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Interest rate uncertainty, Investment and their relationship on different industries; Evidence from Jiangsu, China

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Abstract. The aim of this study is to investigate the impact of real interest rate on investment level on different industries of Jiangsu, China over the period of 10 years from 2003 to 2012. The effect of interest rate on investment in different industries is tested by using static and dynamic panel-data model. The empirical evidences indicated that interest rate and investment are positively correlated. However, interest rate uncertainty has small impact on rate of investment in different industries. Industries like manufacturing, power, gas, and water industry, finance and real estate are more sensitive to interest rate fluctuation. Furthermore, evidence indicated that sensitivity of interest rate on investment is also low.

It is suggested that government should accelerate the pace of interest rate liberalization and improve the sensitivity of investment to interest rate. The government should encourage rate sensitive industries in province.

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1. INTRODUCTION & LITERATURE REVIEW

1.1. Introduction

As per previous literature it is well known concept that investment acts as life blood in every industry. All kinds of investments directly or indirectly become part of any industry. But interest rate has big impact on investment in an enterprise. The interest rate can control the investment behavior of an enterprise by

raising or lowering its financial expenses. Different enterprises have various capital structures, especially in distinct industries. The ratio of equity capital to total capital is larger in some industries but in others the ratio of debt capital is larger. Furthermore, in few industries, the ratio of fixed assets to total assets is larger but in others the ratio of floating capital is higher. The relationship between interest rate and investment is seriously affected by difference in capital structure of enterprises

Therefore, the capital structure of the enterprise is able to influence the reaction of investment to the interest rate. At the same time, some other factors like the nature of enterprise can influence investment objectively. In this paper, the static and dynamic panel-data model is used to explore the impact of interest rate on investment in different industries through investment data of ten industries in Jiangsu Province.

1.2. Brief Literature Review

Many scholars draw different conclusions about the relationship between interest rate and investment in different industries and come out with different empirical findings. 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 indexes over a period of (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 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).

If some productizing corporations in the USA are chosen as samples to research the relationship between their investment behaviors and real interest rate, it turned out that there is a negative relationship, which accords with the traditional theory in developed countries. From the point of industries, the interest rate sensitivity is lower in rapid-developing industries. (Fazzari, StevenM and BrueeC. Peterson, 1993)

Many Chinese researchers came out with result that there is a positive relationship between interest rate and investment. Zhou Siyuan, (2011) conducted a research based on 400 listed companies in manufacturing industry by using panel data concluded that there is a positive relationship between interest rate and choice of investment behavior in company.

Few of them came out with diverse results. They think there is no significant relationship between interest rate and investment. An analysis based on policy effect of interest rate on investment, the interest rate elasticity of investment is low. The asymmetric financial structure is one of the reasons behind low rate of returns on investment. Furthermore, state-owned enterprises are not sensitive to interest rate fluctuations (Zhao Shangmei, 2003). Peng Qinghao (2010) conducted a study to check relationship between interest rates and investment in fixed assets and the consumption over a period of (2004-2008) and concluded that there is no obvious correlation between them in china.

This article is structured as follows: Section 2 describes the data and characteristics of the market analyzed. Research methodology included in Section 3 while, results are presented in Section 4. Finally in section 5 describe our conclusions and discuss implications for policy.

2. THE SITUATION OF INVESTMENT IN DIFFERENT INDUSTRIES OF JIANGSU

This study attempts to explore the impact of interest rate on investment in different industries of Jiangsu over a period of 10 years from 2003 to 2012. But, only five years data is presented in Table 1.

Investment in ten industries is chosen to represent the situation of investment in Jiangsu. Agriculture sector along with mining, information, wholesale and retail and real estate industry are the key industries under consideration.

The total investment in fixed assets and ratio in some parts of industries in recent five years are shown as Table 1 and the pie chart of ratio in 2012 is shown as Fig 1.

Table 1

The total investment in fixed assets and ratio Unit: Billion Yuan

Time	Agriculture	Ratio	Mining	Ratio	Manufacturing	Ratio
2008	111.8	0.73%	58.53	0.38%	7,699.71	50.32%
2009	177.14	0.93%	76.65	0.40%	9,453.27	49.89%
2010	221.9	0.96%	83.1	0.36%	11,656.40	50.28%
2011	225.42	0.84%	68.02	0.25%	13,103.64	49.09%
2012	251.91	0.82%	85.57	0.28%	14,792.53	47.94%
Time	Wholesale and retail	Ratio	Finance	Ratio	Real estate	Ratio
2008	387.2	2.53%	3.85	0.03%	3,800.57	24.84%
2009	493.37	2.60%	17.61	0.09%	4,077.36	21.52%
2010	578.3	2.49%	42	0.18%	5,182.90	22.36%
2011	609.36	2.28%	55.41	0.21%	6,746.61	25.28%
2012	713.23	2.31%	93.26	0.30%	7,746.82	25.11%

Source: National Bureau of Statistics of China.

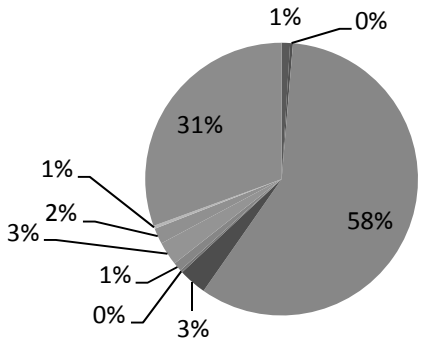

Fig. 1. The pie chart of the ratio of total social investment in ten industries in 2012

Source: National Bureau of Statistics of China.

As can be seen from Fig.1, the fixed assets investment in manufacturing industry accounted for 58%, the real estate industry accounted for 31%, while other industries accounted for less than 3%. Thus, the quantity of investment in manufacturing and the real estate industry is the largest in Jiangsu Province, which

means it has great influence on the whole province. According to the change trend, the ratio of agricultural, mining, and manufacturing are reducing year by year, which means the investment scale of the first and the second industry is narrowing down. The short rise in 2009 is likely relative to the lower interest rate. But the difference of the influence between different industries needs to be analyzed by the following static and dynamic panel data model.

3 EMPIRICAL ANALYSES

3.1 Measure and data

Panel-data model is a model obtained two-dimensional data both in time and space. This model not only reflects the individual data in a certain period of time, but also describes the individual changes with time. This model is integrated with common advantages of time series and cross section data.

Agriculture sector along with mining, information, wholesale and retail and real estate industry are the key industries under consideration.

In this part, annual data of investment and interest rate from 2003-2012 are used to do the analysis. One-year lending rate is chosen to be the variable of rate and assets investment is chosen to be the variable of investment. The data comes from State Statistical Bureau. In order to eliminate the effect of price on investment, it is divided by CPI. Logarithmic treatment is made for the variables of investment in the ten industries in order to eliminate possible heteroskedasticity and they are marked as Agriculture, Mining, Manufacturing, Power, Construction, Information, Wholesale and retail, Accommodation and catering, Finance, and Real estate industry. The whole investment in Jiangsu Province is marked as LNTZ. The rate in each year is calculated averagely and is marked as R. All the estimation and test are conducted by Eviews 8.0.

3.2 Static panel data model

Stability test of Panel-data model is similar to time series. Different methods for the stability test may appear different results. The unit root test with LLC((Levin-Lin-Chu), Breitung T-stat, ADF(Augmented Dickey-Fuller test), and PP(Phillips-Perron) methods are used to ensure the test results are accurate. And the test results as shown in the Table 2 and Table 3.

Table 2

The unit root results of LNTZ

	LNTZ			D (LNTZ)		
	Test value	P-value	stability	Test value	P-value	stability
LLC	-4.5052	0.0000	YES	-11.7624	0.0000	YES
Breitung t-stat	0.5227	0.6994	NO	-3.6775	0.0001	YES
ADF	17.3631	0.6293	NO	60.6542	0.0000	YES
PP	25.1040	0.1975	NO	92.7798	0.0000	YES

Source: own calculation.

Table 3

The unit root results of R

	R			D (R)		
	Test value	P-value	stability	Test value	P-value	stability
LLC	0.5588	0.7119	NO	-11.9639	0.0000	YES
ADF	6.7526	0.9974	NO	105.471	0.0000	YES
PP	2.7588	1.0000	NO	111.105	0.0000	YES

LNTZ means the whole investment in Jiangsu Province and R means the rate

Source: own calculation.

As per table 2, 3 results, when Breitung t-stat, ADF, PP methods are applied, the P-value is not significant, so the variable LNTZ contains a unit root and it is not stationary at level AR(0), but it is stationary at first difference, AR(1),which is named as D(LNTZ). So, R as D(R), it means that R and LNTZ are stationary at same level which meets the prerequisite conditions that they may have a long-term relationship between them. Co-integration test based on Pedroni method is used for panel data and the result are presented in Table.4.

Table 4

Co-integration test based on Pedroni

Test statistic	Statistic value	p-value	weighting statistic value	p-value
Panel v-Statistic	-1.2594	0.8961	-1.8362	0.9668
Panel rho-Statistic	-1.0084	0.1566	-0.6826	0.2474
Panel PP-Statistic	-2.5866	0.0048	-3.2717	0.0005
Panel PP-Statistic	-4.6729	0.0000	-5.8097	0.0000
Group rho-Statistic	1.5785	0.9428		
Group PP-Statistic	-3.0466	0.0012		
Group ADF-Statistic	-5.6359	0.0000		

Source: own calculation.

As per table 4 results, Pedroni test within group shows that there is a significant co-integration relationship based on Panel PP-Statistic and Panel PP-Statistic. Furthermore, Group PP-Statistic and Group ADF-Statistic have shown significant co-integration relationship. Therefore, we can conclude that there is a co-integration relationship between the whole investment and interest rate in Jiangsu province.

Granger causality test is applied to furtherly explore the equilibrium relationship between investment and the interest rate in Jiangsu Province. In Granger test 2 lag are chosen by default and the result is shown as in Table.5.

Table 5

Granger causality test

Hypothesis	F value	P value	conclusion
LNTZ does not Granger Cause R	5.30304	0.0070	Reject the null hypothesis
R does not Granger Cause LNTZ	0.48992	0.6146	Accept the null hypothesis

Source: own calculation.

From the table 5 we can see that LNTZ is the Granger Cause of R, but R is not the Granger Cause of LNTZ. It means there is causality between rate and investment. It can be concluded that the interest rate is the cause of investment, but investment cannot cause change in interest rate.

In order to know the impact of interest rate on investment in Jiangsu more directly and clearly, static panel data model is used to reflect the static relationship between them. The total investment in fixed assets is used as dependent variable and interest rate is used as independent variable. Static panel data model includes variable intercept model, varying coefficient model and mixed model.

At first, F statistic test and chi square statistic test are applied for selection of model.

Varying intercept model is expressed as: $y_i = \alpha_i + x_i\beta + \mu_i$

Varying coefficient model is expressed as: $y_i = \alpha_i + x_i\beta_i + \mu_i$

Hypothesis: H_1: $\beta_1 = \beta_2 = \ldots = \beta_N$

H_2: $\alpha_1 = \alpha_2 = \ldots = \alpha_N$

$\beta_1 = \beta_2 = \ldots = \beta_N$

If H_2 is accepted, then mixed model can be used; if H_2 is rejected, and H_1 is accepted, then variable intercept model can be used; if H_1 is rejected, then varying coefficient model can be used.

The first step, assuming that the intercept and coefficient change with sector, then the sum of squared residuals S_1=53.6637. In second step, assuming intercept change and coefficient remain the same, then the sum of squared residuals S_2=87.1912; whereas, in third step assuming the intercept and coefficient remain unchanged then the sum of squared residuals S_3=393.6645. Then pick up sum of squared residuals in these 3 methods, mark them as S1, S2, S3, for a F test for final selection of method.

Then F statistic test is applied to make hypothesis test. N=10, T=10, K=1 then

$$F2 = \left[\left(S3 - S1\right)/\left(N-1\right)\left(k+1\right)\right]/\left[S1/\left(NT - N\left(k+1\right)\right)\right] = 28.19$$

$F_{0.95}$ (18, 80) =1.7, so H_2 is rejected;

$$F1 = \left[\left(S2 - S1\right)/\left(N-1\right)K\right]/\left[S1/\left(NT - N\left(k+1\right)\right)\right] = 5.56$$

$F_{0.95}$ (9, 80) is between 1.96 and 2.04, so H_1 is rejected and varying coefficient model is chosen.

Varying coefficient model is expressed as: $y_i = \alpha + x_i\beta_i + \mu_i$, and the result is shown as below:

$$LNTZ_{it} = \underset{(11.9133)}{8.8802} + \beta_i R_i$$

R^2=0.8553 F=52.5862 SSE=57.1633 DW=0.6476

The value in the bracket is t test value, so as below

The coefficient in each industry is shown as Table. 6. β_i represents the interest rate sensitivity of investment in each industries.

Table 6

Coefficient in each industry β_i s

Industry: i	β_i	t test value	Industry: i	β_i	t test value
Agriculture	0.054525	0.415063	Information, computer and software	0.058726	0.447040
Mining	-0.068444	-0.521014	Wholesale and retail	0.225244	1.714628
Manufacturing	0.745781	5.677108	Accommodation and catering	0.100843	0.767644
Power, gas, and water industry	0.340034	2.588442	Finance	-0.338109	-2.573787
Construction	-0.000324	-0.002465	Real estate industry	0.626987	4.772814

Source: own calculation.

According to the t test result, the coefficient is significant in manufacturing, power, gas, and water industry, finance and real estate industry. It indicates that interest rate have larger influence on these industries than others. The coefficient in manufacturing is the largest, which means interest rate have more impact on it. Rate has a positive effect on investment in manufacturing, so as real estate industry and power, gas, and water industry. On the other hand, rate has a positive effect on investment in finance. Theoretically, power, finance and the real estate are rate-sensitive industries. Therefore, the empirical results support the theory.

3.3 Dynamic panel data model

As per empirical results, goodness of fit is good but the coefficients are not significant in most industries. Furthermore, the DW value is low, which means there may be autocorrelation of residuals. Considering investment is not only affected by interest rate, but also by its historical value and historical value of interest rate. So it is necessary to use dynamic panel model to reveal the relationship between investment, its historical value, current interest rates and historical rate to make up for the inadequacies of static panel data model.

Lag one period for dependent and independent variables are presented in following dynamic panel model:

$$LNTZ_{it} = \alpha_i + \beta_0 LNTZ_{i,t-1} + \beta_1 R_{it} + \beta_2 R_{i,\ t-1} + e_{it}$$

In dynamic panel model, lag of independent variable will lead to endogens of dependent variables. Therefore, instead of Least squares (OLS) a new technique GMM (SYS-GMM) is used for dynamic panel model (Arellano and Bover, 1995, Blundell and Bond, 1998). The regression estimation results by using GMM technique are presented below:

$$\underset{}{LNTZ_{it}} = \underset{}{\alpha_i} + \underset{(15.4472)}{0.7902 LNTZ_{i,t-1}} - \underset{(-2.5191)}{0.0827 R_{it}} + \underset{(3.0492)}{0.2006 R_{i,t-1}}$$

As per LNTZ equation all coefficients are found significant. Furthermore, pre investment has a positive effect on the amount of the later. If investment in the previous year increases 1%, it will increase 0.79% this year. Interest rate has a negative effect on investment. If the rate increases 1%, the amount of investment will increase 0.08%. And pre rate has a positive effect on investment. If pre rate increase 1%, the amount of investment this year will increase 0.2%.

Sargan test is used to test the validity of dynamic panel model. The Sargan test is a statistical test used for testing over-identifying restrictions in a statistical model. As per test results (scalar pval=@chisq (8.465367, 8) =0.3894) we accept the null hypotheses and conclude that that it's an ideal model in this case.

4. RESULTS & CONCLUSIONS

In this study different approaches were used to establish the nexus between interest rate fluctuations on investment in different industries of Jiangsu covering the period of 10 years from 2003 to 2012. During the study by using static panel data estimation models, results indicated that interest rate has a negative effect on investment and pre investment has a positive effect on the amount of the later. Different industries have different sensitivity to interest rate, manufacturing, power, gas, water industry, finance and real estate industry are more sensitive to rate, whereas, other industries are found less sensitive. It is evident that by using both models (static and dynamic), the impact of interest rate on investment is very small.

There may be some reasons: First, interest rate cannot affect investment directly. It needs other intermediate variables such as money supply, loan balance of financial institutions. Second, market-oriented interest rate reform in China is not comprehensive and complete. The current interest rate cannot fully reflect the investment demand, so the elasticity of interest rate on investment is low.

It is recommend that the government of China should accelerate the pace of interest rate liberalization and improve the sensitivity of investment to rate. The enterprises should adjust investment decision flexibly according to their interest rate sensitivity. Lastly, the government in Jiangsu should pay more attention to rate sensitive industries.

REFERENCES

Mustafa Ibicioglu, Ayhan Kapusuzoglu, (2012). An empirical analysis of impact of central bank policy interest rate on the decisions of share investors: evidence from Turkey. *Procedia - Social and Behavioral Sciences*, Vol 62, p. 489 -493

Hiroaki Hata, Jun Sekine. (2006). Solving long term optimal investment problems with Cox-Ingersoll-Ross interest rate. *Advances in Mathematical Economics*, 8, p.231-255

Christoph Sax. (2006). Interest Rates and Exchange Rate Movements: Analyzing Short-term Investments in Long-term Bonds [J].*Financial Markets and Portfolio Management*. 20, Issue 2, p. 205-220.

AlvarezL. And KoskelaE. (2004). Irreversible Investment under Interest Rate Variability. New Results [J]. *Bank of Financial Discussion Papers*, 2004

Fazzari, StevenM, BrueeC. Peterson. (1993). Working Capital and Fixed Investment: New Evidence Financing Constrains. *Rand Journal of Economics*, forthcoming, p. 328-342.

Zhou Siyuan. The effect of interest rate adjustment on investment behavior of listed companies in manufacturing industry [D]. Beijing University of Chemical Technology, Beijing.

Zhao Shangmei (2003). The analysis of investment effect on interest rate policy [J].*Journal of Chinese Academy of Social Sciences*, 2003(3).

Peng Qinghao (2010). Talk about the interest rate transmission mechanism of monetary policy in China [J]. *Fiscal and financial*, 2010, 64-65