

Empirical Study on FDI and Economic Growth in Zhejiang

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Abstract

Based on time series data from 1990 to 2010 of GDP per capita and the actual utilization of foreign investment of Zhejiang, as well as the method of Unit Root Test, Cointegration Test, Granger Causality Test and Error Correction Model, this essay makes an empirical analysis of the relationship between FDI and economic growth in Zhejiang. The result turns out that the actual utilization of foreign investment and the GDP per capita in Zhejiang have a steady equilibrium trend in the long run and a two-way causal relationship. Finally, this essay proposes a series of corresponding strategies.

Keywords: FDI; economic growth; Unit Root Test; Cointegration Test; Granger Causality Test; Error Correcting Model

1. Introduction

Since 1990s, in order to solve the problem of deficiency in funds, countries around the world have adopted various measures to stimulate investment of foreign capitals and acquired favorable effect. Foreign direct investment (FDI) is direct and physical investment made by foreign entities either through mergers and acquisitions in the country or by expanding operations of an existing business in the country^[1].

As core and head of the coastal open regions, Zhejiang enjoys an outstanding attraction of FDI which is the main driver of economic globalization, bringing far-reaching effects to local economic development. Therefore, an in-depth analysis on the interaction between FDI and economic growth in Zhejiang is of great guiding significance to the future direction of the whole district and the choices of decision-making, as well as the formulation of policies.

Based on the former result of research, this paper analyses and demonstrates the relationship between FDI and economic growth in Zhejiang by using ADF test, Cointegration test, Granger causality test and error correction model, to study statistical data from 1990 to 2010, and thus provides scientific basis for FDI policies adjustment in Zhejiang.

2. Description of Current Situation about FDI in Zhejiang

Since the reform and opening-up, economic development in Zhejiang has enjoyed several years of strong growth, and has taken a leading position in the nation. Especially in 2011, GDP of Zhejiang which was the only fourth province after Guangdong, Jiangsu and Shandong to enter the "three trillion club" of GDP for the first time, increased from 90.469 billion yuan in 1990 to 3.2 trillion yuan, growing 34.37 times (see Fig. 1).

Meanwhile, growing out of nothing, FDI in Zhejiang has been developing rapidly. As shown in Fig. 2, by the end of 2010, Zhejiang has practically utilized 110.0175 billion dollars of FDI, growing more than 226 times compared to 0.4844 billion dollars in 1990. Whereas influenced by Asian finance crisis in both 1997 and 1998, FDI in Zhejiang appeared relatively substantially glide, decreasing from 15.2021 million dollars in 1996 to 13.1802 million dollars in 1998. The total amount of FDI in actual use in 2008 and 2009 were 100.7294 million dollars and 99.3974 million dollars respectively, down 2.82% and 4.11% from 103.6576 million dollars in 2007 because of exposure to the financial crisis. A resurgence of foreign capital inflows was witnessed in 2010 when FDI in Zhejiang surged by 10.68% to 110.0175 billion dollars from 2009¹.

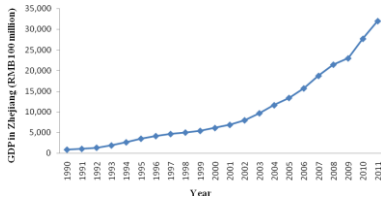


Fig. 1: Trends in GDP in Zhejiang, 1990-2010. (All data are collected from Zhejiang Statistical Yearbook of 2011.)

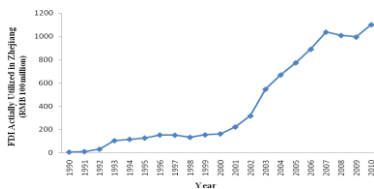


Fig. 2: Trends in FDI Actually Utilized in Zhejiang, 1990-2010. (All data are collected from Zhejiang Statistical Yearbook of 2011.)

FDI in Zhejiang, though growing fast in recent years, has obvious gaps compared with that in Shanghai and Jiangsu. In addition, the distribution of FDI has characteristics of serious imbalance in Zhejiang. According to analysis of Yu Miaozi (2009)^[2], FDI introduced from north-east of Zhejiang ranked the top in Zhejiang, occupying 84.32% of the total capital flow amount in Zhejiang, while FDI absorbed from cities in south-west region accounted for only 15.8% of Zhejiang. Therefore, there is a stark contrast between these two areas in Zhejiang. Moreover, among the world top 500 enterprises that have launched in Zhejiang, 37 took root in Hangzhou, representing 43.5% of total in Zhejiang, followed by Ningbo which took up 40.9%. Up to now, there has been no world top 500 enterprises invested in Xuzhou, Lishui and other cities. Such a situation creates a more polarized world where north-east of Zhejiang become more glorious developed while the economy of inland regions in Zhejiang become less vigorous.

3. Model and Data

3.1. Model

Based on Cobb-Douglas production function, this paper will discuss relationship between FDI and economic growth by interpreting and evaluating the results from the model and bring forward the proposals for Zhejiang.

A simple Cobb-Douglas production function is defined as:

$$GDP = e\beta * FDI\alpha \quad (1)$$

Since the natural logarithm of data can eliminate the different variance phenomenon without changing the interaction between original variables, all variables are converted into logarithms in the equation (1), thus developing a new

¹ All data are collected from Zhejiang Statistical Yearbook of 2011.

model as shown below in accordance with OLS model:

$$\text{Ln}(\text{GDP}) = \beta + \alpha \text{Ln}(\text{FDI}) \quad (2)$$

3.2. Data

According to data availability, this paper adopts the data of FDI in actual use and gross domestic product per capital from 1990 to 2010 in Zhejiang, which are collected from Zhejiang Statistical Yearbook of 2011, to measure foreign direct investment and economic performance, respectively.

As the actual utilization of FDI in statistical yearbook are in U.S. dollars, the data of FDI in actual use are converted into RMB by the annual average series of RMB to U.S. dollar exchange rate that come from China Statistical Yearbook of 2011. At the same time, considering the impact of price factors on the data, this paper adjusts the data of FDI in actual use and gross domestic product per capital through the GDP deflator—gross domestic product per capital in 1990—to remove inflation.

4. Empirical Test And Analysis

4.1. Stationary Test

In linear regressive analysis, the variables are requested to be stable time sequence. However, most time series are nonstationary because of a deterministic trend or a stochastic trend or both in the actual economy^[3]. Unit root test is intended to determine whether a time series is stationary. This paper adopts ADF (Augmented Dickey-Fuller) test to analyze the stability characteristic of the time series.

This paper adopts Eviews 5.1 for analysis and the results as shown in Tab.1: LnGDP and LnFDI variables sequence themselves are not the stationary time series, neither are their first-order

difference series — ΔLnGDP and ΔLnFDI . After second-order difference, the ADF values of $\Delta^2 \text{LnGDP}$ and $\Delta^2 \text{LnFDI}$ are smaller than 1% of the critical values under significant levels, so the null hypothesis test cannot be rejected, that is to say, they are both stationary series. From here LnGDP and LnFDI are considered to be second-order single-whole series, recorded as $\text{LnGDP} \sim I(2)$ process and $\text{LnFDI} \sim I(2)$ process respectively.

Tab. 1: ADF Test On LnFDI and LnGDP

Variables	ADF value	Model stru.	Threshold		
			1%	5%	10%
LnFDI	-1.4481	T	-4.6162	-3.7105	-3.2978
ΔLnFDI	-2.5543	T	-4.8864	-3.8290	-3.3630
$\Delta^2 \text{LnFDI}$	-4.1779	0	-2.6998	-1.9614	-1.6066
LnGDP	-3.0909	T	-4.6162	-3.7105	-3.2978
ΔLnGDP	-2.2269	T	-4.8864	-3.8290	-3.3630
$\Delta^2 \text{LnGDP}$	-3.2585	0	-2.7550	-1.9710	-1.6037

T、C、0 represents 3 models with intercept and trend items, only with intercept item, and with no intercept or trend items respectively, Δ stands for first-order difference, and Δ^2 stands for second-order difference.

4.2. Cointegration Test

The regression of a nonstationary time series on another nonstationary time series may generate the problem of spurious regression which can be guarded against by finding out whether the time series are cointegrated. Cointegration means that the linear combination of two or more nonstationary time series with the same order difference has a stable long-run equilibrium relationship^[4]. As both LnGDP and LnFDI are second-order difference variables, satisfying the prerequisite of cointegration examination, a test for cointegration can be applied to check whether there is a long-term equilibrium trend between variables.

This paper adopts Engle-Granger (EG) test which involves two steps to examine if LnGDP and LnFDI are cointegrated.

First, regress LnGDP on LnFDI by using OLS and obtain the following regression:

$$\begin{aligned} \text{LnGDP} &= 5.792886 + 0.466027 * \text{LnFDI} \\ t &= (19.64985) \quad (10.95999) \\ R^2 &= 0.863429 \quad F = 120.1214 \\ DW &= 0.322868 \end{aligned}$$

This equation shows a positive association between FDI and economic growth in Zhejiang. The regression coefficient is about 0.466, suggesting that every additional per cent of LnFDI will boost LnGDP to go up by about 46.6 per cent.

Second, perform the ADF unit root test on the new series e_t , the residuals estimated from the regression.

The Tab.2 indicates that the ADF value of e_t (-2.740794) is more negative than 1% of the critical values (-2.692358), so the residuals e_t from the regression are $I(0)$, in other words, they are stationary. This proves that LnFDI and LnGDP are cointegrated, that is, there seems to be a stable long-run relationship between them and they will not wander away from each other.

Tab. 2: ADF Test On The Residual

Variables	ADF value	Model stru.	Threshold		
			1%	5%	10%
e_t	-2.7408	0	-2.6924	-1.9602	-1.6071

4.3. Error Correction Model (ECM)

From the above analysis, we can see that both LnFDI and LnGDP are nonstationary series, and there is a long-term cointegration between the two. Nonetheless, in the short run there may exist disequilibrium. An error correction mechanism can correct this imbalance, the corresponding model is called error correction model (ECM) that directly estimates the speed at which the depend variable (LnGDP) returns to equilibrium

after a change in the independent variable (LnFDI). ECM ties the short-run behavioral justification of LnGDP to deviations from the long-run equilibrium^[5].

According to the residual sequence e_t , ECM is constructed as below:

$$\Delta \text{LnGDP} = \beta_0 + \beta_1 \Delta \text{LnFDI} + \beta_2 e_{t-1} + \varepsilon_t$$

Based on OLS method, the regressive results are obtained as follows:

$$\begin{aligned} \Delta \text{LnGDP} &= 0.096145 + 0.077515 \Delta \text{LnFDI} - 0.064095 e_{t-1} + \varepsilon_t \\ t &= (18.62493) \quad (6.611930) \\ &\quad (-3.538181) \\ R^2 &= 0.743324 \quad F = 24.61571 \\ DW &= 0.973955 \end{aligned}$$

Analysis of the above results indicates that the effects on LnGDP are divided in two parts: one is the short-run fluctuation impact of FDI on GDP. The influence coefficient is 0.077515, suggesting that short-term changes in the FDI produce little positive role to economic performance in Zhejiang. The other effect is the long-run impact of the deviation from equilibrium. The coefficient of error correction term— e_t , reflects the degree of adjustment from short-term bias to long-run balance. In this case, the coefficient of e_t , -0.064095, demonstrates that the convergence mechanism is at work and the adjustment is weak.

4.4. Granger Causality Test

Cointegration test turns out that there exists the stable long-term relationship between FDI and economic growth in Zhejiang, but to assess whether one indicator is useful in forecasting the other requires Granger causality test. The results of Granger test can be seen from Tab.3.

The results from the Granger causality test illustrate that on the premise of first-order lag, LnFDI is not Granger caused by LnGDP and FDI is not the Granger cause of GDP in Zhejiang neither. Thus, there is no Granger causality relationship between FDI and GDP. That is to say, these two variables are independent of each other. From two lags to six lags, GDP per capital and FDI inflow in Zhejiang are each other's Granger cause, so there is bidirectional causality between them. In other words, FDI is the reason leading to economic growth. Also the astonishing economic progress in Zhejiang provide foreign investors with larger market size and more customers, and thus promote Zhejiang to absorb more FDI which gives the economy a boost again.

Tab. 3: Adf Test On The Residual

Null Hypothesis	Lag order	F Statistics	P value
LnGDP does not Granger Cause LnFDI	1	0.55523	0.46637
LnFDI does not Granger Cause LnGDP		0.34267	0.56598
LnGDP does not Granger Cause LnFDI	2	6.16149	0.01204
LnFDI does not Granger Cause LnGDP		8.48876	0.00385
LnGDP does not Granger Cause LnFDI	3	1.95827	0.17882
LnFDI does not Granger Cause LnGDP		2.30684	0.13313
LnGDP does not Granger Cause LnFDI	4	2.53489	0.12242
LnFDI does not Granger Cause LnGDP		8.57086	0.00544
LnGDP does not Granger Cause LnFDI	5	24.7893	0.00154
LnFDI does not Granger Cause LnGDP		11.1967	0.00955
LnGDP does not Granger Cause LnFDI	6	10.4888	0.08959
LnFDI does not Granger Cause LnGDP		10.7601	0.08746

5. Conclusion And Suggestion

Based on the empirical research, this paper draws the following conclusions: (1) Although the time series of LnFDI and LnGDP from 1990 to 2010 are both

nonstationary, their second-order difference are smooth. LnFDI and LnGDP are cointegrated, implying that there exists a long-term equilibrium between them. (2) The short-run fluctuation of LnFDI and LnGDP are corrected in a positive fashion, but this positive correlation between them is not significant. And the degree of adjustment from short-term bias to long-run balance reaches 0.064. (3) In the long run, between FDI and GDP exists two-way causal relationship. FDI can make a positive contribution to economic growth in Zhejiang, and the stable growth of GDP in Zhejiang is also the main reason that attracts FDI.

In the view of above conclusion, this paper puts forward the following three proposals:

First of all, efforts should be made to improve investment environment and attract more foreign capital. In part two, this paper recognizes that the distribution of FDI has characteristics of serious imbalance in Zhejiang. As between FDI and GDP exists a stable positive trend, Zhejiang should learn advanced experience from other developed regions and improve the situation of uneven development to introduce more FDI, thus benefiting the whole economy in Zhejiang. For north-east of Zhejiang, policies need to be adopted to control the scale of foreign investment and conditions should be created to guide foreign investors to transfer to the central and western regions. For the central and western areas in Zhejiang, measures should be taken to enhance infrastructure construction, improve the soft investment environment, and speed up the building of economic zones.

Secondly, the government should optimize industry structure based on the demand of Zhejiang. While discussing the relationship between FDI and economic growth in Zhejiang, this paper discovers that FDI plays a poor role in

promoting the economic development in Zhejiang in the short run, so it is important to recognize the interaction effects between the lag of FDI and GDP. Consequently, government should design policies that respond to the specific needs at different stages of development. While attracting FDI, Zhejiang should combine the local industrial development and the long-term goals of economy to optimize the industrial structure and accelerate technical innovation further.

Finally, the technology absorptive capability and human capital should be enhanced. A great deal of theories have shown that technology progress is the engineer of economic growth. Considering that FDI and economic performance complement and reinforce each other, local enterprises should proactively improve the ability of independent innovation and the capacity to assimilate and absorb the foreign technology. Furthermore, government should intensify innovation efforts to train personnel, offer the

introduction of support personnel policy to attract overseas talents, and strengthen mechanisms to retain people in the cause.

6. References

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