进作用,提出了完善市场体系和加强对外资企业的进口管理两项政策建议,以缓解我国农产品进口压力。
关键词 外商直接投资;农产品;国际贸易