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Digital Infrastructure for Urban Innovation and Entrepreneurship: Logic, Mechanisms and Safeguards

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Abstract: Enhancing support for innovation and entrepreneurship and boosting vitality of urban innovation and entrepreneurial are critical tools for steady growth in China. Starting from the historical and practical logic of infrastructure development perspectives, this paper analyzes the role of digital infrastructure to promote urban innovation and entrepreneurship from aspects of cost and economy of scale. Moreover the paper also explores the safeguard measures of digital infrastructure to add up to urban innovation and entrepreneurship based on the government side. The goal of this paper is for improving digital infrastructure to drive urban innovation and entrepreneurship and fuel urban economy and employment.

1. Introduction

According to the “Global Entrepreneurial Ecosystem Index 2022 Report” released by Starup Blink, a global entrepreneurship research organization, China ranked No.10 in the world with Beijing and Shanghai ranked No.6 and No.7 respectively in the innovation eco-city ranking. Since the “2015 Government Work Report” officially proposed to make "mass entrepreneurship and innovation" a new engine for economic development, encouraging innovation and entrepreneurship has become an important point for stabilizing growth, preserving employment and promoting transformation. However, in recent years, uncertainties such as changes in international situation and impact of the pandemic have led to an economic downturn and a decrease in the demand for talent by enterprises. Therefore encouraging innovation and entrepreneurship remains an essential measure to alleviate the employment tension in the country.

With rapid moving of the new round of scientific and technological revolution around world, the new digital infrastructure formed by the combination of new-generation information technology-big data, 5G, artificial intelligence, blockchain and so on-has become a new driving force to promote China's industrial change and economic structural transformation. "Digital" has become a crucial factor endowment in social production activities, and urban digital infrastructure as the bearer of "digital" can give play to its great potential to realize the value of innovation and entrepreneurship.

As the new digital infrastructure is increasingly becoming a big strategic resource for national and regional promotion of high-quality development, exploring the logic and mechanism of the effects of digital infrastructure on urban innovation and entrepreneurship as well as its safeguard

measures can provide learnable ideas for the policies related to the infrastructure construction of governments around China as well as the formulation and implementation of urban innovation and entrepreneurship development strategies.

2. Research Significance

Most of the existing research focuses on the economic effects generated by the construction of digital infrastructure and its mechanism of action, but research on the relationship between digital infrastructure and innovation and entrepreneurship is relatively rare. For example, these scholars have conducted in-depth studies on the economic effects generated by digital infrastructure on the manufacturing industry [1], [12], [13], and [14]. The theoretical significance of this paper lies in sorting out the internal logic of urban infrastructure construction and innovation and entrepreneurship. At the same time, this paper combines with the classical economic theory to carry out an in-depth study of digital infrastructure's role mechanism, which innovates the research perspective of the role mechanism of scale effect.

The practical significance of this paper is to provide more decision-making references for government and entrepreneurial business participants about policies making. This paper wants to actively respond to the central government's dual creative call "mass entrepreneurship and innovation", contribute to the national economic recovery in post-epidemic era, stabilize social employment and encourage innovation and entrepreneurship.

3. The Logic of Digital Infrastructure Promoting Urban Innovation and Entrepreneurship

The development of urban infrastructure is closely related to its innovation and entrepreneurship development. Urban infrastructure construction has different characteristics and needs in different times, and its promotion of urban innovation and entrepreneurship level is not only necessary for the times but also for the development of the real economy.

3.1. Historical Requirement: Overview of China's Digital Infrastructure Construction

In the first half of 20th century, China transitioned from a traditional agricultural economy to a modern industrial economy, with the majority of the industrial and commercial class-accounting for approximately 2.5% of the national population-concentrated in various provinces and cities along the Yangtze River and coastal areas. At this time, urban infrastructure construction emphasized the traditional physical infrastructure, viewing the construction of infrastructure systems such as railways, highways, and waterways as the main focus. The railways in the coastal areas or along the Yangtze River account for 53%, and electricity accounts for 87% of the country. It is also a gathering place for new industries and enterprises. Among the 1302 factories that existed between 1920 and 1930, about two-thirds were located in the four major cities along the Yangtze River: 645 in Shanghai, 110 in Wuxi, 38 in Hankou, and 34 in Dalian [7].

Since the founding of the People's Republic of China, China's infrastructure has achieved some historic achievements. At the beginning, China actively promoted the construction of traditional physical and information communication infrastructure, obtaining a series of significant innovative achievements and significant improvements in innovative application capabilities, such as independent intellectual property rights in railway technology, major breakthroughs in key communication technologies, and formulation of 5G standards. In the digital era that began globally in 2000, there were differences in the endowment of digital economy development factors supported by regional digital infrastructure, which could influence regional innovation through talent aggregation, digital finance and industrial agglomeration [8]. Therefore, from the dimension

of temporal logic, when China vigorously developed its industrial manufacturing industry in the past, the good physical infrastructure of cities could better meet the transaction and transportation needs of innovation and entrepreneurship. However, with the advent of digital economy era, only by promoting the construction of digital infrastructure can we better meet the information and data flow needs of urban innovation and entrepreneurship.

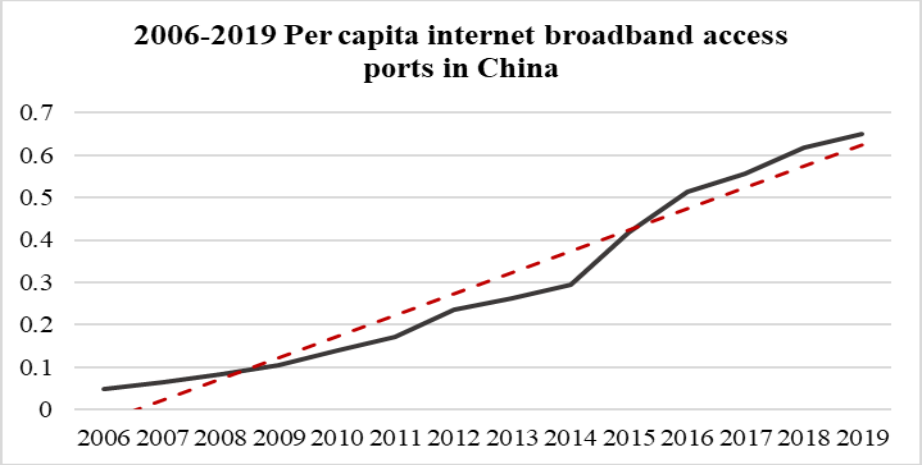

Figure 1: China's Digital Infrastructure Development Mapping.

Through reference literature to illustrate used indicators such as the number of internet users to measure the level of digital infrastructure [2, 3], as shown in Figure 1. The per capita number of internet broadband access ports in China has increased from 0.0488 in 2006 to 0.7216 in 2021. There is also regional heterogeneity among them, with the eastern coastal areas having a higher starting point and more advanced and complete urban infrastructure, followed by the central and western regions. As shown in Figure 2, comparing the average of China's regional innovation and entrepreneurship index and the growth trend of per capita internet broadband access ports, it can be roughly inferred that when the regional innovation and entrepreneurship index increases, it may be promoted by a significant increase of digital infrastructure. When the innovation and entrepreneurship index drops, it may be more likely due to external environmental uncertainties than a slowdown in digital infrastructure construction, such as the significant decline in China's innovation and entrepreneurship index caused by the 2008 global financial crisis.

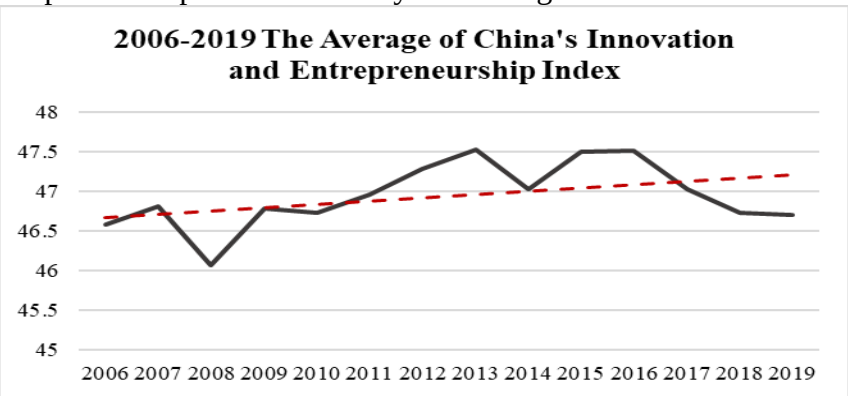

Figure 2: China's Innovation and Entreneurship Index Mapping.

3.2. Realistic Logic: Digital Infrastructure Supports Urban Innovation and Entrepreneurship

The infrastructure of innovation and entrepreneurship refers to the infrastructure that provides convenient conditions for innovation and entrepreneurship activities. These basic conditions are

necessary for innovation and entrepreneurship activities but cannot be solved by personal factors, including industry technology infrastructure, communication infrastructure, logistics infrastructure, intelligence and information infrastructure etc. In the process of innovation and entrepreneurship activities, personal factors such as mentality, knowledge and ability, experience and technology, and funding are key factors for their success. However, environmental factors such as urban infrastructure, government policies, market opportunities, financing constraints etc. also play a decisive role in urban innovation and entrepreneurship activities, and can even affect the development of personal factors.

On the one hand, digital technology basically involves various industries, and sub industries such as agricultural automation, intelligent manufacturing, cultural entertainment, and digital finance are all facing opportunities and challenges of digitization. Therefore, innovation and entrepreneurship activities in a specific field, especially in digital related industries such as ICT product services, e-commerce, financial services, logistics services, etc., require the support of advanced and complete digital infrastructure services in cities. As shown in Table 1, the regional innovation level is measured by the per capita domestic patent acceptance volume. The top five are Beijing, Shanghai, Jiangsu, Guangdong, and Zhejiang provinces, all of which are cities in the eastern region and mostly coastal, and all of which include the first batch of pilot cities for "Broadband China". The level of digital infrastructure is relatively high, with per capita internet port access ranking high (Guangdong Province and other provinces with lower rankings are greatly affected by population density).

On the other hand, the construction of digital infrastructure itself can generate positive economic effects to improve the economic environment for innovation and entrepreneurship. Cardona M. pointed out that digital infrastructure can promote economic and social development at different levels in both developed and underdeveloped countries [4]. Yajun Liu used "Broadband China" as a quasi natural experiment to prove that digital infrastructure construction measures stimulate urban innovation vitality, drive the development of digital enterprises, and improve urban entrepreneurship activity to promote the development of urban digital economy [9].

Therefore, in order to cope with the triple pressure of shrinking demand for economic recovery, attacking shocks, and weakening expectations in China, also to alleviate the still tense employment situation in China, it is necessary to fully leverage the support role of urban digital infrastructure construction for innovation and entrepreneurship, achieving digital empowerment for innovation and entrepreneurship.

Table 1: 2021 Ranking of Per Capita Domestic Patent Acceptances in China.

Region	Patent Acceptances (per capita)	Rank	Internet Access (per capita)
Beijing City	129.3439	1	5
Shanghai City	93.5789	2	4
Jiangsu Province	81.9156	3	6
Guangdong Province	77.3126	4	15
Zhejiang Province	76.9414	5	3
Tianjin City	65.8929	6	2
Fujian Province	38.3814	7	8
Shandong Province	36.3294	8	22
Anhui Province	32.1326	9	25
Hubei Province	30.0706	10	26

4. Echanism of Digital Infrastructure Promoting Urban Innovation and Entrepreneurship

The existing research on the impact mechanism of digital infrastructure on urban innovation and entrepreneurship is relatively rich, but the mechanism analysis varies from different research perspectives. Ke Wang elaborated and demonstrated the impact mechanism of new digital infrastructure on urban entrepreneurship activity from three aspects: cost, market, and financing [10]. Lichao Wu pointed out that urban digital construction promotes regional entrepreneurship levels through resource allocation, information sharing, knowledge spillover, and labor quality improvement. On the basis of existing mechanism research, this article combines classic economic and trade theories - transaction cost theory and economies of scale theory, to systematically study and summarize the mechanism of digital infrastructure promoting urban innovation and entrepreneurship from the perspective of cost effect [11].

4.1. Cost Effect

This article analyzes the cost effect of digital infrastructure construction on improving the level of urban innovation and entrepreneurship from four aspects: investment, factors, information, and sales. Details are shown as Figure 3.

Firstly, from the perspective of investment costs in innovation and entrepreneurship, under the influence of digital technology, enterprises can integrate and apply digital technology, and have more efficient and advanced software and hardware equipment with lower costs; At the same time, digital infrastructure promotes enterprises to apply digital technology to their organizational management system, reducing internal information asymmetry, enhancing the effectiveness of enterprise decision-making, and thereby reducing investment in management costs. Therefore, the improvement of urban digital infrastructure attracts more participants by saving investment costs for innovation and entrepreneurship.

Secondly, from the perspective of factor costs, highly skilled talents with outstanding comprehensive qualities are the main force of innovation and entrepreneurship. The improvement of urban digital infrastructure construction can attract more human capital and make its flow more convenient, thereby reducing the cost of obtaining people required for urban innovation and entrepreneurship activities; The development of digital technology can promote the efficient and convenient development of the financial services industry. The government strengthens financial support for related industries, relaxes financing restrictions, and thus saves the cost of obtaining funds for urban innovation and entrepreneurship. On the other hand, the cost savings of enterprises in non productive activities such as equipment and management are conducive to increasing their investment in research and development to achieve greater innovation benefits; Meanwhile, compared to traditional physical innovation and entrepreneurship, modern innovation and entrepreneurship supported by digital infrastructure can obtain knowledge spillover effects more conveniently and diversified through the Internet, big data, and other means, thereby promoting the development of urban innovation and entrepreneurship.

Thirdly, it pointed out that transaction costs are the expenses required to obtain accurate market information, negotiate, and recurring contracts, which are composed of information search costs, negotiation costs, contracting costs, supervision costs, and possible default costs [5]. Thanks to the construction of new digital infrastructure, the innovation and application of digital technologies such as big data, 5G, and artificial intelligence, innovative and entrepreneurial enterprises have broken the limitations of time and space, promoted the formation of effective information markets, provided broad trading platforms and efficient communication tools, and effectively reduced the cost of information search and communication for enterprises; At the same time, paperless office, as an important part of enterprise digitization, can also greatly save expenses on daily material costs

such as contracting and supervision of enterprise operations.

Fourthly, the widespread application of digital technology in the enterprise value chain has reduced the number of intermediaries in the value chain, enabling enterprises to directly connect with customers and achieve low-cost and effective relationship maintenance. On the other hand, in the digital era, online marketing is becoming increasingly mature, and diversified online marketing platforms can quickly open up marketing channels for enterprises. Compared to traditional offline marketing models, they can create brand images in a shorter time and at a lower cost, achieving profit growth.

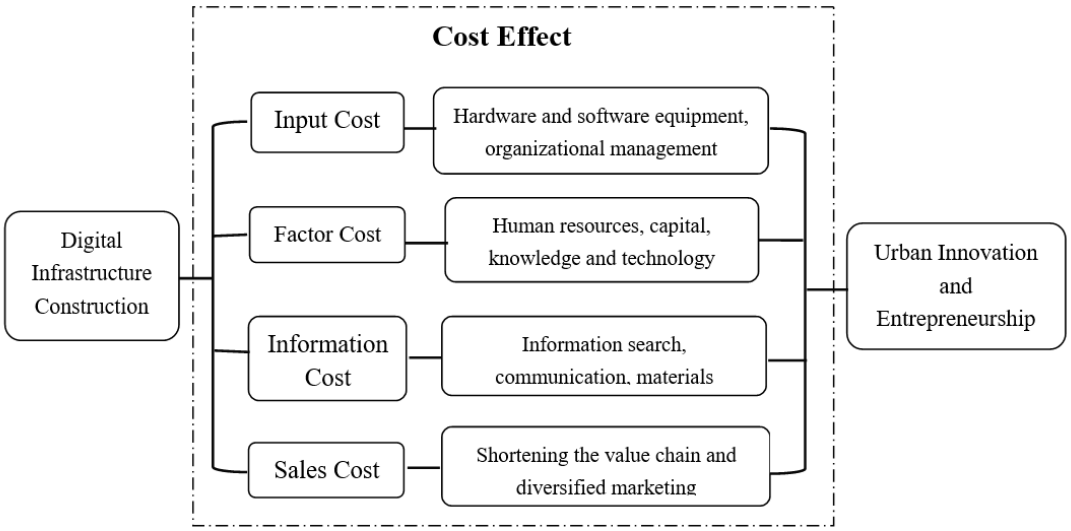

Figure 3: Cost Effect of Digital Infrastructure Promoting Urban Innovation and Entrepreneurship.

4.2. Economy of Scale Effect

The related materials proposed that economies of scale refer to the moderate expansion of production scale, the more effective allocation of production factors, and the reduction of average product costs resulting in greater economic benefits [6]. There are two ways to achieve economies of scale: internal economies of scale - which rely on the full and effective utilization of resources by enterprises, the improvement of organizational and operational efficiency, and external economies of scale - which rely on the rational layout, division of labor, and collaboration among multiple enterprises. The following Figure 4 presents a clear explanation.

The internal economies of scale are mainly reflected in the expansion of digital infrastructure into the market. The improvement of digital infrastructure can more accurately and effectively connect and match the market, implicitly enhancing the market perception ability of urban innovation and entrepreneurship entities, providing convenient conditions for them to achieve economies of scale and obtain greater profits. At the same time, the digital transformation of various industries can stimulate the demand for creating more diversified markets, thereby providing favorable conditions for the expansion of enterprise business scale.

External economies of scale are mainly reflected in the agglomeration of industries, enterprises, and key factors. The construction of urban digital infrastructure enhances the attractiveness of the city, and a good digital infrastructure is an important consideration factor for selecting upstream and downstream related enterprises. The aggregation and flow of key core elements such as data depend on the level of digital infrastructure.

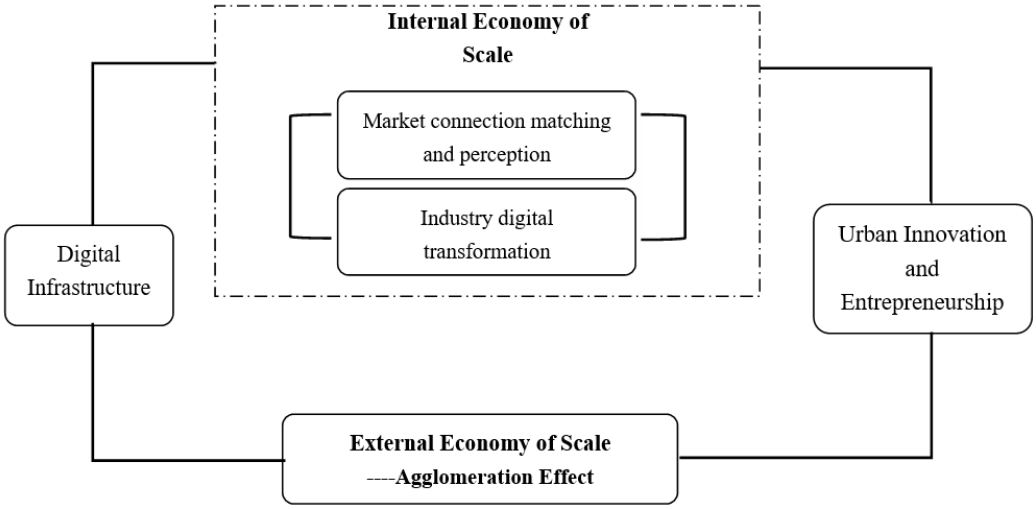

Figure 4: Economy of Scale Effect of Digital Infrastructure Promoting Urban Innovation and Entrepreneurship

5. Safeguard Measures to Promote Urban Innovation and Entrepreneurship through Digital Infrastruture

5.1. Strengthen the Construction of new Digital Infrastructure and Accelerate its promotion and application

Regional governments should increase investment in core technologies and basic research of digital infrastructure. This research actively supports the construction of key laboratories related to the construction of digital infrastructure, encourages school-enterprise research cooperation, and strives to overcome technical barriers. At the same time, the government should attach importance to the security issues of digital infrastructure construction, establish an endogenous network security system in key areas such as finance, public services, and information communication, and ensure security while promoting the application of digital infrastructure.

5.2. The Government Encourages Enterprises to Digitalize and Supports Innovative and Entrepreneurial Enterprises

The government has introduced preferential tax policies and encouraged enterprises in key areas to promote digital transformation based on urban digital infrastructure, in order to promote urban innovation and entrepreneurship. At the same time, the government should encourage more enterprises to innovate and participate in the competition of the global digital economy, expand the scale of the urban internet market, and promote the influence of digital infrastructure and its deepening construction.

5.3. Establish a Coordination Mechanism for Digital Infrastructure and Coordinate the Development of Various Regions and Industries

According to the heterogeneity of geographical regions and industrial characteristics of each city, the layout, structure, function, and development mode of digital infrastructure vary in different regions and fields. Therefore, each city should comprehensively consider its own location and resource endowment advantages, and formulate urban infrastructure construction plans tailored to

local conditions to more effectively stimulate the vitality of urban innovation and entrepreneurship.

6. Conclusion

This article is based on the positive relationship between urban digital infrastructure construction and urban innovation and entrepreneurship, and conducts a systematic analysis of the logic and mechanism of its role, combining theory and practice. It further provides reference ideas for regional governments to play the role of digital infrastructure to ensure the vitality of urban innovation and entrepreneurship. The construction of digital infrastructure is a need in our digital era, a need to address the current digital transformation of industries, and a need to promote entrepreneurship and innovation to alleviate employment pressure; Digital infrastructure has played a promoting role in urban innovation and entrepreneurship through cost and economies of scale effects; At the same time, the construction planning of urban digital infrastructure should also be combined with the characteristics of urban location and economic development, in order to achieve its driving effect on urban innovation and entrepreneurship, and alleviate the current tense employment situation in China.

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