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Research on the relationship between urbanization and economic growth in China - econometric analysis based on data from 1952 to 2013

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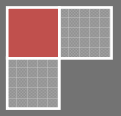
ABSTRACT

By means of cointegration test, vector error correction model(VECM), granger causality test and so on, this article has respectively tested the relations between urbanization and economic growth in China during 1952-2013. The result shows that the cointegration relationship varies from loose to tight in different sample interval. Urbanization does not play a significant role in promoting economic growth until the 21st century. Otherwise economic growth does not significantly increase urbanization level, although it promotes urbanization in short term. Entering the 21st century, the new urbanization keeps eye on "quality" rather than "quantity".

KEYWORDS

Economic growth; Urbanization; Vector error correction; Cointegration analysis; Granger causality test.



INTRODUCTION

The relationship between urbanization and economic growth has been always an important topic which is universally discussed around the world. Urbanization is a process of population and economic activities concentrating from rural to urban, and various economic elements gathering and redistributing in space. Urbanization is an important social phenomenon nowadays, and it usually goes with economic growth.

In China, coordinated development of urbanization and economic growth is an important issue which has to be confronted and solved. The process of urbanization has experienced the lag phase before the reform and opening up, and accelerated development stage after that since the founding of our country. Entering the 21st century, the report of 16th Party Congress proposed specifically that coordinated development of big and medium cities and small towns needed persist, and urbanization should be with Chinese characteristics. The report of 17th Party Congress pointed out the new path of urban-rural integration was an inevitable choice. Therefore, research on the relation between urbanization and economic growth has crucial realistic meaning and reference value for policies.

In recent years, scholars have done a lot of work on the relation between urbanization and economic growth. Wang (2002) measured the optimal size of cities in our country by using the revenue function and external cost function based on 660 cities' data samples from 1989 to 1996, then estimated the net-contribution rate of urbanization to economic growth (deducting external cost) could reach 3.6% in the next 10 years under the condition of accelerating urbanization, so that urbanization could become the main contributing element to boost economic growth[1]. Hu (2003) argued that urbanization, which is the major impetus that drives economic development of China in the future, was the basic way to achieve Chinese modernization and also the fundamental way to solve the problem of "agriculture, rural areas and farmers"[2]. Zhao (2006), using the time series data from 1978, made a quantitative analysis on "the urbanization effect" of economic development and "the economic effect" of urbanization since the reform and opening up. He proved that there existed short-term effect and long-term effect between economic development and urbanization[3]. Guo (2012) empirically studied the relationship between economic growth and urbanization in our country by using modern econometric method based on data from 1979 to 2010. Guo thought there was a long-term equilibrium relationship between urbanization and economic growth at present, and this long-term equilibrium relationship constrained the short-term fluctuations strongly. The mutual stimulative mechanism between urbanization and economic growth has not yet formed[4].

Based on the existing research, this paper shall carry on an empirical analysis on the long-term and short-term dynamic relationship between urbanization and economic growth based on data from 1952 to 2013 in China in order to discuss the mutual influence direction and impact of both. Methods including Engel-Granger cointegration test, vector error correction model, granger causality test and so on are introduced and utilized.

DATA DESCRIPTION AND EMPIRICAL ANALYSIS

Index selection and data analysis

(1) Index selection

Two key indexes are selected in this paper: ratio of urban population and GDP per capita, which shall be used to measure the level of urbanization and economic growth separately.

Set urbanization level for URB. When the population and economic activities concentrate from rural to urban, it would inevitably bring about the expansion of city scale and the increase of city number. Thus geographic concentration of population and economic activities make the proportion of urban residents rise. For most countries and regions, people often adopt the proportion of urban population to measure urbanization level. This paper will also take the expression.

Set the level of economic growth for GDP. Here GDP refers in particular to GDP per capita, which will be used to measure the level of economic growth, like most economic analysis. It should be noted that population flow related urbanization level is associated with "nominal value", as Todalo's population flow model shows that movement of labor from rural to urban would not stop as long as the anticipated income is higher and the chance of getting job is greater in the city than in the country[5]. Therefore, the value of GDP per capita is nominal GDP corresponding to that of urbanization level in this paper.

(2) Data analysis

Data from 1952 to 2013 used in this paper are all from the China Statistical Yearbook of 2013, of which data in 2013 is from the latest annual figures on the National Bureau of Statistics website. The time series graph of the ratio of urban population (URB) and GDP per capita (GDP) in China is shown in Figure 1.

Urbanization level increases along with the increasing of the level of economic growth since the founding of China, as shown in Figure 1. Before the reform and opening up, Chinese urbanization level increased slowly from 12.46% in 1952 to 17.92% in 1978. The annual increase averaged only 1.41% in the past 26 years. After the reform and opening up till to the beginning of this century, urbanization level increased 17.26% and the average annual growth reached 3.13%. Modern urbanization speeded up significantly and the rate of growth is more than doubling since 1952 to 1978. Entering this century, urbanization level in our country, which is developing at a high speed, rose to over 50% in 2013.

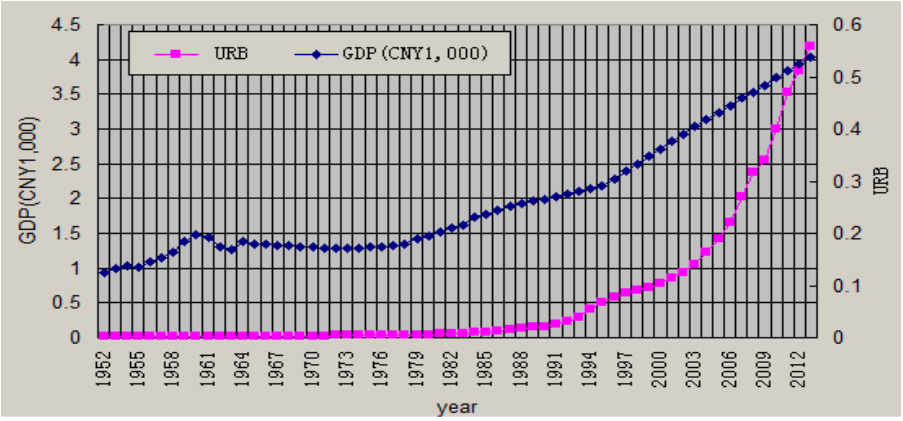


Figure 1 : The basic trend of URB and GDP in China from 1952 to 2013

According with the pace of urbanization, improvement of GDP per capita in China has also experienced several stages. Before the reform and opening up, GDP per capita was nearly stagnant as it spent 30 years to rise from ￥119 of 1952 to ￥500 of 1982. After the reform and opening up, GDP per capita reached ￥1112 in 1987, exceeded ￥1000 for the first time, and then ￥5046 in 1995. It took 8 years to achieve annual growth rates of 8.56% from 1987 to 1995 (by constant price account). From 1995 to 2003, the annual growth rates averaged 7.91% (by constant price account). It was 2003 that GDP per capita exceeded ￥10000 to ￥10542 for the first time and then over ￥30000 in 2010.

Empirical analysis

(1) Stationary test of series

Most time series of economic data is non-stationary, which are encountered frequently in the real economic life. And it is difficult to predict the future information by establishing a model with these non-stationary sequences[6]. Therefore, unit root test is needed to determine whether there is a long-term cointegration relationship among these variables before specific equation estimation and relevant inspection. In addition, the natural logarithm processing of data is introduced, considering possible heteroscedasticity of data, signed as LnURB and LnGDP respectively. These two variables would be adopted in later analysis unless otherwise specified. In order to avoid the autocorrelation of random error terms, ADF unit root test will be implemented with eviews6.0 software, of which the optimal lag order is determined by AIC criteria. The test results are shown in TABLE 1, which indicates that the value of LnURB and LnGDP are non-stationary under the significance level of 1%, 5% and 10%. After the first order difference, the value of both is stationary. As a result, LnURB and LnGDP are I (1) sequence (integrated of order 1).

TABLE 1 : ADF test of LnURB and LnGDP

Variable	Test type(C, T, L)	ADF value	Critical value			Conclusion
			1%	5%	10%	
LnURB	(0,0,5)	-1.5289	-2.6069	-1.9468	-1.6131	Non-stationary
LnGDP	(C,T,2)	-1.2927	-4.1213	-3.4878	-3.1723	Non-stationary
ΔLnURB	(0,0,4)	-1.6717	-2.6069	-1.9468	-1.6131	Stationary
ΔLnGDP	(C,0,1)	-3.9973	-3.5461	-2.9117	-2.5936	Stationary

Note: "Δ" denotes first order difference. Test type (C, T, L) respectively means constant term, time trend and lag order included in the unit root test equation, 0 means the equation does not include constant term, time trend or lag order.

(2) Cointegration analysis

Theory of cointegration proposes that there can exist a long-term stable equilibrium relationship among some economic variables when their linear combination is likely to be the stationary sequence, although these variables are non-stationary[7]. In this paper, LnURB and LnGDP are both integrated of order 1, which shows that a long-term stable cointegration relationship exists between them. Because two variables are involved here, Engel-Granger cointegration test will be taken.

Considering the impact brought about by the changes of policies in the past decades, as well as the particularity of urbanization which is determined by the era background and national conditions in China, and studying the relationship between urbanization and economic growth in different periods, in this paper, the whole sample interval is divided into three stages: 1952-1978, 1978-2000 and 2001-2013, corresponding with the lag stage of urbanization adapting to the period of heavy industry prior developing before the reform and opening up, the accelerated stage of urbanization adapting to the

period of light industry developing during the reform and opening up, and the basic realization stage of urbanization adapting to the period of heavy industry redeveloping since entering the 21st century[8].

First, in 1952-2013, there is a long-term stable cointegration relationship between LnURB and LnGDP. The function is expressed as (T value is in parentheses. R^2 is the coefficient of determination, and $\bar{R}^2$ is the adjusted coefficient of determination.):

$$LnGDP = 13.3828 + 4.4384 * LnURB$$

(93.6748) (45.9084) **(1)**

R^2 =0.9723 $\bar{R}^2$ =0.9719

Function 1 shows that changes of urbanization and economic growth are in the same direction and there is a linear correlation relationship between them from the founding of new China to the 21st century. Model calculation results indicate that every 1% rise in urbanization level would lead the level of economic growth increase by 4.44% in China.

Second, in 1952-1978, there does not exist a long-term stable cointegration relationship between LnURB and LnGDP. Due to the planned economy before the reform and opening up and the strict restrictions to the flow of population, economic growth has little correlation with the transfer of population. The relationship between urbanization and economic growth is exogenous to some extent.

Third, in 1979-2000, the cointegration relationship between LnURB and LnGDP is denoted as (t value within parentheses):

$$LnGDP = 14.6644 + 5.3509 * LnURB$$

(37.4092) (18.5112) **(2)**

R^2 =0.9448 $\bar{R}^2$ =0.9421

Function 2 shows that the coefficient of determination of the regression equation is big. If we consider 22 years from 1979 to 2000 as a long-term process, we can find every 1% rise in urbanization level leads the level of economic growth increase by 5.35%. This illustrates that the economic system reform after the reform and opening up not only promotes the development of urbanization and economic growth significantly, but also strengthens the relationship of them.

Fourth, in 2001-2013, the cointegration relationship between LnURB and LnGDP is proved through analyzing which is denoted as (t value within parentheses):

$$LnGDP = 13.5699 + 4.7051 * LnURB$$

(157.9032) (43.5115) **(3)**

R^2 =0.9942 $\bar{R}^2$ =0.9937

Function 3 shows that changes of urbanization and economic growth maintain in the same direction after entering the 21st century. During this period, every 1% increase in urbanization level leads the level of economic growth increase by 4.71%, 0.64% less than those in the reform and opening up period. It shows that urbanization with Chinese characteristics does not mean slowing down the pace but developing of industry and economy in moderate and synchronous way.

TABLE 2 : Regression results of vector error correction model

Variable	1952-2013		1979-2000		2001-2013	
	ΔLnGDP	**ΔLnURB**	**ΔLnGDP**	**ΔLnURB**	**ΔLnGDP**	**ΔLnURB**
CointEq1	-0.0197	0.0292	-0.0898	0.0321	-0.1944	0.1092
	(-0.7373)	(2.5768)**	(-1.6102)***	(2.6335)*	(-0.5548)	(2.3422) ***
ΔLnGDP(-1)	0.6829	0.1033	0.7227	-0.0777	0.3035	-0.0337
	(6.1112)*	(2.1818)**	(3.8378)*	(-1.8836)***	(0.8589)	(-0.7169)*
ΔLnURB(-1)	-0.4515	0.2996	-0.4175	0.3016	3.8783	-0.2196
	(-1.6302)***	(2.5524)**	(-0.4598)	(1.5162)***	(1.1903)***	(-0.5064)

Note: T value is in parentheses. *, **, * are respectively significant under the significance level of 1%, 5% and 10%.**

(3) Vector error correction model and granger causality test

Granger theorem points out that as long as there is a cointegration relationship among variables, vector error correction model can be established to analyze the short-term volatility of variables. In this paper, the cointegration test results have proved that there existed a long-term stable equilibrium relationship between urbanization and economic growth in the period of 1952-2013, 1979-2000 and 2001-2013. So vector error correction model can be used to further analyze the short-term fluctuation relationship of both, of which the lag order is 1. The estimated results are shown in TABLE 2.

From TABLE 2, several results could be obtained. First, in 1952-2013, the error correction term of the level of economic growth in the error correction equation is negative and non-significant. Meanwhile, that of urbanization level is positive and significant, but the coefficient of the error correction term is small which means the adjustment from short-run bias to long-run equilibrium is insufficient, and the visible revision is shallow. Second, in 1979-2000, the error correction terms of urbanization level and the level of economic growth are both significant in the error correction equation, but the coefficients of them are small, which shows the velocity of adjustment from short-run divergence to long-run equilibrium is not fast. Third, in 2001-2013, the trend of adjustment to long-run equilibrium of the level of economic growth speeds up obviously but the error correction term is non-significant when the short-run fluctuations deviated from its long-run equilibrium. However, the unequal error of urbanization level is adjusted by the rate of 10.92% within one year. Fourth, entering the new century, viewing the influence of short-run volatility to the dependent variable, the elasticity coefficient of urbanization level of lag one is significantly higher than that in the period from 1979 to 2000, which is 3.8738.

Granger causality test will be carried on. Essentially, granger causality test tests whether the lagged variable of a variable can be introduced into other variable equations, to determine how the lagged variable can explain other variables[6]. As non-stationary series with cointegration relationship can be tested by granger causality test, we apply this test to inspect whether there is causal relationship between LnURB and LnGDP. Results are shown in TABLE 3.

TABLE 3 : Inspection results of granger causality test

Lag order	Null hypothesis	F value	P value	Conclusion
	LnURB not granger cause of LnGDP 1952-2013	1.3632	0.2643	Accept null hypothesis
2	1979-2000	1.1132	0.3542	Accept null hypothesis
	2001-2013	5.8593	0.0386	Reject null hypothesis
	LnGDP not granger cause of LnURB 1952-2013	7.0043	0.0020	Reject null hypothesis
2	1979-2000	3.9810	0.0410	Reject null hypothesis
	2001-2013	1.5265	0.2479	Accept null hypothesis

TABLE 3 shows that urbanization level is increased by economic growth on the whole sample of 1952-2013 and the accelerated stage of urbanization after the reform and opening up. Economic growth will inevitably need the regional transfer of rural surplus labor, while the transfer of rural surplus labor to cities will bring about the increase of urbanization level. Entering the 21st century, as the strategy choice of new urbanization is implemented, economic growth is not the one-way causation of urbanization any more on the premise of second-order lag. In this situation, upgrading of industry structure, optimal allocation of resources, promoting of talent etc. are in great need for economic growth. Therefore, the demand for rural surplus labor declines gradually. Besides, the real urbanization rather than "urban passenger" of the migrant rural workers is urged.

From TABLE 3, on the premise of second-order lag, urbanization is not the granger cause of economic growth in the whole sample period of 1952-2013 and the sample interval of 1979-2000, at least the one-way causation between them does not establish in the statistical sense. In 2001-2013, economic growth begins to be stimulated significantly by urbanization, which further reflects the periodic characteristics of the development of Chinese urbanization. When urban labor and capital stock grow to a certain degree, leading the reconfiguration of labor and capital in the inter-industry and the intra-industry, while promoting of human capital, optimization of industrial structure and expansion of investment getting urban economy going, urban-driven pattern of urban economic growth could be achieved[9].

CONCLUSION

In this paper, several means including cointegration test, vector error correction model(VECM) and granger causality test are introduced in analyzing the relationship between urbanization level and GDP per capita of China from 1952 to 2013. Conclusions can be obtained as follows.

The effect of urbanization on economic growth

The cointegration test results show that the cointegration relationship between urbanization and economic growth differs obviously in different sample intervals. The significant correlation between urbanization and economic growth exists in the whole sample period of 1952-2013, the interval of 1979-2000 and the interval of 2001-2013. During these periods, the elasticity coefficients of economic growth on urbanization are all positive, that is, every 1% increase in urbanization level

leads that of economic growth increase by 4% minimum. On the premise of second-order lag, urbanization is not the granger cause of economic growth in the whole sample period of 1952-2013 and the interval of 1979-2000 until the new century. The short-run error correction illustrates the adjustment of economic growth to long-run equilibrium and the effect of urbanization on economic growth become bigger and bigger as the urbanization proceeding. And the cointegration analysis in 1952-1978 shows that the impact of urbanization on economic growth or the relationship between them is almost none in the planned economy era. The correlation between urbanization and economic growth is more likely exogenous.

The effect of economic growth on urbanization

On the premise of second-order lag, economic growth is the granger cause of urbanization in the whole sample period of 1952-2013 and the interval of 1979-2000, which shows that economic growth has persistent effect on urbanization, and its leading role is greater than that of urbanization, but this situation changes when entering the new century. A long-term dynamic equilibrium relationship between economic growth and urbanization lies in all sample intervals except in the period of 1952-1978. This connection of them becomes more and more closely with the deepening of economic reform. In short term, when the value of urbanization level deviates from equilibrium one, the adjustment of unbalanced error correction term is slow. Although economic growth stimulated the urbanization in a short time, the effect of it on urbanization is not that obvious in general, especially after the proposing of the new path of urbanization in the new century, that urbanization is focused on "quality" rather than "quantity". Overall, the interaction mechanism between economic growth and urbanization development is not obvious. In addition, before the reform and opening up, the development of Chinese cities were limited to a considerable extent due to the policy of restricting urban development, particularly that of big and medium-sized cities, so the effect of economic growth on urbanization is rather minimal.

SUMMARY

The econometric analysis in this paper shows that the development of urbanization and economic growth is incompatible during a long period of time in China, which related to the particularity and stage of urbanization. At present, China is in the process of the third stage of industrialization which is driven by informatization and pushed with urbanization simultaneously.

Although the new path of urbanization, which pays attention to the coordinated development of urban and rural areas, has less positive effect on economic growth, urbanization with quality will become the most important point of consumption growth and the driving force of economic growth in the future. Well handling of the relationship between urbanization and economic growth to make this two develop in coordination and interact with efficiency is necessary nowadays.

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