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Impact of change in exchange rate on foreign direct investment: Evidence from China

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Impact of Change in Exchange Rate on Foreign Direct Investment: Evidence from China

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Abstract

Based on the monthly data of foreign direct investment (FDI) in China and the index of real effective exchange rate (REER) of RMB during Jan 1997 to Sep 2012, we develop a statistical model in this paper to test the impact of changes in exchange rate in the host country on FDI, with reference to international and domestic research. According to the results of the empirical test, the appreciation of RMB promotes FDI after the reforms in the exchange rate regime in 2005 and this phenomenon is a result from the change in the type of FDI into China in recent years. In the long term, the proper appreciation of RMB and a more flexible exchange rate regime will impact on China's currency and micro-control policies positively.

1. Introduction

International investment is becoming increasingly important to a country's economy. Foreign direct investment (FDI) has made an important contribution to the long-term growth of China's economy. Since 1979, economic reforms and the "open door policy" embarked on by China have led to a fast-growing FDI into the country. The fast-growing economy in China and an increasingly open investment environment have attracted more and more foreign investments.

On July 21, 2005, China began to implement a managed floating exchange rate regime based on market supply and demand with reference to a basket of currencies (Hu 2010). Due to the fact that China is steadily going forward the reform of exchange rate, the RMB exchange rate is steadily improving. Research into the exchange rate mechanism and its impact on FDI will help us analyze trends in FDI and its impact on the macro economy. In our paper, we make use of a combination of theoretical modeling and empirical testing methods to explore the mechanism and impact of exchange rate on FDI.

2. Literature Review

2.1 Global Views

Since the 1970s, foreign scholars began to study the impact of exchange rate changes on FDI, but there has been a lack of consistent findings in research about the relationship between the exchange rate and FDI.

Kohlhagen's regression test in 1977 showed that: In 1960's, depreciation or appreciation of the major currencies in European countries (Great Britain, 1967; France, 1969; Germany, 1961, 1969) would influence the U.S. FDI systemically, even with existence of capital controls.

In the 1980s, it was generally believed that international currency devaluation would affect FDI positively because the currency devaluation would make domestic assets cheaper, thereby making them attractive to foreign investors. However, since early 1990s, many economists began to question this belief.

According to the theory of "relative production cost effect" raised by Cushman (1985) and the theory of "relative wealth hypothesis" summed up by Froot and Stein (1991), currency depreciation will promote the inflow of FDI. "Relative production cost effect" theory emphasizes the impact of exchange rate changes on the level of the cost of production of the host country. This theory believed that when other factors are held constant, the devaluation

of the currency of a country will reduce local relative to foreign production costs, especially labor costs. "Relative wealth hypothesis" theory holds that devaluation of host currency can improve the relative wealth of foreign investors, which is conducive for the acquisitions of the host country's domestic enterprises.

Cushman (1985) analyzed the annual level of FDI in the United States and other five major industrialized countries through empirical tests, with the conclusion that appreciation of the real exchange rate would have a positive impact on FDI.

On the contrary, researchers such as Campa (1993) stated that currency devaluation would inhibit FDI inflow. They believed that overseas investment decisions by multinational corporations depend on expectations of future earnings. Therefore, the stronger the currency in the host country, the higher the future earnings expectations multinational corporations will hold before they enter the market of the host country, which will attract more FDIs. Relatively, devaluation has the opposite effect.

In addition, Goldberg and Kolstad (1995) found that depreciation of exchange rate did not have any large or significant impact on FDI; however, the intensity of the fluctuations in exchange rates affected FDI positively.

Dewenter (1995) concluded from empirical analysis that the relationship between the relative level of the exchange rate and FDI was not statistically significant, based on data in the United States from 1975 to1989.

2.2 Domestic Views

At the same time, scholars in China also have done a large number of studies on this issue. Feng and Li (2012) concluded that there is a negative correlation between FDI and the real effective exchange rate through the regression of data from January 2003 to October 2011. They also found that the long-term mutual influence between the two was significant.

Sun, Liu and Song (2006) established a model of the whole FDI to China and two sub-sample models including market-oriented FDI and cost-oriented FDI to China to test the effects of exchange rate changes on FDI based on the data from 2001 to 2003. They found that appreciation of RMB would attract more market-oriented FDI, whereas it would decrease cost-oriented FDI through the sub-sample models. However, through the model of the whole FDI, the real effective exchange rate did not significantly affect FDI during their regression experiment period.

According to the above analyses, the conclusions about relationship between FDI and fluctuations of the foreign exchange rate can be described as inconsistent among various regions and regression experiment periods.

In addition, the main drawbacks of domestic studies included: (i) using limited sample points because of the use of annual or seasonal data as the data sample. The result of this is that the empirical results tend to lack credibility (ii) selecting the RMB exchange rate to US dollar as the data sample and ignoring the impact of U.S. dollar depreciation to the real exchange rate of the RMB (iii) ignoring the impacts of reforms in the exchange rate regime in 2005 as most researchers selected the data sample before 2008, the time that the policy effects of the exchange rate reform had not been felt significantly.

In our report, we will not only examine the relationship between real effective exchange rate (REER) and FDI in China, but also we will observe the impacts of exchange rate regime reforms in 2005 by empirical test.

3. The Economic Model

According to a research into the determinants of FDI across China by Qian, Tong and Qiao (2002), market demand, market size, labor quality and labor cost affected FDI significantly. Based on the above observation, Sun, Liu and Song (2006) established the model:

$$\text{Ln}(fdi_t) = \beta_0 + \beta_1 \ln(gdp_t) + \beta_2 \ln(w_t) + \beta_3 \ln(re_t) + \beta_4 WTO_t + \varepsilon_t$$

In this model: $\text{Ln}(fdi_t)$ is the logarithm of FDI; $\ln(gdp_t)$ is the logarithm of GDP, used to capture the market demand and market size; $\ln(w_t)$ is the logarithm of wage, used as a measure for labor cost; $\ln(re_t)$ is the logarithm of real effective exchange rate (REER), used to examine the impact from exchange rate on FDI. The researchers also added a dummy variable – WTO to observe change of FDI after China joined in WTO in 2001.

4. The Statistical Model

In our study, we only focus on the impact on FDI by exchange rate. Hence, we establish a simple model with two variables – FDI in China and real effective exchange rate (REER) of RMB:

$$\text{Ln}(FDI_t) = \beta_0 + \beta_1 \ln(REER_t) + \varepsilon_t$$

In this model: $\text{Ln}(FDI_t)$ is the logarithm of FDI, $\ln(REER_t)$ is the logarithm of real effective exchange rate of RMB and ε_t is the residual term.

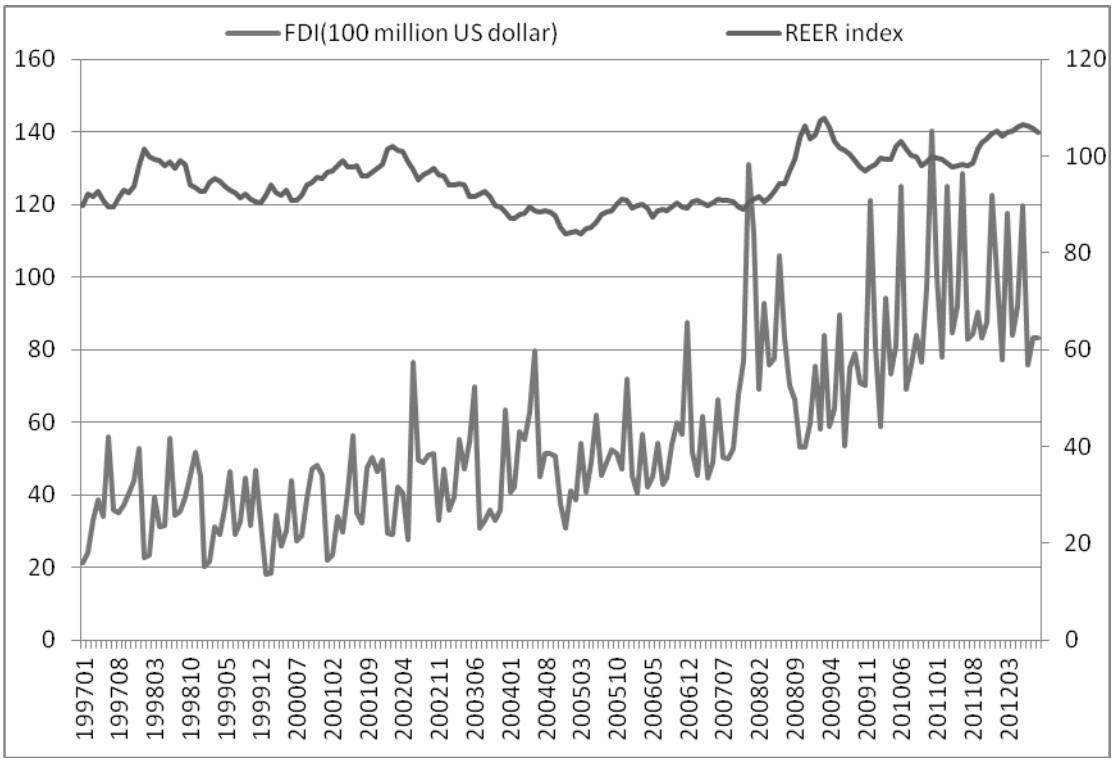
The REER index is weighted average of a country's currency relative to an index or basket of other major currencies adjusted for the effects of inflation. The weights are determined by

comparing the relative trade balances, in terms of one country's currency, with each country within the index.

For a more accurate observation, we select monthly data of FDI and REER from January 2002 to September 2012, including 189 pairs of observations. Data of FDI come from Ministry of Commerce of China while data of real effective exchange rate are index data from the Bank for International Settlements.

5. Data Description and Methodology

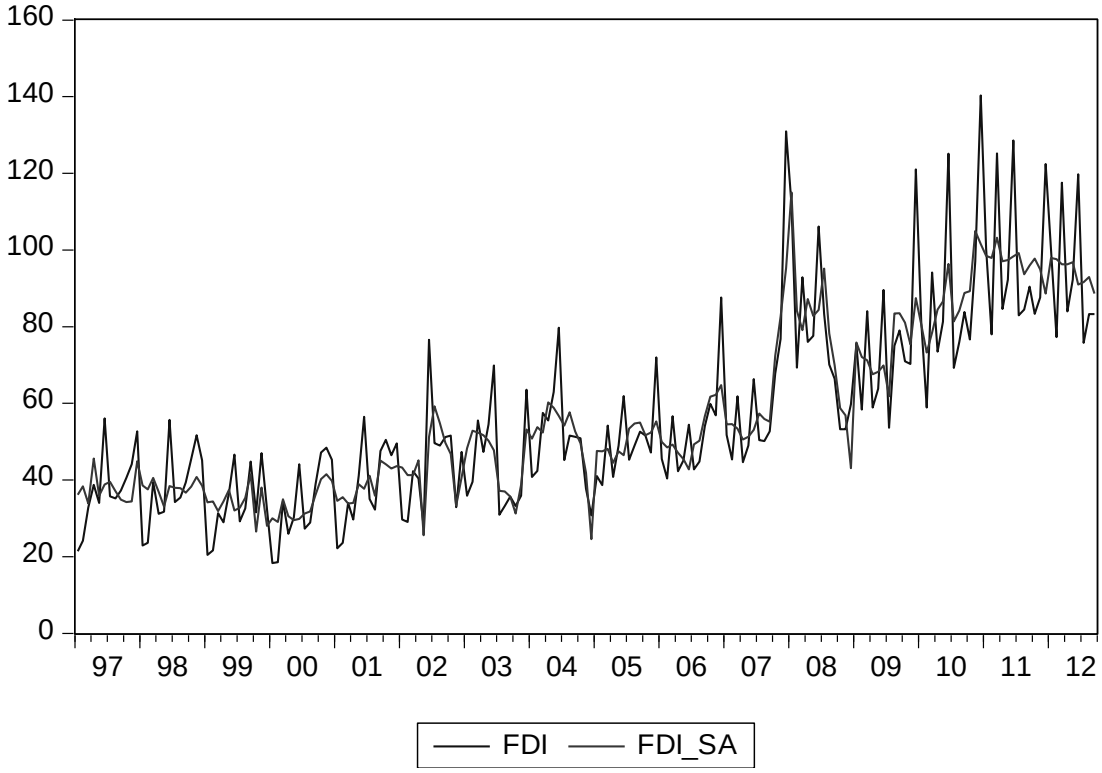
5.1 Data Description



Graph 1: Monthly statistics of FDI and REER

According to the above graph, in the period from January 1997 to December 2002, the real effective exchange rate index of RMB fluctuated in a narrow range. After 2003, the index showed an increasing trend with wide fluctuations, with the lowest point in 2005.

On the other hand, we can observe an increasing trend of FDI in China during the whole period, with a faster growth after 2005. However, the data also showed a significant seasonal pattern. To eliminate the seasonal effect, we need to do seasonal adjustment of the original data and use the data after seasonal adjustment for empirical test.



Graph 2: FDI & FDI after seasonal adjustment

5.2 Methodology

We will run OLS first to test the linearity of the two time series and check the stationarity of the two time series by ADF test. If the two time series are stationary or both stationary at first difference form, we will examine the cointegration between them using Engle-Granger a two-step approach.

If the two series are not cointegrated, we will estimate the two log-differencing time series dln (FDI) and dln (REER) using VAR approach. Hence, we need to conduct Granger causality test to test the causality among the two time series.

If the two series are cointegrated, we will estimate the time series by using error-correction model (ECM).

6. Empirical Results

6.1 Full Sample Period: 01/1997-09/2012

Run OLS at first and test the linearity of REER and FDI.

Table 1: Linearity of REER and FDI for Full Sample Period

Dependent Variable: LNREER				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**

C	4.304054	0.040854	105.3516	0.0000
LNFDI	0.062397	0.010256	6.084066	0.0000
Dependent Variable: LNFDI				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-8.08772	1.981247	-4.08214	0.0001
LNREER	2.648161	0.435262	6.084066	0.0000

According to the table above, the results indicate statistical significance between the two variables. We can form the equation:

Ln(FDI)= -8.08772+2.648161ln(REER)

This equation means that a 1% increase in real effective exchange rate of RMB leads to a 2.648% increase in FDI in China. This equation indicates that the appreciation of RMB will lead to capital inflow into China.

We do the ADF-test to test whether the data of FDI and REER are stationary. (Δ means first difference)

Table 2: Unit Root Test Results of Full Sample Period:

	ADF – test	**p-value**	**5% – CV**	**Conclusion**
lnFDI	-6.506141	0.0000	-3.433906	**I(0)**
lnREER	-2.162843	0.5070	-3.434036	**I(1)**
ΔlnREER	-10.192550	0.0000	-2.876843	**I(0)**

A necessary condition for cointegration test is that the time series of the variables must be stationary in the same order. Based on the results of ADF test above, ln(FDI) series is stationary while the ln(REER) series has a unit root and is stationary at first difference form. In this case, we cannot use the Engle-Granger two steps approach for cointegration test. Therefore, we cannot say that there is a long-term stable equilibrium relationship between FDI and REER.

Due to the fact that the two series are not cointegrated, we will estimate the two log-differencing time series [dln(FDI)] and [dln(REER)] using VAR approach to test the causality between them.

We use the AIC criteria to determine that lag 3 is the optimal lag length of VAR model. Then we re-estimate the VAR by using the optimal lag length and get the following results by Granger causality test:

Table 3: Granger Causality Test Results of Full Sample Period:

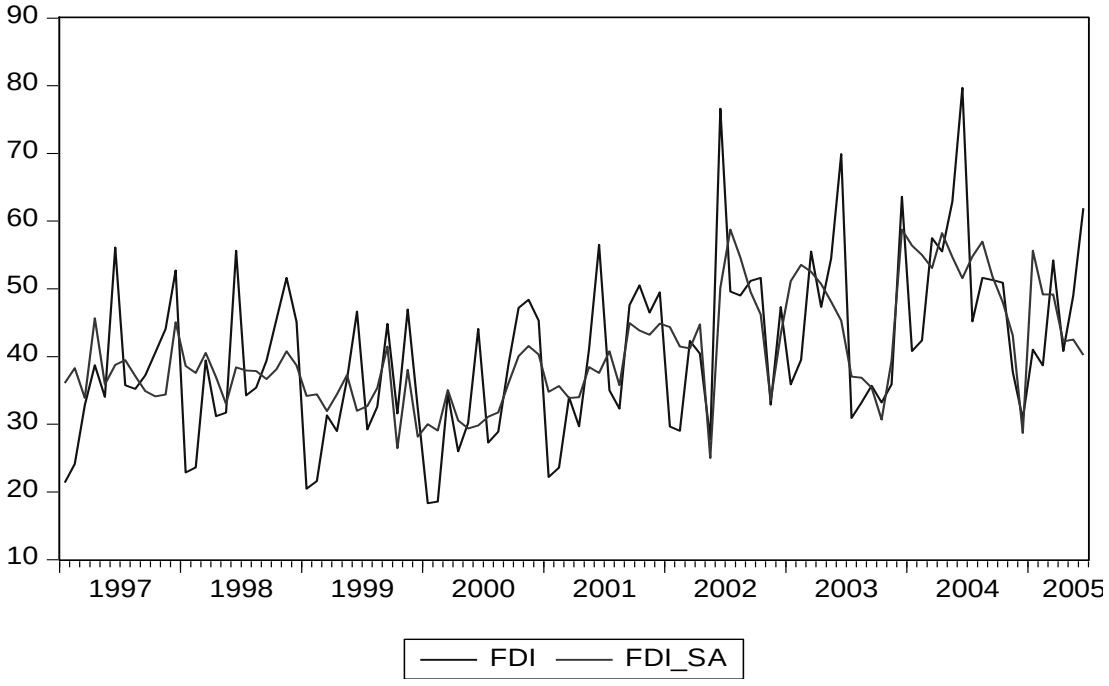
Dependent variable: DLNREER			
Excluded	**Chi-sq**	**df**	**Prob.**
DLNFDI	2.612245	5	0.7595
Dependent variable: DLNFDI			
Excluded	**Chi-sq**	**df**	**Prob.**
DLNREER	10.64766	5	0.0588

According to above results, a change in FDI cannot cause a change in real effective exchange rate significantly in the long-run. However, a change in REER will cause a change in FDI at 10% statistical level, even though this causality is not significant at 5% level.

6.2 Sub Sample Period: 01/1997-07/2005

As discussed earlier, FDI development in China takes several stages. Due to the reforms in the exchange rate regime in July 2005, we split the sample into pre- and post-2005 periods and examine individually to see if the relationship between FDI and REER behaves differently.

As before, we use the data of FDI after seasonal adjustment.



Graph 3: FDI & FDI after seasonal adjustment from 01/1997 to 06/2005

Run OLS to test the linearity of REER and FDI.

Table 4: Linearity of REER and FDI for Sub-Sample Period: 01/1997 to 06/2005

Dependent Variable: LNREER

Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	4.705114	0.086416	54.44741	0.0000
LNFDI	-0.046146	0.023406	-1.971582	0.0514
Dependent Variable: LNFDI				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	7.363943	1.865153	3.94817	0.0001
LNREER	-0.810832	0.411259	-1.971582	0.0514

According to the table above, the results indicate statistical significance between the two variables at 10% statistical level but the relationship is not significant at 5% level. We can also form an equation:

Ln (FDI)= 7.363943-0.8108321ln(REER)

This equation means that a 1% increase in real effective exchange rate of RMB leads to a 0.81% decrease in foreign direct investment in China. Correspondingly, we can conclude that the depreciation of RMB will attract the capital inflow in China before July 2005, a similar finding to the research from other scholars, although the conclusion is opposite to the results of the full sample period.

We do the ADF-test to test whether the data of FDI and REER are stationary. (Δ means first difference)

Table 5: Unit Root Test Results of Sub-Sample Period: 01/1997 to 06/2005

	ADF – test	p-value	5% – CV	Conclusion
lnFDI	-6.051701	0.0000	-3.454919	**I(0)**
lnREER	-2.026444	0.5797	-3.454919	**I(1)**
ΔlnREER	-8.011835	0.0000	-2.890623	**I(0)**

Similar to the conclusion from the results of the full sample data, there is no long-term stable equilibrium relationship between FDI and REER from January 1997 to June 2005 because the two time series are not stationary at the same order.

Due to the fact that the two series are not cointegrated, we will estimate the two log-differencing time series [dln(FDI)] and [dln(REER)] using VAR approach. We use the AIC criteria to determine that lag 1 is the optimal lag length of VAR model. Then we re-estimate the VAR by using the optimal lag length and get the following results by Granger causality test:

Table 6: Granger Causality Test Results of Sub-Sample Period: 01/1997 to 06/2005

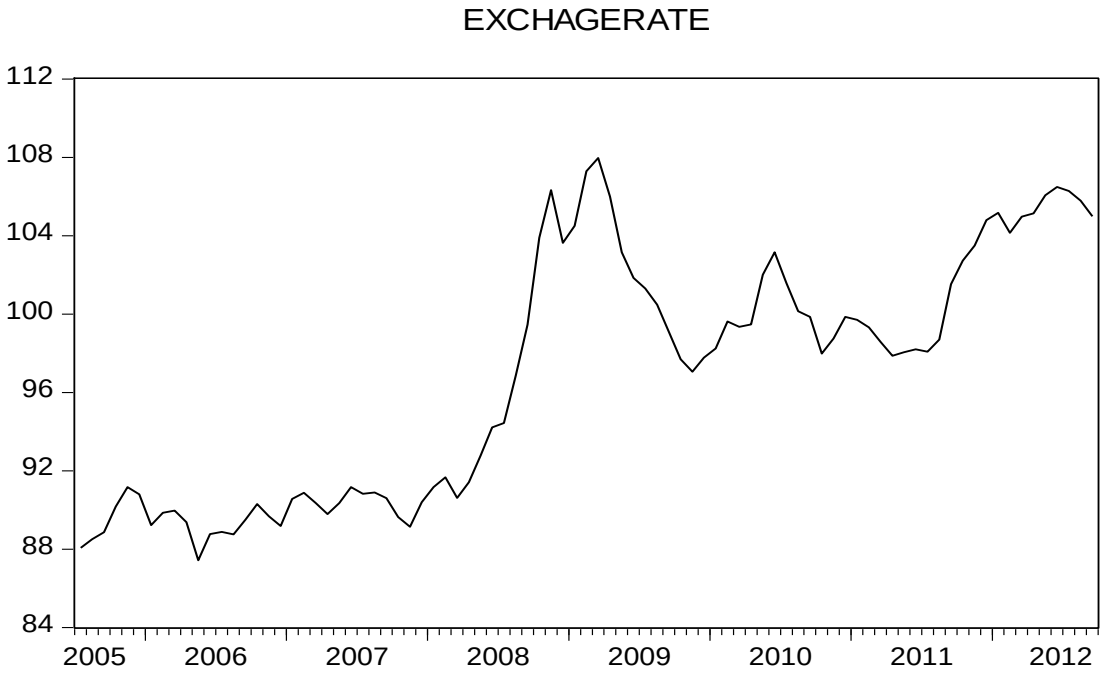
Dependent variable: DLNFDI			
Excluded	**Chi-sq**	**df**	**Prob.**

DLNREER	2.574591	1	0.1086
Dependent variable: DLNEXR			
Excluded	**Chi-sq**	**df**	**Prob.**
DLNREER	0.395305	1	0.5295

According to the above results, there is no significant causality between FDI in China and REER of RMB before the reforms. They cannot cause each other. This result is also different from the conclusion of the full sample data.

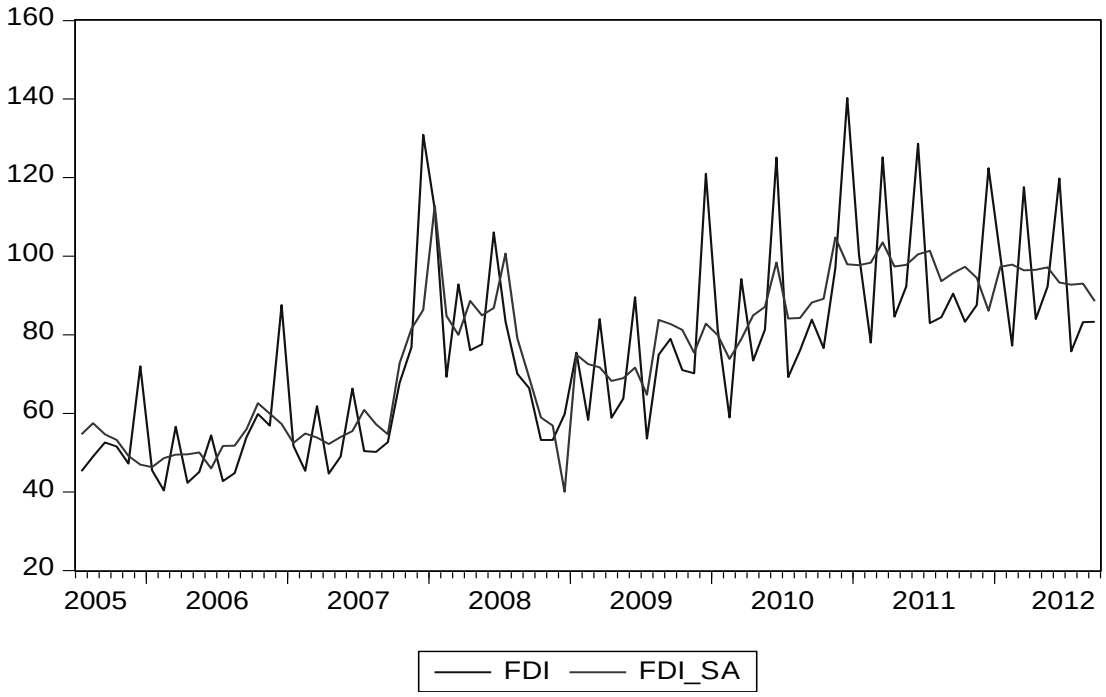
6.3 Sub Sample Period: 07/2005-09/2012

As the Graph 4 shows below, RMB experienced an accelerated appreciation from March 2008 to March 2009. The accelerated appreciation was as a result of such factors as weakness in the U.S. dollar on the international market in 2008, soaring international crude oil prices and a large trade surplus in China. At the same time, the FDI showed an increasing trend with wide fluctuations. To examine the complex relationship between the two variables, we will do the empirical test step by step.



Graph 4: Real Effective Exchange Rate in Sub-Sample Period: 07/2005-09/2012

As we have done before, we use the data of FDI after seasonal adjustment.



Graph 5: FDI & FDI after seasonal adjustment 07/2005-09/2012

Run OLS to test the linearity of REER and FDI.

Table 7: Linearity of REER and FDI for Sub-Sample Period: 07/2005-09/2012

Dependent Variable: LNREER12				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	3.963206	0.093228	42.5109	0.0000
LNFDI12	0.141482	0.021667	6.529692	0.0000
Dependent Variable: LNFDI12				
Variable	**Coefficient**	**Std. Error**	**t-Statistic**	**Prob.**
C	-6.497352	1.652923	-3.930826	0.0002
LNREER12	2.361066	0.361589	6.529692	0.0000

The results above indicate statistical significance between the two variables. We can form the equation:

Ln (fdi) = -6.497352+2.361066ln (reer)

This equation means that a 1% increase in real effective exchange rate of RMB leads to a 2.36% increase in foreign direct investment in China. This equation indicates that the appreciation of RMB will lead to the capital inflow into China after the exchange rate regime reforms in July 2005.

We do the ADF-test to test whether the data of FDI and REER are stationary. (Δ means first difference)

Table 8: Unit Root Test Results of Sub-Sample Period: 07/2005-09/2012

	ADF – test	**p-value**	**5% – CV**	**Conclusion**
LnFDI12	-3.943073	0.0143	-4.06829	**I(0)**
LnREER12	-2.502004	0.3266	-3.463547	**I(1)**
ΔlnREER12	-6.33862	0.0000	-2.896346	**I(0)**

Similar to the conclusion from the results of the full sample data, there is no long-term stable equilibrium relationship between FDI and real effective exchange rate from July 2005 to September 2012 in that the two time series are not stationary at the same order.

Due to the fact that the two series are not cointegrated, we will estimate the two log-differencing time series [dln (FDI)] and [dln (REER)] using VAR approach to test the causality of them.

We use the AIC criteria to determine that lag 1 is the optimal lag length of VAR model. Then we re-estimate the VAR by using the optimal lag length and get the following results by Granger causality test:

Table 9: Granger Causality Test Results of Sub-Sample Period: 07/2005-09/2012

Dependent variable: DLNREER12			
Excluded	**Chi-sq**	**df**	**Prob.**
DLNFDI12	0.174625	1	0.6760
Dependent variable: DLNFDI12			
Excluded	**Chi-sq**	**df**	**Prob.**
DLNREER12	7.095377	1	0.0077

According to the results above, a change in FDI cannot cause a change in real effective exchange rate significantly in the long-run. However, a change in real effective exchange rate will cause a change in FDI significantly.

7. Theoretical Explanation

From the empirical test results above, we can conclude that: (i) in the long-run, changes in the RMB exchange rate will cause a significant movement in FDI and the appreciation of RMB impacts on the foreign capital inflow into China positively; (ii) depreciation of RMB attracted the capital inflow into China until the exchange rate regime reforms in July 2005, but this situation was reversed after 2005; (iii) the causality of change of RMB on FDI becomes significant after the exchange rate regime reforms.

With reference to the findings in the research by Sun, Liu and Song (2006), we believe the following explanations will be the possible reasons for this phenomenon:

(i) The negative effect of appreciation of RMB on FDI is still not large so far, and the relatively low labor costs, as well as preferential policies for foreign investments, still make China attractive to foreign investors;
(ii) With the rapid economic growth in China, FDI flow into China has changed from being cost-oriented to being market-oriented.

With market-oriented FDI, production and sales are both in the country into which the investments flow. Investors are, therefore, entitled to the profits generated in the country and the appreciation of the currency in host country means increase in the wealth of foreign investors. However, with cost-oriented FDI, in order to reduce costs for foreign investors, production takes place in the country receiving the investment while sales take place in the investors' country or a third country. Hence, appreciation of the host country's currency would lead to the rising of cost for foreign investors which inhibits capital inflows. Therefore, the change in China's FDI from a cost-oriented to a market-oriented one may be the reason for this phenomenon.

8. Conclusion

In conclusion, the 2005 reforms of the RMB exchange rate regime increase the flexibility of the regime and help the regime to become more suitable for the needs of the development of China's economy. Although the slight appreciation of RMB in the short term has caused fluctuations in commodity prices and trade volume of China's imports and exports, in the long term, the proper valuation of the RMB and a more flexible exchange rate mechanism will impact on China's currency and macro-control policies positively.

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Appendix

DATA OF FDI & REEER

year-month	FDI(100 million US dollar)	REER index
199701	21.39	89.69
199702	24.12	92.12
199703	32.86	91.71
199704	38.71	92.84
199705	34.02	90.88
199706	56.11	89.47
199707	35.78	89.58

DATA OF FDI & REEER

year-month	FDI(100 million US dollar)	REER index
199912	32.32	90.22
200001	18.32	91.83
200002	18.58	94.17
200003	34.5	92.4
200004	26	92.04
200005	30.2	92.93
200006	44.1	90.91

199708	35.21	91.32	200007	27.3	90.96
199709	37.21	93.05	200008	28.9	91.88
199710	40.57	92.37	200009	38.9	93.93
199711	44.09	93.87	200010	47.2	94.64
199712	52.71	98.12	200011	48.4	95.62
199801	22.88	101.6	200012	45.3	95.44
199802	23.64	99.86	200101	22.2	96.77
199803	39.44	99.46	200102	23.6	96.92
199804	31.2	99.11	200103	34	97.94
199805	31.69	98.09	200104	29.7	99.1
199806	55.65	98.79	200105	41.1	97.86
199807	34.27	97.43	200106	56.49	97.68
199808	35.4	99.01	200107	35.01	97.93
199809	39.38	98.38	200108	32.3	95.87
199810	45.52	94.08	200109	47.6	95.91
199811	51.63	93.62	200110	50.5	96.69
199812	45.12	92.66	200111	46.5	97.44
199901	20.46	92.83	200112	49.5	98.28
199902	21.62	94.52	200201	29.66	101.37
199903	31.32	95.49	200202	29.04	101.95
199904	29	94.78	200203	42.3	101.29
199905	36.63	93.72	200204	40.4	100.84
199906	46.63	92.9	200205	27.8	98.92
199907	29.21	92.45	200206	76.6	97.21
199908	32.62	91.29	200207	49.6	95.2
199909	44.84	92.18	200208	49	96.09
199910	31.57	91.06	200209	51.2	96.61
199911	46.98	90.72	200210	51.6	97.5

DATA OF FDI & REEER

year-month	FDI(100 million US dollar)	REER index
200211	32.9	96.26
200212	47.3	95.88
200301	35.9	94.18
200302	39.5	94.14
200303	55.5	94.24

DATA OF FDI & REEER

year-month	FDI(100 million US dollar)	REER index
200601	45.5	89.22
200602	40.4	89.85
200603	56.6	89.96
200604	42.3	89.37
200605	45.1	87.43

200304	47.3	94.16	200606	54.4	88.77
200305	54.5	91.69	200607	42.77	88.88
200306	69.9	91.54	200608	44.83	88.75
200307	30.9	92.11	200609	53.99	89.5
200308	33.2	92.71	200610	59.87	90.29
200309	35.7	91.64	200611	56.87	89.67
200310	33.2	89.68	200612	87.58	89.18
200311	35.9	89.67	200701	51.75	90.56
200312	63.6	88.35	200702	45.34	90.87
200401	40.8	87.2	200703	61.84	90.35
200402	42.39	87.04	200704	44.66	89.79
200403	57.51	88.06	200705	48.99	90.35
200404	55.5	88.29	200706	66.31	91.16
200405	62.9	89.57	200707	50.42	90.82
200406	79.7	88.78	200708	50.18	90.89
200407	45.2	88.42	200709	52.7	90.6
200408	51.6	88.86	200710	67.76	89.64
200409	51.3	88.61	200711	76.79	89.14
200410	50.9	87.7	200712	130.94	90.39
200411	37.7	85.38	200801	112	91.17
200412	30.8	84.09	200802	69.29	91.66
200501	41	84.36	200803	92.86	90.62
200502	38.7	84.45	200804	76.03	91.42
200503	54.2	84	200805	77.61	92.78
200504	40.8	84.92	200806	106.1	94.21
200505	49	85.17	200807	83.36	94.43
200506	61.9	86.49	200808	70.08	96.86
200507	45.3	88.06	200809	66.42	99.46
200508	49	88.5	200810	53.22	103.89
200509	52.6	88.86	200811	53.22	106.33
200510	51.6	90.17	200812	59.78	103.63
200511	47.2	91.17	200901	75.41	104.51
200512	72	90.79	200902	58.33	107.29

DATA OF FDI & REEER

year-month	FDI(100 million US dollar)	REER index

DATA OF FDI & REEER

year-month	FDI(100 million US dollar)	REER index

200903	84.03	107.96	201205	92.29	106.06
200904	58.9	106	201206	119.79	106.49
200905	63.79	103.15	201207	75.79	106.28
200906	89.61	101.84	201208	83.26	105.79
200907	53.6	101.31	201209	83.28	104.99
200908	74.99	100.48			
200909	78.99	99.08			
200910	71	97.69			
200911	70.23	97.05			
200912	121	97.77			
201001	81.29	98.24			
201002	58.95	99.62			
201003	94.18	99.34			
201004	73.46	99.47			
201005	81.32	102.01			
201006	125.1	103.15			
201007	69.24	101.58			
201008	76.02	100.15			
201009	83.84	99.85			
201010	76.63	97.98			
201011	97.04	98.75			
201012	140.33	99.85			
201101	100.3	99.7			
201102	78	99.32			
201103	125.2	98.57			
201104	84.64	97.87			
201105	92.25	98.05			
201106	128.63	98.2			
201107	82.97	98.07			
201108	84.46	98.69			
201109	90.45	101.53			
201110	83.34	102.73			
201111	87.57	103.5			
201112	122.42	104.79			
201201	99.97	105.17			
201202	77.26	104.14			
201203	117.57	104.97			
201204	84.01	105.14			