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How the "Absorption Processes" of Urban Innovation Contribute to Sustainable Development—A Fussy Set Qualitative Comparative Analysis Based on Seventy-Two Cities in China

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Abstract: The goals and transformation of sustainable urban development require fundamental innovation; however, urban innovation is a cyclical process, the paradigm of innovation itself needs to be dramatically transformed, and all innovation key elements need to be coordinated with each other to achieve sustainable urban outputs. Based on this, this paper uses the absorptive capacity theory to construct a model of the relationships between the acquisition dimension, digestion dimension, conversion dimension, utilization dimension, and sustainable development in the innovation process of smart cities and uses the fuzzy set qualitative comparative analysis (FSQCA) method to investigate the configuration mechanism in depth to show how the innovation process of these cities affects their sustainable development, taking the top 72 cities in China in terms of innovation capacity in 2020 as the research objects. The results of the study form three complex configuration paths that affect sustainable urban development, centered on the transformation of technological achievements, innovation management drive, and smart cities, and reveal that the economic and market foundations as the dimensions of urban innovation acquisition are not the core conditions for sustainable urban development. Based on this, this study develops a configuration classification for innovative cities that can achieve sustainable development, i.e., industrial paths, governance paths, and technology paths, and proposes strategic directions for sustainable urban innovation development.

Keywords: urban innovation; sustainable development; absorption theory; configuration effect

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1. Introduction

With sustainable development becoming the new urban norm in the 21st century, the shift from innovative cities to sustainable innovative cities has generated intense academic debate, with a growing number of scholars realizing that the transition to and reaching the goal of sustainable urban development require fundamental innovation and that sustainable development as a source of innovation provides opportunities to enhance competitiveness and promote economic growth [1,2]. Although the concept has become a basic global consensus, there are still many unresolved issues due to the causal complexity of innovation and sustainable development, and it can be said that the process of urban innovation is difficult on the road to sustainable development [3], while the modes of innovation themselves need to be transformed significantly [4]. Urban innovation is a cyclical process, just like the absorption system of the human body, which requires food to be input, digested, and transformed into the nutrients needed by the human body to move on to yet another innovation channel. Studies have developed an understanding of the new approaches to innovation management required to take account of the growing pressures and emerging opportunities in the 'sustainability' agenda [5]. Therefore, managing the innovation process is crucial for sustainable urban development. Undoubtedly, the process of innovation absorption breeds sustainability, but the innovation process is also uncertain, and the processes of resource acquisition, innovation management, input transformation, and innovation outcome formation do not necessarily lead to positive socially and environmentally beneficial outcomes. Especially when these processes are highly novel to the mainstream, urban sustainability is more likely to be off-track [6].

Drawing on the ideas of absorption theory, this study decomposes the process of urban innovation into a process of absorption and digestion from primitive economic accumulation to innovation achievement, and adopts a configuration path, expecting to discover the complexity of sustainable innovation affecting cities through different combinations of conditions of the innovation development process. In this context, multiple explanatory factors are combined in a complex and sometimes contradictory way and there is equality, i.e., multiple alternative paths of outcomes [7]. Meanwhile, this paper combines the theories of Zahra and George [8], further modified based on Cohen and Levinthal's research on the three dimensions of absorptive capacity theory [9], as well as identified the four dimensions of absorptive capacity theory, acquisition, digestion, conversion, and utilization, among which acquisition and digestion belong to the potential absorptive capacity and conversion and utilization belong to the actual absorptive capacity. As a result, this paper identifies a set of innovative city elements (i.e., market, management, innovation platform, R&D inputs, translational outcomes, and smart cities) and observes how these elements relate to achieving sustainable development in the urban innovation process. Thereafter, this paper explores how these elements of urban innovation are interdependent and illuminate how multiple configuration models can achieve or hinder the desired outcomes.

In the case of China, for example, its GDP has been growing at a rapid rate of about ten percent per year since the 1980s, until it became the world's second-largest economy in 2010. Behind the rapid economic development are the high input, high consumption, and high pollution rates of the crude growth method of excessive consumption of energy, as well as the great damage to the environment. According to the Global Cities Competitiveness Report 2017–2018, data, Chinese cities are rapidly emerging in terms of their urban economic competitiveness, with 21 cities in the top 100 global rankings, but only nine Chinese cities are in the top 100 global lists in terms of urban sustainability competitiveness. This indicates that Chinese cities are significantly weaker in terms of sustainable development, which is not quite commensurate with their economic competitiveness performance. Nowadays, China's urbanization level continues to increase by an average of 1.29 percentage points per year, and the urbanization rate of the population will reach 64.72% by the beginning of 2022. The Chinese government has proposed a new urbanization strategy to adapt to this rapid transformation, emphasizing that new cities must develop around the goals of "innovation, green, wisdom, livability, humanity, and resilience". Although China has also made many efforts to address environmental and sustainability issues, such as public interest campaigns and policy formulation, the effects have been greatly reduced, implying that China has a long way to go to achieve sustainable cities. To solve this realistic governance dilemma and to fill the existing theoretical gaps, this paper constructs an analytical framework of four dimensions of the urban innovation absorption process and adopts a fuzzy set of qualitative comparative analysis methods to explore the key factors and configuration paths that can influence sustainable urban development in the innovation process. Therefore, discovering the influencing mechanisms of sustainable urban development in the innovation process is the main goal of this study.

2. Literature Review and Theoretical Analysis Framework

2.1. Innovation—Sustainable Cities

2.1.1. Innovation—Connotations for Sustainable Cities

Sustainable cities focus on issues related to urban sustainability and livability [10], and in some studies, the relationship between innovative and sustainable cities is seen as a chain from means to end, as the solutions offered by innovative cities may help to solve key social problems and improve the quality of life of citizens [11,12]. On the one hand, innovative cities use high-tech and communication technologies to manage social issues such as transportation, energy, knowledge, and the environment, relieving traffic congestion, improve public facilities, and collecting various data to improve public services [13]. On the other hand, sustainable development promotes innovative technologies and economic and social development by supporting soft environments such as knowledge technologies, public administration, and security [14].

However, the development of urban innovation processes is not without costs and brings new problems and challenges; therefore, the new concept of sustainable innovation has emerged, along with the development of innovation, but the relationship between innovation and sustainable development exists at several levels in academia; for example, some scholars understand sustainable innovation as the sustainability of innovation, i.e., whether innovation can continuously bring lasting competitive advantage [15,16], while some scholars understand sustainable innovation as green eco-innovation, which aims to reduce the negative impact of innovation activities on the ecological environment [17,18]. However, the most popular view on the relationship between innovation and sustainable development in recent years is as sustainable development-oriented innovation, which focuses on how to achieve the unity of economic, social, and environmental benefits [19]. Table 1 shows the representative scholars' views summarized in this paper.

Table 1. Views regarding the relationship between innovation and sustainable development.

Views	Literatures
Sustainable Innovation	[15,16]
Continuous Innovation	[20]
Continuous Improvement	[21,22]
Eco-innovation	[23,24]
Green Innovation	[17,18]
Sustainability-driven	[25]

Sustainable innovation is a relatively new concept. Academics who have too many inconsistent definitions would be detrimental to the development of a unified theoretical system of sustainable innovation. This study is concerned with the influencing factors related to sustainable development in the process of achieving innovation in cities. Thus, this paper defines sustainable innovation as a city that generates continuous innovation activities, including technology, knowledge, and markets, and achieves the sustainable and healthy development of social and economic innovation activities as a result of sustainable development.

2.1.2. The Impact of the Innovation Process on Sustainable Development

It is of great practical significance to explore the key factors influencing sustainable urban development to enhance sustainable urban development. Only a comprehensive and full understanding of the impact of the innovation process on sustainable urban development can be targeted to enhance sustainable urban development. Through an empirical analysis of 35 cities' development, Cormick listed the key factors affecting the sustainable development of cities, mainly including government management, technological innovation, hardware facilities, and innovation funding [26]. Other scholars argue that a city's resource base and hardware facilities are important prerequisites for sustainable urban development and that the resource base and hardware facilities help to attract highly efficient enterprises and highly qualified personnel, thereby achieving innovative performance based on enhancing sustainable urban efficiency [27]. In addition, markets characterized by diversified industrial clusters are also the basis for sustainable urban development. Economic development has a positive impact on enhancing the sustainable competitiveness of cities, especially the development of diversified industrial agglomeration markets, which can improve the productivity of business clusters through agglomeration and selection effects, thereby promoting the sustainable development of cities [28].

Under the influence of the technological revolution, China's economy has entered a new normal, and the impact of the new pneumonia epidemic, stimulating market vitality and driving innovative development, has become the way to seize the opportunities of the times and promote sustainable urban development in China. Innovation development has become a key force to promote the sustainable development of cities [29], with the accumulation and transformation of knowledge being crucial to enhancing the sustainable competitiveness of cities. On the one hand, the innovation platform represented by universities and research institutions is an important factor in stimulating the innovation ability of cities, and there is a positive correlation with the economic growth of cities. In the post-industrial era, cities mainly achieve sustainable economic prosperity through innovation; on the other hand, the competition among cities is changing from traditional hard conditions to soft power, among which knowledge is a symbol used to reflect the soft power of cities, and the transformation of technological achievements has become the strongest driving force to enhance the sustainable competitiveness of cities [30]. Activating the innovation capacity and promoting sustainable urban development also requires an effective management system [31]. The improvement of government management and the rule of law is an indispensable external factor for urban development, and urban development depends on the stability of the external environment, so government policy support is an important initiative to promote sustainable urban development. In addition, innovation and development can bring sustainable development vitality to smart cities, and smart city construction and sustainable development are mutually promoting and co-developing relationships, so it is also crucial to study the impact of smart city construction on sustainable development in the innovation process of cities in the context of exploring sustainable development [32].

At present, many scholars have conducted in-depth studies on the factors influencing urban sustainability in the innovation process. However, most scholars have mainly studied the positive effects of key factors in the innovation process on sustainable development, fewer scholars have focused on the negative effects of these factors, and few scholars have studied the interaction of factors affecting the sustainable development of cities in the innovation process from a configuration perspective. Based on this, this paper applies the absorptive capacity theory to the top 72 cities in China in terms of the innovation capacity to fill the gaps in the above-mentioned studies and provide theoretical references for the sustainable development of cities.

2.2. Theoretical Framework and Variable Indicators

2.2.1. Theoretical Basis

The ability of different subjects to assimilate and replicate new knowledge from the outside world can vary, and this ability was first proposed by Cohen and Levinthal and applied at the firm level as the absorptive capacity [9]. The absorptive capacity represents the ability of a subject to acquire, digest, and apply knowledge, which is based on the subject's ability to make full use of the accumulated amount of basic resources, which is manifested by the quality of sharing unique knowledge and being able to make use of new knowledge. To reveal the causal complexity of urban innovation and sustainability, this paper draws on Zahra and George's absorption theory and draws a model diagram in which they define four dimensions of absorptive capacity, i.e., acquisition, digestion, conversion, and utilization [8] (see Figure 1), while also emphasizing that more attention should be paid to the ability to convert knowledge, through which an informal mechanism of social integration is formed to achieve the ultimate utilization of new knowledge [33].

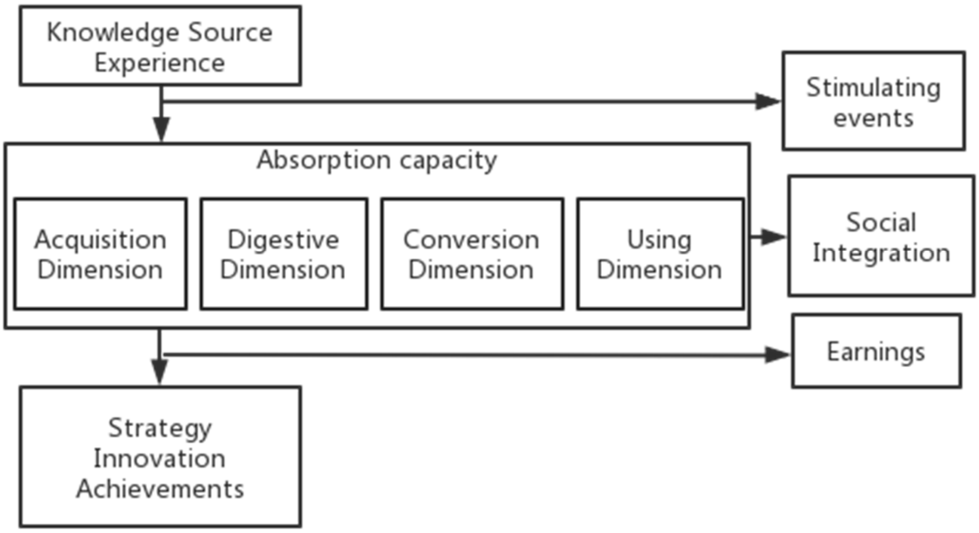

Figure 1. Structural diagram of absorptive capacity.

To strengthen their capacity, the subject must have the ability to integrate resources and information in addition to actively acquiring external resources, but this integration ability mainly depends on whether the subject can effectively manage resources and transform resources and information through the platform [34]. At the same time, if the relevant personnel have the relevant knowledge base when integrating information, the process of integration is bound to be more efficient and effective and can be transformed into the knowledge type and content required by the subject. Levinson and Asahi argue that the stronger the absorptive capacity, the greater the control over the external environment and the greater the dynamic capacity that the subject has. In general, the absorptive capacity lies in accumulating resources, identifying and digesting useful information, transforming and applying the knowledge in practice, and ultimately using it for the subject. This is not only conducive to creating conditions for knowledge integration and utilization, but also to improving the dynamic ability of the subject and laying a good foundation for sustainable competitive advantage [35].

In terms of the research methodology, this paper adopts Furnar's configuration theory, which has three stages: scoping, linking, and naming [7]. Scoping identifies how various factors form configuration from theories and pairs of phenomena; linking focuses on how various factors are connected through the ideas of union, equality, and asymmetry; and naming marks individual configurations to identify higher-level themes of the whole. Such an analytical model can not only produce multiple configurations of the same results but can also summarize them into overarching patterns.

2.2.2. Analytical Framework and Metrics Construction

Inspired by Furnari, this paper complicates the process of explaining the sustainability of innovative cities by decomposing it into multiple influencing factors and examining the rationality of these factors. This study follows the principles of comprehensiveness, systematicity, and operability, and constructs a microscale measurement indicator system by referring to the Global Sustainable Development Report, the United Nations Commission on Sustainable Development, the United Nations 2030 Agenda for Sustainable Development, and the Chinese Position Paper on Implementation for the 2030 Agenda for Sustainable Development (See Table 2).

Table 2. Definitions of the relationship between innovation and sustainable development.

Variable Types	Dimensions	Variables	Variable Explanation
Conditional Variables (X)	Acquisition Dimension	Economic and Market Basis (EM)	Gross production value, social consumption, total exports, total imports, results calculated by weighting method (25% for each of the four indicators)
	Digestive Dimension	Innovation Management (IM)	Government policy documents and laws and regulations with the title of innovation and sustainability in the decade of 2010–2020, as well as policy documents and laws and regulations with a high degree of relevance to innovation and sustainability
		Innovation Platform (IP)	General higher education institutions, national and provincial key laboratories, national and provincial key engineering construction management centers, national and provincial engineering technology R&D centers, national and provincial incubators, high-tech enterprises, technology-based enterprises
	Conversion Dimension	R&D Funding (RD)	R&D expenditure as a share of GDP
		Transformation of Technological Achievements (TA)	Amount of technology contracts signed
	Using Dimension	Smart City (SC)	Smart City Ranking
Result Variable (Y)		Sustainable Development (SR)	China 2020 Sustainable Development Indicator System Ranking

Zahra and George's study classified absorptive capacity as acquisition, digestion, conversion, and utilization [8]. This paper also explores sustainable enhancement paths for innovative cities in these four dimensions: (1) The acquisition dimension, where the access ability is measured as the resource base of urban innovation, the value of the resource base is not automatically shown and needs the subject to be able to actively access it, while the access dimension in this study is represented by the economy and market, whereby the city gets a strong economic base by acquiring economic resources through production and consumption and then stimulates trade development by enhancing market activity through import and export trades. These basic resources represent to a certain extent represent the carrying capacity and starting point of the innovation for the whole city. (2) The digestion dimension, where in this stage the subject can use its cognitive structure to understand and interpret the valuable resources and to fully digest the acquired resources to combine them into the subject's cognitive structure. The digestion dimension in this study is represented by the use of innovation management approaches and platforms, where the local government formulates laws, regulations, and policy documents to manage the innovation process while providing a suitable development platform for innovation. On the one hand, the resource base needs to be matched with a research platform to provide technical support for the sustainability of the innovative city, and on the other hand the exploitation of the basic resources depends on the economic motivation of the resource holders and requires governmental institutions with management capabilities to provide quality services for this purpose, providing a guarantee for sustainable development. (3) The conversion dimension, whereby the conversion capability is also the process of transforming innovation results, which refers to the subject's use of a range of skills, knowledge, and experience to convert digested new knowledge and resources into new results and use them for urban development. The conversion dimension in this study is expressed in terms of R&D funding and the transformation of technological results. The mature practical experience worldwide shows that effective government management models are still the basic support tools for sustainable cities [36], but the realization of the goal also requires sufficient financial support and adequate transformation of knowledge. Although the management approaches and platform are the basic support tools for sustainable cities, the original social system can only change essentially when funds and technology enter the absorption process. (4) The using dimension, whereby the using capacity represents the conversion of urban innovativeness at the practical level and refers to the innovative city's use of digested and transformed resources to form a new performance indicator—the smart city (i.e., the results of the city's innovation practices). Now that the basic needs of cities for innovation capabilities have been met and people prefer and people prefer information and communication technology (ICT), energy, housing, health, and environmental approaches to be used in smart cities, the innovation class must not only deeply grasp the laws of urban innovation development but also physically invest in the construction of green and livable smart cities [37]. Dovetailing with the concept of sustainable development, the essence of a sustainable city is a city that successfully balances the economy, environment, and society [38]; it is a state rather than the outcome. This paper considers the sustainability of urban innovation processes in terms of the resources, management, and development technology, further investigating the extent of influence of sustainability factors to conclude how the process of urban innovation affects sustainable development.

2.3. Acquisition Dimension: Economic and Market Basis

The market and economic base of a city refer to the economic environment and underlying innovation industries that contribute to the development of innovation in the city. The study in this paper uses the urban output and market transactions to constitute the access dimension, both of which are critical to the development of urban innovation activities. The resource based theory is important in the innovation development process, and this idea can be traced back to the recognition of the critical role of basic resources by scholars such as Chamberlin. Thereafter, Grant proposed that resources can bring a competitive advantage, and such resources are the inexhaustible driving force of innovation development, which can help innovation subjects improve their knowledge accumulation and learning ability in the ever-changing environment and can solidify the foundation of innovation [39]. In studying the relationship between innovation and resources, Morrison points out that there is a mutual influence between the two: resources can promote the development of innovative activities, while in turn innovation can push innovation subjects to take the initiative to acquire unique resources and capabilities [40]. At the same time, the market, characterized by diverse industrial agglomeration, is also the basis for innovation development. The market dynamics have a positive impact on enhancing innovation activities, especially the development of diversified industrial clusters, which can improve the productivity of business clusters through agglomeration and selection effects, thereby promoting the innovative development of cities [28].

2.4. Digestion Dimension: Innovation Management

Innovation management can be defined as the general ability of the government to integrate the management and coordination of stakeholders in the urban innovation process through policies, services, and other factors [41]. Arrow, the winner of the 1972 Nobel Prize in Economics, argued that the access dimension alone is not sufficient to achieve innovation, and that without regulation serious market failures can occur and market mechanisms can be inefficient in allocating inventive activities, meaning government intervention is needed to reduce the problem of insufficient R&D incentives. He gives the reason that knowledge has the two properties comprising non-competitive and non-exclusive public goods, and that in a market environment, the producers of public goods cannot obtain sufficient returns with their products, which means that the economy and the market alone cannot provide effective incentives for the production of new technological ideas. Thus, the rationality of government intervention stems from the access dimension, which implies that institutions engaged in R&D can face incentives and regulations from both the market and the government [42]. Using data from Spain, Huergo and Huergo found that government innovation policies significantly increase the motivation of innovation agents to engage in R&D activities and that regions supported by policies tend to exhibit higher productivity [31,43]. It is also argued that the import of government management facilitates the formation of an innovation climate and innovation environment, and provides the driving force and innovation platform for organizational innovation [44].

2.5. Digestion Dimension: Innovation Platform

The "innovation platform" is a support system made up of various innovation elements such as knowledge, talent, technology, and information. It is an integrated system led by the government or an organization to carry out scientific research and technological development activities by gathering innovation elements and integrating scientific and technological resources to support independent innovation and scientific and technological progress in a certain industry and region [45]. From this perspective, the main driver of value creation is the ability of the organization to "digest" the platform. Schilke's research on organizational management and innovation processes based on the dynamic capability theory suggests that the improvement of innovation platforms and their service capability can result in the effective combination and digestion of organizational innovation assets and can further result in value creation [46]. At the same time, the continuous improvement of hardware facilities, such as through infrastructure and platform construction, can help attract highly efficient enterprises and high-quality talent, which in turn can enhance labor productivity. Since cities generally have both government and industry elements, academia is particularly concerned about the influence of universities, research institutions, and technology-based enterprises on regional innovation or national innovation systems. Wang summarizes the spillover effects of cooperation patterns between different innovation agents, such as industry–academia and government–academia cooperation, on the regional innovation level; the study confirmed that government–academia cooperation and industry–academia cooperation between universities, governments, and enterprises have significant effects on regional economic growth [47].

2.6. Conversion Dimension: R&D Funding

In the process of urban innovation, due to the inefficiency of the market allocation process, it is necessary to use the government's "visible hand" to allocate resources, emphasizing that the government should promote more innovation transformation through direct means such as tax incentives, R&D funding, and government technology procurement, so that innovation investments can reach the socially optimal level [48]. The R&D activities of innovation platforms represent the process of transforming knowledge and resources, and their high-cost nature determines that innovation platforms face external and internal financing constraints. Government funding not only directly finances innovation platforms but also serves as a positive signal to indirectly alleviate their financing constraints and promote the sustainability of innovation and its development. In addition, government funding is awarded through the careful screening of the innovative value and potential competitiveness, strict approval procedures, and a preference for supporting and sustaining innovation transformation activities, unlike other external investors, whose purpose is based on investment returns [49]. Thus, government investment in R&D largely ensures the continuous transformation of innovative activities. Using the R&D funding program policy in Northern Italy, Bronzini and Piselli found that the program had a significant boosting effect on the number of patent applications achieved by regional firms and that government innovation grants acted as a signaling mechanism to effectively boost external inputs such as private investment and external financing for innovation activities [50].

2.7. Conversion Dimension: Transformation of Technological Achievements

The transformation of technological achievements refers to the subsequent testing, development, application, and promotion of technological achievements for the formation of new technologies, processes, materials, and products and the development of new industries to improve productivity, which is an extremely important transformation dimension of innovation activities, reflected in the dissemination and application of technology [51]. The transformation of technological achievements is of great strategic importance to both cities and countries, and some studies have pointed out that the key to whether an innovation entity can stand firm in the innovation market lies in the transformation dimension, i.e., whether it can commercialize its technological achievements and obtain benefits; that is, the high-intensity transformation of technological achievements determines whether the innovation entity can survive in the fluctuation of the changing innovation market [52]. In the innovation process, after the resources and knowledge held by the innovation subject have been produced, it is often the transformation of technological achievements that plays the role of the flow and the "upward and downward" motion, with the signing of technology contracts forming the flow of realizable resources among the various elements, which are finally fully utilized in the environment [30].

2.8. Using Dimension: Smart City

A smart city is the practical result of innovation and development eventually being used, and is a complex innovation ecosystem [32] that reshapes the production space, living space, and ecological space of the city through digital technology and also achieves the sustainable development of the city through digital technology, mainly in the following aspects. First, the construction of a smart city can meet the technological innovation requirements of sustainable development. Second, the development of information technology and a smart economy can lead to enhanced social efficiency, promoting ecological and economic development. Thirdly, technological innovation can improve the level of urban wisdom management, saving on social management and social operation costs and enhancing the sustainable development of the whole society. Fourthly, the construction of smart spaces can help in the integration and synergistic development of different functional areas of the city, the optimization of the functional structure of the overall space of the city, and the innovation and sustainable development of space [53]. Smart cities belong to the utilization dimension of the absorption process because the innovative development process must apply new information technology and involve the ability to make the city management and development processes more intelligent and informative. The smart city concept is the inevitable trend and direction of the advanced stage of innovative city development. Paskalev points out that smart city construction and innovation have an inseparable dynamic relationship, with smart city construction providing the spatial environment and factor resources for innovation, and innovation in turn making cities smarter [54]. The study finds that the process of smart city construction in China follows the development of innovation in the city because smart cities become more informative and intelligent in the context of innovation activities. By constructing a spatial Durbin panel model, Yang and Xu conclude that the interaction terms of urban development and technological innovation have significant promotion and spillover effects on the informatization of smart cities [55]. Using a panel of 171 prefecture-level cities in China, Liu used a double difference model to empirically investigate whether smart city construction in China makes a significant positive contribution to the level of urban technological innovation [56].

3. Research Methodology and Case Selection

3.1. FSQCA Method

The qualitative comparative analysis (QCA) method was introduced by Ragin in 1987 and has since been developed and refined in academia, starting with the fields of political science and sociology, with a focus on the social sciences. Later on, it made a splash in management disciplines, especially in organizational management, and the number of those using QCA methods for research has grown. Currently, the QCA method has penetrated the fields of political science, sociology, management, communication, and economics, and is widely used by scholars in these fields [57].

The basic idea of the FSQCA approach is the idea of organizational configuration, which refers to a set of combinations of multiple-dimensional characteristics, such as the environment, technology, market, talent, process, and outcome. These characteristics and traits can be grouped into different combinations to express the same or different social functions and social effects. In other words, the realization of any social function or effect is not achieved by a single variable but is the result of a combination of multiple variables, where the relationship between the individual variables and the outcome is not a unilinear cause–effect relationship [57]. The FSQCA approach ultimately addresses the causal complexity between multiple variables in a social phenomenon.

The FSQCA research method attempts to solve the problem of the inability to communicate between quantitative and qualitative approaches by integrating the strengths of both “qualitative” and “quantitative” research methods. The “qualitative” approach requires a theoretical basis for the variables in the study, while the “quantitative” approach is based on the Boolean and set theory computational techniques. The traditional linear statistical method assumes that the variables are independent of each other, provides an insufficient analysis of multiple concurrent relationships among independent variables, presents obstacles by explaining the paths through which the results occur, and at the same time requires a high sample size, which lacks explanatory power when applied to a limited number of innovative studies with a regional unit of analysis. In contrast, the FSQCA method based on the set theory can identify the core and marginal conditions of urban innovation and sustainable development, can explain the complex logical path of sustainable development in the process of urban innovation [58], and is oriented toward quantitative analyses of specific cases, which can be used to analyze the mechanism of each variable in a small sample and has the advantages of combining both quantitative and qualitative analyses [59]. In this study, there is no clear threshold for the values of both the condition variable and the outcome variable, so the FSQCA research method is chosen. In this paper, firstly the variables are calibrated based on measurements to give meaning to the set of variables. Secondly, the conditions and combinations of conditions are analyzed in conjunction with the set theory to conclude whether they constitute the sufficient or necessary conditions for the outcome. Finally, the multiple equivalent paths shown in the results are used to explain the causal complexity of the urban innovation process and sustainable development.

3.2. Sample and Data

3.2.1. Sample Selection

This paper selects a sample of the top 72 cities in China in terms of innovation capacity in 2020, with data from China’s National Innovative Cities Innovation Capacity Monitoring Report 2020 and National Innovative Cities Innovation Capacity Assessment Report 2020, which are the best choices for the number of cases included in the analysis based on the research design and data availability. On the whole, the selected cases meet the basic requirements for FSQCA case selection. First, the sample cities cover most of China and are rooted in the same institutional context, with strong similarity and comparability. Second, there is strong heterogeneity among cities due to their wide coverage. Third, the sample cities contain cases with both “positive” and “negative” outcomes. Fourth, the number of cases meets the basic requirements for a medium-sized QCA sample size [57].

3.2.2. Data Collection

The data for the outcome variables in this study are derived from the comprehensive ranking of urban sustainable development in China's "China Sustainable Development Evaluation Report 2020". We obtain the China Sustainable City Index values by calculating the weights of five first-level indicators: economic development, social and livelihood, resources and environment, consumption and emissions, and governance and protection. Since the ranking of the report only includes the sustainable development indexes of 52 cities in the sample, this paper uses the same indicators and weighting calculation method to derive the sustainable development indexes of the remaining 20 cities (See Table 3).

Table 3. Urban sustainable development indicator set and weights.

Category	Indicators	Weights
Economic Development (21.66%)	GDP per capita	7.21%
	Value added to tertiary industry as a proportion of GDP	4.85%
	Urban registered unemployment rate	3.64%
	Fiscal science and technology expenditure as a percentage of GDP	3.92%
	GDP growth rate	2.04%
Society and People's Livelihood (31.45%)	Ratio of house price to GDP per capita	4.91%
	Number of medical institutions per 1000 people	10.73%
	Social security and employment financial expenditure per capita	3.92%
	Ratio of students to teachers in elementary and secondary schools	4.13%
	Urban road area per capita	3.27%
	Percentage of resident population aged 0–14	4.49%
Resource Environment (15.05%)	Water resources per capita	4.54%
	Urban green space per 10,000 people	6.24%
	Number of days with good air quality index	4.27%
Consumption Emissions (23.78%)	Unit GDP consumption and energy consumption	12.1%
	Unit secondary and tertiary industries added value accounted for the built-up area	5.78%
	Sulfur dioxide emissions per unit of gross industrial output	3.61%
	Wastewater emissions per unit of gross industrial output	2.29%
Governance Protection (8.06%)	Centralized treatment rate of sewage treatment plants	2.34%
	Fiscal expenditure on energy conservation and environmental protection as a proportion of GDP	2.61%
	General industrial solid waste comprehensive utilization rate	2.16%
	Harmless disposal rate of domestic waste	0.95%

For the collection of data on conditional variables, this paper used the official website of the Bureau of Statistics, the websites of provincial governments and departments, the websites of municipal governments and departments, the statistical yearbooks of each city, and the websites of the Science and Technology Bureau to conduct the search, firstly taking the "promulgation of relevant policy documents or statistical documents on related topics" as the core basis for data adoption and using the "local government name + policy document name" as the keywords to conduct the search one by one. To ensure the authority and accuracy of the data, the official government website was used as the data source, and the data not found in the search process and not recorded were supplemented by telephone interviews with the local government to ensure the integrity of the research data to the maximum extent (See Table 4).

Table 4. Data source.

Conditional Variables	Data Sources
EM	Public information and data from China City Statistical Yearbook 2020, the statistical yearbooks of each city, the official website of the Bureau of Statistics, the official website of the Development and Reform Commission, and the website of the Economic and Information Commission
IM	Public information and data from the official government statistical websites, government bulletins, and the website of the Economic and Information Commission, as well as telephone interviews with municipal government departments
IP	The China Science and Technology Statistical Yearbook 2020, the Science and Technology Statistical Yearbook of each city, the government gazette, the Development and Reform Commission, the Science and Technology Bureau website public information and data
RD	The China Science and Technology Statistical Yearbook 2020, the Science and Technology Statistical Yearbook of each city, information and data made public by the websites of Science and Technology Bureau and Economic and Information Commission
TA	Information and data made public by the China Science and Technology Statistical Yearbook 2020, the Science and Technology Statistical Yearbook of each city, government gazettes, the website of the Science and Technology Bureau
SC	The Smart City Development Yearbook 2020, the China Green Smart City Development Think Tank Report, telephone interviews with municipal government departments

4. Analysis of Data and Results

4.1. Data Analysis

4.1.1. Variable Calibration and Necessity Check

Before the data analysis, it is necessary to transform the sustainability index and its conditions in the urban innovation process expressed using absolute values into a fuzzy affiliation representation. In this paper, we combine theory and practice to determine the complete affiliation, crossover point, and complete disaffiliation points, and use the direct calibration method provided by Ragin to set three anchor points for the outcome variables and influencing conditions ("complete affiliation = 0.95", "crossover point = 0.50", "completely unaffiliated = 0.05") to transform the values of the variables into fuzzy set affiliations between 0 and 1 [57]. The calibration points are shown in Table 5.

Table 5. Calibration anchor points for the variables.

Variables	Full Affiliation Point	Intersection Point	Fully Unaffiliated Points
SR (Ranking)	10	50	100
EM (Mean Value Method)	0.85	0.25	0.1
IM (PCS)	1000	450	250
IP (PCS)	6000	2500	1500
RD (%)	3.5	2.3	1.5
TA (Billion)	500	70	10
SC (Ranking)	10	50	100

In this paper, we adopt consistency and coverage indicators to measure the degree of necessity and explanatory strength of each condition variable for the outcome variable. Consistency refers to the extent to which all cases included in the analysis share a given condition or combination of conditions that lead to the occurrence of the outcome; in general, X is considered a sufficient condition for Y if the consistency indicator of the condition variable X is greater than 0.8 for the outcome variable Y, and X is considered necessary for Y if the consistency of X for Y is greater than 0.9. Coverage refers to the extent to which a particular condition or combination of conditions explains the occurrence of the outcome, and the closer its value is to 1, the closer X is to the unique explanation of Y [59]. The formulas for both are as follows:

$$\text{Consistency}(X_i \leq Y_i) = \sum min(X_i, Y_i) / \sum X_i \tag{1}$$

$$\text{Coverage}(X_i \leq Y_i) = \sum min(X_i, Y_i) / \sum Y_i \tag{2}$$

It is worth noting that this paper examines how to promote sustainability in the urban innovation process, so it only examines sustainability in cities that already can innovate. The existing research confirms that attention to the results of the various one-way studies in this paper has been paid by academics, and the FSQCA approach can provide the same support in terms of a data analysis. Therefore, this paper begins by testing whether the six conditional variables and their "not" status are necessary conditions for sustainability in the urban innovation process. The results are based on the truth table for the conditional variables (see Table 6). According to Fiss' research, in the process of using and calculating the FSQCA method, this is considered necessary when the consistency of a variable is not less than 0.9 for the outcome variable, and the analysis results show that the consistency of each condition variable with the occurrence of the outcome is less than 0.9, indicating that there is no necessary condition affecting the outcome in this study, i.e., the sustainability of the innovative city is influenced by the combined factors [59], so the next step is to conduct the path analysis of the effects of the composite factors.

4.1.2. Truth Table and Configuration Analysis

In constructing the truth table, an adequacy analysis of the configuration is required. In this study, a frequency threshold of 1 and a consistency threshold of 0.8 were set [57], and the data after excluding the necessary conditions were calculated to obtain the complex solution, the simple solution, and the intermediate solution, then the intermediate solution was selected for the analysis because it incorporated logical residual terms that were consistent with theoretical expectations and empirical evidence. During the analysis, the six variables included in the "highly sustainable, non-highly sustainable" option were analyzed using FSQCA software to obtain the configuration path results (see Tables 7 and 8). The results show four different paths with an overall solution consisting of 0.834414, which is higher than the acceptable threshold of 0.8 and can be considered as a sufficient condition for the sustainable development of innovative cities, further confirming that the antecedents promoting the sustainable development of innovative cities are multiple and concurrent. The following table further compares these four paths, specifically to reveal which paths can solve the sustainable and unsustainable issues.

Table 6. Consistency and coverage of variables.

Conditional Variables	**Result Variable**			
	SR		**~SR**	
	Consistency	**Coverage**	**Consistency**	**Coverage**
EM	0.756354	0.779169	0.436872	0.445077
~EM	0.461326	0.453066	0.783240	0.760716
IM	0.776796	0.792441	0.542179	0.477961
~IM	0.414364	0.477859	0.651117	0.742593
IP	0.712707	0.787306	0.390224	0.426305
~IP	0.480663	0.443538	0.805307	0.734897
RD	0.715470	0.666839	0.578212	0.532956
~RD	0.498895	0.544632	0.638548	0.689385
TA	0.850553	0.852215	0.353911	0.349889
~TA	0.351105	0.355128	0.850000	0.848328
SC	0.825967	0.854306	0.321508	0.333123
~SC	0.354420	0.342680	0.860894	0.833046

Note: ~indicates that the condition does not exist.

Table 7. Urban highly sustainable conditions configuration.

Variables	**Paths**			
	I	**II**	**III**	**IV**
EM	⊗	•	⊗	⊗
IM	•	●	•	⊗
IP	⊗	•	•	•
RD	•	•	⊗	•
TA	●	●	•	⊗
SC			●	●
Consistency	0.735945	0.922671	0.777885	0.650862
Original Coverage	0.190608	0.530663	0.233702	0.125138
Unique Coverage	0.0239232	0.367127	0.0828729	0.0256346
Consistency of Solution	0.834414			
Coverage of Solution	0.663812			

Note: ● indicates that the core condition exists; ⊗ indicates that the core condition does not exist; • indicates that the edge condition exists; blank indicates that the antecedent condition can either exist or not exist.

Table 8. Urban non-highly sustainable conditions configuration.

Variables	**Paths**		
	V	**VI**	**VII**
EM	⊗	•	⊗
IM	⊗	•	⊗
IP	⨂	⊗	⊗
RD		⊗	•
TA	⨂	⊗	⨂
SC	⊗	⨂	⨂
Consistency	0.82999	0.81391	0.88642
Original Coverage	0.462291	0.483799	0.200559
Unique Coverage	0.0624581	0.0582681	0.0459776
Consistency of Solution		0.678492	
Coverage of Solution		0.792879	

Note: ⨂ indicates that the core condition does not exist; • indicates that the edge condition exists; ⊗ indicates that the edge condition does not exist; blank indicates that the antecedent condition can either exist or not exist.

4.2. Analysis of Results

4.2.1. Urban Innovation under High-Sustainability Conditions

Configuration I: Industrial path with the transformation of technological achievements as the main line (~EM*IM*~IP*RD*TA)(*represent conditions that need to be present at the same time. Same below.). This configuration indicates that a path with technology transformation outcomes as the core conditions, a complementary high management base and R&D investment, and a low-innovation platform and economic base as the marginal conditions can generate high sustainability in cities. This suggests that regardless of a city's innovation infrastructure and economic base, high-intensity technology transformation combined with government policies and financial support can create high sustainability, even when a city's economic base is not high. This situation constitutes a type of innovative city dominated by industry–academia–research cooperation, which is most closely reflected by the collaboration with enterprises to transform results into technology applications. In this path, collaboration with enterprises becomes a key force for sustainable urban development. The government, coupled with policy support, exports the results, and in the process the resources are complementary through the transformation of knowledge into practical applications, promoting the sustainability of urban innovation. One study found that universities are most likely to produce innovative results under industry–university–research cooperation [60], while enterprises influence the development of urban innovation sustainability by facilitating the transformation of results into products.

Configuration II: A governance path driven by innovative management (EM*IM*IP*RD*TA). This path has the highest coverage and explains more than half of the cases. The configuration points out the path of a high management base and technology achievement transformation as the core conditions, complementing a high-innovation platform, economic and market base, and R&D investment as the marginal conditions that can produce high sustainability in urban innovation. This shows that high sustainability in urban innovation can be achieved through strong government support for science and technology infrastructure, combined with high-intensity innovation activities in universities, R&D institutions, and high-tech enterprises, which drive the transformation of urban science and technology outcomes. This situation is mostly found in the case of high-intensity government policies and financial support for key technologies by universities, research institutions, and high-tech enterprises, often for various major projects, such as national and provincial science and technology projects, including manned spaceflight and lunar exploration projects, as well a national and provincial key R&D program projects. In this state, the government is the initiator of the project, and through funding and policy support, the innovation platform works together to make breakthroughs in key technologies and achieve sustainable development in the city's innovation process.

Configuration III and Configuration IV: The smart city as the core technology path (~EM*IM*IP*~RD*TA*SC, ~EM*~IM*IP*RD*~TA*SC). Both subjects have the same core condition, i.e., being a smart city, and comparing the two configurations reveals that the main differences lie in three aspects—government support, R&D investment, and technology achievement transformation—with the former having the achievement of transformation and the management basis as the marginal conditions, and the latter having R&D investment as the marginal condition. In other words, smart cities are the core condition in the sustainability improvement of innovative cities, and the remaining variables such as the auxiliary conditions have substitution effects in the process. In the first two configurations, the government directs certain financial and policy support efforts to the research activities of universities and enterprises, especially in the transformation of the results, and some regional governments will set up a guided fund to help transform the innovation results into productivity to improve the innovation performance. Smart cities are the practical result of innovation. On the one hand, smart cities reduce ecological inputs through a high degree of information technology utilization to facilitate future generations to meet their needs. On the other hand, they achieve comprehensive human development through the elements; for example, smart cities increase their ICT-related employment opportunities, promoting the development of a smart economy, while local governments also guarantee the efficiency and quality of e-government [61]. Although smart cities may lack a resource base compared to other cities of the same size, they form a more traditional approach to urban sustainability, but are also highly dependent on elements such as the smart economy and smart people when the transformation of technological achievements and government support are no longer core conditions, i.e., they correspond to the state described by the two configurations.

For the impact paths of sustainability in the urban innovation process, typical cases can be found in the sample cities. Both configurations I and II have high levels of technology achievement transformation and policy support, and the representative cases are Guangzhou, Xi'an, Chengdu, and Shenzhen. The cities in these two paths are mostly developed cities with high levels of technological and economic development; deep industrial and technological foundations; and a large number of high-technology enterprises, scientific research institutions, and universities. The government often assigns the task of key technology tapping to these regions to take advantage of their strong basic ability to acquire new knowledge and transform and apply it while using key technology research to achieve sustainability in highly urban innovation. For both configuration III and configuration IV, there are high levels of IT applications, i.e., smart cities, with representative cases in Changsha, Foshan, Qingdao, and Suzhou. Compared to the cities in the first two configurations, the infrastructure in these areas is relatively less robust, but they have a high level of IT utilization and focus on ecological protection. As a result, research activities are often conducted to meet the city's internal needs and promote urban development, i.e., meeting its current environmental, social, and economic outputs, with appropriate government support to enhance the sustainability of the city through the cooperation of various innovation platforms within the city.

4.2.2. Urban Innovation under Low-Sustainability Conditions

This paper also examines the conditional configurations (i.e., configurations V, VI, and VII) that generate low urban innovation sustainability. First, configuration V shows that in cities lacking a core innovation platform and technology achievement transformation, as well as the edge conditions of being a smart city, having an economic and management foundation, and showing sustainability as an innovative city, will not be highly innovative regardless of the high or low levels of government R&D investment. Configuration VI shows that in cities lacking the core conditions of smart cities and the edge conditions of innovation platforms, R&D investment, and the transformation of technological achievements, even with some form of economic base and policy support, they will not produce high sustainability. Configuration VII shows that without the transformation of technological achievements at the level of smart cities, even if there is more R&D funding, this still will not produce high sustainability in innovative cities. This paper finds that these three configurations mainly lack the conditions of smart cities, technology achievement transformation, and innovation platforms, leading to low urban innovation, once again illustrating the importance of smart cities and technology achievement transformation in the process of sustainable development. From the representative cases, Baoji, Longyan, Hanzhong, and other regions have relatively low rankings as smart cities, have fewer higher education and research institutions, and have fewer high-tech enterprises that can drive the transformation of technological achievements, making it more difficult to obtain high sustainability under this path.

4.2.3. Insights from Configuration Results

The sample in this paper is the top 72 cities in China in terms of their innovation capacity in 2020, so all sample cities have some level of innovation capacity. In the results of this paper, the economy and market, which are the access dimensions, do not appear as core conditions in any of the configurations. Although some cities have a basic configuration to enhance their innovation capacity and have strong economic and market bases, their sustainable development configuration is low and their innovation capacity is offset by significant ecological costs, resulting in them being innovative but unsustainable. In 2020, the Chinese government shifted the focus of the economic market from the supply side to the demand side, hoping to promote the formation of a new development pattern based on a large domestic cycle, with both domestic and international cycles promoting each other, i.e., China's current industrial system will continue to produce new consumer goods and services of high quality and deliver them more quickly to consumers through a nationwide unified and fair competitive market and effective distribution channels. With this in mind, local governments are seeking new opportunities for urban production and consumption growth to support economic and market development. However, some governments have overly pursued economic and market production values, such as Dongguan, Foshan, and Changzhou, where the government provides support while neglecting the construction of smart cities and the protection of the ecological environment, thereby failing to achieve sustainable development in the process of urban innovation.

In contrast, the core conditions appear in the digestion, conversion, and utilization dimensions, respectively, indicating that high sustainability is largely attributed to the conversion and utilization stages of the innovation process, with representative cities including Changsha, Shenyang, and Dalian. These cities do not have a particularly strong economic and market base, but the government has a good management base. They make full use of their economic base through government leadership, repeatedly digest and transform information with the help of innovation platforms, and actively build smart cities to promote sustainable urban development. The above analysis fully illustrates that although the economic base is one of the necessary conditions for innovation, it is a double-edged sword for the sustainable urban development of cities, which can either form sustainability through conversion and utilization or lead to unsustainable cities due to the blind exploitation of resources and pollution. Achieving the SDGs related to resource efficiency, environmental impacts, and human well-being depends on which production models will dominate the economic practices conducted by companies in the industrial sector [62]. From the analysis, the two histological paths with the transformation of technological achievements as the core condition can explain seventy percent of the cases, indicating that the transformation of technological achievements is more important to the overall utility of the sustainable development system. Therefore, cities should make efforts to introduce and absorb knowledge and technology from other regions based on their absorption capacity and strengthen the communication and cooperation among the various sectors regarding technological achievement transformation (government, universities, R&D institutions, and enterprises) to improve the transformation of technological achievements and sustainable development.

4.3. Robustness Tests

To further ensure the robustness of the findings in this paper, the data were tested for robustness using two methods commonly used in academia, adjusting the consistency threshold and adjusting the frequency of cases [63]. If the configuration information and changes obtained after testing by both methods are not significant, this indicates that the results of the study are highly robust. First, the consistency threshold was raised from 0.8 to 0.85 for case rescreening, and configuration results did not change significantly. Secondly, this study further increased the case frequency threshold and performed further censoring of cases by raising the threshold from 8 to 9, and the results again did not change significantly. Therefore, the results of this paper are considered to be highly robust.

5. Conclusions

5.1. Research Conclusions and Recommendations

In the process of improving their innovation capacity, cities should pay attention to both external conditions such as the market value and economic resources, as well as internal conditions such as digestion and transformation in the innovation process, rather than blindly pursuing market and production values, in order to strengthen the management of basic resources, to make use of valuable technologies and knowledge, to internalize the resources into the city's resources and capabilities, and to make the city's innovation achievements sustainable. This study identifies six key causal variables from the four dimensions of absorption theory and explores their complex linkage effects on sustainability strategies in the urban innovation process. The results of the study form three complex configuration paths that affect sustainable urban development centered on the transformation of technological achievements, innovation management, and smart cities, and reveal that the economic and market bases, which are the dimensions of urban innovation acquisition, are not the core conditions for sustainable urban development. Synthesizing the results of the configuration analysis above, this paper summarizes the following research conclusions and recommendations.

First, the driving mechanisms of high sustainability in innovative cities are divided into four pathways. In the first configuration, the transformation of technological achievements as the core condition plays an important influential role, and this pathway shows that sustainability is not highly correlated with the basic resources and innovation capacity. When the city's basic resources are under pressure, the industrialization and marketization of technological achievements can lead to the application of new technologies and economic development, thereby achieving high sustainability in innovative cities. This configuration is consistent with the findings of Chen and Zhang [30,64]. The core conditions of the second configuration are government management and the technology outcome transformation, which emphasizes that the technology outcome transformation and government significantly influence the improvement of urban sustainability. This is in line with Huergo, Moreno, and Li, who argue that government management is an important external force driving the improvement of sustainability in innovative cities [43,44]. The core conditions of the third and fourth configurations are consistent with smart cities playing a more important role in this category, emphasizing that high sustainability can be achieved when the degree of technology adoption within the city is strong enough, regardless of whether sufficient external pressures are applied. The results of this study are consistent with those of the Jacobites and Paskalev [54,65]. However, unlike the above studies, this paper does not limit itself to exploring a single-dimensional element for research, but rather explores the sustainability mechanisms of new innovative cities based on a histological perspective and interprets the influencing factors of sustainability in the urban innovation process from a more comprehensive perspective.

Second, summarizing the results of the previous study, it can be found that the core factors that drive sustainable urban innovation are the transformation of technological achievements, government management, and smart cities, respectively. Therefore, recommendations can be made to promote higher sustainability in urban development strategies from the above perspectives. First, the transformation of technological achievements should be strengthened. From the perspective of sustainable development, each city should fully understand its technological innovation, reasonably invest resources, avoid wasting resources, strengthen the information communication and cooperation among various groups involved in the technology achievement transformation, and give full play to the overall coordinated utility of technology achievements in sustainable development. At the same time, according to the situation, strengths should be utilized and weaknesses should be avoided to transfer technology from other regions to form a situation of complementary resources and shared results. Secondly, the government should continue to implement its strategy on sustainable development for urban innovation so that more and more investors and managers realize that sustainable development is the way toward the future development of urban innovation, which would prompt more stakeholders to demand sustainable development from innovation institutions. At the same time, the improvement of sustainability-related content in policy documents and laws and regulations should be strengthened. Compared with macroscopic policies or regulations, more detailed and specific policies or guidelines of local governments are more likely to be noticed by innovation institutions, so we can start by strengthening local policies and regulations or industry guidelines to achieve the goal of sustainable development for urban innovation. Finally, cities should prioritize the development of soft infrastructure, improve their information network construction and e-service links, and strengthen the development and sharing of public resources. At the same time, they should strengthen the cultivation of the advantageous industrial clusters supporting the wisdom platform; grow and promote its differentiation to form the characteristic wisdom industry chain; and enhance the external flow of technology, talent, products, and services with the industry chain as the conduction. The multi-source real-time information channels should be strengthened to achieve sustainable application and self-organization supply system for users, to promote the bottom-up self-organization structure, and to attract diverse innovation sectors to participate and form the wisdom conduction ecosystem, forming characteristic application services and demonstration wisdom communities and gradually guiding the generation of advantageous wisdom industries with regional characteristics.

Finally, this study has three contributions. Firstly, it clarifies the mechanism of the relationship between the different dimensions of the absorptive capacity and sustainable development in urban innovation, which enriches and deepens the path mechanism affecting the sustainable efficiency of cities and also extends the study of the antecedent variables of urban innovation. Secondly, it further enriches and improves the theory of sustainable development by analyzing the enhancement path of sustainable development for innovative cities from the perspective of the view configuration. It provides valuable ideas and directions for further research on the topic of sustainable development for urban innovation in the future. Thirdly, it provides reliable practical support for the sustainable development of urban innovation; provides theoretical arguments based on the empirical basis for the topic; and provides new ideas for policymakers regarding the design, implementation, and evaluation of sustainable development policies.

5.2. Research Limitations and Future Research Directions

Based on the absorptive capacity theory, this paper innovated the allocation path for cities to achieve sustainable development from the perspective of allocation and has achieved certain theoretical and practical insights. However, this study still had the following limitations: (1) This study examined only six factors that have been shown to have an impact on the sustainability of innovative cities. There may be other factors that contribute to the sustainability of innovative cities, such as urban motivation, market orientation, and higher education. Therefore, the examination of these factors is a possible direction worthy of further research. (2) The data used in this study included survey data, and the subjective factors of the interviewees may lead to biased results. Therefore, objective measures should be introduced in future studies whenever possible. (3) Our sample in this study consisted of 72 high-innovation capacity cities in China, which may also lead to sample bias in the results. Given the complexity of China's economic development, future studies need to select data from other countries to test the hypotheses, expand the sample source and sample size, and improve the quality and applicability of the study.

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