An Empirical Study on the Impact of Scientific and Technological Innovation on New Urbanization

In Case of Guangdong Province

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Abstract. Based on the data of new urbanization and scientific and scientific and technological innovation in Guangdong Province from 2006 to 2018, the regression model and typical correlation coefficient analysis method are used to study the impact of scientific and technological innovation level on new urbanization in Guangdong Province. The results show that the scientific and technological innovation level and the new urbanization level are fluctuating, and the scientific and technological innovation has a positive and significant impact on the new urbanization in Guangdong. When the scientific and technological innovation factor changes by 1%, the new urbanization rate changes by 0.524%. And technology innovation and population urbanization, economic urbanization and social urbanization related to a higher degree, but with infrastructure and resources environment urbanization slightly inadequate. Therefore, in the process of accelerating the construction of new urbanization in Guangdong Province, we need to change the development mode of "factor-driven" to "innovation-driven".

Keywords: Scientific and technological innovation · New urbanization · Canonical correlation coefficient

1 Foreword

China has entered the decisive stage of building a well-to-do society in an all-round way. It is in an important period of economic transformation and upgrading and speeding up the socialist modernization, as well as in a key period of new-type urbanization construction. It is of great significance to deeply understand the urbanization and urban development to the economic and social development, grasp the great opportunity of urbanization, accurately study and judge the new trend and new characteristics of urbanization development, and properly deal with the risk challenge of urbanization. With the economic development entering into the "new normal", the dynamic mechanism of urban development and urbanization will undergo structural changes in China.

H. Song and D. Jiang (Eds.): SIMUtools 2020, LNICST 369, pp. 593–610, 2021.
https://doi.org/10.1007/978-3-030-72792-5_47

The mode of development has shifted from intensive factor input and extensive development to innovative activities and production services, which will lead to changes in urban employment structure, functional division, spatial layout and even adjustment of urbanization patterns. Scientifically analyze and accurately grasp the new law of urban development and urbanization under the "new normal" and enhance the forward-looking nature of urban and town group planning, which is not only related to the general direction of china's urban construction in the next few decades, but also related to further enhance the comprehensive competitiveness of our cities. Due to the continuous growth of population and the improvement of urbanization level, Chinese cities have experienced unprecedented rapid expansion. China is faced with prominent urban diseases and great resource pressure, which restrict the sustainable and healthy development of cities. How to improve the quality of urban development and urban service functions through scientific and technological innovation, and further realize the balanced development of urban and rural areas, and build a beautiful China, is a major and urgent practical problem during the 14th five-year Plan period. In order to clarify the development ideas, overall objectives, key tasks and safeguard measures of scientific and technological innovation in the field of urbanization and urban development during the 13th Five Year Plan period, a series of documents were formulated for overall deployment. For example "The "13th Five-Year" Urbanization and Urban Development Science and Technology Innovation Special Plan", "National Innovation-driven Development Strategy Outline", "13th Five-Year" National Science and Technology Innovation Plan, "National Medium and Long-term Science and Technology Development Plan Outline (2006–2020)", "National New Urbanization Plan (2014–2020)". It is the first time that the field of urbanization and urban development has been independently deployed as a key area, highlighting the important position and strategic significance of urbanization and urban development in China's economic and social development. The innovation of science and technology is the strong support of the new-type urbanization, which accelerates the process of urbanization and promotes the industrial transformation and upgrading. In the new socialist era, we should further clarify the laws of scientific and technological innovation and the development of new urbanization, clarify the technological needs of the development of new urbanization and the strategic path of relying on scientific and technological innovation to promote the development of new urbanization. It is of great significance to actively and steadily promote the construction of new-type urbanization.

2 Literature Review

Through an overview of domestic and foreign research trends, scientific and technological innovation and urbanization have always been one of the hot topics for scholars to study, and have made abundant achievements. By the end of 2020, a total of 52,939 literatures were searched on CNKI with "urbanization" as the key word. A total of 169,320 literatures were searched with "scientific and technological innovation" as the key word. However, there are only 877 literatures on the relationship between scientific and technological innovation and urbanization, among which only one was published in 1991. During the five years from 2013 to 2017, the research results were the most, with about 100 articles per year. It can be seen that the relationship between scientific

and technological innovation and urbanization has attracted more and more attention from scholars. However, compared with the research results of "urbanization" and "scientific and technological innovation", it can be seen that the research in relevant fields is slightly insufficient. From the current literature, it can be concluded as the following three aspects:

First, It is theoretical research British economist K. J. Button (1986) thought that "the development of industrialization promoted the development of urbanization and the development of urbanization reacted on the development of industrialization because of the agglomeration effect and promotes the further development of the scale of cities. And pointed out that scientific and technological innovation is the basis of urbanization, driving the development of urbanization. Grossman believed that "endogenous technological progress can promote the development of urbanization" [1]. Chen Qiang yuan and Liang Qi used the framework of spatial economics research, simulation, derivation and numerical methods that found under the assumption of heterogeneous labor force and knowledge spillover. It is considered that high productivity and high technology industries support the development of urbanization. The local government should attach importance to the technological progress and industrial upgrading of the city, and cultivate the comparative advantage of the technology of the city, so as to improve the comprehensive strength of its own city [2].

Second, It is empirical research. Lu JiTong used VAR model to study the dynamic relationship between scientific and technological innovation, direct investment and urbanization in the Beijing-Tianjin-Hebei region from 1998 to 2013. He believed that scientific and technological innovation and the evolution trend of urbanization level are similar, and scientific and technological innovation has a strong driving effect on the development of urbanization [3]. Wang WanYin applied the structural equation model analysis method, and the result showed that the innovation ability of science and technology in Shanxi Province has the support function to the new urbanization development, and the science and technology investment and the environment have the biggest promotion function to the new type urbanization [4]. Tian Yi-piao, Xu Xiuchuan and others used inter-provincial panel data to analyze the dynamic correlation between scientific and technological innovation in 30 provinces and cities and the development of newly opened urbanization. The results show that there is a two-way positive relationship between scientific and technological innovation and new urbanization. However, the impact of science and technology on urbanization has some lag, and science and technology show the characteristics of "inverted U" type [5]. Zhang Jian Qing used PVAR model to analyze the correlation between new urbanization and scientific and technological innovation in the middle and lower reaches of the Yangtze River. The results show that the dynamic correlation between scientific and technological innovation and new urbanization is time-delay, and the interaction effect between the two is negative. The influence between the two changes from negative to positive over time. Moreover, the effect of new urbanization on scientific and technological innovation is stronger than that on new urbanization, and there is a strong regional difference in the interaction between the two [6]. Zheng Qiang's method of building the panel threshold model systematically analyzes the impact of China's scientific and technological innovation on new-type urbanization. The results show that: "in the sample period, the level of China's

new-type urbanization presented a fluctuating upward trend and had the spatial pattern characteristics of decreasing gradient in coastal, inland and border regions; The impact of scientific and technological innovation on new-type urbanization is significantly based on the positive double-threshold effect of scientific and technological innovation level and time" [7]. The positive effect of scientific and technological innovation on new-type urbanization will gradually weaken with the improvement of scientific and technological innovation level and the passage of time.

Third, the study of the relationship between the scientific and technological innovation and urbanization. The research on the relationship between scientific and technological innovation and urbanization mainly includes two aspects: on the one hand, it is about the impact of scientific and technological innovation on urbanization. Grossman believes that "endogenous technology innovation can improve the development level of urbanization" to promote a country's long-term economic development [1]; Wang Jiwu believes that the key to breaking through the bottleneck of urbanization lies in scientific and technological innovation [8]; Liu Weiwei believes that "scientific and technological innovation to promote and promote the development of new urbanization" [9]; Yu Lian (2016) thought that "scientific and technological innovation is the strong support of new urbanization" [10]. On the other hand, the research on the interactive relationship between scientific and technological innovation and urbanization. Cheng Kaiming et al. found that urbanization has a strong influence on scientific and technological innovation, and vice versa [11]. Through empirical studies, Tian Yiqian proved that there was a bidirectional positive relationship between S&T innovation and new urbanization, but the effect of mutual influence was lagging [12].

A comprehensive review of the literature, although there is a considerable amount of research on urbanization and scientific and technological innovation materials. However, the research on the interaction between technology innovation and urbanization is relatively insufficient, which mainly shows two points. First, the focus of the study is to replace urbanization with population urbanization and the research on new urbanization is slightly deficient because the new urbanization emphasizes the urbanization of people and the connotation of all-round development. Second, there are more qualitative studies on the relationship between scientific and technological innovation and new urbanization and fewer articles use quantitative analysis with more analysis of national or provincial data. Due to the natural environment, geographical location, resource endowment, economic base and policy inclination, the level of scientific and technological innovation in each region may also be different so the impact on new urbanization may also be different. From the current literature, there is little research on the correlation analysis of scientific and technological innovation and new urbanization in Guangdong. Therefore, it is necessary to explore the impact of scientific and technological innovation on the new urbanization in Guangdong Province.

Based on this, this study attempts to make a comparative and systematic study of Guangdong Province from the following two aspects. First, based on the connotation of new urbanization, 18 indicators were selected from the five aspects of population, economy, society, resources and environment and infrastructure urbanization to build a comprehensive evaluation index system for the new urbanization level. Based on the connotation of scientific and technological innovation, a comprehensive evaluation index

system of scientific and technological innovation is constructed from the four aspects of input of scientific and technological innovation, output capacity of scientific and technological innovation, environment of scientific and technological innovation and transformation capacity of scientific and technological innovation. Second, it carries out non-dimensionless quantification of the two index systems. Then the standard deviation, mean value and coefficient of variation of each indicator are calculated, and the weight of each indicator, the level of scientific and technological innovation and the level of new urbanization are calculated. Finally, the regression analysis is carried out.

3 Construction of Evaluation Index System of Scientific and Technological Innovation and New Urbanization

3.1 Selection of Indicators

The scientific and technological innovation ability and the new urbanization appraisal index system follow the principle: first, the comprehensive principle. According to the existing research results, try to reflect the connotation of comprehensive scientific and technological innovation and new urbanization; The second is the principle of brevity, which requires the reflection of essential or important problems in the design of indicators. For those special, secondary, non-essential issues are not considered; Third, the availability of data. The availability of data is an important condition for measurement. Starting from the connotation of science and technology innovation ability and new urbanization development, this paper designs the evaluation level index of science and technology innovation development and new urbanization development, and selects 11 and 18 indexes for data collection, and then makes statistics and analysis on them. The indicators are shown in Tables 1 and 2:

3.2 Methods of Research

The measurement of scientific and scientific and technological innovation ability and new urbanization is a comprehensive measure. We first determine the weight of 15 indicators of scientific and scientific and technological innovation ability by using the coefficient of variation method, and then determine the annual comprehensive score through the efficiency coefficient method. The new urbanization is calculated by the same method. The calculation process of variation coefficient method and efficacy coefficient method is as follows:

1. Normalization of data

Since there are 15 indicators in the evaluation of scientific and scientific and technological innovation capability, the order of magnitude and units of each index are quite different. Therefore, we first normalize the data, that is, dimensionless quantitative method. There are two common methods for data normalization, one is maximum and minimum normalization, and the other is standard coefficient normalization. Since the normalization of standard coefficient requires the number of samples to be compared Therefore, this paper uses simple normalization. The calculation formula is as follows:

Table 1. Indicator system of STI capability

Level indicators	The secondary indicators	Level 3 indicators
Index of scientific and technological innovation ability (X)	Scientific and technological innovation input (X1)	R&D Investment status (billion) (X01)
		R&D Activity growth rate (%) (X02)
		R&D Full-time personnel equivalent (Ten thousand person years) (X03)
		R&D Intensity of investment (%) (X04)
	Output capacity of scientific and technological innovation (X2)	Number of applications for invention patents accepted (piece) (X05)
		Power of attorney for patent application for invention (piece) (X06)
		Number of scientific papers published(sheet) (X07)
		Number of technological activities (nape) (X08)
	Scientific and technological innovation environment (X3)	Number of college graduates(people) (X09)
		The share of Science Education in GDP (%) (X10)
		The share of Government Science and Technology Appropriations in Local Fiscal Expenditure (%) (X11)
		Number of libraries per 10,000 people (individual) (X12)
	Ability to transform scientific and technological innovation (X4)	Number of contracts in the technical market (nape) (X13)
		Technology market turnover (billion) (X14)
		Output value of high-tech industry (billion) (X15)

Dimensionless quantification:

$$z_{ij} = \frac{x_{ij} - \min(x_{ij})}{\max(x_{ij}) - \min(x_{ij})} \; i = 1, 2, ..., 13; \; j = 01, 02, ..., 15 \qquad \text{(formula1)}$$

Table 2. New urbanization indicator system

Level indicators	The secondary indicators	Level 3 indicators
New type urbanization comprehensive development level (Y)	Population urbanization (Y1)	Proportion of non-agricultural population (%) (Y01)
		Population density (person/km^2) (Y02)
		Second and third industry personnel accounted for the total population proportion (%) (Y03)
	Economic urbanization (Y2)	Per capita gross domestic product (Yuan/person) (Y04)
		Per capita retail sales of consumer goods (yuan) (Y05)
		Per capita disposable income of urban residents (yuan) (Y06)
		The second and third industries' output value as a proportion of GDP (%) (Y07)
		Per capita investment in fixed assets (Yuan/person) (Y08)
	Social urbanization (Y3)	Passenger vehicles (thousands) (Y09)
		Number of students in colleges and universities per 10,000 population (people) (Y10)
		Number of hospital beds per 10,000 persons (sheet) (Y11)
	Infrastructure urbanization (Y4)	Total urban water supply (10,000 cubic metres) (Y12)
		Urban water penetration rate (%) (Y13)
		Urban construction land area (km^2) (Y14)
	Resources and environment urbanization (Y5)	Green coverage (%) (Y15)

(*continued*)

Table 2. (*continued*)

Level indicators	The secondary indicators	Level 3 indicators
		Per capita park green area (m^2/person) (Y16)
		Per capita forest area (ha) (Y17)
		Water resources per capita (m^3/person) (Y18)

Among them, i represents the years from 2006 to 2018, 2006 is 1, and 2008 is 13; j represents the number of indicators, a total of 15 indicators; X_{ij} represents the number of indicators 15 for raw data; X_{ij} represents the dimensionless value.

2. Calculate the coefficient of variation of each index

Firstly, the standard deviation and mean value of each index are calculated, and then the coefficient of variation is calculated by using the formula of coefficient of variation. Finally, the weight of each index, the level of scientific and scientific and technological innovation and the level of new urbanization are calculated.

$$\text{mean value} : \overline{z_j} = \sum_{i=1}^{n} z_{ij} \ (i = 1, 2, ..., 13; \ j = 01, 02, ...15)$$

$$\text{standard deviation} : \sigma_j = \sqrt{\sum_{i=1}^{n} \frac{\left(z_{ij} - \overline{z_j}\right)^2}{n}} \ (i = 1, 2, ..., 13; \ j = 01, 02, ..., 15)$$

$$\text{Coefficient of variation} : v_j = \frac{\sigma_j}{z_j} \ (j = 01, 02, ..., 15) \qquad \text{(formula2)}$$

Among them, σ_j represents the standard deviation of each index, $\overline{z_j}$ represents the average value of each index, and v_j represents the coefficient of variation of the index.

3. Calculate the weight of each index

$$\text{The weight of each index} : w_j = \frac{v_j}{\sum_{j=1}^{n} v_j} \ (j = 01, 02, ..., 15) \qquad \text{(formula3)}$$

4. Comprehensive score of scientific and scientific and technological innovation development level

Development level of scientific and scientific and technological innovation:

$$c_i = \sum_{j=y}^{n} z_{ij} * \left(w_j\right)^T \ (i = 1, 2, ..., 13; \ j = 01, 02, ..., 15) \qquad \text{(formula4)}$$

Among them, c_i represents the annual comprehensive score of the development level of scientific and scientific and technological innovation, $(w_j)^T$ represents the transposition of the weight matrix. According to the same calculation method, the weight and comprehensive score of the development level of new urbanization are calculated.

3.3 Sources of Data

According to the index system established above, the original data of scientific and scientific and technological innovation indicators and new urbanization development indicators can be found in the statistical yearbook of Guangdong Province, science and Technology Yearbook of Guangdong Province, China Science and Technology Yearbook, wind database and Government Gazette from 2006 to 2019.

4 An Empirical Study on the Impact of Scientific and Technological Innovation on the Development of New Urbanization

4.1 The Measurement of Technology Innovation Ability

According to the index system of scientific and scientific and technological innovation ability constructed above, the weights of 15 indicators of scientific and scientific and technological innovation ability are obtained through coefficient of variation method from 2006 to 2018 in Guangdong statistical yearbook, Guangdong science and Technology Yearbook, China Science and Technology Yearbook, wind database and Government Gazette.

Table 3. Weight of STI capability indicators

Index	Code name	Weight
Scientific and technological innovation investment	X1	0.318992033
Investment in R&D (a hundred million of yuan)	X01	0.063883841
Growth rate of R&D activists (%)	X02	0.1524177
R&D hourly equivalent (10,000 person-years)	X03	0.0513548
Investment intensity of R&D (%)	X04	0.051335692
Technology innovation output ability	X2	0.284985464
Number of applications for patent for invention (piece)	X05	0.089058722
Patent Application Authorization letter for Invention (piece)	X06	0.076175194
Number of scientific papers published (article)	X07	0.046925845
Number of topics on technological activities (item)	X08	0.072825702
Scientific and technological innovation environment	X3	0.200313548
Number of graduates of higher education (persons)	X09	0.047001536
The share of science education in GDP (%)	X10	0.037332483
Share of government science and technology appropriations in local fiscal expenditure (%)	X11	0.071862958
Number of libraries per 10,000 people (units)	X12	0.044116572

(*continued*)

Table 3. (*continued*)

Index	Code name	Weight
Transformation ability of science and technology innovation	X4	0.195708955
Number of contracts in technology market (item)	X13	0.05514667
Turnover in Technology Market (one hundred million)	X14	0.078427355
Output value of high-tech industries (one hundred million)	X15	0.062134929

According to the weight of Table 3 and formula 2, 3 and 4, the level of scientific and scientific and technological innovation ability is measured. Table 4 shows the level of scientific and scientific and technological innovation of Guangdong Province from 2006 to 2018.

Table 4. Level of technology innovation in Guangdong Province 2006–2017

Year	2006	2007	2008	2009	2010	2011	2012
Level of scientific and technological innovation	6.9	12.2	13.8	19.5	26.3	28.9	35.5
Year	2013	2014	2015	2016	2017	2018	
Level of scientific and technological innovation	42.2	40.8	48.5	63.5	73.6	93.4	

4.2 The Measurement of Technology Innovation Ability

According to the index system of new urbanization level constructed above, the weight of new urbanization level is calculated by coefficient of variation method based on the data found in Guangdong statistical yearbook, Guangdong science and Technology Yearbook, China Science and Technology Yearbook, wind database and Government Gazette from 2006 to 2019, as shown in Table 5.

Table 5. Weights of indicators for new urbanization capacity

Index	Code name	Weight
Urbanization of population	Y1	0.163961149
Proportion of non-agricultural population (%) [proportion of urban population]	Y01	0.067815278
Population density (person/km^2)	Y02	0.050513224
Proportion of second and third industry personnel in total population (%)	Y03	0.045632647

(*continued*)

Table 5. (*continued*)

Index	Code name	Weight
Economic urbanization	Y2	0.307369052
GDP per capita (yuan/person)	Y04	0.078117884
Total retail sales of consumer goods per capita (yuan)	Y05	0.059112076
Per capita disposable income of urban residents (yuan)	Y06	0.065515644
Second, third industry output value as a proportion of GDP (%)	Y07	0.039726222
Per capita fixed asset investment (yuan/person)	Y08	0.064897226
Social urbanization	Y3	0.17763937
Passenger cars (ten thousand)	Y09	0.070780826
Number of students in colleges and universities per 10,000 population (number of students)	Y10	0.048480027
Number of hospital beds per 10,000 persons (sheet)	Y11	0.058378517
Infrastructure urbanization	Y4	0.147219444
Total urban water supply (10,000/m^3)	Y12	0.052441346
Urban water penetration rate (%)	Y13	0.02970857
Urban construction land area (square kilometers)	Y14	0.065069529
Urbanization of resources and environment	Y5	0.203810984
Completion green coverage rate (%)	Y15	0.036360052
Park green area per capita (square meters/person)	Y16	0.050569134
Forest area per capita (ha)	Y17	0.056369138
Per capita water resources (m^3/person)	Y18	0.060512659

According to the weight and formula 2, 3 and 4 obtained in Table 5, the capacity level of new-type urbanization was measured and the comprehensive development level of new-type urbanization in Guangdong province from 2006 to 2018 was obtained in Table 6.

Table 6. Comprehensive development level of new urbanization in Guangdong province from 2006 to 2017.

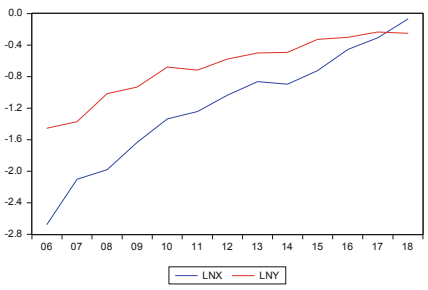
Year	2006	2007	2008	2009	2010	2011	2012
New urbanization level (%)	23.4	25.4	36.2	39.4	50.8	48.9	56.2
Year	2013	2014	2015	2016	2017	2018	
New urbanization level (%)	60.7	61.2	72.2	74.1	79.2	77.9	

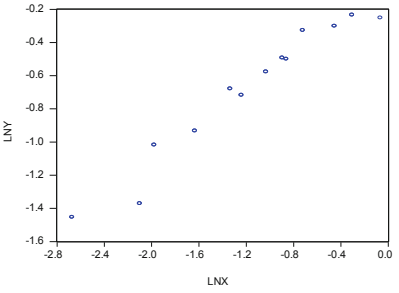
4.3 Empirical Analysis of the Impact of Scientific and Technological Innovation on the Development of New Urbanization

Scientific and technological innovation influences the urbanization of population, economy, society, resources, environment and infrastructure, and then affects the whole process of new urbanization. The rate of scientific and technological innovation and the rate of new urbanization are both time series data. Through the unit root test, it is found that the rate of scientific and scientific and technological innovation and the rate of new urbanization are both unstable time series, and the logarithm of the two variables tends to be stable and the scatter plot of lnx and lny can be seen that the correlation between the two is very strong (Table 7).

Table 7. Stationary test for each variable

Variable	ADF Inspection value	Critical value (5%)	Prob*	Conclusion	Smoothness
X	2.89667	−6.605269	1.0000	Unit root exists	Unsmooth
lnX	−6.265369	−1.974028	0.0000	No unit root	Steady
Y	2.446107	−1.974028	0.9923	Unit root exists	Unsmooth
lnY	−8.424613	−1.977738	0.0000	No unit root	Steady





After unit root test, in order to avoid pseudo regression, we use LNY and LNX as our dependent variables and independent variables. First of all, In this paper, there are assumptions about scientific and scientific and technological innovation and new urbanization.

$$\ln(UR_t) = \alpha_1 + \alpha_2 \ln(KT_t) + \varepsilon$$

Among them, UR_t stands for the level of urbanization and KT_t stands for the level of scientific and technological innovation.

Secondly, OLS regression analysis was used. According to the above hypothesis, regression analysis is carried out on the level of scientific and scientific and technological innovation (Table 4) and new urbanization level (Table 6) through Eviews 10.0 (Table 8).

Table 8. OLS Regression Results of New Urbanization in technology innovation

Variable	Coefficient	Std. Error	t-Statistic	Prob
C	−0.063253	0.049318	−1.282575	0.2260
LNX	0.523536	0.035616	14.69926	0.0000
R-squared	0.951557	Durbin-Watson stat		2.056871

The regression results showed that: $R^2 = 0.951557$, the equation fitted well, and the significance $P = 0.0000$. It passed the 0.05 significance test. The results showed that the innovation of science and technology has a positive effect on the new urbanization in Guangdong. According to the parameters of the double-to-analog model, the elastic coefficient of the urbanization rate of the two new cities on the innovation rate of science and technology is reflected. When the change of the innovation coefficient of science and technology is 1%, the change of the new urbanization rate is 0.524%.

Finally, the paper used R language and canonical correlation coefficient analysis method to analyze the scientific and scientific and technological innovation, and to test the correlation between the mechanism of new urbanization. From 2006 to 2018, both scientific and technological innovation and new urbanization in Guangdong Province developed rapidly, and scientific and technological innovation played a role in promoting the development of new urbanization in Guangdong Province. Based on this basis, this paper examines the relevance of scientific and technological innovation to the indicators of new urbanization, as shown in Table 9:

Table 9. The correlation between scientific and technological innovation and the development of new urbanization

Index	Code name	Pearson correlation
Proportion of non-agricultural population (%) [proportion of urban population]	Y01	0.921
Population density (person/km^2)	Y02	0.914
Proportion of second and third industry personnel in total population (%)	Y03	0.54
Per capita GDP (yuan/person)	Y04	0.987
Total retail sales of consumer goods per capita (yuan)	Y05	0.885
Per capita disposable income of urban residents (yuan)	Y06	0.978
Ratio of output value of the second and third industries to GDP (%)	Y07	−0.555
Per capita fixed asset investment (yuan/person)	Y08	0.94

(*continued*)

Table 9. (*continued*)

Index	Code name	Pearson correlation
Passenger cars (ten thousand)	Y09	0.444
Number of college students per 10,000 population (person)	Y10	0.869
Number of hospital beds per 10,000 persons (sheet)	Y11	−0.094
Total urban water supply (10,000/m^3)	Y12	0.776
Urban water penetration rate (%)	Y13	0.356
Urban construction land area (square kilometers)	Y14	0.812
Completion green coverage rate (%)	Y15	0.857
Park green area per capita (square meters/person)	Y16	0.899
Forest area per capita (ha)	Y17	−0.726
Per capita water resources (m^3/person)	Y18	−0.263

Note: according to experience, the correlation coefficient is divided into: $0.8 \leq P < 1$ was highly correlated; $0.5 \leq P < 0.8$, was moderately correlated; $0.3 \leq P < 0.5$, was low correlated; $0.3 \leq P < 0.5$ was weakly correlated; $P < 0$ was negatively correlated.

According to Table 3 and Table 4, the scientific and technological innovation level of Guangdong Province has been significantly improved in the observation period. However, the weight of "input in science and technology innovation" is much greater than that of "output of science and technology". This shows that the level of scientific and technological innovation in this region mainly depends on "science and technology investment". Although it is obvious advantages in economic development, and easier to attract innovative talents and capital agglomeration, but it needs to be improved about the transformation ability of scientific and technological innovation and technological innovation environment.

As can be seen from Table 5 and Table 6, the urbanization level of Guangdong province has been significantly improved in the observation period, reaching a peak of 79.2% in 2017, while in 2018, the urbanization level has declined. This may be related to the return of population. According to the data in recent years, the urbanization rate of Guangdong Province is mainly manifested in economic urbanization, while population urbanization and infrastructure urbanization are relatively weak.

As shown in Table 9, The relationship between the level of technological innovation and specific indicators of urbanization. Non-agricultural population proportion, population density, per capita GDP, per capita disposable income of urban residents, per capita investment in fixed assets, the correlation coefficients of the five indicators are all greater than 0.9, all of them have strong correlations. The correlation coefficient of the total retail sales of social consumer goods per capita (yuan), the number of students in Colleges and universities per 10000 population, the area of urban construction land, the coverage rate of built-up green space and the per capita green area of parks are also above 0.8, which has a strong correlation.

The correlation coefficient of the proportion of secondary and tertiary industry personnel in the total population is between 0.5 and 0.8, which belongs to moderate correlation. However, the output value of the secondary and tertiary industries accounted for the proportion of GDP, the number of hospital beds per 10,000 people, the per capita forest area, and the per capita water resources, the four indicators have negative correlation coefficients.

5 Conclusions and Recommendations

5.1 The Main Conclusion

This paper estimates the level of scientific and technological innovation and urbanization rate in Guangdong Province from 2006 to 2018, and simulates the role of scientific and technological innovation level in promoting urbanization. The results show that: first, during the observation period, the level of scientific and technological innovation and the level of new urbanization in Guangdong Province showed an upward trend. At present, the level of scientific and technological innovation is mainly based on scientific and technological input, while the ability of scientific and technological output and transformation is relatively weak. The new urbanization level of Guangdong Province is mainly manifested in population urbanization and economic urbanization, infrastructure urbanization, resource and environment urbanization development is not enough. But in 2018, the urbanization rate declined for the first time, which may be related to the return of population.

Second, the level of scientific and technological innovation has a positive role in promoting the change of new urbanization in Guangdong Province. Every 1% change of science and technology innovation coefficient will bring about 0.524% change of new urbanization rate. Scientific and technological innovation can promote the new urbanization in Guangdong Province, but its role is not particularly obvious. The possible reason is that science and technology innovation in Guangdong Province mainly relies on a large amount of investment, and forms a "crowding out" effect on the development of urbanization. It should be noted that the correlation coefficient between scientific and technological innovation and the proportion of the output value of the secondary and tertiary industries in GDP, the number of hospital beds per 10000 people, the per capita forest area and the per capita water resources are negative. On the one hand, it reflects that the driving force of the development of the secondary and tertiary industries in Guangdong Province mainly comes from the input of labor, land and capital elements and the high cost of environmental resources. On the other hand, it shows that the urban public infrastructure in Guangdong Province is relatively weak.

5.2 Suggestions and Countermeasures

First, Guangdong provincial government should maintain investment in scientific and scientific and technological innovation and build a better environment for scientific and scientific and technological innovation. Although the development of economic urbanization and social urbanization in Guangdong Province is good, there is a situation

of unbalanced development structure, and the development of infrastructure urbanization and population towns is still relatively backward, and there is a big gap with other urbanization processes.

At present, there are still some problems in Guangdong Province, such as the lack of basic research and original innovation ability, the lack of close integration of science and technology resources with local economy, the weak technical support of leading industries, the shortage of high-level innovation and entrepreneurship talents, and the relatively insufficient intensity of science and technology investment.

In the new normalization of the economy, although the growth rate of Guangdong's GDP is relatively stable in recent years, and the investment in scientific and technological innovation is also in a relatively high growth rate. However, in order to see the current problems, Guangdong should aim at the general trend and direction of future scientific and technological innovation, prepare early and plan early, dare to "empty the cage and replace the bird" for the backward production capacity, and boldly innovate the traditional industries. It is necessary to continue to increase technological investment, improve the joint mechanism between schools and enterprises, seize the strategic opportunity of the new normal economy, increase the transformation of technological achievements, build a better scientific and technological innovation environment, enhance the technological content of manufacturing industry, and promote industry upgrade, and improve the environment of scientific and technological innovation in Guangdong Province.

Second, China is stepping into an aging society, and the population will reach its peak soon. Over the past three decades, due to the continuous growth of population and the continuous improvement of urbanization level, Guangdong Province has promoted urban development from focusing on quantity expansion to focusing on quality improvement. Cities in Guangdong Province have experienced unprecedented high-speed expansion. At the same time, these cities are facing prominent urban diseases and great pressure of resources and environment, which restrict the sustainable and healthy development of cities. Urban environmental pollution, water shortage, traffic congestion, urban garbage and other issues need to play the core role of scientific and technological innovation. How to improve the development quality and service function of the city through scientific and technological innovation, and further realize the coordinated development of urban and rural areas, and build a beautiful Guangdong Province, is a major and urgent practical problem during the "14th five year plan".

At the same time, China's social development has entered the "new normal", which puts forward new requirements for urban functions and management system. On the one hand, China's urban aging population is growing, which puts forward new requirements for urban functions and facilities. On the other hand, the population flow between urban and rural areas and between cities is becoming more and more complex. It is urgent to realize the reconstruction of urban functions and the improvement of service management level through scientific and technological innovation, accelerate the citizenization of migrant population, promote local urbanization nearby, and optimize the spatial layout and structure of urban and rural areas. Therefore, to lead and adapt to the "new normal" of social development through scientific and technological innovation is a new major task for the scientific and technological circles.

Therefore, it is a new major task for the scientific and technological circles to lead and adapt to the "new normal" of social development through scientific and technological innovation. Urban construction and operation need to pay more attention to people-oriented, and the concept of scientific research also needs to be changed. Therefore, Guangdong Province should rely on scientific and technological progress to optimize the development of urban construction, strengthen the scientificity of urban planning, improve the construction of municipal public facilities, and constantly improve the application of science and technology in urbanization construction.

Third, we need to strengthen our capacity for scientific and technological innovation in combination with the development of new urbanization.

The government should follow the laws of urban development and enhance the forward-looking and scientific nature of urban and regional planning; Strengthen key technology integration research and improve urban infrastructure support capacity and spatial efficiency; Strengthen the research of new technology application, improve the construction quality and construction level. The government should strengthen the construction of big data platforms, improve urban smart management and social governance capacity, strengthen the construction of technology transformation platforms, and upgrade the industrialization of technological achievements. The government should increase the capacity of science and technology to support urbanization, resolve difficulties in urbanization development, and release new drivers of economic development. Therefore, the local government needs to strengthen the investment of scientific and technological innovation ability and the research of urban science and technology. For example, strengthen the construction of a strong data platform to improve the ability of urban intelligent management and social governance. Research and develop the provincial urban and rural planning management information platform, focus on social organizations, floating population and poor people, employment and entrepreneurship, social security and other fields, establish urban operation, social governance and public service platform, standards, systems and equipment, promote the promotion and application and demonstration in the whole country, improve the social governance ability and fine level of public service, and realize social governance and public service refinement The intellectualization and modernization of public services provide strong scientific and technological support.

We will build a team of scientific and technological innovation talents, innovative enterprises and scientific research platforms. Through various forms such as independent training and active introduction, we will cultivate and form leading talents in science and technology, high skilled talents, entrepreneurs, specialists in science and technology benefiting the people and innovation service personnel. We will also train a number of key enterprises in scientific and technological innovation in the field of urbanization and backbone enterprises in the application and demonstration of the whole industrial chain, and promote the construction of science and technology innovation base, innovation team and industrial technology innovation strategic alliance in Guangdong Province.

Fourth, we can accelerate the transformation of the economy driven by scientific and technological innovation.

We will accelerate the transformation of the economy driven by scientific and technological innovation, establish a mechanism for regular assessment and structural analysis of technological progress and promote the coordinated development of population urbanization and ecological urbanization. We will strengthen our capacity for scientific and technological innovation and promote the concentration of resources, technologies and talents in technological enterprises through technological progress. Finally, the goal of driving new urbanization development in Guangdong province with scientific and technological innovation is achieved. At the same time, the local government fully mobilize the enthusiasm, initiative and creativity of universities, scientific research institutes, enterprises and other aspects through the combination of regulation and optimization of service. We should build an open and efficient innovation resource sharing network, promote the organic combination of scientific and technological innovation with mass entrepreneurship and innovation, expand the space for public participation, enrich the public participation carrier, and promote the development of urban science and technology through collaborative innovation.

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