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Empirical Analysis of Factors Affecting China's FDI

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Abstract - Foreign direct investment (FDI) is an important aspect for our country to open to the outside, in the past 30 years, the Chinese government gives a lot of preferential policies to attract foreign capital inflows. But the main factors which influence foreign capital inflows have always been the focus of academic debate. On the basis of Macroeconomic theory knowledge, in the paper, we make the econometric analysis on the data of China's total foreign direct investment and its influence factors which contain exchange rate, GDP, CPI, resident consumption level and total export during the years of 1983 to 2011. Through the model test and correction, the empirical results show that China's Total FDI mainly affected by exchange rate, CPI, consumption level and period of investment effect.

Keywords - FDI; Econometric analysis; Model modification

1. Introduction

Economic globalization is one of the important characteristics of today's world economy and also is the important trend of world economic development, however, FDI and International Trade is the core of the process of globalization, they represent respectively the capital and goods flow across the world. FDI is the collection of capital, knowledge and management; it becomes the most important transfer and carrier of knowledge and technology, and plays an important role in the development of national economy.

Domestic and foreign scholars have had studied on FDI management. For example, Stephen Hymer puts forward the Theory of Monopoly Advantage which also known as Theory of Industrial Organization. He believes that the impact of foreign capital inflow is differentiated investment environment; capital flow from counties which have the knowledge capital and advanced management technology advantages into the counties which do not have these advantages. German scholar Weber thinks that, foreign capital tends to flow into the areas which have huge market consumption, raw materials production, abundant labor and industrial agglomeration; and the areas which have low cost of combination of factors of production, low cost of the transaction cost and information and the export replacement purposes. Wei-Xian Wei uses the Multiple Linear Regression Methods with time series data, and he thinks that the market size, labor costs, imports and exchange rate play a significant role in China's use of FDI. Zhao-Ming Sun selects relevant variables and analyzes the factors which affect on China's foreign investment with Cointegration Method，he considers that the main factor is the stable development trend and prospects.

According to the principle of econometrics, we use

Eviews 6.0 to do an empirical analysis on the influence factors that affect the actual use of China's total FDI.

2. Model construction, inspection and correction

We select the relevant data of China's FDI amount and its main influencing factors during 1983-2011 as the basis of the established model. As is shown in Table 1.

Based on the analysis of the macroscopic economic theory and the research from the former scholars, we select the main influencing factors which including Exchange rate(EXC); Real Gross domestic product(GDP)-on behalf of the macro-economic situation; Consumer price index(CPI)-on behalf of the inflation rate; Resident consumption level(RCL)-represents the size of the market; Total exports(TEX)-on behalf of the international trade scale ; Dummy variable D1 value is 0 before 2001 (The year China joined into WTO) and value is 1 after 2002.

Table 1 . China's FDI and its influence factors data during 1983-2011

Years	FDI/Billion dollars	EXC	GDP/Billion Yuan	CPI/%	RCL/Yuan	TEX/Billion dollars	D1
1983	22.61	1.9757	5962.7	101.5	316	222.3	0
1984	28.66	2.3270	7208.1	102.8	361	261.4	0
1985	47.60	2.9366	9016.0	109.3	446	273.5	0
1986	76.28	3.4528	10275.2	106.5	497	309.4	0
1987	84.52	3.7221	12058.6	107.3	565	394.4	0
1988	102.26	3.7221	15042.8	118.8	714	475.2	0
1989	100.60	3.7651	16992.3	118.0	788	525.4	0
1990	102.89	4.7832	18667.8	103.1	833	620.9	0
1991	115.54	5.3233	21781.5	103.4	932	719.1	0
1992	192.03	5.5146	26923.5	106.4	1116	849.4	0
1993	389.60	5.7620	35333.9	114.7	1393	917.4	0
1994	432.13	8.6187	48197.9	124.1	1833	1210.1	0
1995	481.33	8.3510	60793.7	117.1	2355	1487.8	0
1996	548.05	8.3142	71176.6	108.3	2789	1510.5	0
1997	644.08	8.2898	78973.0	102.8	3002	1827.9	0
1998	585.57	8.2791	84402.3	99.2	3159	1837.1	0
1999	526.59	8.2783	89677.1	98.6	3346	1949.3	0
2000	593.56	8.2784	99214.6	100.4	3632	2492.0	0
2001	496.72	8.2770	109655.2	100.7	3887	2661.0	0
2002	550.11	8.2770	120332.7	99.2	4144	3256.0	1
2003	561.40	8.2770	135822.8	101.2	4475	4382.3	1
2004	640.72	8.2768	159878.3	103.9	5032	5933.3	1
2005	638.05	8.1917	184937.4	101.8	5596	7619.5	1
2006	670.76	7.9718	216314.4	101.5	6299	9689.8	1
2007	783.39	7.6040	265810.3	104.8	7310	12204.6	1
2008	952.53	6.9451	314045.4	105.9	8430	14306.9	1
2009	918.04	6.8310	340902.8	99.3	9283	12016.1	1
2010	1088.21	6.7695	401202.0	103.3	10522	15777.5	1
2011	1160.11	6.3133	472882.0	105.4	12272	18980.3	1

Note: Table variable data from the "China Statistical Yearbook"

Select multiple linear model of the above variables and make regression: $\mathrm{FDI} = c + \beta 1(\mathrm{EXC}) + \beta 2(\mathrm{GDP}) +$

$\beta 3(\mathrm{CPI}) + \beta 4(\mathrm{RCL}) + \beta 5(\mathrm{TEX}) + \beta 6(\mathrm{D1})$ The regression results are shown in Table 2:

Table 2 . Initial linear regression results

	Coefficient	Std. Error	t-Statistic	Prob.
C	-371.4793	234.2481	-1.585837	0.1270
EXC	37.24225	18.03446	2.065060	0.0509
GDP	-0.001917	0.003513	-0.545579	0.5908
CPI	2.326092	2.286147	1.017473	0.3200
RCL	0.165057	0.126379	1.306048	0.2050
TEX	0.003856	0.018761	0.205543	0.8390
D1	-102.3875	47.44395	-2.158073	0.0421
R-squared	0.976762	Prob(F-statistic)		0.000000

From the regressive results, only dummy variable is statistically significant in 5% of the significant level, the probability it occurs error is less than 5%; the exchange rate and the virtual variables are statistically significant in 10% of the significant level; and the goodness-of-fit of model R2=0.976762, which has reached a very high level. But it also needs further examination to make sure that whether the model is correct or not.

2.1 Test for Model Mis-specification

Model's goodness-of-fit is very high. So it will not be missing relevant variables, but there may be excrescent variables, therefore, it needs to test whether the model contains irrelevant variables or not. Get rid of GDP and CPI, then make F test to judge whether the two variables are excrescent variables.

Table 3 . The removal of GDP and CPI regression results

	Coefficient	Std. Error	t-Statistic	Prob.
C	-136.8445	36.08741	-3.792029	0.0009
EXC	48.20819	8.158244	5.909137	0.0000
RCL	0.088194	0.020862	4.227480	0.0003
TEX	0.002441	0.012274	0.198841	0.8441
D1	-103.0267	40.75511	-2.527946	0.0185
R-squared	0.975668	Prob(F-statistic)		0.000000

According to Table 3: R^2=0.975668, t statistic of total exports is not significant. Make F-test as followings: Null hypothesis H0: $\beta 2 = \beta 3 = 0$

According to the relationship of F statistic and R^2:

$F = \frac{R^2/K}{(1-R^2)/(T-K-1)} = 0.5179 < F(2, 22) = 3.44$,

Therefore, it forced to accept the null hypothesis: $\beta 2 = \beta 3 = 0$

Because the t statistic of TEX is not significant, it is necessary to remove TEX and CPI and do regression again, the results are showed as Table 4，R^2=0.975647.

Table 4 . The removal of TEX and CPI regression results

	Coefficient	Std. Error	t-Statistic	Prob.
C	-136.8295	39.01509	-3.507092	0.0018

EXC	48.70731	13.49906	3.608200	0.0014
GDP	0.000269	0.001963	0.137152	0.8921
RCL	0.081117	0.080788	1.004073	0.3254
D1	-99.80448	39.38575	-2.534025	0.0182
R-squared	0.975647	Prob(F-statistic)		0.000000

We learn that the t test of GDP is not significant. So we do F test again:

Null hypothesis H0: $\beta 3 = \beta 5 = 0$

Same as, F = 0.5287 < F (2, 22) = 3.44, Therefore, it forced to accept the null hypothesis: $\beta 3 = \beta 5 = 0$

Based on the two similar validation results, we know that GDP, CPI and TEX may contain redundant variables. However, this approach has limitations; the regression models can't be easily to add a variable, also can't be easily to remove any variables. Model does not recommend the use of data mining strategy, we emphasize the theoretical basis, and we will commit a serious omission of variable errors if we eliminate the variable just because the t statistic is not significant. Omissions related variables are much more serious than the situation of choosing more uncorrelated variables. Not only estimator biased and inconsistent but also the variance of the random interference items also tends to be overestimated, so that it make the inference procedures become invalid, even the economic value of the parameters may also be unreasonable. While in multiple selection irrelevant variable case, the consequence is reduction in the efficiency only. Therefore, we need to do further test analysis.

2.2 McKinnon-White-Davidson Test (MWD Test)

MWD test is used to help us to choose model between linear and nonlinear. Establish hypotheses as follows:

Null hypothesis H0: linear model

Alternative hypothesis H1: logarithmic linear model

We get the estimate of FDI after estimate linear model and the estimate of LNFDI after estimate linear logarithm model; Make Z is equal to FDI estimator of logarithmic minus the FDI logarithmic estimator. Do regression LNY to EXC GDP CPI RCL TEX D1 and Z, if the statistics of Z coefficient is not significant according to t test, then rejects the null hypothesis.

As shown in Table 5: t-statistic of Z is not significant, which rejects H0 hypothesis and chooses the alterative hypothesis, so the model is logarithmic linear form.

Table 5 . McKinnon-White-Davidson test (MWD test)

	Coefficient	Std. Error	t-Statistic	Prob.
Z	0.002427	0.002719	0.892682	0.3817
R-squared	0.963107			

2.3 Multicollinearity Test

From the perspective of economics, GDP may have multicollinearity with TEX and RCL, export growth will pull the GDP growth, and GDP growth is bound to increase in the level of consumer. Regression results of Table 2 show that goodness-of-fit is up to 0.976762, but the number of variables which through the t statistic test is little, so the model exist multicolliearity, we need to do auxiliary regression test.

Remove the constant and dummy variables, then do the regression of each variable on the other variables with the remaining five economic variables, and extract the value of R2 and F at the same time.

Regression Description	Adjusted R-squared	F-statistic

EXC regression on other variables	0.907019	69.28402
GDP regression on other variables	0.999211	8862.273
CPI regression on other variables	0.413882	5.942990
RCL regression on other variables	0.999110	7857.029
TEX regression on other variables	0.981850	379.6805

It follows that there is a serious collinearity among EXC, GDP and RCL. When the independent variables appear collinearity problems, we should attempt to eliminate the influence. On the one hand, we collect more data to increase the sample capacity; on the other hand, we change the form of the model. Since the model is based on economic theory，and there is no way to get extra data of every annual or new samples. So we'd better consider the new model.

The new model is logarithmic, and then we continue to do regression.

Table 6 . The regression results after using logarithmic form

	Coefficient	**Std. Error**	**t-Statistic**	**Prob.**
C	-12.85900	3.318756	-3.874645	0.0008
EXC	0.092530	0.034481	2.683526	0.0136
LNGDP	3.989355	1.583910	2.518676	0.0196
CPI	0.015463	0.005093	3.036209	0.0061
LNRCL	-2.558442	1.575037	-1.624369	0.1185
LNTEX	-1.031694	0.363435	-2.838730	0.0096
D1	-0.136200	0.164224	-0.829354	0.4158
R-squared	0.984978	Prob(F-statistic)		0.000000

The results in Table 6: some variables are still not significant (t statistic of RCL and D1 are not significant), so let's make the auxiliary regression again.

Regression Description	**Adjusted R-squared**	**F-statistic**
EXC regression on other variables	0.814312	31.69760
LNGDP regression on other variables	0.999758	28972.87
CPI regression on other variables	0.077088	1.584692
LNRCL regression on other variables	0.999656	20336.18
LNTEX regression on other variables	0.994391	1241.889

According to the table, there is still a serious multicolliearity. Therefore, we have to use exclusion method to delete unqualified variables; we can determine that there is serious multicolliearity among GDP, RCL and TEX combining with the above regression.

Due to RCL reflects China's potential market and the degree of marketization; therefore, we remove the GDP and exports. The results are shown in Table 7 after we do regression: all statistics are significant at the 5% significant level and the goodness-of-fit R2=0.979301, it improved a lot compared to the previous one.

Table 7 . Regression results after eliminating GDP and TEX

	Coefficient	Std. Error	t-Statistic	Prob.
C	-4.185672	0.791534	-5.288054	0.0000
EXC	0.120656	0.031350	3.848659	0.0008
CPI	0.018031	0.005408	3.334149	0.0028
LNRCL	0.951347	0.087925	10.81998	0.0000
D1	-0.337539	0.129397	-2.608553	0.0154
R-squared	0.979301	Durbin-Watson stat		1.597117
F-statistic	283.8640	Prob(F-statistic)		0.000000

So far, the model variables and the form of the test problems have been resolved; we get the initial ideal model after amended.

2.4 Heteroscedasticity Test

An important assumption of the classical linear regression model is that the random disturbance terms which enter the overall regression function are the same variance. If there is heteroscedasticity, it will lead to the significant parameters inspection meaningless, predictive failure.

Although heteroscedasticity always appears in the cross-sectional data, the time series data also need to be inspected because of the small sample size. The following table is general heteroscedasticity inspection-White test; the results are shown in Table 8:

Table 8 . White test

F-statistic	1.579306	Prob. F(13,15)	0.1973
Obs*R-squared	16.75716	Prob. Chi-Square (13)	0.2106

Judging from the results, it accepts the null hypothesis because the value of Prob. Chi-Square (13) is 0.2106-more than the 5% level of significant, so there is no heteroscedasticity.

2.5 Autocorrelation Test (D.W. Test, LM test)

Due to time-series data, it is likely to exist autocorrelation problems. We make Autocorrelation test next.

According to Table 7: D.W. =1.597117, the sample size n=29, the number of explanatory variable k=4, from the D-W table, D_L=1.12 and d_u=1.74 in the 5% significant level. We get the answer that D_L<D.W. <d_u, so it can't estimate the self-correlation. Therefore, we can only judge by LM test.

Table 9 . Lagrange Multiplier test (LM test)

	Coefficient	Std. Error	t-Statistic	Prob.
RESID(-1)	-0.320735	0.253997	-1.262754	0.2212
RESID(-2)	-0.652113	0.224866	-2.900006	0.0089
RESID(-3)	-0.532333	0.212707	-2.502657	0.0211
RESID(-4)	-0.383265	0.227153	-1.687254	0.1071
F-statistic	3.761640	Prob. F(4,20)		0.0194
Obs*R-squared	12.45059	Prob. Chi-Square(4)		0.0143

Results of LM test are shown in Table 9, both RESID (-1) and RESID (-4) are not significant, while the RESID (-2) and RESID (-3) are statistically significant. So the model exists autocorrelation between RESID (-2) and RESID (-3). Therefore, we need to join the two variables into the model to eliminate autocorrelation influence.

Then correct model again, the results are shown in Table 10:

Table 10 . The final correction results

	Coefficient	Std. Error	t-Statistic	Prob.
C	-2.632092	0.477011	-5.517888	0.0000
EXC	0.105342	0.014897	7.071341	0.0000
CPI	0.010377	0.002894	3.585658	0.0021
LNRCL	0.868934	0.043226	20.10190	0.0000
D1	-0.254865	0.061683	-4.131861	0.0006
RESID02	-0.349127	0.159479	-2.189170	0.0420
RESID03	-1.112714	0.142100	-7.830506	0.0000
R-squared	0.992689	Durbin-Watson stat		1.442410
Prob(F-statistic)	0.000000			

Through the above inspection and correction, we get the final model: $\mathrm{LNFDI} = -2.632 + 0.105(\mathrm{EXC}) + 0.0104（\mathrm{CPI}） + 0.87\mathrm{LN}（\mathrm{RCL}） - 0.255(\mathrm{D1}) - 0.349\mathrm{RESID02} - 1.113\mathrm{RESID03}$

3. Analysis of confirmed results

According to the above model, we perform an analysis for its degree of economic viability.

(1) Coefficient of EXC indicates that it is the main influence factor. For the total of China's foreign capital will increase by 10.5% when the EXC increases by one unit-RMB devalues one unit. The cheap labor price of China is a main factor to attract FDI inflow. Multinational Corporations invest in China also because China is the "world's factory" where they can sell their products to the world market. The RMB exchange rate appears different degree of depreciation trend since 1983; the accumulated effect of this monetary policy brings significant effects which keep the relative labor cost of China. This explains why China's ability of absorbing foreign capital is so strong.

(2) The coefficient of the CPI shows that the total China's FDI will rise 1.04% if the price index raises a unit. The coefficient of RCL shows that the total China's actual use of foreign capital will rise 0.87% if the consumer level rises 1%, the improvement of RCL can increase China's foreign investment .

(3) The coefficient of Dummy variable is -0.255, it means that growth rate of FDI dropped 25.5% after China's accession to the WTO; this has refuted the theory that joining the WTO should be conducive to attract foreign capital. On this issue, I think, begin from 1978, China has launched a lot of preferential policies and it makes FDI growth obviously. Since 1983, FDI had grown more obviously than before. From the data in Table 1, 1983-1997 is the fastest time of the foreign growth. By 1997, the growth of foreign investment has reached a relatively normal level; the speed of growth rate is slowing down. Therefore, that's why the impact of China's accession to the WTO is negative after 2002 from the data. In addition, we should pay attention to that foreign merchant did not increase investment in China by the western development policy advantages with China's accession to the WTO, and it has the opposite trend. It is another reason why coefficient of D1 is negative.

(4) We know that foreign investment has continuity from the coefficient of RESID (-2) and RESID (-3). We can learn from the results of final model that foreign investment is generally in three years or more.

In addition, the inflow of FDI must be influenced by the whole macroeconomic environment. When the international economic environment is good and international liquidity is sufficient, China's actual use of FDI amount will increase.

4. Conclusion

(1) This model pinpoints the influencing factors which affect FDI in China clearly. Absorbing foreign investment

has great influence to the development of China's economy. The introduction of foreign investment has a major impact on China's economic development. We could analysis the foreign capital inflow trend when we analysis out the influencing factors. Then we could achieve the action of macroscopically adjusting control.

(2) The above analysis shows the correlation relationship between China's FDI and some economic factors. The RMB exchange rate, the CPI and the RCL have considerable influence to FDI no matter in the short and long term. To promote China's utilization of FDI on a new level, we should expand economic scale, increase the income of the residents, improve residents' consumption ability and encourage consumption further; appropriate improvement of the CPI and inflation can promote China's economic vitality, and it can increase the total amount of FDI at the same time. In addition, as the investment subject to prior periods, our government should keep the introduction of foreign policy continuity and stability, and increasing the confident of investors. Maintain the sustainability of the foreign investment.

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