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The effect of interest rate on investment; Empirical evidence of Jiangsu Province, China

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Abstract. The main reason of this study is to test the interest rate impact on investment in Jiangsu Province of China. Jiangsu has the largest quantity of investment in China. For long run, nexus Johansen Co-integration test is employed. Whereas, vector error correction model (VECM) is used to find short run association over the period of 2003-2012. The results indicate that there is a long-term relationship association among variables. It has negative relation in the long run but positive in short run. This research also produces suggestions that will help in terms of interest rate policy as well as improving investment that promotes economic growth in Jiangsu Province.

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INTRODUCTION

Changes in interest rates can reflect the basic situation of the operation of macro economy; it also effects all the macroeconomic variables such as GDP, price level, the level of employment, international balance of payments, the rate of economic growth, etc. Obviously the interest rate is an important economic variable that plays an important role in both macro and micro economy activity.

Therefore, a change in interest rates is one of the main factors to judge the macroeconomic situation and the interest rate trend analysis is the main method to predict the macroscopic economic situation. Western economists believe that the market rate of interest, the total social savings and investment are closely linked. Therefore, the current interest rates affect the investment activities. At the same time, current interest rates also affect the scale of investment in the future by adjusting the savings. If the interest rate rises, bond prices fall, if the interest rate falls, bond prices rise.

The influence of interest rate on investment scale is operate as the opportunity cost of investment on total investment, Under the condition of unchanged in investment income, the rising interest rates increase the cost of investment and then inevitably cause lower income investors to withdraw from the area of investment, so that the demand for investment is reduced. However, falling interest rates means that investment costs decline, thereby stimulating investment and the total social investments increase.

The authorities in western economic theory circles and monetary management treat the interest rate as an important means for an important index to measure the function of the economy and adjustment of economic operation.

Jiangsu province is located in the eastern part of China; the economy occupies an important position in the Chinese economy. The quantity of investment in Jiangsu is one of the largest in China. Empirical test is conducted in this paper to test the effect of interest rate on investment in Jiangsu Province.

LITERATURE REVIEW

Many scholars draw different conclusions about the relationship between interest rate and investment according to a large number of empirical analyses. If investment was added as an endogenous variable into a monetary utility function model, the result turned out that investment indeed has a certain impact on interest rates (Qing and Chong, 2004). If discount rate was replaced by stochastic interest rate in a real option model, the result turned out that the uncertainty of interest rate had obvious effects on investment (Ingersoll and Ross, 1992). The analysis of irreversible investment under the changing rates showed that the change in rate had positive or negative effect on the demand of investment (Alvareand and Koskef, 2004). The diffusion model of short-term rates showed that the uncertainty of rate may limit the best investment and enterprise scale (Luis H.R Alvarez 2010).

Different from the traditional theory, some scholars concluded that there was a positive correlation between interest rate and investment. Based on the evidence of 21 developing countries, 1971 to 1980, the analysis about the real financial assets showed that there was a positive relationship between the growth of real interest rates and financial assets. (Lanyi and saracoglu, 1983). If the discount factor was selected to represent the variable of investment and the GMM estimation method was used to analyze the relationship between investment and interest rate in an uncertain environment, the result turned out that there was a positive correlation between them. And the higher volatility the interest rate had, the more positive the correlation would be (Andrea Beccarini, 2007).

There are also some scholars believe that the rates may have no impact on the investment. VAR model was used to test the causal relationship between interest rates and investment, and found that investment depended on the level of demand in the macroeconomic, rather than interest rates (Mohammed Dore, 2013). According to the analysis of three rate hikes from 1960 to 1978 in West Germany, it turned out that the effect of interest rate on investment is different in two periods due to the different policy (R. T. Baillie and P. C. McMahon, 1981).

In the field of microeconomics, impulse response was used to analyze the effect of rate policy on investors. Based on the data of interest rates and ISE national 100 index, 2002-2010, the result showed that investors can't cope with the impact of interest rates in the short term (Mustafa and Ayhan, 2012).

When it came to the optimal investment decision-making under the rate risk in the long term, it is proved that interest rate had a great influence on the investment income. (Hiroaki and Jun, 2006). Empirical analysis was applied according to the long-term interest rates, short-term exchange rate and investment. On the analysis of short-term investment on the long-term bonds, it turned out that there was a weak relationship between interest rate changes and investment in Switzerland. And in the United States the relationship curve corresponded better to the interest rate parity theory (Christoph Sax, 2006). The article is structured as follows: Section 2 describes the data and characteristics of the market analyzed. Methodologies included in Sect.3, while Sect.4we present our results. Finally in section 5 describe our conclusions and discuss implications for policy.

THE SITUATION OF RATE AND INVESTMENT IN CHINA AND JIANGSU

The situation of rate and investment in China

Since 1991, the central bank has raised the interest rate four times. In July 1, 1995, the rate reached the highest point in the past 20 years. Since 2010, the economy has recovered gradually, the central bank raised interest rates again to maintain a stable price and sustain economic development.

Some parts of adjustment of rate in nearly 10 years is shown in Table 1.

Table 1

The adjustment of rate in nearly 10 years

Time	The benchmark deposit rate			The benchmark loan rate		
	before	after	range	before	after	range
2012.7.6	3.25%	3.00%	-0.25%	6.31%	6.00%	-0.31%
2011.7.7	3.25%	3.50%	0.25%	6.31%	6.56%	0.25%
2010.12.26	2.50%	2.75%	0.25%	5.56%	5.81%	0.25%
2008.12.23	2.52%	2.25%	-0.27%	5.58%	5.31%	-0.27%
2007.12.21	3.87%	4.14%	0.27%	7.29%	7.47%	0.18%
2006.8.19	2.25%	2.52%	0.27%	5.85%	6.12%	0.27%
2006.4.28	2.25%	2.25%	0.00%	5.58%	5.85%	0.27%
2004.10.29	1.98%	2.25%	0.27%	5.31%	5.58%	0.27%
2002.2.21	2.25%	1.98%	-0.27%	5.85%	5.31%	-0.54%

Source: National Bureau of Statistics of China.

As can be seen from the table, the central bank adjusted the rate with different frequency in different periods. It can be summarized that the characteristic of interest rate adjustment in China is raising or lowering the rate in concentration continuously and adjust it frequently in special economic environment.

Since the reform and opening-up, the economy of China has increased rapidly. Investment is growing with GDP. Empirical data shows that, GDP and investment have a positive relationship. The relationship between GDP and total investment in fixed assets are shown in Table 2.

Table 2

The GDP and Total investment in fixed assets Unit: billion Yuan

Time	GDP	Total investment in fixed assets	Investment ratio
1	2	3	4
2003	135,822.76	55,566.61	40.91%
2004	159,878.34	70,477.43	44.08%
2005	184,937.37	88,773.61	48.00%
2006	216,314.43	109,998.16	50.85%
2007	265,810.31	137,323.94	51.66%
2008	314,045.43	172,828.40	55.03%
2009	340,902.81	224,598.77	65.88%

1	2	3	4
2010	401,512.80	251,683.77	62.68%
2011	473,104.05	311,485.13	65.84%
2012	519,470.10	374,694.74	72.13%

Source: National Bureau of Statistics of China.

From the table, it is clear that the Investment and GDP growth has a positive relationship. It can be concluded that investment contribute to economy.

The situation of investment in Jiangsu province

As a major economic province post reform and opening-up, the GDP of Jiangsu has been increasing rapidly. Investment makes great contribution to GDP and to the whole economy of Jiangsu.

Table 3

The GDP and Total investment in fixed assets in Jiangsu Unit: billion Yuan

Time	GDP	Total investment in fixed assets	Investment ratio
2003	12,442.87	5,233.00	42.06%
2004	15,003.60	6,557.05	43.70%
2005	18,598.69	8,165.38	43.90%
2006	21,742.05	10,069.22	46.31%
2007	26,018.48	12,268.06	47.15%
2008	30,981.98	15,300.55	49.39%
2009	12,442.87	5,233.00	42.06%
2010	15,003.60	6,557.05	43.70%
2011	18,598.69	8,165.38	43.90%
2012	21,742.05	10,069.22	46.31%

Source: National Bureau of Statistics of China.

As shown in Table 3, the investment ratio has increased to 50% from 2003 to 2012, which means Jiangsu is in the model of investment pulling economy. Total investment in fixed assets is rising slowly and reaching stability.

In the following part evidence in 2003-2012 will be used to make an empirical analysis, hoping to help the government complete the rate and investment policies to improve the quality of investment and promote economic activity in Jiangsu.

EMPIRICAL ANALYSES

In this part the VECM is used to analyze the effect of interest rate on the total investment in Jiangsu Province.

One-year lending rate is chosen as the variable of rate and the price index of fixed assets investment is chosen as the variable of investment. The data comes from State Statistical Bureau. We make a logarithmic treatment for the variable of investment to eliminate possible heteroskedasticity and mark it as LNTZ. The rate is calculated each year and marked as R. All the estimation and tests are conducted by Eviews 6.0.

First, it should draw great attention that whether it can pass through the stability test or not. Unit root test (ADF test) is used to determine the stability of the variables. The test results are shown in Table 4.

Table 4

The ADF test

Variables	ADF test statistic	1% critical value	5% critical value	10% critical value	stability
R	-1.3593	-2.6924	-1.9602	-1.6071	NO
LNTZ	-2.3890	-3.9591	-3.0810	-2.6813	YES
D(R)	-2.6614	-2.6997	-1.9614	-1.6066	NO
D(LNTZ)	-4.0715	-3.8868	-3.0522	-2.6666	YES

Source: own calculations.

The test results show that R and LNTZ are both not stationary at level AR(0), but they are stationary at first difference, AR(1),which is named as D(R) and D(LNTZ). It is means that R and LNTZ are I (1) and it meet the prerequisite conditions that there may exist a long-term equilibrium relationship between R and LNTZ.

Before establishing the VECM, the best lag period should be determined. The best lag period test is shown as Table 5.

Table 5

The best lag period test

Lag	LogL	LR	FPE	AIC	SC	HQ
0	-2.991	NA	0.0059	0.5545	0.6534	0.5682
1	21.2828	40.45636*	0.0006*	-1.6980*	-1.4013*	-1.6572*
2	24.5807	4.7637	0.0007	-1.6201	-1.1254	-1.5519

The lag mark* is the best. It follows the principle of AIC, SC. As can be seen from the table 5, lag 1 is available. Then the stability test for the VECM is needed through the AR roots graph to test it. The result is shown as Fig 1.

Source: own calculations.

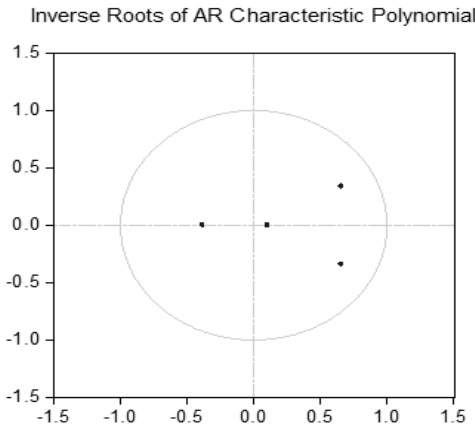

Fig. 1. AR roots figure

It can be seen that inverse roots of characteristic polynomial are all in the unit circle, so the VECM is stable.

Before establishing an economic model, it is necessary to perform a co-integration test to determine whether there is a long-term equilibrium relationship between variables. From the unit root test, the variables are both I (1) series, so it can proceed to conduct a co-integration test. Johnson test is used to test it and the result is shown as Table 6.

Table 6

The Johnson test

Null hypothesis	characteristic value	Statistic	5% critical value	P value
None *	0.7508	34.9903	25.8721	0.0028
At most 1	0.4876	10.3679	12.5179	0.1772

Source: own calculations.

Through the Johnson test it can be seen that under the confidence level of 95%, the statistic rejects the null hypothesis which means there is not one co-integration relationship and accepts the alternative hypothesis, which says that there is at least one co-integration. In conclusion, there is long run association among variables.

The standardized co-integration vector can be expressed as follows:

$$LNTZ = 4.6494 - 0.0014R$$
$$(0.0180)\ (0.0006)$$

The numbers in brackets represent the residuals. The smaller the residuals are, the more accurate the co-integration equation is. It can be seen that the rate and investment have a negative long-term relationship. If the rate reduces by 1%, the investment will increase 0.0014%. Now, Granger causality is used to test the causality between rate and investment in Jiangsu.

The 1 lag is available to make Granger causality test. The result is shown as Table 7.

Table 7

Granger causality test

Hypothesis	F value	P value	conclusion
LNTZ does not Granger Cause R	12.7290	0.0025	Reject the null hypothesis
R does not Granger Cause LNTZ	11.2719	0.0036	Reject the null hypothesis

Source: own calculations.

As the table shows, LNTZ is the Granger Cause of R, and R is also the Granger Cause of LNTZ. This means there is a bi-directional causality between interest rate and investment. So the interest rate and investment may promote each other.

VECM (Vector error correction model) is a constraint VAR model (Vector auto regression model). If there is a co-integration relationship between two variables, VECM can be established. After finding the long-term equilibrium relationship between variables, then the VECM can be used to test the short-term relationship between them. On the basis of the co-integration equation above, the VECM can be expressed as:

$$D(LNTZ) = -0.0066 - 0.3934\ ECM_{t-1} - 0.1134D(LNTZ_{t-1}) + 0.0160D(R_{t-1})$$

and

$$ECM_{t-1} = -4.6494 + LNTZ_{t-1} + 0.0014R_{t-1}$$

The coefficient and t-test value of each variables are shown in Table 8.

Table 8

The coefficient and t-test value

	Variable	coefficient	t-test value	
	ECM_{t-1}	- 0.3934	-3.4603	
	$D(LNTZ_{t-1})$	- 0.1134	-0.7752	
	$D(R_{t-1})$	0.0160	1.0562	
	C	-0.0066	-0.6912	
R^2= 0.5604	ADJ-R^2=0.4662	F= 5.9498	AIC =-3.5071	SC=-3.3093

Source: own calculations.

From table 8, ECM values are negative and significant. This shows a short run relationship between variables. The speed of adjustment towards long run equilibrium is 39.4 percent.

As can be seen from table 8, in the short term, the interest rate and the investment in Jiangsu have a positive relationship. If the rate increases by 1%, the investment in Jiangsu will increase 0.016%. So it can be concluded that increasing interest rate will promote investment in the short term. However, at the same time, it is found that the goodness of fit is not so good referring to the R^2value. And the t-test value is small which means the coefficient is not significant. This model is a non-theory model, so impulse response analysis and variance decomposition are usually used to analyze the model.

Impulse response analysis focuses on the analysis of dynamic effect on the system when an error term changes and the model suffers from a certain impact. This method is used to describe how the depend-

ent variable in a single equation responds to the impact given by other factors. Impulse response analysis for each variable of the former 10 periods and the result are shown as Fig.2:

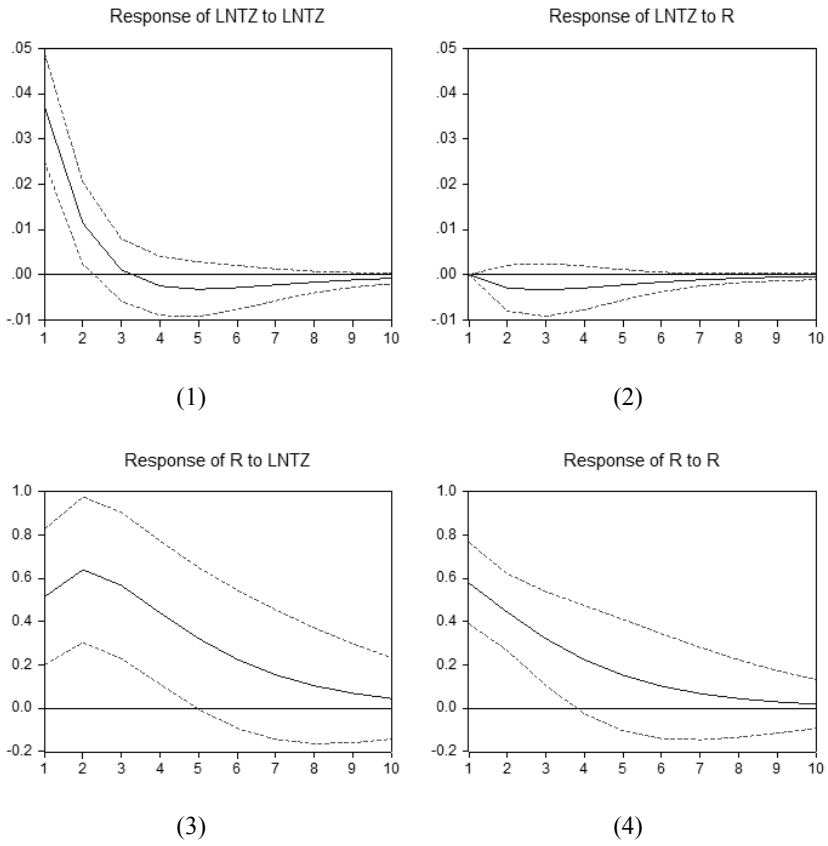

Fig. 2. Impulse response figure

As shown in the figures, the variable of investment has a strong response to its own standard deviation in formation. When rate is impacted by a standard unit the variable of investment does not change in the first period and shows a negative correlation in the second period and reaches the lowest point of -0.01 in the third period. The variable then increases until the sixth period and becomes relatively stable. It can be seen that there is always a negative correlation between rate and investment and the impact reduces with time.

Different from the impulse response, variance decomposition can decompose the variance of a variable into each disturbance and then describes the system changes in a dynamic perspective. It seems to calculate a contribution ratio of each variable. We choose the former 10 periods and the result is shown as follows:

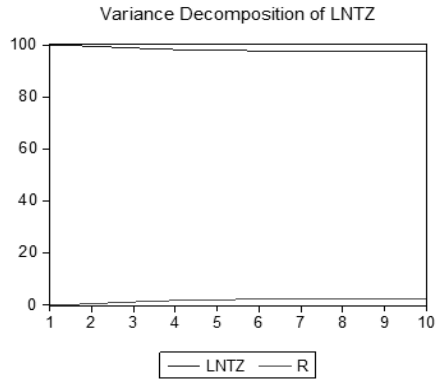

Fig. 3. Variance decomposition of investment

Table.9

Variance decomposition table

Period	S.E.	LNTZ	R
1	0.037142	100.0000	0.000000
2	0.038963	99.42648	0.573525
3	0.039123	98.68593	1.314067
4	0.039311	98.14998	1.850016
5	0.039505	97.84654	2.153465
6	0.039641	97.69379	2.306211
7	0.039719	97.62164	2.378361
8	0.039760	97.58888	2.411123
9	0.039780	97.57440	2.425600
10	0.039789	97.56813	2.431872

Source: own calculations.

It is found that the impact of investment on itself is very strong. The contribution ratio remains as 97% until the tenth period which means investment can be impacted by its historical value easily. The contribution ratio of rate to investment keeps rising and remains as 2.4% in the eighth period. So it can be concluded that rate is one of the influencing factors of investment but the impact is not strong.

RESULTS

The VECM is established with the data of investment and rate from 2003 to 2012 to test the relationship between them. Now it can be concluded that there is a long-term equilibrium relationship between variables. In the long run, investment and rate have a negative relationship, and if the rate reduces by 1%, then the investment will increase 0.0014%. However, in the short term, investment and rate have a positive relationship. If interest rate increases by 1%, the investment in Jiangsu will increase 0.016%.

CONCLUSIONS AND POLICY IMPLICATIONS

Now it can be concluded that in the long run, rate and investment have a positive relationship. Reducing the rate will promote investment in Jiangsu.

But at the same time, it is observed that although the interest rate has an effect on the investment, it is a relatively weak impact. Aside from rate, there are also many other factors, which affect the investment in Jiangsu, such as market size, economic development level, investment environmental and preferential policies.

According to the results of empirical analysis, the impact of interest rates on investment in Jiangsu Province exists and the impact is different depending on the industry. Therefore, there are some suggestions: The investors in enterprises should make correct and informed decisions according to the change of interest rate; the government of Jiangsu should make flexible investment policies and pay more attention to interest-sensitive industries. Some suggestions are given to complete interest rate policy and to increase the sensitivity of each investment subject on interest rate; first, accelerate the pace of interest rate liberalization. Second, improve investment channels and environment. Third, improve the sensitivity of investment to rate in firms.

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