

Review

A study of new industrialization and foreign direct investment (FDI) based on China's East, Middle and West regions

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In recent years, China has made remarkable achievements in bringing in foreign investments. Not only foreign direct investment (FDI) made up for the insufficient construction funds in China, it also effectively promoted China's process of new industrialization. This paper presents the situation of FDI and process of new industrialization in China's east, middle and west regions from 1981 to 2009 and study the linkage between these two factors with co-integration theories. First, FDI has the biggest promotional effect on the process of new industrialization in the middle region, followed by the east region and the effect on the west region is the last. Second, the long-term equilibrium elasticity of FDI in the east region to the process of new industrialization is 0.3221, that in the middle region is 0.3863 and that in the west region is 0.1936. Third, there exists bilateral Granger cause between FDI and process of new industrialization in the middle region, while only significant unilateral Granger cause exists in the east and west regions.

Key words: Foreign investments, industrialization, empirical study.

INTRODUCTION

In recent years, China has made remarkable achievements in utilizing foreign investments since the reform and opening up. Foreign direct investment (FDI) not only have made up for the insufficient construction funds in China and enhanced technical equipment level of Chinese industries, but also have promoted the improvement of China's capability of international competition to some degree (Lin, 2011). Due to its dual role as a mover of production efficiency and a shifter of production frontier FDI is a powerful driver of economic growth for China to catch up with the world's most advanced countries (Chen et al., 1995). To understand why FDI is important in the economic growth process, it is necessary to compare the different roles of FDI and

domestic investment (DI). In the post-Keynesian and neo-classical models, DI is a necessary condition for production growth and technical progress, but it may take advantage of advanced technologies available in the developed world (Aitken and Harrison, 1999). FDI is different from DI in two important aspects although, both can be treated as a basic physical input in the production process, FDI accelerates the speed of adoption of general purpose technologies (GPT) in the host countries; FDI is embedded with new technologies and know-how unavailable in the host countries (Hu and Jefferson, 2002).

Different authors have studied the linkage between FDI and economic growth from different perspectives. Many empirical studies have focused on the linkage between exports and growth, or between FDI and growth or examine the triangular relationship among FDI, export and growth (Yao, 2006). An alternative estimation is by

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use of the GMM approach through the dynamic panel data estimation technique proposed by Arellano and Bond (1982). Moreover, agglomeration economies and FDI acquisition were closely associated with market size and export propensity in the case of European integration. Using a panel unit root test, gross domestic product (GDP), FDI, domestic investment, transportation, human capital and international trade are all confirmed so. The same finding is confirmed by Lardy (1995) and Chuang and Hsu (2004).

Existing studies provide useful insights and rich empirical evidence on the role of FDI in economic growth, but the exact mechanism of how FDI contributes to the growth process of a new industrialization has not been well studied. This paper is organized as follows. Theoretical framework on the role of FDI in the growth process of economies; background on FDI which covers 31 provinces over the entire reform period 1980 to 2009; growth process of new industrialization in China; the use of empirical data in test the linkage between FDI and new industrialization with co-integration theories; conclusion, policy implications and suggestions.

THE SITUATION OF FOREIGN DIRECT INVESTMENT (FDI) IN CHINA'S EAST, MIDDLE AND WEST REGIONS

First, we divided the years from 1981 to 2009 into six time ranges on the basis of the eleventh five-year plan of national economic and social development approved by the National People's Congress in 1985. Secondly, the thirty-one provinces can be divided into the east, middle and west regions as per the three economic zones proposed in this Plan. In this Plan the east region covers eleven provinces and cities of Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, Hainan. The middle region covers eight provinces and cities of Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei and Hunan. The west region covers twelve provinces and cities of Inner Mongolia, Guangxi, Sichuan, Guizhou, Yunnan, Tibet, Sha'anxi, Gansu, Ningxia, Qinghai and Xinjiang. As the Municipality of Chongqing was established late, the data from Chongqing were included in those from Sichuan for the convenience of quantitative analysis. The data from 1981 to 1995 come from the Collective Compilation of New China's Fifty-Year Statistical and the data from 1996 to 2009 come from China Statistical Yearbook as follows (Table 1).

We can see from the data that the regional dispersion is extremely imbalanced regarding the scale of FDI, the east region has the absolute advantage, followed by the middle region and the west region is the last. The average proportion of FDI in the east region is 87.15, 8.24% in the middle region and 4.61% in the west region. Secondly, regarding the developing tendency of FDI, the east region obtained absolute advantage at high level during the 1981-1985 year and 1986 to 1990 while the

middle and west regions were at low level. Since 1991 to 1995, the east region has displayed smooth downtrend; the middle region has maintained constant uptrend while the west region is gradually displaying slow downtrend. The FDI keep uptrend in the middle region is that the economic development level, market environment and labor force quality in the middle region are gradually narrowing the gaps with those in the east region (FuXiaolan, 2004). The middle region has the geographical advantage in connecting the West and the East, thereby become the first choice by the foreign investors. Moreover, the labor cost and land cost in this region are obviously lower than those in the east region. The industrial infrastructure is strengthening with better supporting capacity day by day, which are helpful for foreign enterprises to expand their production scope. Thirdly, FDI in the west region are displaying slow downtrend, although, the Central Government has extended a series of favorable policies to the west region in 2001 to 2005 and 2006 to 2009 year (Yanchun, 2011). This is due to the existence of the lagging of the economic system and the regional protectionism in the west region. West region has severe deficiencies in structuring market integration, such as many restrictive conditions on market entry etc, which have politically hampered FDI. West region has the disadvantages in economic foundation and geographical conditions etc and is not competitive enough in attracting FDI (Awokuse and Hong, 2010).

THE NEW INDUSTRIALIZATION IN CHINA'S EAST, MIDDLE AND WEST REGIONS

As no single specification can completely describe the overview of any nation's or regions new industrialization, we referred to the indicator structure of new industrialization indices and selecting methods of indicators (Han, 2004). It is decided that the following structure indicators are selected based on the concrete situation of China and new industrialization can be reached through integrally calculating the indicators.

New industrialization index = (the industrialized index of labor productivity \times 3 + the industrialized index of incremental value \times 2 + The industrialized index of labor force) \times 1/6 among which, the industrialized index of labor productivity = the labor productivity during report period/the labor productivity at advanced stage of basic industrialization. The industrialized index of incremental value = (the incremental values of secondary industry/the incremental values of primary industry) \div 7.

The industrialized index of labor force = (practitioners of secondary industry/practitioners of primary industry) \div 1.5 (Table 2).

The data summarized in Table 2 are all primary data of FDI amount. In order to reduce the heteroscedasticity and volatility of data, we takes the natural logarithm of the

Table 1. FDI in China's east, middle and west regions.

Year	All region		East region		Middle region		West region	
	Amount (Billion)	Percentage	Amount (Billion)	Percentage	Amount (Billion)	Percentage	Amount (Billion)	Percentage
1981-1985	235	100	214.46	91.26	10.29	4.38	10.15	4.36
1986-1990	743	100	665.80	89.61	38.93	5.24	38.27	5.15
1991-1995	2885	100	2530.43	87.71	236.85	8.21	117.65	5.28
1996-2000	6341	100	5460.89	86.12	599.85	9.46	280.26	5.94
2001-2005	8686	100	7371.80	84.87	922.45	10.62	391.75	4.67
2006-2009	6155	100	5136.45	83.45	712.13	11.57	306.42	4.98

Source: The collective compilation of New China's fifty-year statistical data and China statistical yearbook.

Table 2. The new industrialization of China's east, middle and west regions from 1981 to 2009.

Year	New industrialization index of all region	New industrialization index of east region	New industrialization index of middle region	New industrialization index of west region
1981-1985 Year	0.2979	0.1053	0.1001	0.0925
1986-1990 Year	0.3318	0.1224	0.1136	0.0958
1991-1995 Year	0.4562	0.1872	0.1463	0.1227
1996-2000 Year	0.6338	0.2872	0.1974	0.1542
2001-2005 Year	0.8427	0.3712	0.2512	0.2203
2006-2009 Year	1.0004	0.4322	0.3011	0.2671

Data source: The collective compilation of New China's fifty-year statistical data and China statistical yearbook.

industrialization indices of the East, middle and west regions and the standardized values of the actual FDI amount respectively, which are described as LnGYH1, LnGYH2, LnGYH3 and LnFDI1, LnFDI2, LnFDI3, in which LnGYH is Ln of industrialization index and LnFDI is the Ln of FDI. Figures 1 and 2 indicate the post-logarithm tendency of new industrialization and FDI of China's East, middle and west regions from 1981 to 2009. It can be seen from the diagrams that the sequence trends of these two diagrams have large similarities. The tendency of new industrialization of China's East, middle, west regions from 1981 to 2009 are shown in Figure 1.

EMPIRICAL STUDY

The study uses Granger Causality method to analyze the correlations between FDI and new industrialization. The method was initiated by the famous economist Clive W.J. Granger, the 2003 Nobel Prize winner in Economics. This test method is specialized in analyzing the causalities between economic variables. Under the circumstances of time series, the Granger causality between two economic variables X and Y is defined as: on the condition that the past information of variables X and Y has been included, the predictive effect on Variable Y is superior to the

predictive effect to Variable Y merely done by Y's past information, which Variable X is helpful to interpret the future change of variable Y. Thus, variable X is considered as the Granger Causality to lead to variable Y. One pre-requisite to carry on Causality test is that the time series must have steadiness, otherwise spurious regression may occur. Therefore, the unit root test on the steadiness of each indicator's time series must be done before Granger Causality test is carried on. It is worth noticing that, although the conclusions of Granger causality test are only the statistical causality, the reference to the test is not obstructed and this test still takes a lot of effects on economic prediction.

The unit root test on the steadiness of time series

The steadiness of two panels of data needs to be considered prior to the implementation of Granger causality test. This is because based on the principles of time series, the regression model and the Test can be considered to establish when stable change tendency exists between the two panels of data. Otherwise spurious regression may occur. ADF unit root test method is used here as steadiness test to check the steadiness of variables like LnFDI_i and LnGYH_i (i=1, 2, 3). The critical

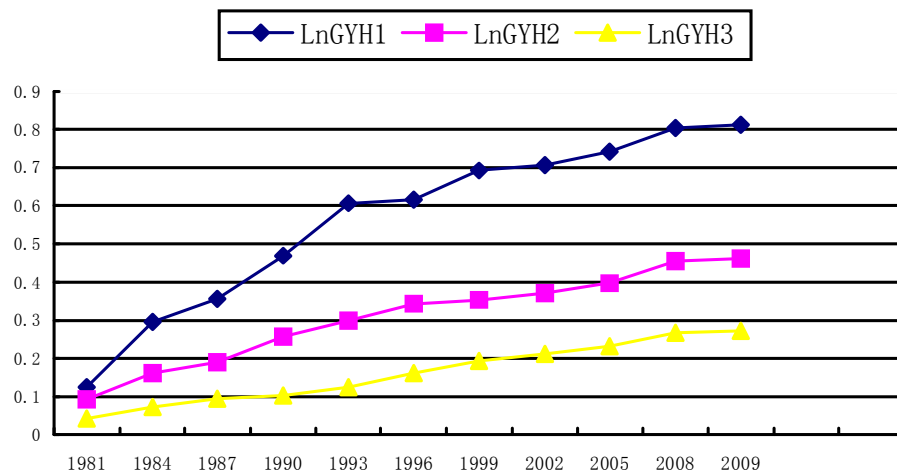


Figure 1. The tendency of new industrialization of China's east, middle, west regions from 1981 to 2009.

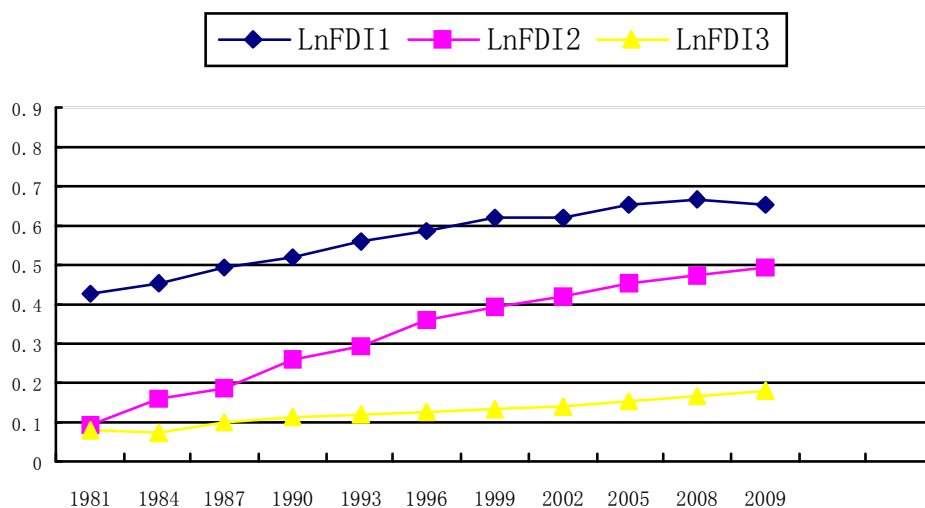


Figure 2. The tendency of FDI in China's east, middle and west Regions from 1981 to 2009.

Table 3. Testing results of single integration.

Variable	Test type (c,t,n)	ADF Statistic value	10% Critical value	DW test	Test result
$\geq \text{LnFDI}_1$	(c,t,0)	-4.752213**	-3.280516	1.952112	Steady
$\geq \text{LnFDI}_2$	(c,t,0)	-4.188042	-3.300623	1.880901	Steady
$\geq \text{LnFDI}_3$	(c,t,0)	-3.362359	-3.367834	2.201232	Steady
$\geq \text{LnGYH}_1$	(c,t,0)	-4.129705*	-3.694325	2.052431	Steady
$\geq \text{LnGYH}_2$	(c,0,0)	-3.624012*	-2.825671	2.015012	Steady
$\geq \text{LnGYH}_3$	(c,0,1)	-3.256902*	-2.882425	1.773021	Steady

value is set as 10% here in selecting intercept and tendency. AIC norm is adhered to in selecting the best lag period with one period as the maximum. The test results

are listed in Table 3.

The results show that: with 10% significance level, the statistical volume of the first difference of the variable is

Table 4. Long-term causality test results.

Null hypothesis H_0	Lag exponent number	F test statistic value	Probability to reject null hypothesis	Results
LnFDI ₁ is not the Granger causality of LnGYH ₁	2	0.46422	0.56125	Accept
	1	0.46528	0.47671	
LnGYH ₁ is not the Granger causality of LnFDI ₁	2	3.4552	0.05019	Reject
	1	17.02	0.0003	
LnFDI ₂ is not the Granger causality of LnGYH ₂	2	2.05723	0.15738	Accept
	1	0.00472	0.92624	
LnGYH ₂ is not the Granger causality of LnFDI ₂	2	0.00686	0.99225	Accept
	1	0.02016	0.88633	
LnFDI ₃ is not the Granger causality of LnGYH ₃	2	0.50641	0.45864	Accept
	1	0.70015	0.70251	
LnGYH ₃ is not the Granger causality of LnFDI ₃	2	8.23134	0.00032	Reject
	1	6.47135	0.04002	

The probability is subject to the large one between one period lag and two periods Lag. Whether the probability is more than 0.05.

less than the McKinnon critical value, and therefore the null hypothesis of a unit root to \geq LnFDI₁, \geq LnFDI₂, \geq LnFDI₃ and the \geq LnGYH₁, \geq LnGYH₂ and \geq LnGYH₃ is refused, which indicates that LnFDI₁, LnFDI₂, LnFDI₃ and LnGYH₁, LnGYH₂, LnGYH₃ are in single order in whole, that is, conforming to I (1) can be co-integration analysis.

Granger causality test

The Granger causality test will be further carried on to LnFDI_{*i*} and LnGYH_{*i*} (*i*=1, 2, 3) sequence in this aspect in order to ascertain that it is bilateral impact or interactive impact between FDI of east, middle and west regions and industrialization. As Granger causality test is very sensitive to the lag exponent numbers, the regression lag exponent numbers are selected as one and two respectively. The test results are listed in Table 4.

It is revealed from Table 4 that LnFDI₂ and LnGYH₂ are the Granger causality of each other when the lag period is one and two, while LnFDI₁ and LnFDI₃ are the respective Granger causality of LnGDP₁ and LnGDP₃ but not vice versa; the rest results indicate that bilateral Granger causality exists between FDI and new industrialization in the middle region from 1981 to 2009, while only unilateral causality exists in the east and west regions. First, the middle region is during the stable rising phase of economic growth with stronger absorption effects of the industrial growth on FDI. Second, FDI in the east region are relatively developed with fierce competition and smaller marginal benefit of FDI. Therefore, the absorption effects

of industrialization to FDI are also weaker. Whereas the resource scarcity in the west region and the deficiency in the systems lead to the lagged development of FDI, and also simultaneously restrict new industrialization to some degree.

Co-integration test

On the basis of Granger causality test, the co-integration test can testify whether long-term and stable correlations exist between the variables. Johansen test is used in this article to systematically test the variables in the east, middle and west regions. The regression is done on LnFDI₁ and LnGYH₁, LnFDI₂ and LnGYH₂, LnFDI₃ and LnGYH₃ respectively. The co-integration equations are obtained as follows:

$$\text{LnGYH}_1 = 2.2624 + 0.3221 \times \text{LnFDI}_1 + e_1 \quad (1)$$

$$\text{LnGYH}_2 = 1.8915 + 0.3863 \times \text{LnFDI}_2 + e_2 \quad (2)$$

$$\text{LnGYH}_3 = 1.6531 + 0.1936 \times \text{LnFDI}_3 + e_3 \quad (3)$$

In terms of long-term equilibrium relationship, FDI have positive and promotional effects on new industrialization. Among the three regions, the middle region enjoys the biggest pulling effect, followed by the east region and the west region enjoys the least. Specifically speaking, the long-term equilibrium elasticity of FDI in the east region to its process of industrialization is 0.3221, that is, the new industrialization grows by 0.3221% with FDI increased by 1%. The long-term equilibrium elasticity of FDI in the middle region to its industrial incremental value is 0.3863,

Table 5. The estimated results of vector ECM in the east region.

Equation	ECM ₁	LnFDI ₁₋₁	LnFDI ₁₋₂	LnGYH ₁₋₁	LnGYH ₁₋₂
LnFDI ₁					
LnGYH ₁	-0.0515 (-3.18711)	-0.3162 (-2.3012)		-0.823753 (2.24057)	
LnFDI ₂					0.2151 (5.3082)
LnGYH ₂	-0.0952 (-2.325)	0.2851 (-2.1480)			
LnFDI ₃				0.2013 (3.7984)	
LnGYH ₃	-0.1233 (-1.322)	0.2013 (1.44793)			

that is, the gross industrial production grows by 0.3863% with FDI increased by 1%. The elasticity of FDI in west region to its gross industrial production is 0.1936, that is, the gross industrial production grows by 0.1936% with FDI increased by 1%.

The establishment of error-correction model

We establish the vector error-correction model as follows. Firstly, we estimate the vector regression model made up of LnFDI_i and LnGYH_i (i=1, 2, 3) during I(0) process. Secondly, introduce the co-integration relationship previously estimated into the model as error corrections. Table 5 tests how the short-term fluctuations of \geq LnSGDP₁, \geq LnSGDP₂ and \geq LnSGDP₃ are determined through the establishment of error-correction model (ECM). The error-corrections in the tables reflect the impact of long-term equilibrium on short-term volatility.

$$\geq \text{LnGYH}_1 = 0.3162 \times \geq \text{LnFDI}_1 - 0.0515 \times \text{EC1} \quad (-1) \quad (4)$$

$$\geq \text{LnGYH}_2 = 0.2851 \times \geq \text{LnFDI}_2 - 0.0952 \times \text{EC2} \quad (-1) \quad (5)$$

$$\geq \text{LnGYH}_3 = 0.2013 \times \geq \text{LnFDI}_3 - 0.1233 \times \text{EC3} \quad (-1) \quad (6)$$

The results of ECM show that FDI of all regions have positive effects on the regions' process of industrialization, that is, all regions' new industrialization levels are going up with the increase of China's foreign investments in the short run. First, FDI with one lag period all have positive coefficients, which indicates that increase of FDI can promote the growth of industries very effectively in the east region. The elasticity coefficient is 0.3162, which means the industrial incremental value goes up by 0.3162% with FDI increased by 1%. Secondly, FDI with one lag period have positive coefficient with the industrialization, which indicates that the increase of FDI in the short run can increase the short-term industrial incremental value. The elasticity coefficient is 0.2851, which means the industrial incremental value goes up by 0.2851% with FDI increased by 1% in the middle region. Thirdly, FDI with one lag period have positive coefficient, which indicates that the increase of FDI of the west region in the short run can promote its industrial growth in the west region. The elasticity coefficient is 0.2013, which means the industrial

incremental value goes up by 0.2013% with FDI increased by 1%. Finally, the long-term equilibriums of the east, middle and west regions have the respective adjustments of 0.0515, 0.0952 and 0.1233% to their short-term volatilities.

CONCLUSIONS

In the long term, FDI have positive promotional effects on new industrialization. Among the three regions, the middle region enjoys the biggest pulling effect, followed by the east region and the west region that enjoys the least. Concretely speaking, the long-term equilibrium elasticity of FDI in the east region to the industrial incremental value is 0.3221, as FDI increase by 1%, the gross new industrialization increases by 0.3221%. The long-term equilibrium elasticity of FDI in the middle region to the industrial incremental value is 0.3863, as FDI increase by 1%, its gross new industrialization increases by 0.3863%. The elasticity of FDI in the west region to the industrial incremental value is 0.1936, as FDI increase by 1%, its gross new industrialization increases by 0.1936%.

In the short run, the elastic coefficient of FDI in the east region to new industrialization is 0.3162. The elastic coefficient of FDI in the middle region to industrialization is 0.2851. The elastic coefficient is 0.2013, as FDI increase by 1%, the new industrialization increases by 0.2013%. The long-term equilibrium of the east, middle and west regions have the adjustments of 0.0515, 0.0952 and 0.1233% to respective short-term volatility.

Although, FDI have positive effects on new industrialization, the regional gaps do exist. As the east region brought in FDI early with fierce competition, the marginal benefit is small and the absorption effect on its FDI during the new industrialization process is weak. Therefore, the east region should selectively absorb FDI, especially paying attention to absorbing FDI with high level of management and technology, which will be helpful to promote the new industrialization process.

The middle region has high marginal effects in absorbing FDI. So it needs to optimize the system environment and fully exert its flexible and favorable financial and taxation policies as well as its advantages in the policies attracting merchants and investments.

Meanwhile, the middle region should catch hold of the historical opportunity of “rising of the middle region”, carry on the innovation suitable for its local circumstances and create a good investment environment with every effort. It should also further enhance the degree of openness and enlarge the promotional effects of FDI on new industrialization.

During the implementation of the Western China's Development strategy, the west region should gradually strengthen the infrastructure and narrow the regional gaps between east, middle and west regions. Not only should it strengthen the infrastructure, it also should improve local investment environment and financing environment, thereby attracting FDI to flow to the west, improving the capital endowment of the west region and eventually accelerating the industrialization process.

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