Research on the Influence of People's Living Standard and Environmental Protection Ability on Urban Innovation

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Abstract

With the acceleration of urbanization and the increasingly prominent emergence of global environmental problems, sustainable development is widely advocated around the world, and people's living quality and environmental protection ability have become important factors for urban development. In order to explore the impact of people's living standards and environmental protection ability on urban innovation, this paper establishes a regression model, analyzes the experimental results and related literature, combined with empirical research methods, and deeply explores how these two factors act on urban innovation activities. It is concluded that the improvement of people's living standards and environmental protection ability has a positive impact on urban innovation. By improving people's living standards and strengthening their environmental protection capacity, it can promote the in-depth development of urban innovation activities and provide strong support for the sustainable development of cities.

Keywords

Sustainable development; Urban innovation; Positive impact.

1. Introduction

Improving national innovation capacity and national quality of life are two important policies of China in the 21st century. In recent decades, with the continuous economic growth and social development, people's living standards have been steadily rising, which means that more resources will flow to education development and innovation and research and development compared with the past. As people's sense of achievement, happiness and security grows, they also have higher demands and expectations for quality of life, which contributes to the creation of a high-level and high-quality living environment, and also creates the basis for the exchange and collision of innovative ideas.

As one of the development concepts widely recognized around the world, sustainable development means that in modernization, population control, resource conservation and environmental protection should be put in an important position, so as to make the population growth compatible with the development of social productivity, and in the process of development to lead to the solution of the population, resources, environment and social problems, so as to achieve the sustainable development of the economy, resources, and the ecology and society. The impact of the long-term implementation also confirms that sustainable development is an inevitable choice for the development of China and even human society. Environmental protection, which occupies an important position in sustainable development, has attracted a great deal of attention. With the strengthening of China's environmental management and maintenance, the question of whether this action can reverse the promotion of urban innovation has become a topic of concern for scholars. As the idea of environmental protection becomes more and more popular and widely publicized, it also inspires cities and

enterprises to carry out green innovation. At present, there are three main methods to measure green innovation, one is to measure from the process and product level, the second is to use DEA and other methods to measure the efficiency of green innovation, and the third is to use the number of green patents, the first two methods are more difficult to be extended to the city level, therefore, the number of output of green patents is generally used to measure the green innovation of the city.

In recent years, scholars have been conducting increasingly in-depth research in the field of the impact of quality of life and environmental protection capability on innovation capability. Zheng Zongsheng, Wu Shuyao, He Chuanqi [1]in the "quality of life and national innovation capacity correlation analysis" research results show that the quality of life and the national innovation capacity is significantly positively correlated, with the improvement of the quality of life, people pursue a higher level of needs, the pursuit of spirituality, the pursuit of self-fulfillment is conducive to scientific and technological advances, and innovation becomes the driving force to improve the quality of life. Rao Huixia [2] in the "R & D staff quality of life on the impact of corporate innovation performance" research results show that the quality of life of R & D staff has a certain impact on their innovation performance and a positive relationship, so managers in the enhancement of R & D management process efficiency at the same time, you can consider from the perspective of human resource management, targeted to improve the quality of life of R & D staff to achieve the goal of incentivizing their innovative behavior and improve innovation performance, and then to improve innovation performance, and thus the driving force to improve the quality of life. Therefore, managers can consider improving the quality of life of R&D personnel from the perspective of human resource management, so as to motivate their innovative work behaviors and enhance their innovative performance, and then achieve the ultimate goal of improving organizational performance. Luo Yonggen, Yang Jinyu, and Chen Shijiang[3] conducted a study on the impact of air pollution on inventors' innovation output and its mechanism of action in 2019, proposing that air pollution significantly inhibits the innovation output of patent inventors and significantly increases the possibility of inventor mobility. It is not difficult to realize that as long as the influencing factors are regulated in a benign direction, urban innovation can be promoted for the benefit of national development and construction. It is also not difficult to see through the research of the above scholars that the improvement of the quality of life and the improvement of environmental protection ability both have a positive impact on the innovation ability.

2. Theoretical Analysis and Research Hypothesis

The improvement of people's living standards means that more resources and capital can be used for education and research and development, which directly contributes to the improvement of innovation capacity. Rising living standards also bring about a demand for a high quality of life, a demand that drives innovation in new technologies, products and services, thus contributing to the development and upgrading of the urban economy. Higher living standards also mean an increased demand for people's participation in social and political life, which contributes to a more open and inclusive social environment, one that is conducive to the exchange and collision of innovative ideas, thus promoting urban innovation.

The improvement of environmental protection capacity, especially green technology innovation, has an important impact on urban innovation. For example, some studies have shown that urban green technological innovation presents obvious regional heterogeneity in terms of temporal development and spatial distribution, with the eastern region dominating in terms of green technological innovation. In addition, there is a positive spillover effect of urban green technology innovation under the perspective of formal environmental regulation, indicating that environmental regulation has a positive role in promoting innovation.

This study will measure urban innovation capacity from the dimensions of innovation conditions and innovation output, and put forward two hypotheses.

Hypothesis 1: Improvement of people's living standards will promote urban innovation capacity.

Hypothesis 2: Improvement of environmental protection capacity will help to enhance urban innovation capacity.

3. Research Methodology and Data Sources

3.1. Model Establishment

In order to comprehensively analyze the impact of people's living standards and environmental protection ability on urban innovation ability, and at the same time to reduce the impact of data heteroscedasticity, this study takes the logarithm of the variable data respectively and constructs the following regression model:

$$\text{Ln}innova_{it} = \alpha_0 + \alpha_1 Gdp_{it} + \alpha_2 Epd_{it} + \beta X_{it} + \gamma_i + \delta_t + \varepsilon_{it} \tag{1}$$

Where $Lninnova_{it}$ is used as an explanatory variable, representing the innovation capacity of place i in year t; Gdp_{it}, Epd_{it} are used as the core explanatory variables, representing the people's living standard and environmental protection capacity of place i in year t, respectively; X_{it} represents other control variables that may affect the urban innovation capacity; γ_i represents the city fixed effect; δ_t represents the time fixed effect; and ε_{it} represents the error perturbation term.

3.2. 3.2. Variable Selection

(1) Explained variable: urban innovation capacity (innova). Referring to the empirical practice of Gao Yafei and Wei Haiming[4], this study summarizes urban innovation capacity into two dimensions: innovation conditions and innovation output. Combined with the "China Regional Innovation Capability Evaluation Report 2023", and with full consideration of data availability and representativeness, we constructed the following evaluation index system of urban innovation capability (as shown in the table 1), and on the basis of which, we used entropy weighting and objective weighting (CRITIC) method to measure and conclude that there is a positive correlation between high and low scores and high and low urban innovation capability.

Table 1. Urban innovation capacity evaluation indicator system

Evaluation dimensions	Evaluation indicators	Indicator units
Innovation conditions	Number of students in general higher education institutions	10,000 people
	Number of public libraries	seat
	Ratio of science and technology expenditure (science and technology expenditure/financial expenditure)	%
	Percentageof educationexpenditure(educationexpenditure/financial expenditure)	%
	Employees in the information transmission, software and information technology service industry	%
	Gross city product	Billion yuan
	Number of books in public libraries	10,000 books
	Number of Internet users	10,000 households

	Urban Registered Unemployment Rate	%
Innovation Output	Patent Authorization per 10,000 Persons (Patent Authorization/Total Population at the End of the Year)	piece
	Patent Authorization Rate (Patent Authorizations/Patent Applications)	%

① Entropy weight method. The specific calculation process is as follows:

Positive indicator standardization:

$$Y_{ij} = \frac{X_{ij} - \min(X_i)}{\max(X_i) - \min(X_i)} \tag{2}$$

Negative indicator standardization:

$$Y_{ij} = \frac{\max(X_i) - X_{ij}}{\max(X_i) - \min(X_i)} \tag{3}$$

Calculate weight:

$$C_i = \sum\nolimits_{j=1}^{m} w_1 \cdot Y_{ij}^{'} \tag{4}$$

Where, X_{ij} is the data of the jth indicator under the ith region, and Y_{ij} is the value of each indicator after standardization (i = 1, … ,29; j = 1,…,11). Considering the possibility of 0 values after standardization, the standardized data are shifted $Y'_{ij} = Y_{ij} + 0.001$. w_j is the weight occupied by the jth indicator, m is the number of indicators for evaluation of urban innovation capacity, and C_i is the score of innovation capacity of the ith region.

② CRITIC method. The specific calculation process is as follows:

$$w_j = F_j \cdot \sum\nolimits_{i=1}^{n} (1 - r_{ij}) / \sum\nolimits_{j=1}^{n} (F_j \cdot \sum\nolimits_{i=1}^{n} (1 - r_{ij})) \tag{5}$$

$$C_i = \sum\nolimits_{j=1}^{m} w_j \cdot Y_{ij}^{'} \tag{6}$$

Where, F_j is the standard deviation of the jth indicator, r_{ij} is the correlation coefficient between i and j indicators, w_j is the weight accounted for by the jth indicator, Y'_{ij} is the standardized value of the indicator, n denotes the number of indicators of the evaluation of the city's innovation capacity, and C_j is the score of the jth city's innovation capacity.

(2) Explanatory variables: people's living standard (gdp) and environmental protection ability (epd). There is a close link between people's living standard and urban innovativeness. Improving people's living standard can promote the enhancement of urban innovativeness, and the enhancement of urban innovativeness can further improve people's living standard; innovative cities promote technological innovation, industrial structure optimization, and economic development mode change, which is conducive to lowering the level of carbon emissions and further improving carbon emission performance, and by enhancing urban innovativeness, pollution emissions can be effectively reduced, thus improving urban air quality. This shows that environmental protection and the enhancement of urban innovation capacity are complementary and there is a close interaction between them.

(3) Control variables. In order to reduce the interference of irrelevant factors on the empirical test, three control variables are added to the model to ensure that the research results are more scientific and accurate. ① Education level (edu). The average years of education in each place is used to measure. ②The degree of urbanization (urban), using the indicator of urbanization rate to measure. ③ Industrial structure (indus), referring to the research of Shangguan Xuming and Ge Binhua[5] and adjusting the industrial structure, the proportion of the output value of the secondary industry in GDP is used to measure.

3.3. Data sources

China's provincial and municipal level data from 2010 to 2022 are selected as the research sample, and the data are mainly obtained from the China Urban Statistical Yearbook of past years, the website of the National Bureau of Statistics and the China Geographic Resources Journal Library. Considering the availability of data, this study adopts the mean value method to supplement the missing data for some years.

3.4. Descriptive analysis

Before regression analysis, this study smoothed the data of some indicators on the basis of keeping the relative relationship of each indicator unchanged, and the descriptive statistics of the main variables are shown in the table 2.

Table 2. Descriptive statistics of main variables

Variable	Sample size	Mean value	SD	Min	Max
innova	1740	4.232	0.273	2.187	5.287
gdp	1740	3.820	0.369	2.212	4.328
epd	1740	0.264	0.927	0.001	3.293
edu	1740	1.491	0.374	0.572	2.482
urban	1740	4.163	0.283	3.481	4.827
indus	1740	0.126	0.162	0.082	0.549

4. Empirical Results and Analysis

4.1. Smoothness test

In order to ensure the smoothness of the time series and the accuracy of the regression results, this study utilizes the software STATA16 to conduct the panel data unit root test LLC for each indicator variable, and the test results are shown in the table 3. From the table 3, it can be seen that each variable in the LLC test rejects the original hypothesis at the 1% significant level, that is, the variables do not have a unit root, and have a time series of smoothness.

Table 3. The results of LLC test for unit root in panel data

Variable	t-statistic	P-value
innova	-6.1214	0.0000
gdp	-12.7276	0.0000
epd	-4.2832	0.0001
edu	-3.4876	0.0004
urban	-3.2932	0.0000
indus	-4.2833	0.0000

4.2. Benchmark regression

Substituting the indicator data into the regression model, the regression results are shown in column (1) of the table 4. The regression results show that the correlation coefficient between people's living standard and urban innovation capacity is 0535 and significant at 1% level, indicating that people's living standard has a facilitating effect on enhancing urban innovation capacity, which is in line with Hypothesis 1;it shows that the correlation coefficient between environmental protection capacity and urban innovation capacity is 0.026 and significant at 1% level, indicating that improving environmental protection capacity has a facilitating effect on enhancing urban innovation capacity, which is in line with Hypothesis 2.

Column (2) of the table 4 shows the influence of different control variables on urban innovation ability, and it can be found that the correlation coefficient of education level is 1.885, the correlation coefficient of urbanization degree is -0.205, and the test result is insignificant, and the correlation coefficient of industrial structure is 0.106.

The above conclusions show that the promotion effect of urbanization degree is insignificant, and it may play a negative role in the innovation ability of the city, and the improvement of environmental protection ability may have a negative effect on the innovation ability of the city. The above findings indicate that the promotion effect of urbanization degree is not significant and may have a negative effect on urban innovation capacity, and that improving education level and adjusting industrial structure both help to enhance the driving effect of urban innovation capacity. Column (3) of Table 4 draws the same conclusion as column (2) when random effects are taken into account.

Table 4. Benchmark regression results

Variable	(1)	(2)	(3)
	Innova	Innova	Innova
gdp	0.535***	0.459***	0.462***
	(21.38)	(18.28)	(18.22)
epd	0.026***	0.028***	0.052***
	(8.279)	(8.561)	(7.287)
edu	—	1.885*	2.258**
		(1.92)	(2.22)
urban	—	-0.205	-0.102
		(-1.19)	(-1.32)
indus	—	0.106***	0.094***
		(0.024)	(0.022)
Constant	22.381***	24.262***	24.265***
	(18.23)	(17.83)	(17.02)
Goodness of fit	0.286	0.562	0.658
Fixed effects	YES	YES	NO

Notes: *** p<0.01, ** p<0.05, * p<0.1

5. Conclusions and Inspiration

5.1. Conclusions

From the results of the above regression model analysis, the correlation coefficients of people's living standard and environmental protection ability and urban innovation ability are 0535 and 0.026 respectively, and both are significant at 1% level, indicating that they have a large positive correlation effect with urban innovation ability. It can be seen that people's living standards improve, environmental protection ability increases, and urban innovation ability will be improved. At the same time, education level and industrialization also show a certain positive correlation, so the improvement of education level and optimization of industrial structure also have a certain role in boosting the development of urban innovation.

The improvement of people's living standard means that life is getting more and more comfortable, people are getting healthier and the society is getting safer, which is a very positive trend reflecting the development and progress of the whole society. In addition to this meaning, the improvement of people's living standard also produces a deep and comprehensive, indispensable but easily neglected role in urban innovation and development. People are the productive forces and the owners of the means of production. The improvement of living standard opens up people's thinking, inspires innovation and relaxes their emotions at the same time, increasing the demand and connecting the innovation chain and industrial chain, which verifies that the living standard of the people is an important factor influencing the level of urban innovation.

The improvement of environmental protection ability brings the integrity and stability of the ecosystem, and also promotes the improvement of urban competitiveness. While environmental protection ability and urban innovation seem to be poorly correlated, they are inextricably linked. The ecological environment is an important foundation for urban development, the pursuit of the city's environmental appearance has given rise to environmental protection innovation, and the excellent ecological environment is the cradle of innovation, which verifies that the improvement of environmental protection ability is an important factor affecting the level of urban innovation.

5.2. Constructive inspiration

This study is highly inspiring for the development of urban innovation.

(1) On the basis of economic development, further increase the income of urban and rural residents, optimize the consumption structure, improve the living environment, satisfy people's diversified material and cultural needs, and further improve people's living standard. This is manifested in the following ways: constantly increasing the incomes of urban and rural residents, broadening the field of consumption, optimizing the consumption structure, and satisfying people's diversified material and cultural needs; establishing and improving the health service system, medical care system and epidemic prevention system, improving the medical and sanitary situation in rural areas, and putting the people's health and safety of life in the first place; and the construction of new rural areas, changing the outlook of rural areas, and improving the happiness index of peasants.

(2) On the basis of social development, starting from cognition, system, and regulation of interests, deep thinking and improvement of environmental protection ability and ecological construction level. Specific performance: do a good job of garbage classification, clear method of garbage classification, regular environmental protection education in the family, school, optimize the installation of related facilities; reduce environmental pollution, less or no fireworks, less use of fertilizers and pesticides, to avoid noise nuisance; saving resources, attention to the details of life, water and electricity saving, advocate environmentally friendly packaging, and put an end to waste.

(3) On the basis of social economy, make full use of the elements of social development of various industries, seize the emerging buds, and strive to create innovative development "blossom everywhere", a thriving situation. Specifically manifested as: to build the city brand and reputation, such as the urban environment, urban characteristics of culture, historical and cultural heritage, to build the city's cultural value and attractiveness; to provide a variety of services and innovation platforms, such as innovation and entrepreneurship parks, science and technology centers and so on.

5.3. Policy Implications

This study has certain policy implications, which lie in the fact that improving people's living standards and enhancing environmental protection capability are important factors affecting the enhancement of urban innovation capability. In order to promote the enhancement of innovation level in each region and increase the number of patents in each city, the relevant departments should include the efforts to improve people's living standards and enhance the overall environmental protection capability of the city into the framework of policy formulation, and adopt a three-pronged approach to the three measures and the three laws. Together, we will move towards the road of urban innovation.

The government has a strong guiding ability in science and technology innovation, which is mainly reflected in the level of scientific and technological education resources, land, capital and other factors. The government allocates factor resources by policy means to promote the

enhancement of innovation capability. Therefore, the establishment of an accurate and scientific innovation policy system is particularly important.

(1) Improve the incentive system for local innovation projects in the growth period. To help start-up projects grow steadily, the government should not only look down, but also improve the support mechanism for projects at this stage, flexibly utilize land and financial policies, and increase the support of innovation factor resources.

(2) Improve the access mechanism and evaluation mechanism for foreign-introduced innovation projects. The government needs to make comprehensive consideration of the industry chain, technology chain and value chain of the industry in which it is located on the basis of traditional innovation evaluation indexes, and conduct due diligence to prevent fake innovation and real fraudulent subsidies.

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