Research on the Supply of Basic Public Services Under the Construction of Smart Cities

Zejing Xu(✉)

Harbin University of Commerce, Harbin, Heilongjiang, China
1055535198@qq.com

Abstract. In recent years, smart city construction has been developing rapidly worldwide, and traditional smart city research has focused on modern information technology and hardware devices to build a smart city system based on the Internet of Things and big data. Smart cities have become a comprehensive and sustainable development model, which has greatly improved the efficiency and accuracy of management work and services of government departments, and also posed new challenges to the management work thinking and social governance models of government departments. The purpose of this paper is to explore in depth the impact of smart city construction on the technical level of basic public service supply, and to prove its feasibility through empirical tests, so as to provide reference for the future development of smart services, so as to better adjust the smart city construction strategy and improve the public service supply system.

Keywords: smart city · public services · double difference model

1 Introduction

Smart City is a new management model that integrates the Internet and urban processes, aiming to bring more intelligent management services to government departments, enterprises and individuals, in order to promote the sustainable construction of cities, improve the quality of life of citizens, and promote the harmonious development of cities. Since its introduction, the concept of "smart city" has been warmly welcomed by the world, and China has been actively promoting technological innovation in application models to accelerate the process of intelligent construction [1]. Along with the construction of smart cities, the concept of "smart management" has also come into being, bringing new development ideas and directions to the urban process. Along with the construction of smart cities, the application of information technology has not only changed the production and life style of the city, but also improved the security of services and brought new opportunities to government departments. In order to meet the needs of citizens and improve the efficiency of urban operation, government departments must constantly innovate governance tools in order to provide public services in a more timely and accurate manner, and this innovation is imminent.

N. Akhtar et al. (Eds.): PMIS 2023, AHIS 8, pp. 602–612, 2023.
https://doi.org/10.2991/978-94-6463-200-2_62

2 Analysis of the Current Situation of Smart City Construction

Since 2010, policy documents on the top-level design and concrete implementation initiatives of smart cities have started to appear and show a trend of gradual increase in number. The relevant policy documents mainly focused on the long-term planning, construction standards and guidance for wisdom cities in the early stage. In 2020, the 14th Five-Year Plan proposed to accelerate the construction of wisdom cities and digital villages, and promote the construction of new wisdom cities in a graded and classified manner [2]. It can be seen that in the opening of a new stage of building a comprehensive socialist modern state, the construction of smart cities is still receiving high attention.

At present, China's smart city construction is mainly focused on intelligent urban transportation [3], intelligent government comprehensive management and operation platform, intelligent public services, intelligent education and cultural services, as well as intelligent security services, etc., of which the three most rapidly developing key areas are intelligent urban transportation, intelligent security services, intelligent medical and government services. According to IDC forecasts, China's smart city market will reach $2.5 billion in 2022, and by 2023, its technology-related investment scale will reach $38.92 billion [4], with smart grid, fixed intelligent video surveillance and intelligent public transport systems ranking among the top three key application scenarios for investment. Smart city construction can use modern technology to promote efficient and intelligent urban operation, creating a better urban life for the people, and the changes it brings to the city are immeasurable.

3 Empirical Analysis of Whether Smart City Construction Can Enhance the Supply of Basic Public Services

3.1 Model Setting

In this paper, we consider the first batch of smart city pilots announced in 2012 as a quasi-natural experiment [5], defining pilot cities as the experimental group and non-pilot cities as the control group. For this purpose, we use a Difference-in-differences (DID) model with the following model settings:

$$bps_{it} = \partial_0 + \partial_1 did_{it} + \partial_2 control_{it} + \mu_i + \eta_t + \varepsilon_{it} \quad (1)$$

$$did_{it} = post_i \times treat_{it} \quad (2)$$

where *bps* is the explanatory variable and refers to the comprehensive evaluation index of basic public service provision, *i* indicates the city and, *t* indicates the year. did_{it} is the core explanatory variable, $control_{it}$ is a dummy variable indicating whether each city is a smart city pilot, μ_i is other control variables, η_t is a city fixed effect, ε_{it} is a time fixed effect and ∂_1 is a random error term. The core coefficient of most interest in this paper is ∂_1, which measures the net impact of a smart city pilot on the level of provision of basic public services. The ∂_1 coefficient is significantly positive if the smart city pilot contributes to an increase in the level of provision of basic public services in the city [6].

3.2 Variable Description

a) **Explanatory variables**

In empirical studies, there are significant differences in the selection of indicators concerning the supply of basic public services. In this paper, combining the connotation of basic public services and drawing on the research results of some scholars, as well as considering the systematic nature of the evaluation system and the availability of data, the five elements of basic education, medical and health care, social security, cultural services, environmental protection, are included in the research field of basic public service supply, and the specific Based on this, the entropy value method was used to determine the weights of the indicators in order to construct a complete comprehensive evaluation index of public service supply.

b) **Core explanatory vaiables**

The smart city pilot interaction term $did_{it} = post_i \times treat_{it}$ assuming that a municipality i is classified as a smart city pilot in year t, takes the value of 1, and vice versa, takes the value of 0. Where post is a dummy variable for the year, which is set to 0 for the year before the first smart city pilots and 1 for the year after the end of the experiment. *treat* is a dummy variable for policy, which is selected as the pilot city as the experimental group and set to 1, and the county-level cities not selected as smart city pilots as the control group and set it to 0.

c) **Control vaiables**

In this paper, regional economic development level, government financial scale, financial autonomy, informationization level, and service industry development are selected as control variables. GDP is an important indicator of economic development level, and government financial scale is directly related to the government's financial support and importance to basic public service supply. By comparing the ratio of general budget revenue to expenditure, the impact of local financial autonomy on the supply of basic public services can be measured. The digital development of basic public services is also inseparable from the support of information technology construction; therefore, the level of information technology is also one of the control variables chosen for this paper. The flourishing development of service industry is inseparable from infrastructure, and this paper will evaluate the level of service industry by the proportion of three industries in the total domestic area.

3.3 Data Source

The list of pilot smart cities announced by the Ministry of Housing and Urban-Rural Development in 2012 is the core explanatory variable for this paper. The data related to the explanatory variables and control variables are mainly obtained from the China City Statistical Yearbook [7]. This study extends the study to 173 prefecture-level cities across China, spanning the period from 2008 to 2019 [8]. In order to reduce the influence of individual outliers on the results, a 1% tailing process was applied to the variables. Table 3 shows the results of descriptive statistics for each of the main variables (Tables 1 and 2).

Table 1. Description of Variables

Variables	Variable Name	Variable Description	Unit
Explain edvariables	Basic public service supply level (bps)	Entropy method to calculate the composite score	None
Core explanatory variables	Smart City Construction (did)	Policy dummy variable * Time dummy variable	None
Policy dummy variables	Policy dummy variable (treat)	Yes, the value is 1; No, the value is 0	None
Time dummy variable	Time dummy variable (post)	Yes, the value is 1; No, the value is 0	None
Control variables	Economic development level (lnpgdp)	ln Gross regional product per capita	RMB / person
	Size of government finances (gov)	General budget expenditure /gdp	%
	Financial autonomy (fd)	General Budget Revenue / General Budget Expenditure	%
	Informatization level (lnint)	ln Number of Internet users	household
	Service industry development (ind3)	Value added of tertiary sector / Gross regional product	%

4 Empirical Analysis

4.1 Baseline Regression Results

The net effect of smart city construction on basic public services was first tested using a two-way stationary model, and the results of the baseline model regression are reported in Table 4. Model 1 includes only the core explanatory variables, at which time the estimated coefficient of the dummy variable of smart city construction is significantly positive at the 1% statistical level, indicating that smart city construction is conducive to the improvement of basic public service supply level; Model 2 includes five control variables on the basis of Model 1, and after including the control variables, the estimated coefficient of the dummy variable of smart city construction is still significantly positive at the 1% statistical level. This indicates that after excluding the effect of omitted variables, smart city construction can still effectively improve the level of basic public service provision. Model 2 also shows that the four control variables of economic development, financial autonomy, government financial scale, and information technology construction are significantly positive at the 1% or 5% level, reflecting the positive effects of economic strength, financial autonomy, financial investment, and information technology on the improvement of basic public service provision. The development of

Table 2. Basic Public Service measurement Index System

Econdary indicators	Weights	Tertiary indicators	Unit	Weights
Basic Education	23.12%	Education expenditure per capita	People / Yuan	15.23%
		General elementary school teacher-student ratio	People / Thousands	3.80%
		General secondary school teacher-student ratio	People / Thousands	4.09%
Health Care	26.46%	Number of doctors per 10,000 people	People / 10,000	5.31%
		Number of hospital and health center beds per 10,000 people	Sheet/ 10,000 people	4.62%
		Number of hospitals and health centers per 10,000 people	People/million people	16.53%
Social Security	38.57%	Number of urban basic pension insurance participants per 10,000 people	People/million people	11.49%
		Number of people participating in urban basic medical insurance per 10,000 people	People/million people	12.14%
		Number of unemployment insurance participants per 10,000 people	People/million people	14.94%
Cultural Services	7.03%	Public library book collections per 10,000 people	Pieces/million people	7.03%
Environmental Protection	4.81%	Comprehensive utilization rate of industrial solid waste	%	2.13%
		Centralized treatment rate of sewage treatment plants	%	1.46%
		Harmless disposal rate of domestic waste	%	1.22%

Table 3. Descriptive Statistics

Variables	Observations	Average value	Standard deviation	Minimum value	Maximum value
Basic public service supply level (bps)	2,076	0.130	0.0561	0.0447	0.467
Policy dummy variables (treat)	2,076	0.202	0.402	0	1
Time dummy variable (post)	2,076	0.667	0.472	0	1
Smart City Construction (did)	2,076	0.135	0.342	0	1
Level of economic development (lnpgdp)	2,076	10.46	0.601	8.709	11.81
Size of government finances (gov)	2,076	20.04	10.99	7.146	67.50
Financial autonomy (fd)	2,076	43.11	21.25	7.908	97.84
Level of informatization (lnint)	2,076	61.95	59.25	4.216	318
Service industry development(ind3)	2,076	38.69	8.930	19.70	66.10

the service sector is not significant, probably because cities are facing problems such as lower consumer demand due to various factors, thus limiting the positive impact of the service sector on the supply of basic public services.

4.2 PSM-DID Test

To overcome the selectivity bias of the double difference method in the assessment of policy effects, the propensity score matching (PSM-DID) method is chosen for robustness testing. The kernel density matching algorithm was chosen to match the experimental group samples with the control group samples. Firstly, the kernel density plot was used to verify the matching effect, and the left panel represents the common support domain before matching and the right panel represents the common support domain after matching. The left panel represents the common support domain before matching and the right panel represents the common support domain after matching. Figure 1 shows that there is a clear proximity and overlap between the experimental and control groups after matching, therefore, the samples obtained by kernel density matching have good results.

The kernel density-matched sample is again subjected to double-difference empirical analysis to verify the robustness of the finding that smart city construction promotes

Table 4. Baseline Model Regression Results

Variables	Model 1	Model 2
Smart City Construction	0.025***	0.011***
	(12.12)	(5.52)
Economic Development Level		0.017***
		(9.90)
Size of government finances		0.000***
		(3.62)
Financial autonomy		0.000**
		(2.15)
Level of informatization		0.000***
		(4.94)
Service Industry Development		-0.000
		(-0.98)
Constant term	0.127***	-0.070***
	(239.55)	(-4.06)
Observations	2,076	2,076
Goodness of fit	0.072	0.229

a.*** denotes $p < 0.01$, ** denotes $p < 0.05$, * denotes $p < 0.1$

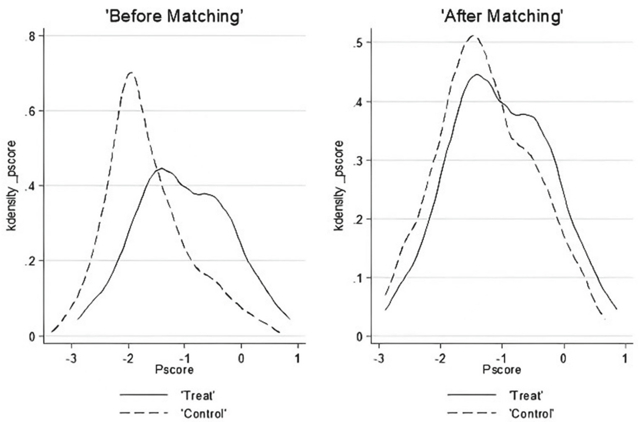

Fig. 1. Kernel Density Function Plot

the improvement of basic public service provision. Table 5 reports the results of the PSM-DID regressions. Column (2) shows that after kernel density matching, the implementation of the smart city pilot policy can still effectively improve local governments' basic public services and effectively promote their supply level. Compared with the unmatched baseline regression results presented in column (1), the estimated coefficients of the matched sample do not change significantly and still remain significantly positive at the 1% level. In order to ensure the robustness of the matching procedure, the matching algorithm is changed and the results in columns (3) and (4) are obtained by double difference analysis with caliper radius matching and proximity matching again. The regression results in columns (3) and (4) are still similar to the baseline regression and kernel matching algorithm. Thus, the results of smart city construction for improving the level of basic public service provision remain stable after the multiple score matching procedure.

Table 5. PSM-Did Regression Results

Variables	Baseline regression results (1)	Nuclear matching (2)	Caliper radius matching (3)	Neighbourhood Matching (4)
Smart City Building	0.011***	0.011***	0.011***	0.011***
	(5.52)	(5.30)	(5.22)	(5.22)
Level of economic development	0.017***	0.018***	0.018***	0.018***
	(9.90)	(9.71)	(9.84)	(9.84)
Size of government finances	0.000***	0.000***	0.000***	0.000***
	(3.62)	(3.50)	(3.49)	(3.49)
Financial autonomy	0.000**	0.000**	0.000**	0.000**
	(2.15)	(2.18)	(2.17)	(2.17)
Level of informatization	0.000***	0.000***	0.000***	0.000***
	(4.94)	(4.92)	(4.65)	(4.65)
Service Industry Development	-0.000	-0.000	-0.000	-0.000
	(-0.98)	(-1.14)	(-1.07)	(-1.07)
Constant term	-0.070***	-0.074***	-0.077***	-0.077***
	(-4.06)	(-4.10)	(-4.24)	(-4.24)
Observations	2,076	2032	2032	2,032
Goodness of fit	0.229	0.221	0.220	0.220

a.*** denotes $p < 0.01$, ** denotes $p < 0.05$, * denotes $p < 0.1$

4.3 Heterogeneity Analysis

Whether there are differences in the policy effects of smart cities under different city sizes still deserves further exploration. The division of city size according to the Notice of the State Council on Adjusting the Criteria for the Division of City Size cannot accurately reflect the policy effect of smart city construction on the supply of basic public services due to the unbalanced sample size, thus affecting the effectiveness and feasibility of the policy. Based on the findings of previous scholars, this paper distinguishes large and medium-sized cities into three categories: large cities (with a population of more than four million), medium-sized metropolises (with a population between two and four million), and small cities (with a population of less than two million). We conducted group regressions for these three types of metropolitan cities and present the empirical results in Table 6.

After the analysis of city size heterogeneity, we found that the regression relationship of the focal solution factor was significantly positive in Models I and II, and the calculated level reached 1%. However, in Model III, this result is not significant. This suggests that there are differences in the effects of different sizes of pilot cities on the policy effects.

4.4 Results of the Empirical Analysis

The findings show that pilot smart city construction has a significant contribution to the provision of basic public services in large and medium-sized cities, while there is no significant impact on smart city construction in smaller cities. In addition, the larger the size of the city, the stronger the incentive for residents to demand government public services, and the greater the impetus for the government to improve the level of public services. In contrast, cities with smaller populations have a gap with medium and large cities in terms of development resources and government incentives, making it difficult for smart city construction to effectively promote the supply of basic public services.

4.5 Practice Inspiration

Government departments should actively promote the construction of smart cities and continuously explore the integrated application of digital technology in the field of basic public services in order to enhance the intelligence level in areas such as public teaching, social insurance, medicine and health, public culture and environment, and promote more comprehensive and sustainable growth [9]. Government departments should also build a good information exchange channel between the government and the public, innovate the basic public service supply model, accurately grasp the supply and demand of basic public services, and build a balanced pattern of basic public service supply and demand. Finally, it is necessary to implement smart city construction programs according to the different characteristics of the current situation of basic public service supply in each city and the actual situation of the city scale, make use of the resource inclination and policy support of the pilot cities, optimize the regional development environment, actively explore the solutions of new smart city construction suitable for the local area, and promote the local government to meet the diversified basic public service needs of the public.

Table 6. Analysis of City Size Heterogeneity

Variables	Large cities (1)	Medium-sized cities (2)	Small Cities (3)
Smart City Construction	0.020***	0.015***	−0.005
	(6.47)	(5.09)	(−0.96)
Economic Development Level	0.020***	0.018***	0.015***
	(6.67)	(7.44)	(2.98)
Size of government finances	0.000	0.000**	0.001***
	(0.80)	(1.98)	(3.15)
Financial autonomy	−0.000	0.000**	0.000**
	(−0.44)	(2.54)	(2.07)
Level of Informatization	0.000***	0.000***	0.000
	(3.04)	(3.40)	(1.24)
Service Industry Development	−0.000	0.000	−0.000
	(−1..40)	(0.65)	(−0.53)
Constant term	0.087***	−0.085***	−0.028
	(−3.12)	(−3.67)	(−0.57)
Observations	780	828	468
Goodness of fit	0.322	0.306	0.098
Number of cities	65	69	39

a.*** denotes $p < 0.01$, ** denotes $p < 0.05$, * denotes $p < 0.1$

4.6 Conclusion

As a new model of modern city operation and Chile, smart city construction has increasingly received wide attention from priests and all walks of life. Through the construction of smart cities, not only can the level of supply of basic public services be significantly improved, but also can promote the advancement of technology, enhance the efficiency of services, and realize the effective matching of supply and demand. In the context of the development of the digital era, it is an important topic for academic research and a realistic need to enhance people's well-being to consider the impact of smart city construction on basic public services with the new generation of information technology as the core support, and to explore how to make use of the policy opportunities of smart cities to crack the problems of basic public service supply [10].

References

1. Guan Xinping. The current institutional construction and social policy analysis of enhancing the vitality of social organizations in China[J]. Jiangsu Social Science,2014(03):83-89. DOI:https://doi.org/10.13858/j.cnki.cn32-1312/c.2014.03.013.
2. Gathering synergies and making concerted efforts [J]. National Grid,2021(06):12–13.

3. Xu Yucong. Ten trends of smart city construction[J]. Data,2021(04):16-18.
4. Shi Dachian, Ding Hai, Wei Ping, Liu Jianjiang. Can smart city construction reduce environmental pollution[J]. China Industrial Economics,2018(06):117-135. DOI:https://doi.org/10.19581/j.cnki.ciejournal.2018.06.008.
5. Sun Xianmin, Zhang Guowei. Smart city-driven development of commerce circulation industry: theoretical mechanism, measurement test and policy implications [J]. Business Research, 2022(04): 58-66.DOI:https://doi.org/10.13902/j.cnki.syyj.2022.04.007.
6. Zhao Caijing, Wu Bojun. Does smart city construction promote urban development quality improvement? --An assessment of policy effects based on a multi-period DID approach[J]. Economic Economics,2020,37(06):18-27.DOI:https://doi.org/10.15931/j.cnki.1006-1096.20201010.008.
7. Wang W. Smart city construction boosts the development of digital economy[J]. China State of the Nation,2018(07):8-9. doi:https://doi.org/10.13561/j.cnki.zggqgl.2018.07.003.
8. Zhang YJ. Can smart cities promote economic growth--a quasi-natural experiment based on smart city construction [J]. Business Economics,2017(09):20-22.
9. Huang C.Y.. Smart city construction will bring more new opportunities and changes to the access control market[J]. China Security,2015(Z2):17-21.
10. Chen Yin'e, Sun Qiong. Infrastructure development level measurement and influencing factors in China-an empirical study based on provincial panel data[J]. Economic Geography, 2016, 36(08): 23-30.DOI:https://doi.org/10.15957/j.cnki.jjdl.2016.08.004.