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A Cointegration Study on the Relationship Between FDI And the Strength of Scientific Research in China

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Abstract: Based on the analysis of the relationship between foreign direct investment and the strength of scientific research, cointegration theory was used to select the actual amount of foreign direct investment and R & D investment intensity from 1995 to 2016 for empirical analysis. Empirical results show that at the 10% level of significance, when the lag period is 2 and 3, the strengthening of the research intensity is the Granger cause of the increase of foreign direct investment. However, when the lag period is 4, the two are not As a causal relationship. At last, we put forward suggestions on how to promote the stable development between foreign direct investment and the intensity of our country's scientific research from the aspects of optimizing the foreign direct investment structure, enhancing the capability of independent innovation and improving the market supervision.
Keywords: FDI, Research Intensity, Cointegration Theory.

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1. INTRODUCTION

Progress in science and technology is an inexhaustible motive force for the long-term development of a country. The 18th National Congress of the Communist Party made it clear that scientific and technological innovation is a strategic support for raising social productivity and overall national strength and must be placed at the core of the overall national development. The strength of scientific research is an important manifestation of the importance of scientific and technological innovation. In order to achieve technological innovation, each country will, through independent innovation and introduction of external technology, introduce its own efforts. The latter is often regarded as an effective means to shorten the gap with advanced technologies. Foreign investment in science and technology to promote innovation is an important way to absorb the introduction.

For a long time, our country attracts foreign investment with cheap labor and a vast market. Meanwhile, in order to better attract foreign investment, the investment environment is constantly improving. With the continuous increase of foreign investment, the foreign technology is gradually increasing. The introduction of technology has become an important source of promoting the scientific and technological progress in our country. The progress of science and technology, in turn, has given impetus to the growing economy in our country and has thus reacted to the attraction of foreign investment.

2. RELATED THEORETICAL ANALYSIS

Foreign direct investment spillover effect about the existence of the host country science and technology innovation, from the perspective of the result of study can be divided into two camps: part of scholars believe that foreign direct investment has played a significant role in promoting science and technology innovation for the host country. Such as Dimelis, Louri (2002) the results confirmed the existence of the technology spillover effect[1];Li Zhen (2014) compared with private enterprises and state-owned enterprises, found that foreign direct investment there is significant positive spillover effects on car manufacturing[2];Chen Xiangsen (2017) found in shandong province as the research object of foreign direct investment and there is a long-term co-integration relationship of science and technology innovation[3].Another part of the scholars disagree, foreign direct investment in inhibiting the innovation of science and technology level of the host country. Such as Wang Wei, Hu Xiaoqun (2012) analysis of the characteristics of the use of foreign direct investment in Harbin, it is concluded that the city's foreign direct investment and technology spillover effect is not significant conclusions[4];He Shunlan, wen-ting zhou (2017) from the digestive ability of domestic enterprises, the technology gap between two angle of view analysis, found that foreign direct investment to the state-owned enterprise did not produce technology spillover effect [5].

So the relationship between foreign direct investment and China's scientific research strength, to explore whether between technology spillover effect, to promote the sustainable development of our country's economy is of great significance. In this paper, based on the cointegration theory, analysis of foreign direct investment and the relationship between the strength of scientific research in our country, on this basis, in order to better use of foreign capital in our country, promote the scientific research strength and the economic development of our country, put forward the corresponding policy recommendations.

3. FDI AND AN EMPIRICAL ANALYSIS OF THE RELATIONSHIP BETWEEN SCIENTIFIC RESEARCH STRENGTH IN CHINA

Find out the relationship between FDI and scientific research strength, can attract FDI and optimize the investment structure more reasonable, to promote the increase of China's scientific research strength, or on the basis of strengthen the independent innovation, to attract more foreign direct investment. Therefore, this article through studies the actual use of foreign

direct investment and development in our country in the cointegration relationship between the strength and promote FDI and scientific research strength, long-term stable development.

3.1Variable Design and Explanation

In the comprehensive analysis on the basis of numerous literatures, in this paper, the scientific research strength as the dependent variable, with r&d intensity (R), namely research spending and the gross domestic product ratio as the r&d input intensity;Foreign direct investment as the independent variable, with actual use of foreign direct investment each year (F).

3.2Source of Data and Instructions

This article selects 1995-2016, our country scientific research spending, gross domestic product (GDP) and the actual use of foreign direct investment of three kinds of data, and according to the empirical need to R and F the exponential respectively, is the LnR and LnF.

3.3Descriptive Statistics

According to the data collected in this article the research variables are descriptive statistical analysis, the results as shown in table 1.According to table 1 reflect the situation, combined with the actual number, 1995-2016, the r&d input intensity present the growth, the minimum 0.0056 came in 1996, the maximum 0.0333 is 2016;The actual use of foreign direct investment shows the same trend, the minimum value is 401.96 billion yuan in 1995, the maximum value is 2016 yuan in 2016.

Table 1. Descriptive Statistics of Variables

Variables / Statistics	Scientific Research Investment (R)	Actual Utilization of Foreign Direct Investment (F, RMB 100 million)
Avg	0.0138	5856.8
Max	0.0333	8132.2
Min	0.0056	4019.6
St.	0.0066	1343.9

3.4Correlation Analysis Between Foreign Direct Investment and Scientific Research Intensity in China

To study the correlation between foreign direct investment and China's scientific research strength, were held for variables and LnR LnF stationarity test, cointegration test and granger causality test, the above steps are conducted with EVIEWS8.0 econometric analysis software.

3.4.1 Stability Test

In order to avoid the phenomenon of pseudo regression, the paper firstly carried out the stability test of the variable LnR and the variable LnF, and the results are shown in the table below.

Table 2. Sequence Stability Test

Variables	t-Statistic	Prob.	1% level	5% level	10% level	judgment
LnF	-0.349958	0.9004	-3.808546	-3.020686	-2.650413	Not smooth
ΔLnF	-5.217362	0.0034**	-4.616209	-3.710482	-3.297799	smooth
LnR	-0.364033	0.9760	-3.788030	-3.012363	-2.646119	Not smooth
ΔLnR	-3.102392	0.0426**	-3.808546	-3.020686	-2.650413	smooth

It can be seen from the above table that the absolute value of ADF of LnF and LnR sequences is less than 5% of the critical value of both the LnF and LnR sequences. Both sets of variables are non-stationary sequences. However, after the first difference of the variable, both of them are significant at 5% level, and all of them refuse to accept the assumption that there is a unit root. The first order difference between LnF and LnR is the stationary sequence. Therefore, these two variables are first-order single sequences and can be further tested by co-integration.

3.4.2Cointegration Test

The co-integration test is to test whether the variables LnR and LnF have a long-term stable equilibrium relationship. In this paper, the equilibrium relationship of variable sequences is tested with EG two-step method.

The first step is to establish a linear regression equation between LnR and LnF shown below, where et is the residual term:

$$LnR = C + a * LnF + e_t$$

In the first place, the regression equation was tested statistically, and the p-value was 0.0000, indicating that the regression model was significantly under 1%, while AIC was 0.0401, indicating that the model was highly accurate. Secondly, the regression and significance test of the variable LnF are performed, and the results are shown in the following table.

Table 3. Regression Analysis and Sgnificance Test

Variables	Coefficient	Std.Error	t-Statistic	Prob.
constant	-20.03183	1.949068	-10.27765	0.0000***
LnF	1.809608	0.225242	8.034047	0.0000***

Through regression analysis, we can see that LnF of LnR in 1% significance level, regression coefficient is 1.81, shows that foreign direct investment in r&d intensity has a promoting effect to our country, therefore, the regression equation is:

$$LnR = -20.03 + 1.81 * LnF + e_t$$

In the second step, the residual items are tested for stability and the results are shown in the table.

Table 4. Table of Stability of Residual Items

Variables	t-Statistic	Prob.	1% level	5% level	10% level	judgment
e_t	-1.844440	0.3502	-3.788030	-3.012363	-2.646119	Not smooth
Δe_t	-4.712883	0.0014**	-3.808546	-3.020686	-2.650413	smooth

The results show that the residual item after the first order difference sequence is smooth, under 5% significance level, the variable is a cointegration relationship between LnR and LnF, in the long term, stable relationship between two-time series.

3.4.3 Granger Causality Test

According to the above analysis, both LnR and LnF are first-order, and the results of co-integration test show that there is a long-term stable equilibrium relationship between FDI and r&d investment intensity. However, the direction of this relationship is not clear, which can be solved by granger causality test on two variables. From the establishment of the actual utilization of foreign investment and r&d strength, it can be seen as both a cointegration relationship, so between them there are at least one direction of causality, but because of who is who, who's who of the fruit does not know, so for the two variables granger test [6-7], test results as follows:

Table 5. Granger Causality Test Results

Granger causality	statistic	P	Lag period according	Conclusions
LnR does not Granger Cause LnF	2.90282	0.1056	1	accept
LnF does not Granger Cause LnR	0.47605	0.4990	1	accept
LnR does not Granger Cause LnF	2.99721	0.0803*	2	reject
LnF does not Granger Cause LnR	0.28618	0.7551	2	accept
LnR does not Granger Cause LnF	3.48776	0.0501*	3	reject
LnF does not Granger Cause LnR	0.27663	0.8412	3	accept
LnR does not Granger Cause LnF	2.65846	0.1027	4	accept
LnF does not Granger Cause LnR	0.21458	0.9237	4	accept

From the results of the above table, it can be seen that, at the significance level of 10%, the Granger causality hypothesis is accepted at the time of the lag period of 1, namely, the direct investment and scientific research intensity of foreign direct investment are not causality; Lag of 2 and 3, rejected the hypothesis "LnR does not Granger Cause LnF", accepted hypothesis "LnF does not Granger Cause LnR", that is to say, the enhancement of scientific research strength is the Granger Cause of increase in foreign direct investment; But when the lag is 4, the result is 1. So, say, foreign direct investment does not promote the scientific research strength, instead increasing scientific research strength, to some extent, and so did the foreign direct investment situation, but in the long run the effect is limited.

The cause of this result may be in China for a long time of positioning is "world factory", the main foreign investment in the industry to "processing", in the application of science and technology progress at a disadvantage; But with the development of the Internet economy, sharing economy in our country, the development of the large data driven, represented by no cash payments of a large number of products on the Internet has become a world leader, all of this to a large extent can attract more foreign capital injection, also caused the role of scientific research strength in the phenomenon of foreign direct investment.

4. CONCLUSION ANALYSIS AND POLICY RECOMMENDATIONS

Foreign direct investment in China and the scientific research strength is presented in this paper, on the basis of the cointegration test between foreign direct investment were analyzed by using granger causality test and the causal relationship between the scientific research strength in our country, it can be seen that foreign direct investment of our country does not have a significant role in promoting scientific research strength, on the contrary, the scientific research strength in the long run will drive the foreign direct investment, but the effect is limited. In order to develop a stable development relationship between foreign direct investment and scientific research strength in China, the following Suggestions are proposed:

First, we should optimize the structure of foreign investment and encourage foreign investment in various ways. Through preferential policies such as taxation, foreign investors are encouraged to invest in equity and invest in high-tech industries, modern services and so on. We encourage domestic enterprises to actively explore international markets, acquire advanced technologies by reverse acquiring foreign enterprises and research institutions [8], and promote technological spillovers to the positive effects of innovation.

Second, promote the independent innovation consciousness of Chinese enterprises. Core competitiveness is the enterprise long-term development powerful guarantee, enterprise can through the rational use of foreign investment, increase r&d investment, and colleges and universities, scientific research institution cooperation mode, taking the path of independent innovation, promote technological progress of science and technology.

Third, improve the regulatory measures to help the capital market function. Relevant market regulators should do well in the top-level regulatory measures [9], handle the relationship between the regulation and development, can be in accordance with the specification, and is

conducive to the development requirements, actively yet prudently proceed with market development, to guard against and defuse financial risks, in order to expand and promote enterprise listed financing.

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