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## **Prospects for China's Agricultural FDI Inflows: A Gravity Model Approach**

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***Abstract:*** *This paper attempts to provide insights into the prospects for China's agricultural FDI inflows through a gravity model approach. A panel data over 1994-2001 is used. Determinants of China's agricultural FDI inflows are identified and future levels of China's agricultural FDI inflows from major source countries are evaluated.*

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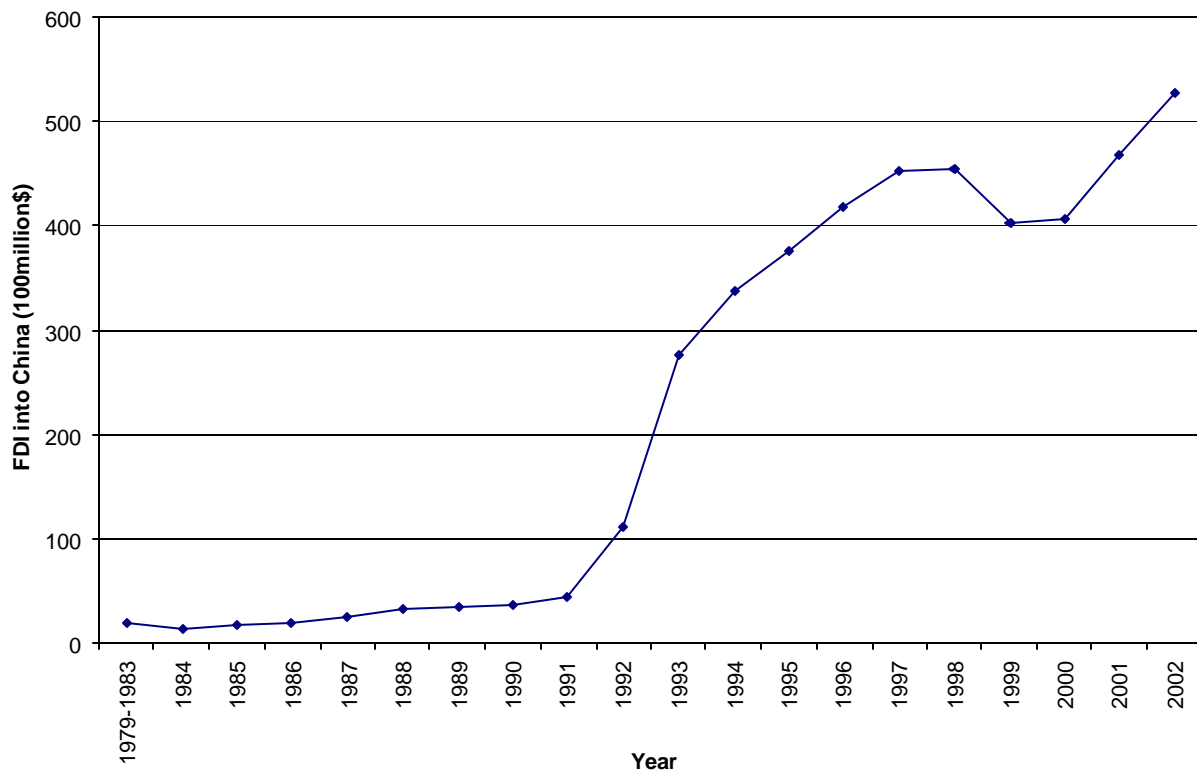
## **Introduction**

Foreign direct investment (FDI) inflows into China have expanded dramatically for more than twenty years and have been a major source of external financing for China since 1992 (World Bank, 1997). The utilized amount of inward FDI soared from \$18 million in the beginning of 1980s to \$52,740 million in 2002 (Figure 1). Figure 1 indicates that there exists a strong increasing trend of FDI inflow into China. As China accesses into the World Trade Organization (WTO) and fulfill its commitment of WTO, China has become a major destination of foreign direct investments in the world.

In 2002, the total amount of foreign capital to be used in agriculture through the signed agreements and contracts are \$1.69 billion which accounts for 2.04% of the total amount. The amount of foreign direct investment actually used is \$1.03 billion. Even though only about 2% of the total amount of FDI inflows is directed into the agricultural sector, these FDI inflows contribute much to China's agricultural economic development. During the last decades, the percentage of agricultural FDI inflows in total amount of FDI inflows into China remains about 2%. Agricultural FDI inflows into China also pose a strong increasing trend.

Since capital shortage is a constraint for China's agricultural economic development historically, attracting large inflows of agricultural FDI becomes a major objective in China's

Figure 1: China's FDI Inflows During Last Two Decades



strategy (Francoise, 2000). It is of interest for the Chinese government and foreign investors to examine the future prospects of FDI inflows into China.

The overall objective of this paper is to explore the prospects for China's agricultural FDI inflows. To obtain this overall objective, the following specific objectives are included:

1. To construct a model for China's agricultural FDI inflows using a gravity model approach;
2. To forecast the potential and identify the best capital source country for China's agricultural FDI inflows using the developed gravity model.

This paper is organized as follows: Next section discusses research methodologies of

gravity model. Following methodology discussion, the variables definition and data sources are provided. Empirical modeling results are then reported for gravity models. Finally, implications from our results are drawn about China's agricultural FDI inflows.

## **Methodology**

The gravity model has been successfully and widely used in analyzing flows of varying types, such as migration, flows of buyers to shopping centers, recreational traffic, international trade as well as foreign direct investment. The gravity model has a long history of empirical success and has been justified theoretically by Linnemann (1966), Leamer and Stern (1970), Anderson (1979) and Bergstrand (1989, 1990). For the international trade flow, the gravity model states that the size of trade flows between two countries is determined by supply conditions at the source country, by demand conditions at the destination, and by stimulating or restraining forces relating to the specific flows between the two countries. The size trade flows between countries is positively related to GDP and negatively to the distance. Foreign direct investment flows can be also analyzed similarly. Hufbauer, Lakdawalla and Malani (1994) apply a gravity model to study determinants of foreign direct investment and its connection to trade. The use investment stock and investment flows as dependent variables instead of bilateral trade flows. This study uses a gravity model to capture the "attractiveness" of China in FDI from other countries and explain the geographic distribution of FDI.

A gravity model in this research recognizes the following variables: relative factor endowments, countries' similarity in size, geographic distance between China and the source

countries, “economic space” between the two countries (indicated by GDPs of the two partner countries) and dummy variable (representing impacts of exogenous shocks such as 1997 Asian Financial Crisis). Then the gravity equation of the model used in this study takes the form:

$$(1) \quad \ln Y_{ijt} = \alpha + \beta_1 \ln GDP_{it} + \beta_2 \ln GDP_{jt} + \beta_3 SIMSIZE_{ijt} + \beta_4 RELEND_{ijt} \\ + \beta_5 \ln DIST_{ij} + \beta_6 \ln IMP_{ijt} + \beta_7 \ln ERV_{ijt} + \sum_k \gamma_k D_{kij} + e_t$$

where  $Y_{jt}$  are the values of the agricultural FDI inflow from country  $i$  to  $j$  ( $j = \text{China}$ ) at time period  $t$ ,

$$(2) \quad SIMSIZE_{ijt} = \ln \left[ 1 - \left( \frac{GDP_{it}}{GDP_{it} + GDP_{jt}} \right)^2 - \left( \frac{GDP_{jt}}{GDP_{it} + GDP_{jt}} \right)^2 \right]$$

$$(3) \quad RELEND_{ijt} = \left( \ln \frac{GDP_{it}}{POP_{it}} - \ln \frac{GDP_{jt}}{POP_{jt}} \right)$$

$GDP_{it}$  and  $GDP_{jt}$  are gross domestic products of China and its partner countries,

$DIST_{ij}$  is the distance between country  $i$  and China,

$IMP_{ijt}$  is the value of agricultural import from country  $i$  to China,

$D_t$  is the dummy variable representing impacts of exogenous variables such as Asian financial crisis.

The income variables  $GDP_{it}$  and  $GDP_{jt}$  determine the potential demand and supply of foreign direct investment. Since greater productive capacity and incomes promote investment, the coefficients of  $GDP_{it}$  and  $GDP_{jt}$  are expected to be positive. The more similar the partner countries are, the more attractive for investment seems to be observed. So similarity of country size ( $SIMSIZE$ ) is expected to have a positive sign. Foreign direct investment is likely to be

driven by differences in factor endowments between two countries. Then a positive sign is expected for the coefficient of relative endowment (RELEND0). The distance variable is a proxy variable for natural resistance to investment which is a composite of transportation cost or transport time. The further the two countries are, the less likely the two countries make direct investment to reduce the transportation cost. So the sign is expected to be negative for the distance (DIST). The coefficient sign of trade (IMP) indicates the relationship between foreign direct investment and trade. A positive sign suggests that foreign direct investment and trade is complementary which a negative sign suggests that foreign direct investment and trade is substitute.

During estimation procedures of empirical models, we specify different forms of the gravity model in order to better fit the data. First, we estimate a fixed effect model and a random effect model and then conduct Hausman test to check whether there is any difference in the true coefficients of these two models. Finally we estimate classical regression models with cross-sectional heteroscedasticity. The null hypothesis about cross-sectional heteroscedasticity is that the variances of the errors are the same across all the selected countries.

$$H_0: \sigma_i^2 = \sigma_j^2, i \neq j \quad H_a: \text{otherwise}$$

We apply the Lagrange Multiplier test (LM), Wald test (W) and Likelihood Ratio test (LR) to test this hypothesis. The test statistic for each testing method is given by

$$LM = \frac{T}{2} \sum_{i=1}^n \left[ \frac{\hat{\sigma}_i^2}{\hat{\sigma}^2} - 1 \right]^2, \hat{\sigma}_i^2 = \frac{1}{T} \sum_{t=1}^T e_{i,t}^2, \hat{\sigma}^2 = \frac{1}{n} \sum_{i=1}^n \hat{\sigma}_i^2$$

$$W = \frac{T}{2} \sum_{i=1}^n \left[ \frac{\hat{S}_i^2}{\hat{S}_i^2} - 1 \right]^2$$

$$LR = nT \ln \hat{S}^2 - T \sum_{i=1}^n \ln \hat{S}_i^2$$

## Data

A panel data were collected for China and its major FDI source countries/areas (including Hong Kong, the United States, Japan, Singapore, the United Kingdom, Germany, France and Canada) over a period from 1994 to 2001. The FDI inflows and import data of China were from China's Statistic Yearbooks. GDP, population for each country were from IMF International Financial Statistics Yearbook 2003. Geographic distances are from the data source maintained by Jon Haveman.<sup>?</sup>

## Empirical Results

Table 1 reports the estimation results of fixed effects model and random effects model. Both model specifications have a high R-square. The coefficient signs of  $\ln GDP_j$  and  $RELEND$  are different from the expected positive signs. Hausman test result shows that there is significant difference in the true coefficients of these two models, which means that these two models depict differently the impacts of explanatory variables on China's FDI inflows.

The modeling results for classical regression model with cross-sectional Heteroscedasticity by OLS, FGLS and MLE methods are reported in Table 2. Variables GDP and

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<sup>?</sup> This distance data is available at website  
<http://www.maclester.edu/research/economics/PAGE/HAVEMAN/Trade.Resources/Data/Gravity/dist.txt>

**Table 1: Regression Results of Fixed Effects Model v.s. Random Effects Model**

Variables	Fixed Effects Model		Random Effects Model	
	Coefficients	t	Coefficients	z
lnGDPi	4.5078	2.81	0.4652	1.30
lnGDPj	-3.9706	-2.66	0.2964	1.28
SIMSIZE	0.6171	1.83	-1.4173	-5.36
RELEND0	-3.6383	-2.31	0.7151	4.64
LnDIST	dropped		-0.8569	-4.77
LnIMP	-0.1368	-0.69	-0.0048	-0.02
DUMMY	0.0283	0.24	0.1033	0.60
Intercept	-6.3241	-0.97	10.1949	3.39
R <sup>2</sup>	0.9722		0.9160	

Hausman Test: Ho: difference in coefficients not systematic

$$\chi^2(6) = (b-B)'[S^{-1}](b-B), S = (S_{fe} - S_{re})$$

$$= 123.87$$

$$\text{Prob}>\chi^2 = 0.0000$$

trade (lnIMP) are not significant at 95% significance level in OLS method. The estimates by OLS method are unbiased and consistent but not the most efficient. The estimates by FGLS and MLE methods are consistent and most efficient but not necessarily unbiased. The standard error estimates are smaller in the case of MLE than those in the cases of FGLS and OLS estimates, which suggest better fitness of the data.

The testing results for cross-sectional heteroscedasticity in Table 3 indicate that the assumption of heteroscedasticity across the selected countries is suitable and then the classical regression model with cross-sectional heteroscedasticity is appropriate for describing the

Table 2: Classical Regression Model with Cross-Sectional Heteroscedasticity

Variables	OLS		FGLS		MLE	
	Coefficients	T	Coefficients	Z	Coefficients	Z
lnGDP <sub>i</sub>	0.4910	1.06	0.8491	3.10	1.1812	11.92
lnGDP <sub>j</sub>	0.2894	1.47	0.4616	3.03	0.5057	5.16
SIMSIZE	-1.8011	-10.13	-1.9877	-12.85	-2.0152	-14.16
RELEND0	0.8678	6.12	1.0577	10.98	1.0967	16.71
LnDIST	-0.8386	-6.29	-0.9255	-8.14	-0.9237	-12.31
LnIMP	-0.0634	-0.33	-0.2508	-1.84	-0.2995	-3.75
DUMMY	0.0978	0.62	0.0157	0.12	-0.1071	-3.17
Intercept	10.5505	3.55	0.7666	4.44	7.7835	7.91
R <sup>2</sup>	0.9214		LR	-11.6091	LR	0.8748

Table 3: Testing Result for Heterscedasticity

Test	Using FGLS Residuals	Using MLE Residuals
LM	70.4396	143.8954
W	904.4858	3285430
LR	466.7525	637.3392
S <sup>2</sup>	0.2051	0.2472

relationship between China's FDI inflows and selected "gravity" variables. The following interpretations are based on the classical regression model with cross-sectional heteroscedasticity by MLE method. In MLE method, all the variables are significant at 95% significance level. The "economic space" variables (GDP<sub>i</sub> and GDP<sub>j</sub>) have significantly positive signs which imply that as the productive capacity increases in China and/or FDI source countries, the FDI inflows into China will increase too. This is consistent with our expectation.

Similarity in size (SIMSIZE) has a significantly negative sign which suggest that the more similar between China and its partner country, the less foreign direct investment will flow into China. This is beyond our expectation.

Relative factor endowment (RELEND) has a expected positive sign which indicates that the more different of factor endowment in two countries, the higher FDI inflows into China.

The proxy variable distance (DIST) for transportation costs has a significantly negative sign which is consistent with our expectation. Transportation costs will increase as the distance between two countries and then there is less incentive for the multinational companies to make investment abroad.

It is found that most large food manufacturers rely more heavily on foreign investment than on exports as their major strategy to access foreign markets (Handy and Henderson, 1994). Our empirical modeling results confirm this substitution relationship between foreign investment and trade again. This is shown by a significantly negative sign of variable lnIMP.

Dummy variable representing 1997 Asian financial crisis has a significantly negative sign which indicates that 1997 Asian financial crisis has negative impacts on foreign direct investment inflow into China. However, this dummy variable is not significant in any other model specifications and estimation methods. In addition, the absolute value of the coefficient of this dummy variable is small. We tend to conclude that 1997 Asian financial crisis has significantly negative impacts on FDI inflows into China but the impacts are small.

## **Concluding Remarks**

Using a gravity model with heteroscedasticity, we find that the effects of explanatory variables on China's FDI inflows are asymmetric and differ significantly across countries. Specifically, we find that a classical regression gravity model with heteroscedasticity fits the data better than fixed effects model and random effects model.

A substitution relationship between China's FDI inflows and international trade (imports from other countries) is found. More and more multinational companies may choose foreign direct investment instead of exports as their market strategies to access Chinese market. Asian financial crisis has limited impacts on foreign direct investment in China. Compared to many other Asian countries which are impaired by Asian financial crisis, China promises greater potentials attracting more foreign capitals. Considering transportation costs, the major sources of China's agricultural FDI may focus on those countries with short distance such as Japan and Singapore.

## References

- Anderson, 1979, "A Theoretical Foundation for the Gravity Equation." *American Economic Review* 69, 106-116.
- Bergstrand, J. H. "The Gravity Equation in International Trade: Some Microeconomic Foundations and Empirical Evidence." *The Review of Economics and Statistics*, 67(August, 1985):474-481.
- Bergstrand, J. H. "The Generalized Gravity Equation, Monopolistic Competition, and the Factor-Proportions Theory in International Trade." *The Review of Economics and Statistics*, 71(February, 1989):143-153.
- Handy, C., and D. Henderson. "Assessing the Role of Foreign Direct Investment in the Food Manufacturing Industry," in M. Bredhal, P. Abbott, and M. Reed (eds.). *Competitiveness in International Food Markets*. Colorado: Westview Press. 1994.
- International Monetary Fund (IMF) *International Financial Statistics Yearbook 2003*.
- Leamer, E. and R. M. Stern. *Quantitative International Economics* Allyn and Bacon Inc. 1970.
- Lemoine, Francoise. "FDI and the Opening Up of China's Economy." CEPII Working Paper 2000-11, June 2000.
- Linnemann, H. *An Econometric Study of International Trade Flows*, North-Hollan, Amsterdam. 1966.
- World Bank "China engaged, Integration with the Global Economy", Washington D.C., 1997.