The Relationship Between Investment and Economic Growth

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Abstract: In this paper, we use the datum from the third quarter of 2010 to the first quarter of 2013 to study the interactive relationship between the investment in fixed assets of different industries in China and the gross domestic product(GDP), using methods including time-difference correlation analysis, principal component analysis, and multiple liner regression. Firstly, we use time-difference correlation analysis to obtain the results that on the premise of economic growth, the scale of investment in fixed assets should keep the pace with the scale of economic development and the current investment in fixed assets has a promoting effect on the development of future economy. Secondly, using the multifactor pricing model which has grown up in the financial markets can we obtain the multifactor model of investment in fixed assets and GDP. Finally, adding on some issues to make effective conclusions.

Keywords*:* Time-Difference Correlation Analysis; Principal Component Analysis; Multiple Linear Regression; SPSS

Introduction

The National Bureau of Statistics divides fixed asset investment into 20 categories by industry. In today's rapidly developing economy, every industry is closely related to the national economy. Guo Qingwang and Jia Junxue used a two-sector endogenous growth model combined with Granger causality test to analyze annual data on government public capital investment in China from 1978 to 2004. They found that public investment in physical capital has a more significant positive impact on long-term economic growth, while public investment in human capital has a smaller positive impact on long-term economic growth and is detrimental to economic growth in the short term.We know that the 20 economic sectors that make up fixed asset investment are closely interconnected and have overall characteristics in actual economic operations. Therefore, this study will treat fixed asset investment as a whole for research purposes.

1. Time Relation Analysis

1.1 Sample Data

This paper uses data provided by the National Bureau of Statistics on Gross Domestic Product (GDP) from the third quarter of 2010 to the first quarter of 2013 (Table 1) and fixed asset investment in various industries (Table 2).

Table 1 Gross Domestic Product (GDP)

Year	Quarter	Absolute GDP (100 million yuan)
2010	3	97747.90
...	...	...
2013	1	118854.80

Note: The original data is quarterly cumulative data, and the existing data is calculated

Source: Statistical data on the website of National Bureau of Statistics

Table 2 Fixed Asset Investment in Various Industries (Excluding Households) (Unit: 100 million yuan)

Year	Qua-rter	AgricultureForestry Graziery	Mining	Manufacturi-ng	Electricity,Heat.Gas and Water	Culture Sports Entertainme-n	Public Administrat-ion,Social

		Fishery			Production and Supply	t	Security and Social Organization
2010	3	1101.04	2593.51	20861.37	3954.60	717.04	1403.75
...	...	...	...	...	...	...	...
2013	1	1177.46	1337.84	20473.04	2443.43	694.02	721.03

Note: (1) The original data was monthly cumulative data, and the current data was calculated accordingly

(2) Before 2011 (including 2011), the name was "Fixed Asset Investment in Urban Areas"

Data source: Same as Table 1.

1.2 Correlation Analysis of Time-Lagged Sample Data

We first organize the corresponding relationship between the two, as shown in Table 3.

Table 3 Corresponding Relationship between Cross-Correlation Analysis of GDP and Fixed Asset Investment in Various Industries

Leading Test of GDP			
Current GPD	Current Fixed Asset Investment	T-1 Fixed Asset Investment	T-2 Fixed Asset Investment
201101	201101	201004	201003
...	...	...	...
201301	201301	201204	201203
Leading Test of Fixed Asset Investment			
Current Fixed Asset Investment	Current GPD	T-1 GDP	T-2 GDP
201101	201101	201004	201003
...	...	...	...
201301	201301	201204	201203

In the above table, "GDP lagging behind fixed asset investment growth" refers to the situation where the growth of fixed asset investment in the early stage lags behind the growth of GDP, which will have an impact on the later growth of GDP. "Fixed asset investment leading GDP" refers to the situation where the growth of fixed asset investment exceeds the growth of GDP, that is, the current scale of fixed asset investment exceeds the scale needed for GDP development, which is equivalent to overdrawing future fixed asset investment to enable GDP to develop in the current year.

Therefore, we can consider that if the correlation coefficient obtained from the GDP lagging behind test is greater than the correlation coefficient obtained from the fixed asset investment leading test, it indicates that the fixed asset investment in the current year will have an impact on future GDP growth, and the scale of fixed asset investment in the current year can be regarded as an indicator for judging the future GDP growth situation.

Table 4 Correlation Analysis Between GDP and Fixed Asset Investment Time Lag in Various Industries

	Agriculture Forestry Graziery Fishery	Mining	Manufacturin-g	Electricity Heat Gas and Water Production and Supply	Culture Sports Entertainment	Public Administrati-on Social Security and Social Organization
t-2	0.534328	0.167432	0.498823	0.106314	0.327049	0.256385
t-1	0.298802	0.079104	0.194453	0.072496	0.192414	0.101802
T	0.766575	0.878532	0.816749	0.862067	0.829323	0.845869
t+1	-0.357100	-0.401720	-0.298690	-0.343500	-0.213190	-0.417410

t+2	0.254731	0.128535	0.235510	0.165841	0.175120	0.169124

We can see that:

(1)The correlation coefficient in the t-row is the largest

(2) The correlation coefficients in the t-1 and t-2 rows are larger than those in the t+1 and t+2 rows

2. Principal Component Analysis(Pca)

2.1 Principal Component Analysis of Sample Data

The various industries that make up fixed asset investment are closely related during the process of economic development. However, due to the characteristics of each industry, their contributions to economic development are different. Therefore, we used principal component analysis to comprehensively study the fixed asset investment data of 19 economic production departments from the third quarter of 2010 to the first quarter of 2013.

According to the rotated component matrix, the 19 economic sectors can be divided into two major categories. The second principal component factor, F2, has a high loading on Wholesale and Retail Trade, Accommodation and Catering Services, and Information Transmission, Software and Information Technology Services. The first principal component factor, F1, has a high loading on the remaining 16 sectors.

Component Score Coefficient Matrix

	1	2		1	2
Agriculture.Forestry.Grazi-ery.Fishery	.072	-.116	Health and Social Work	.106	.090
Mining	.036	.123	Culture.Sports .Entertainment	.093	-.048
Manufacturing	.179	-.013	Public Administration,Social Security and Social Organization	-.008	.122
Education	.114	.076			

We have the following formula for calculating the factor scores (sum of the product of the factor score coefficients and the standardized values of the original variables). The 19 sectors are numbered as x1, x2, ..., xn based on their sector number.

$$F_1 = 0.072x_1 + 0.036x_2 + 0.179x_3 + 0.117x_4 - 0.073x_5 + 0.032x_6 + 0.228x_7 - 0.233x_8 - 0.305x_9 - 0.146x_{10} + 0.072x_{11} + 0.117x_{12} + 0.175x_{13} + 0.177x_{14} + 0.137x_{15} + 0.114x_{16} + 0.106x_{17} + 0.093x_{18} - 0.008x_{19}$$

$$F_2 = -0.116x_1 + 0.123x_2 - 0.013x_3 + 0.152x_4 - 0.072x_5 + 0.561x_6 - 0.198x_7 + 0.185x_8 + 0.132x_9 - 0.046x_{10} - 0.029x_{11} - 0.119x_{12} + 0.015x_{13} + 0.05x_{14} - 0.066x_{15} + 0.076x_{16} + 0.09x_{17} - 0.048x_{18} + 0.122x_{19}$$

3. Multivariate Linear Regression

3.1 Principal Component Analysis (PCA) for Sample Data

We first need to calculate the data of the two principal components from the third quarter of 2010 to the first quarter of 2013. The results are shown in Table 5.

Table 5 Sample data of principal components

Year	Quarter	F1	F2
2010	3	6750.612	5155.742
...	...	...	...
2013	1	7149.860	38.009

3.2 Multivariate Linear Regression Model

We used Eviews to establish the multivariate linear regression model, and the results are as follows:

Dependent Variable: Y				
Method: Least Squares				
Sample: 2010:3 2013:1				
Included observations: 11				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	86306.84	11167.77	7.728209	0.0001
X1	3.018977	0.766662	3.937819	0.0043
X2	1.872316	1.787989	1.047163	0.3256

R-squared	0.660289	Mean dependent var	121608.4
Adjusted R-squared	0.575362	S.D. dependent var	20946.04
S.E. of regression	13649.34	Akaike info criterion	22.10777
Sum squared resid	1.49E+09	Schwarz criterion	22.21629
Log likelihood	-118.5927	F-statistic	7.774721
Durbin-Watson stat	1.835402	Prob(F-statistic)	0.013318

The results of the model estimation

$$Y_t = 86306.84+3.018977\mathrm{F}_1 +1.872316\mathrm{F}_2$$

We will use the model obtained earlier to perform model accuracy testing.The average error accuracy is 0.009230536, indicating a very high model accuracy with an error rate of 0.923%.

4. Supple Momentary Question

This might be because the explanatory variables used in the model only consist of two principal components, which cannot fully represent all aspects of GDP. Therefore, the correlation can only reach a moderate level. However, the model uses the multivariate linear regression method, which can better describe the relationship between GDP and explanatory variables, resulting in high accuracy in prediction. Furthermore, the low error rate of the model also indicates strong predictive ability. Therefore, we can consider this model to be relatively reliable in predicting China's GDP, but in explaining the relationship between GDP and other factors, more explanatory variables may be needed.

The economic significance of this model is to provide a method for predicting the growth of China's GDP by exploring the impact of fixed asset investment on GDP growth from an investment perspective. The premise for using this model is that it does not take into account other factors that promote GDP growth under conditions of high economic growth. Therefore, from the perspective of fixed asset investment in various industries as a whole, if the average fixed asset investment in an industry that constitutes the principal component F1 increases by 100 million yuan, it will lead to an increase of 302 million yuan in GDP growth in the same year. However, we need to pay attention to the fact that the industries that constitute F2, such as (6) Wholesale and Retail Trade, (8) Accommodation and Catering Services, and (9) Information Transmission, Software and Information Technology Services, have greater price elasticity compared to other industries. Therefore, in macroeconomic regulation, we should pay attention to stabilizing the market prices of these industries.

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