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A Study on the Location Determinants of the US FDI in China

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Abstract: The US foreign direct investment in China plays a leading role in the process of introducing FDI to China. This paper carries on an empirical research dynamically on the location factors of US foreign direct investment in China, adopting Johansen cointegration test, the VEC model, Granger causality test and variance decomposition technology, based on analytical data in the period from 1983 to 2006. The studying result demonstrates that there is a stable relationship among the US foreign direct investment in China, China's GDP, fixed asset investment in China and the prophase stock of the US foreign direct investment in the long-run. And China's GDP is the major power to induce the US FDI to bias the long-term equilibrium.
Key words: US FDI; Location factors; Cointegration; VEC; Variance decomposition

1. INTRODUCTION

The US foreign direct investment in China (US FDI, hereinafter) plays a leading role in the process of introducing FDI to China. In accorda1nce with the analysis of the Ministry of Commerce, real amount of US FDI has reached $59.65 billion[3] by the end of 2008. Most of the US-funded enterprises ranking top 500 of the world have established investment entities in China, some of whom are expanding their destinations from the costal areas to the middle and western regions. However, the US FDI in China has entered a period of adjustment since 2002. Take the period of 2002 to 2007 for example, the ratios of the US FDI flow to the total amount of FDI that China utilized are 10.28%, 7.85%, 6.50%, 4.23%, 4.13%, 3.13%[4], respectively, showing a tendency of decreasing. Thus, it is crucial for us to investigate the location factors of the US FDI in China to help us in predicting the future trend of the US FDI utilization in China and proper policies on foreign capital utilization could be suggested.

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2. LITERATURE REVIEW

Scholars have done extensive researches on the relations and their interactions between the US FDI and China's location factors. Based on data of foreign capital invested by the US Multinational Corporations (MNC, hereinafter) from 1983 to 2000, XU Kangning, WANG Jian (2002) modified the linear regression model by adding dummy variables of policy and foreign exchange as the decisive factors. They found that the changes of scale of the US FDI are mainly determined by changes of market demand, opening degree of policies, prophase stock of capital and rate of exchange. CHAI Min (2003) divided the reasons for US FDI in China into seven parts: (1) Monopoly advantage of the US MNCs and the industrial developing tendency. (2) Market scale, economic growth and consumption capacity in China. (3) Globalization of the MNCs' production and organization, as well as the low labor cost in China. (4) High profit margin of investment. (5) Effects of tariff and non-tariff barriers (6) Pull effects of the US MNCs' investment (7) MNCs' reaction on oligopoly .Huang Wei (2005) concluded the motives for US FDI in China from the following six aspects: (1) Ownership advantage of the US MNCs. (2) Location advantage of the US FDI. (3) Internalization advantage (4) US external developing strategies under the circumstance of economic globalization. (5) Systematic factors. (6) Positive "pushing effect" and "demonstration effect" of the prophase investment. Based on the analytical data from 1985 to 2002, ZHANG Ji (2006) suggests that the major factors that affect the US FDI in China contain the Chinese market capacity and its growing prospect, opening degree of the Chinese market to the US and the income disparity between China and the US. ZHUANG Zong-ming and MA Ming-shen (2007) investigated into the reasons for the formation of the US FDI development tendency from three layers, including macroeconomic factors such as economic scale and policy, mediate economic factor like the change of industrial structure and the microeconomic factor like the operating strategies of the enterprises.

Most of the researches above are carried out with classical multiple linear regression model. They can hardly reflect the newly emerged changes in the recent years. In this paper, based on the conclusion of the previous studyings, with the latest data, we adopt Vector Autoregression (VAR, hereinafter) model, Johansen cointegration test, Vector Error Correction (VEC, hereinafter) model, and variance decomposition technology, to dynamically analyze the equilibrium relationships among the location factors of the US FDI in China and their changing process.

The remainder of this paper is structured as follows: Section 3 is the variables selection and illustration of relevant data; Section 4 presents our empirical results and relevant tests on them. And the conclusion is in Section 5.

Table 1: Illustration of the Variables

Dependent Variables	Implication	Variables Illustration
USFDI	US foreign direct investment in China	Reflecting the flow of US foreign direct investment in China
CGDP	Gross domestic product in China	Reflecting China's economic development level and market scale
FDIS	Prephase stock of US FDI in China	Reflecting the agglomeration effect of the US FDI
FAI	Gross fixed asset formation	Reflecting the conditions of China's infrastructure construction

Table 2: ADF Test Result for Variables and Their First Order Difference

Variables		***lnUSFDI***	***lnCGDP***	***lnFAI***	***LnFDIS***
ADF Value		-2.329614	1.066043	2.015157	-1.404288
Critical Value	***1%***	-3.737853	-4.467895	-3.737853	-3.752946
	5%	-2.991878	-3.644963	-2.991878	-2.998064
Prob.		0.1714	0.9997	0.9997	0.5623
Types of Tests(c,t,k)		(1,0,0)	(1,1,3)	(1,0,0)	(1,0,1)
First Order Differences		***D(lnUSFDI)***	***D(lnCGDP)***	***D(lnFAI)***	***D(lnFDIS)***
ADF Value		-4.357584	-4.974370	-4.222724	-3.700040
Critical Value	***1%***	-2.669359	-4.467895	-4.467895	-3.788030
	5%	-1.956406	-3.644963	-3.644963	-3.012363
Prob.		0.0001	0.0036	0.0163	0.0121
Types of Tests (c,t,k)		(0,0,0)	(1,1,2)	(1,1,2)	(1,0,2)

Note: c, t, k in types of test represent the constants in unit root testing equation, time trend term and the lags, respectively. When the values of c, t equal 1, it implies that there are constants and trend terms in the equation, whereas value 0 means that they are not exist. The criterion for lag selection is the minimum amount of AIC information.

Table 3: Johansen Cointegration Test Results

Unrestricted Cointegration Rank Test (Maximum Eigenvalue)				
Hypothesized No. of CE(s)	***Eigenvalue***	***Max-Eigen Statistic***	***0.05Critical Value***	***Prob.*****
None *	0.904577	51.68755	30.81507	0.0000
At most 1	0.641126	22.54527	24.25202	0.0827
At most 2	0.489082	14.77403	17.14769	0.1072
At most 3	0.073375	1.676531	3.841466	0.1954

Note: Max-eigenvalue test indicates 1 cointegrating eqn(s) at the 0.05 level

* denotes rejection of the hypothesis at the 0.05 level

**MacKinnon-Haug-Michelis (1999) p-values

3. VARIABLES SELECTION AND DATA ILLUSTRATION

3.1 Variables Selection

We select the four following variables. The implications of the variables are listed in Tab.1.

3. 2 Data Illustration

The current paper uses annual data from 1983 to 2007(in US dollar), in which, USFDI, CGDP, FAI and FDIS are obtained from <Chinese statistical yearbook>. Series CGDP, FAI and FDIS are adjusted by China's CPI in each year, choosing year 1990 as the basic period.

To reduce potential heteroskedasticity, the four series above are log-transformed into lnUSFDI, lnCGDP, lnFAI and lnFDIS, and their first order difference are denoted by D(lnUSFDI), D(lnCGDP), D(lnFAI) and D(lnFDIS), respectively.

All the econometric computation is carried out with EViews 6.0.

4. EMPIRICAL MODEL AND TESTS

Firstly, we test the stationary of lnUSFDI, lnCGDP, lnFAI and lnFDIS. Then, a VAR model will be built to see if there is any cointegration among the series with Johansen cointegration test. Based on the cointegration, a VEC model will be adopted to analyze the adjustment process in the short-run among the variables, in order to maintain a long-run equilibrium. Then, we use Granger causality test to analyze the possible causality among the variables. Last, Variance decomposition technology is carried out to explain magnitude and dynamics at disturbance.

4.1 Stationary Test

Stationary test is implemented on series lnUSFDI, lnCGDP, lnFAI and lnFDIS by adopting augmented Dick-Fuller (ADF, hereinafter) test. The result shows that for all the four series, nonstationary cannot be rejected at a significant level of 5%. However, the same test for their differenced series demonstrates that nonstationary is rejected. Thus, we make the conclusion that all the four variables are first order integrated I(1). ADF test results for the variables and their first order difference are listed in Tab.2.

4.2 Johansen Cointegration Test

Since lnUSFDI, lnCGDP, lnFAI and lnFDIS are all I(1), cointegration may exist among the four series. In this paper, we adopts Johansen cointegration test to examine the cointegral relation among the four series above, instead of the traditional EG(Engle and Granger) two-step method because of its restriction that it is applicable mainly to the analysis between two variables.

4.2.1 Lag Selection

Before Johansen cointegration test, we must determine the proper lag K in the VAR model, which is judged by the five selection criterions of LR statistics, FPE, SC, AIC and HQ. The larger lag k is, the more the to-be-estimated parameters are, and the less the degree of freedom will be. Thus, we need to make a trade-off between lag length and degree of freedom. In order to raise the degree of freedom for the VAR model, we reduce the maximum lag accordingly, to give a lag of three periods and establish a VAR(3) model.

4.2.2 Johansen Cointegration Test

Table 4: Results of VEC Model Analysis

Error Correction	*D(lnUSFDI)*	*D(lnGDP)*	*D(lnFDIS)*	*D(lnFAI)*
CointEq1	0.20291	-0.10973	0.00764	-0.11287
	[1.5114]	[-5.40695]	[0.23042]	[-2.25591]
D(lnUSFDI(-1))	0.56526	0.00053	0.20638	-0.13875
	[1.0184]	[0.00632]	[1.50508]	[-0.67076]
D(lnUSFDI(-2))	0.59164	-0.09066	0.06450	-0.12947
	[1.2850]	[-1.30249]	[0.56707]	[-0.75453]
D(lnGDP(-1))	1.30377	-0.59527	0.58077	-1.51445
	[0.5595]	[-1.69002]	[1.00890]	[-1.74399]
D(lnGDP(-2))	-0.29644	0.62596	0.35915	0.82242
	[-0.16147]	[2.25547]	[0.79183]	[1.20198]
D(lnFDIS(-1))	-4.46851	-0.41724	-0.42253	0.06198
	[-1.80749]	[-1.11640]	[-0.69178]	[0.06727]
D(lnFDIS(-2))	0.73381	0.54542	0.44088	0.26968
	[0.46043]	[2.26376]	[1.11968]	[0.45401]
D(lnFAI(-1))	1.02039	0.09848	-0.22173	0.78163
	[0.81114]	[0.5178]	[-0.71342]	[1.66713]
D(lnFAI(-2))	0.18993	-0.80723	-0.29781	-1.05873
	[0.11896]	[-3.34448]	[-0.75498]	[-1.77922]

Note: Values in the square parenthesis represent the t-statistics.

Table 5: Granger Causality Test Results

Null Hypothesis	F-Statistic	Prob.	Conclusion
GDP does not Granger Cause USFDI	5.47702	0.0137	Bilateral Granger causality exists between GDP and USFDI
USFDI does not Granger Cause GDP	7.69597	0.0045	
FDIS does not Granger Cause USFDI	5.59532	0.0129	FDIS is the Granger cause of USFDI, otherwise uncomfirmed
USFDI does not Granger Cause FDIS	2.55459	0.1049	
FAI does not Granger Cause USFDI	2.99963	0.0725	Bilateral Granger causality exists between USFDI and FAI
USFDI does not Granger Cause FAI	4.04648	0.0334	
FDIS does not Granger Cause GDP	4.77948	0.0208	Bilateral Granger causality exists between FDIS and GDP
GDP does not Granger Cause FDIS	9.16841	0.0024	
FAI does not Granger Cause GDP	1.97176	0.1774	GDP is the Granger cause of FAI, otherwise unconfirmed
GDP does not Granger Cause FAI	3.04764	0.0698	
FAI does not Granger Cause FDIS	7.48758	0.0050	Bilateral Granger causality exists between FAI and FDIS
FDIS does not Granger Cause FAI	5.1081	0.0170	

For Johansen test is an unrestricted VAR model imposed with vector cointegration restriction, the lag selected for the cointegration test should be equal to the optimal lag under the unrestricted VAR model minus 1, say, the final lag for Johansen test should be 2. By analyzing the oriented data, we determine that the sequence under observation shows no linear tendency and there are no intercepts in the cointegration equation. It is clear to see from Tab.3 that, at a confidence level of 5%, the number of cointegration equation r = 1, indicating that there is only one cointegral relation among the four variables. In another word, under probability of 95%, it is reasonable to believe that there is a single long-term equilibrium among lnUSFDI, lnCGDP, lnFAI and lnFDIS. The cointegration expression is as follows:

lnUSFDI =

$$\underset{(0.30317)}{2.185422\ln CGDP} \quad \underset{(0.40248)}{-2.370837\ln FAI+} \quad \underset{(0.11742)}{0.480734\ln FDIS}$$

Note: The number in the brackets demonstrates the standard deviation of the regression coefficients.

We find from the cointegration testing result that the US FDI in China is positively correlated with both China's GDP and the prophase stock of US FDI. The US FDI will increase by 2.18% when China's GDP increases by 1%. And a 1% growth in the prophase stock of US FDI will drive the US FDI to increase by only 0.48%. While there is a negative correlation between the US FDI and China's gross fixed asset formation. The formal one will decrease by 2.37% with a 1% growth of the later. The spillover effect of China's gross fixed asset formation on the US FDI in China is much more significant.

As for cointegration only demonstrates the long-run relation and their tendency among the variables, we need to build up a VEC model to go into further investigation in consideration of the short-run fluctuation and long-run equilibrium among the variables.

4.3 VEC Model Analysis

Engle and Granger established the VEC model by combining cointegration model with error correction model. VEC model can be derived from VAR model as long as cointegration exists among variables. For each equation in the VAR model is an autoregressive distributed lag model, VEC model can be regarded as a VAR model with cointegral restriction. With VEC model, we can analyze both the direction and the speed of adjustment to an equilibrium status when the explanatory variables bias the long-run equilibrium. See Tab.4 for the details.

From Tab.4, we can find that only the coefficients of D (lnGDP) and D (lnFAI) are significantly negative, which means that the error correction terms show an negative effect of adjustment on D (lnGDP) and D (lnFAI) when the system biases its equilibrium, but no obvious effect on D(lnUSFDI) and D (lnFDIS). By observing the coefficients of the lags, we find that neither the first nor the second lag of D (lnUSFDI) has significant effect on it whereas it is significantly influenced by the first lag of D (lnFDIS). Thus, US FDI is significantly influenced by its prophase stock rather than other factors as it deviates from the long-run equilibrium.

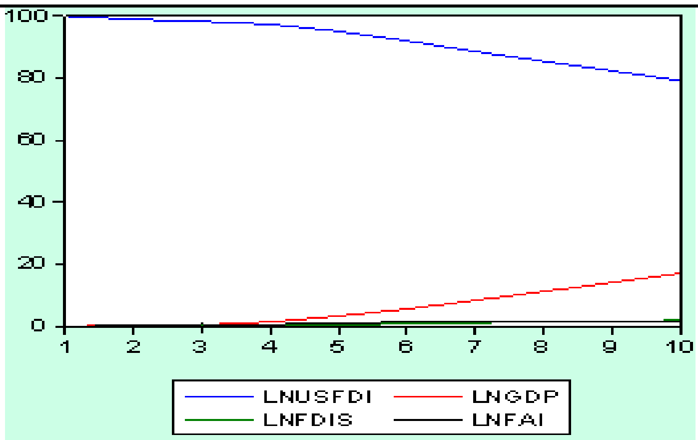

Figure 1: Variance Decomposition of LNUSFDI

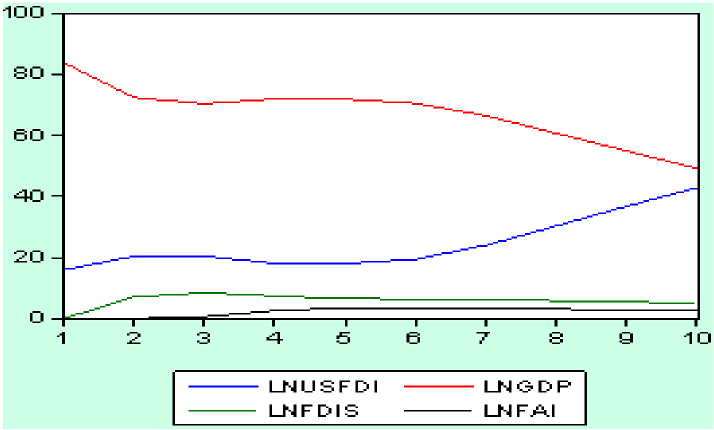

Figure 2: Variance Decomposition of LNGDP

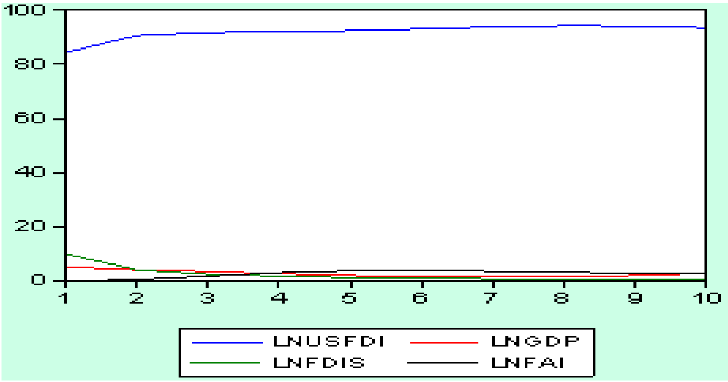

Figure 3: Variance Decomposition of LNFDIS

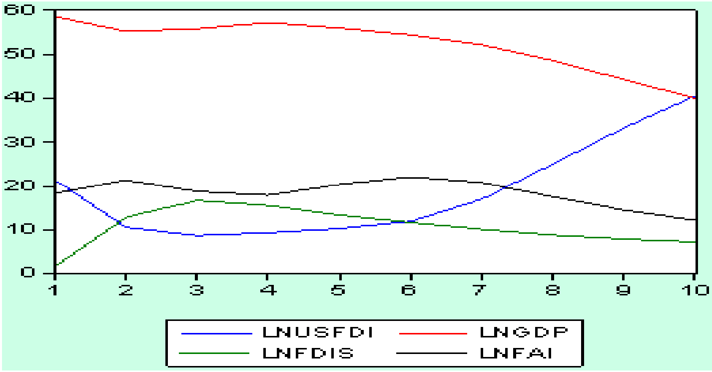

Figure 4: Variance Decomposition of LNFAI

4.4 Granger Causality Test

As what we have referred previously, there is long-run equilibrium relation among lnUSFDI, lnCGDP, lnFAI and lnFDIS. But we are still not confirmed about whether it is a causal relationship or not. We will find the answer by Granger Causality Test first conducted by Granger (1969) and Sims (1972). See the results of the test from Tab.5.

Conclusions drawn from Tab.5 are that, at a confidence level of 90%, there is a bilateral causal relationship between CGDP and USFDI, which reflects that during the past 20 years, China's GDP has enhanced and been promoted by the US FDI in China significantly at the same time. The prophase stock of the US FDI is the Granger cause of the US FDI in China, otherwise disconfirmed, demonstrating that the prophase stock of the US FDI in China has the effects of demonstration and conglomeration on the US FDI. A bilateral causality exists between China's fixed asset formation and the US FDI in China, proving that China has put effort in increasing fixed asset investment and infrastructure constructions in order to induce more US FDI when US FDI in China is enhancing China's fixed asset investment. A bilateral causal relationship also exists between stock of US FDI and China's GDP. As the stock of US FDI in China increases, it provides China with funds and more advanced technology which are necessary in China's economic development. Vise versa, China's economic development provides the US FDI with better investment environment and larger market capacity. For China's fixed asset investment, China's GDP is its unilateral Granger cause. That is to say, China's GDP growth has promoted the fixed asset investment in China. The bilateral causality between China's fixed asset investment and the stock of US FDI in China indicates a spillover relationship between them.

4.5 Variance Decomposition Analysis

The basic thought of variance decomposition technology is to decompose the Mean Square Error (MSE) in the VAR system into separate impact contributed by each variable, that is the ratio of impact from the variable itself to the total impact. In this way, the interactions among the variables can be described quantitatively. The following specific analysis will show the results of the variance decomposition, in combination with Fig.1- Fig. 4.

First, prediction errors of lnUSFDI are impacted mainly by lnUSFDI itself both in the long-run and the short-run. Within the whole prediction period, the proportion of impact from itself in prediction errors of lnUSFDI decreases from 100% to 80%, while that from lnGDP increases from 0 to 20%, which illustrates that in the long-run, the stock of US FDI plays a more important role in affecting the US FDI in China comparing with China's GDP. It is predicted that the stock of US FDI will grow consistently in a comparatively long period. So we can also predict a consistent growth of US FDI. Even with the reality that the amount of US FDI has fallen in the recent two year, the US FDI's trend of increase won't change.

Second, prediction errors of lnGDP are mainly intervened by itself in the short-run and, in the long-run, it is co-influenced by the four endogenous variables. Within the predicting periods, the proportion of "self-impact" in the forecasting errors of lnGDP decreases from 85% to 50%, and that from lnFDIS and lnFAI increases from 16% and 0 to 43% and 3%, respectively. During the first four periods, the impact from lnFDIS on lnGDP slowly rises from 18% to 20%, and reaches 41% after the fourth period. Indexes above indicate that in a relevant long period, the stimulation effect of the US FDI on Chinese economy will be stronger with the steady increase of US FDI in China. It is reasonable because China's economic growth relies on international trades and FDI to a great extent.

Third, the forecasting error of lnFDIS is mainly influenced by impact from lnUSFDI in the short-run, but jointly influenced by itself, lnGDP and lnFAI in the long-run. Within periods from 1 to 10, the proportion of "self-impact" and impact from lnGDP and lnFAI are stable at around 5%. The empirical results indicate that in the long-run, the major motivation for the stock of US FDI in China stems from flow of US FDI.

Finally, prediction errors of lnFAI are mainly impacted by lnGDP. In the long-run, the proportion of impact from lnUSFDI in the forecasting errors of lnFAI steadily increases from 20% to 40%, which demonstrates that the spillover effect of the US FDI in China on China's fixed asset formation is greater gradually. In China, fixed asset investment is a comparatively important pull for the economic growth. So, we can draw the conclusion that the US FDI is becoming more influential for China's economic growth.

5. CONCLUSIONS AND SUGGESTIONS

In accordance with the previous empirical analysis, we draw the conclusion that a long-run equilibrium exists among lnUSFDI, lnCGDP, lnFDIS and lnFAI with Johansen cointegration test. In this equilibrium, the first three variables are positively correlated, but the correlation between China's fixed asset investment and the US FDI in China is negative. Influenced by the US sub-prime credit crisis, the US FDI in China has shown a tendency to fall since 2008. But US-funded enterprises still have strong investment motives with the consistence economic development in China. Then in face with the worldwide economic crises, how to drive the US FDI to contribute more in promoting China's economic development? Two aspects of work are suggested to be arranged properly when introducing the US FDI to China:

First, proper conditions should be provided from the prospects of macroeconomic and microeconomic, in order to maintain the US FDI in China at a relatively high level. Because of the economic crisis, the US government is doomed to reduce the amount of their direct investment to China. So we should adjust our policies on foreign investment introducing to induce more US FDI. Although with a relatively high level of US FDI stock, the US FDI is still limited in its amount, comparing with the total amount of FDI in China. Certain measures should be taken to expand the scale of US FDI so as to better promote China's economic growth.

Second, the structure of the US FDI should be optimized. It should be guided to develop in the direction of advancement just as what is pointed out in <"The Eleventh Five-year Planning on Foreign Investment Introduction">, that the key point of FDI utilization should turn to introduction of advanced technology, management experience and high-quality talents from simply covering the shortage of funds and foreign exchange, combining FDI utilization with upgrading domestic industrial structure and technology.

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