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An Equilibrium Analysis on the Relationship between Economic Growth and Urbanization

−Based on Statistical Data from 1990 to 2015 in Heilongjiang Province

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***Abstract*—The statistical data about annual real per capita GDP and annual proportion of urbanization from 1990 to 2015 was selected as a sample in order to study the relationship between economic growth and urbanization in Heilongjiang Province. It made an empirical analysis by the Granger causality test, unit root test, cointegration test. It showed that there were a one-way Granger causal relationship and long-term equilibrium relationship between economic growth and urbanization in Heilongjiang Province. The economic growth in Heilongjiang Province can Granger cause the level of urbanization. It has obvious explanatory ability to the level of urbanization. So it should promote the construction of new urbanization, pay attention to the adjustment and optimization of industry structure, expand demand by the urbanization effect, stimulate economic growth and improve the urbanization level in Heilongjiang Province. The benign, coordinated and interactive development between economic growth and urbanization would be realized through the above mentioned measures.**

Keywords—urbanization; economic growth; Heilongjiang; cointegration test; Granger causality test

I. INTRODUCTION

Urbanization is an important symbol of regional economic and social development. It is an important driving force for economic development and an important livelihood project. Economic growth pole theory [1], new economic geography theory [2], agglomeration economy theory [3] and so on, have provided the theory support for the government to formulate the urbanization strategy and the regional economic development strategy. From the domestic and international development experience and practice, urbanization is an important support for the optimization of economic structure. It is the biggest potential of domestic demand, and an important engine to promote economic growth. As one of the three provinces in Northeast China, with the rapid growth of economy, urbanization has shown a rapid development trend in Heilongjiang province. It is very important to study the internal relationship between economic growth and urbanization. More representative of the academic literature about the empirical analysis of the relationship between economic growth and urbanization were as followed. Chunxiang Xu, Zhaolong Han (2015) calculated the coordination degree between urbanization and economic development in Liaoning Province through the establishment of comprehensive evaluation of urbanization and economic development level indicator system, using the factor analysis method and coordination degree model. It showed that the urbanization and economic development in Liaoning province have experienced two distinct stages and that there are sharp regional differences among the coordination degree between urbanization and economic development in Liaoning Province [4]. Jianhua Liu, Xiao Zhou (2015) made an empirical analysis by the cointegration analysis of urbanization and economic growth from 1978 to 2013 in Jilin Province. It also made predictions through short period fluctuations on the relationship between the two variables [5]. Xiufeng Zhang, Jiang Liu, Dongfang Li (2016) confirmed that the process of urbanization promotes economic growth based on the panel data of 12 provinces in Western China area from 1985 to 2012 [6]. Mengru Hong investigated the dynamic relationship between urbanization and domestic demand growth in Fujian Province by Var model, impulse response function and variance decomposition technology. It showed that mutual promotion between urbanization and domestic demands is significant, and urbanization stimulates domestic demand growth while domestic demand growth has also accelerated the urbanization [7].

Different from the previous literature, firstly it made the Granger causality test in order to analyze the relationship between economic growth and urbanization in Heilongjiang

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province according to the statistical data about annual real per capita GDP and annual proportion of urbanization from 1990 to 2015 in Heilongjiang Province, using the software Eviews5.1. Secondly, it made the unit root test about the variables. Thirdly, it made the cointegration test in order to test whether there is a long-term equilibrium relationship between the two variables.

II. STATISTICS AND VARIABLES

The statistical data of Heilongjiang province from 1990 to 2015 were selected as samples, and the original data is shown in Table.

TABLE I. 1990-2015 RELATED STATISTICS IN HEILONGJIANG PROVINCE

year	per capita GDP (yuan)	proportion of urban (%)	CPI(1978=100)
1990	2028	48.0	166.1
1991	2310	49.0	178.4
1992	2672	50.1	194.8
1993	3306	51.3	223.6
1994	4390	52.4	272.6
1995	5402	53.7	316.5
1996	6382	53.8	339.0
1997	7133	53.9	353.9
1998	7375	54.0	355.3
1999	7578	54.2	343.8
2000	8294	51.9	337.9
2001	8900	52.4	340.6
2002	9541	52.6	338.2
2003	10638	52.6	341.2
2004	12449	52.8	354.2
2005	14440	53.1	358.5
2006	16255	53.5	365.3
2007	18580	53.9	385.0
2008	21740	55.4	406.6
2009	22447	55.5	407.4
2010	27076	55.7	423.3
2011	32819	56.5	447.8
2012	35711	56.9	462.1
2013	37697	57.4	472.3
2014	39226	58.0	479.4
2015	39352	58.8	484.7

Note: data over the years were derived from the statistical yearbook of Heilongjiang 2015.

The level of urbanization, namely, the urbanization rate index, is measured by urban resident population proportion of the total population (%) in Heilongjiang province at the end of each year. The per capita GDP of Heilongjiang province is selected as the index variable to measure the real economic growth in Heilongjiang province. In consideration of the comparability and consistency of economic statistics data, the CPI (1990=100) is calculated firstly according to the CPI (1978=100). Then the real per capita GDP (1990=100) could be calculated in order to eliminate the fluctuation of price of per capita GDP impact over the years. X and Y respectively represent the actual per capita GDP (1990=100) and the rate of urbanization.

It is generally known that the original relationship between the cointegration variables do not be changed after the transform of natural logarithm. Foremore the data is easy to become a smooth sequence, and to facilitate the analysis of economic significance. It can also modify or eliminate the heteroscedasticity in the regression analysis of time series. So the logarithmic transformation of the two sequences were made. The actual per capita gross domestic product (1990=100) and the rate of urbanization after the transform of natural logarithm in Heilongjiang province were represented by LX and LY respectively.

III. EMPIRICAL ANALYSIS

A. Granger causality test

There is a mutual influence between economic growth and urbanization level based on the theory of economic growth pole. The Granger (1969) causality test method [8] were applied for the two variables. The Granger causality test is essentially testing whether a variable is introduced into another variable with lagged variables, and whether the explanatory power of the model is improved significantly. If a variable is affected by the lagged variables of another variable, it is said that there is a Granger causality between the two variables. If the variable X helps to explain the future change of the variable Y, it is assumed that the variable X is the Grainger cause of the variable Y. In other words, the variable X can Granger cause the variable Y.

The lags need to be selected in the Granger causality test. The lags of the two variables is identified as 1 based on AIC. The results of Granger causality test can be seen from table II.

TABLE II. PAIRWISE GRANGER CAUSALITY TESTS

Sample: 1990 - 2007		
Lags: 1		
Null Hypothesis:	F-Statistic	Probability
LX does not Granger Cause *LY*	3.39	0.07
LY does not Granger Cause *LX*	1.32	0.26

It can be seen that LX can Granger cause LY at the 10% significance level from table Ⅱ. That is to say, economic growth in Heilongjiang province have a significant explanatory power to the urbanization level. The economic growth of Heilongjiang province is the Granger cause of urbanization level. But the level of urbanization in Heilongjiang province does not Granger cause economic growth, in other words, the null hypothesis is true at the 10% significance level. Therefore, it can be concluded that there is only one way Granger causality between the two variables.

B. Unit root test

The time series variables are generally unstable due to the influence of the economic development trend. It can be seen from the data in Table I that the two variables have an upward trend. In other words, both of them are non-stationary time series. The two variables should be tested firstly by the ADF test [9] in order to avoid the "pseudo regression" problem that may arise from ordinary regression methods. The results of unit root tests about the time series LX and LY are shown from table III to table VI as followed.

TABLE III. ADF TEST OF LX

Null Hypothesis: LX has a unit root			
Exogenous: Constant			
Lag Length: 1 (Automatic based on AIC, MAXLAG=5)			
		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-0.87	0.78
Test critical values:	1% level	-3.74	
	5% level	-2.99	
	10% level	-2.64	

TABLE IV. ADF TEST OF LY

Null Hypothesis: LY has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic based on AIC, MAXLAG=5)			
		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-1.48	0.53
Test critical values:	1% level	-3.72	
	5% level	-2.99	
	10% level	-2.63	

TABLE V. ADF TEST OF D(LX)

Null Hypothesis: D(LX) has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic based on AIC, MAXLAG=5)			
		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-2.74	0.08
Test critical values:	1% level	-3.74	
	5% level	-2.99	
	10% level	-2.64	

TABLE VI. ADF TEST OF D(LY)

Null Hypothesis: D(LY) has a unit root			
Exogenous: Constant			
Lag Length: 0 (Automatic based on AIC, MAXLAG=5)			
		t-Statistic	Prob.
Augmented Dickey-Fuller test statistic		-3.86	0.01
Test critical values:	1% level	-3.74	
	5% level	-2.99	
	10% level	-2.64	

As can be seen from table III to table IV, the ADF test statistics of the original time series LX and LY are greater than the test critical values of 10% level. It can be concluded that both of the original time series LX and LY are non-stationary sequences. But it can be seen from table Ⅴ to table VI that the ADF test statistics were less than the test critical values of 10% level for the time series of LX and LY after the first difference. It can be concluded that the time series D(LX) and D(LY), that is the time series LX and LY after the first difference, are stable. That is to say, LX and LY have a unit root. Cointegration analysis can be made for the two variables.

C. Cointegration test

Although the original time series LX and LY are not stable, both of them are I (1) sequences. And there may be a cointegration relationship between them, namely, the long-term stable equilibrium relationship between the two variables. The method of the E-G two step [10] is applied to test the integration relationship between the two variables as followed. The first step of regression analysis was made, as shown in table VII.

TABLE VII. THE RESULT OF REGRESSION

Dependent Variable: LY				
Method: Least Squares				
Sample: 1990 2015				
Included observations: 26				
Variable	Coefficient	Std. Error	t-Statistic	Prob.
C	3.42	0.07	50.75	0.00
LX	0.07	0.01	8.39	0.00

In order to test whether the time series LX and LY have long-term equilibrium relationship, ADF test method is used to test the residual sequence named Ut next, so as to measure its stationarity. The results of ADF test about Ut is shown in tableVIII.

TABLE VIII. ADF TEST OF UT

Null Hypothesis: UT has a unit root			
Exogenous: None			
Lag Length: 0 (Automatic based on AIC, MAXLAG=5)			
		t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic		-2.04	0.04
Test critical values:	1% level	-2.66	
	5% level	-1.96	
	10% level	-1.61	

It can be seen from table III that its ADF test statistics (equivalent to the t-statistic in the regression) is -2.04. And the test critical value is -1.96 at the 5% significance level. It can be concluded that the residual sequence Ut is stationary at the 5% significance level. Therefore, although the time series LX and LY are not stable, there is a long-term equilibrium relationship between the two variables, also known as cointegration relationship. It shows that the time series of LX and LY have high correlation from table Ⅶ. Assuming that other conditions remain unchanged, elasticity of per capita GDP in Heilongjiang Province on the level of urbanization is 0.07. That is to say, over the long run, every 1% growth of the per capita GDP, the urbanization level would increase 0.07% in Heilongjiang Province. This conclution has provided a scientific basis for the provincial government to attach great importance to economic growth and to further improve the level of urbanization.

IV. CONCLUSION

(1) It showed that the economic growth of Heilongjiang province Granger causes the change of the level of urbanization with the help of Granger causality test. But urbanization level in Heilongjiang province does not Granger cause the change of economic growth. To sum up, there is only one-way Granger causality between the two variables. There is a long-term stable equilibrium relationship between the two variables with the help of cointegration test, also known as the cointegration relationship. The per capita GDP plays an important role in promoting the urbanization level significantly in Heilongjiang province. The per capita GDP of the province increases by 1%, which will increase the level of urbanization by 0.07%. This showed that economic growth plays a vital function in promoting urbanization in Heilongjiang province. The degree of regional economic development determines the size and development potential of urbanization. Therefore, it should adapt to the new normal economic development furthermore, improve the quality and efficiency of development as the center, take the supply side structural reform as the main line, revitalize the real economy as the cornerstone, pay attention to cultivate new growth areas, implement the strategy of innovation-driven development, continue to promote the construction of industrial projects, strengthen infrastructure construction. The sound and rapid economic development could be actualized through the above mentioned measures.

(2) Urbanization is a fundamental way to solve the problem of agriculture, countryside and peasants. There is a fundamental adjustment and transformation to the regional economic structure, social structure and the way of life. It relates to the transformation and upgrading of industry and the leading of new industry. Industry is the base of town development, and town is the carrier of industry development. The evolution of industrial structure is the bridge between urbanization and regional economic development. The promotion of urbanization plays an important role in the realization of China's political stability, economic development, social progress and other aspects. In the process of promotion, the first thing to solve is the problem of industrial development. For Heilongjiang Province, it needs to find the path suited to their own industry development and consider the actual conditions of the town itself in the future development direction, such as natural resources, regional advantages and actual situation of industrial development. The benign, orderly and interactive development between industrial transfer and urbanization can be realized. In addition, it should adhere to the basic concept of people foremost and coordinating the economic, social and ecological environment. It suggests that urbanization should lead to a new road of industrialization with low energy consumption, low pollution, low emission and green environment protection.

(3) The experience of economic development in many developed countries shows that urbanization can effectively stimulate social demand and promote regional economic growth. Urbanization can form regional growth pole through population agglomeration and industrial centralization, and then promote regional economic growth. Therefore, the importance of promoting urbanization should be fully understood. Overall planning should be made. It should adhere to scientific development, follow the law of development, clarify the direction and path of urbanization, and improve the public service system for education, culture, medical care, social security and housing. It should strengthen the construction of urban planning, promote the development of the industry, so as to achieve orderly urbanization. In addition, it is necessary to promote the rational and orderly transfer of rural population to cities, and to further promote the construction of new urbanization through population concentration. As far as Heilongjiang province is concerned, it is necessary to proceed from reality and promote the level and quality of urbanization in accordance with local conditions, and strive to realize the benign, coordinated, interactive and balanced development of economic growth and urbanization.

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