

The Impact of New Infrastructure Development on Entrepreneurial Activity

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Abstract: We investigate how the development of new infrastructure influences entrepreneurial dynamics across China, utilizing panel data from 30 provincial-level administrative units (excluding Tibet, Hong Kong, Macao, and Taiwan) between 2007 and 2022. The analysis focuses on three key dimensions of infrastructure development: "information infrastructure", "integrated infrastructure", and "innovation infrastructure". The results show that: (1) all three types of "new infrastructures" have a significant and stable positive effect on entrepreneurial activity. (2) In particular, "information infrastructure" is particularly significant in enhancing entrepreneurial activity, and its main mechanism is that "information infrastructure" promotes the development of innovative industries, lowers market entry barriers, and greatly facilitates information exchange and interaction, thus contributing to the formation of a favorable entrepreneurial environment. The main mechanism is that "information infrastructure construction" promotes the development of innovative industries, lowers market entry barriers, and greatly facilitates information exchange and interaction, thus contributing to the formation of a favorable entrepreneurial ecosystem. (3) A further classification test of 30 provinces according to their level of economic development shows that "new infrastructure" has a more significant entrepreneurial incentive effect in provinces with a higher level of economic development, which implies that the continuous improvement of the business environment and policy system is the key to further realize the entrepreneurial incentive effect of "new infrastructure", which is the key to further improve the business environment and policy system. This implies that continuous improvement of the business environment and policy system is the key to further realize the entrepreneurship promotion effect of the "new infrastructure".

Keywords: New Infrastructure Development; Entrepreneurial Activity; Entropy Approach; Fixed Effects Modeling;

1. Introduction

The construction of new infrastructure is a strategic initiative aimed at addressing the fundamental demand for high-quality economic development in the contemporary era in China. This initiative involves the promotion of a series of infrastructure construction projects designed to catalyze the digital transformation, intelligent upgrading, and convergence and innovation of the economy. The overarching framework for these projects is the information network, with technological innovation serving as the primary catalyst for change. The difference between traditional infrastructure and new infrastructure is mainly reflected in the following four aspects: (1) service object: Traditional infrastructure such as highways, railroads, airports, etc. mainly serves the flow of people and logistics, which greatly facilitates the exchange of people and trade of goods; while new infrastructure such as 5G network, artificial intelligence and blockchain, etc., prioritize the optimized processing of information and capital flow. These infrastructures not only facilitate instantaneous peer-to-peer information services but also accelerate the flow of funds through the Internet and the Internet of Things (IoT) financial payment means, thereby introducing unprecedented convenience to network service trade. (2) the economy of investment: Traditional infrastructure is often accompanied by high investment and long recovery cycle; in contrast, the investment scale of new infrastructure projects varies, but generally has a shorter return cycle. (3) The main body of investment: Traditional infrastructure led by the government, while the new infrastructure investment is more dependent on the spontaneous behavior of market players, the implementation of independent investment, self-financing

model. (4) The economic and social benefits of investment: Traditional infrastructure construction through the construction of a number of transportation hubs, for the development of urban economy has laid a solid foundation; the new infrastructure investment has constructed the life economy, intelligent economy, digital economy, the development of the future civilization of these cornerstones of human civilization, not only directly spawned the digital economy industry system, but also promote the digital transformation of traditional industries, thus producing a significant superposition effect and multiplier effect, injecting new economic development of high quality into the economy. effect, injecting new kinetic energy for the high-quality development of the economy[1]. In recent years, China has witnessed a consistent progression in its infrastructure development, a development that has profoundly influenced the shaping of its novel growth model. Specifically, the construction of new infrastructure has fostered innovation in a variety of high-tech industries, facilitating the emergence of novel business entities and investment opportunities. This has contributed to substantial advancements in the economy and high-quality economic growth[2]. Based on this, this paper focuses on the mechanism and effect of new infrastructure construction on regional entrepreneurial activity.

2. Literature Review

There is a growing academic interest in new infrastructure development and entrepreneurial activity.

Some scholars have put forward their own views on the categorization and scope of new infrastructure. The classification system developed by Wu Xianfu (2021), which

divides infrastructure into three categories—namely, "information infrastructure construction," "integrated infrastructure construction," and "innovation infrastructure construction" [3]—has gained significant traction within academic circles due to its scientific rigor and practical applications. This classification system serves as a foundational framework for the present study, providing a theoretical underpinnings for the analysis. In addressing the scope and measurement standard of new infrastructure, Wang Wenbin(2022) proposes a set of indicators, including the degree of Internet coverage, the number of mobile terminals, the density of 5G base stations, the total length of urban bus lines, the mileage of highways, and the mileage of rail transit operations [4]. Kong Fangxia has proposed a measurement method based on the investment perspective. She and her team use the fixed asset investment in information transmission, software, and information technology services to indicate the level of information infrastructure construction. They measure the level of integration infrastructure construction by the product of the integration coefficient of "new" and "old" infrastructure and the fixed asset investment in traditional infrastructure. The level of innovation infrastructure construction is reflected by the fixed asset investment in scientific research and technology services and health and social work. The level of integration infrastructure is measured by the product of the "new" and "old" infrastructure integration coefficient and traditional infrastructure fixed asset investment. The level of innovation infrastructure is reflected by the amount of fixed asset investment in the scientific research and technology service industry and health and social work [5]. We adopt this method in the subsequent empirical analysis.

As far as entrepreneurial activity is concerned, research focuses mainly on the measurement and assessment of its development index and the exploration of influencing factors. As far as the influencing factors are concerned, the existing research involves multiple dimensions, including but not limited to policy support at the institutional level, property rights protection, talent flow at the factor level, spatial correlation at the regional level, and digital economy at the technological level, among other aspects[8]. In terms of new infrastructure, since the 2018 Central Economic Work Conference established it as a key development strategy, academics have conducted in-depth discussions around its conceptual definition, connotation analysis, category delineation, and theoretical discussions on the characteristics of the era together with its driving effect on high-quality development of the economy and optimization strategies [9], especially the impacts of new infrastructure on improving production efficiency, expanding the scale of exports, facilitating the transformation and upgrading of industries, advancing environmental protection and safeguarding employment have also been revealed [10]. However, extant literature on the relationship between new infrastructure and entrepreneurial activity in China is limited. The existing literature is largely confined to exploring the impact of a particular type of new infrastructure on entrepreneurial activity [11]. This focus, however, does not comprehensively cover the scope of the new infrastructure proposed by the state and its essential attributes. In this regard, foreign scholars have accumulated a relatively rich research literature. However, the impact of new infrastructure development on entrepreneurship remains a subject of debate and has not yet reached a consensus. On the one hand, Marques (2017), based

on the analysis of Global Entrepreneurship Monitor (GEM) data of 40 developing countries from 2005 to 2010, found that good business infrastructure can effectively stimulate entrepreneurial vitality [12]; on the other hand, Audretsch (2015), employing a panel data analysis of disparate German regions, have ascertained that the construction of diverse types of infrastructure exerts a predominantly favorable impact on entrepreneurial activity. However, the efficacy of these infrastructures varies in terms of their entrepreneurial impact. Specifically, there is a progressive diminution in the propensity for infrastructure such as broadband networks and rail transportation to foster entrepreneurship.[13]. In addition, Bennett (2019) finds that private infrastructure investment exhibits more significant effects in terms of promoting employment and boosting entrepreneurship than public infrastructure investment [14].

As we can see from the above studies, the research on the impact of new infrastructure construction on regional entrepreneurial activity is still limited to specific areas, and the specific impact of the overall level of development of new infrastructure on entrepreneurial activity and its intrinsic mechanism are yet to be explored, and the relevant research still needs to be further expanded. This paper is an attempt to systematically investigate the inherent logical relationship between the overall level of development of new infrastructure development and urban entrepreneurial activity. Its main contributions are: (1)It theorizes the impact of new infrastructure development on urban innovation, which not only provides lessons and references for further optimization of urban planning, promotion of employment, and enhancement of the dynamism of market economic growth. It is also a contribution to the research literature on urbanization, informatization and the impact of urban development on entrepreneurship. (2) It employs a comprehensive evaluation index of new infrastructure development to assess its developmental level, thereby effectively addressing the limitations of extant studies, which predominantly concentrate on a solitary aspect of "new infrastructure." It also enables a comprehensive consideration of the impact of new infrastructure on regional entrepreneurial activity, thus offering a more nuanced and comprehensive perspective. (3) In this paper, we not only use the fixed effects model for the study, but we also conduct a series of robustness tests to make sure that the results are robust, which makes the results more credible.

3. Theoretical Analysis and Research Hypothesis

The development of information infrastructure and integrated infrastructure has been demonstrated to have a positive effect on the economic development of a region, as well as to effectively reduce the barriers and costs associated with entrepreneurship. In particular, the development and construction of information infrastructure which is represented by 5G networks, the Internet of Things, artificial intelligence, etc., can break down the space-time barriers to entrepreneurship, expand the radius of production collaboration and the scope of market exchanges among enterprises, attract the agglomeration of high-quality production factors, and ultimately form entrepreneurial ecosystems with a scale effect. In addition, the construction of information infrastructure also optimizes the information dissemination channels, not only reduces the cost of

information acquisition and exchange, but also effectively improves the problem of information asymmetry, so as to enhance the efficiency of market resource allocation. At the same time, the construction of integrated infrastructure is also effective in reducing the cost of entrepreneurship. Taking digital infrastructure as an example, its degree of perfection directly affects the regional business environment, and can effectively alleviate constraints such as traffic congestion and unstable power supply, thus reducing the operating costs of enterprises and improving operational efficiency.

The construction of innovation infrastructure has significantly enhanced entrepreneurs' ability to acquire and process technological information, thereby promoting the efficiency of technological innovation and accelerating the development of new products. For example, the widespread application of 5G network technology has opened up many richer application scenarios for many emerging digital enterprises, thus stimulating new market demand; while the popularization of IoT technology has helped enterprises realize intelligent management of equipment, effectively cutting down their operating costs.

In addition, the new infrastructure itself has been demonstrated to facilitate the optimization of resource allocation and the promotion of a rational layout of enterprises. Based on this, this paper proposes the following research hypothesis: new infrastructure construction has a positive impact on regional entrepreneurial activity.

4. Models, Variables and Data Sources

4.1. Model Construction

$$\ln Ent_{it} = \alpha_0 + \alpha_1 \ln Ent_{it-1} + \alpha_2 \ln Inf_{it} + \alpha_3 \ln Int_{it} + \alpha_4 \ln Inn_{it} \quad (1)$$

In this model, the index i denotes distinct provincial administrative regions, with i ranging from 1 to 30. The index t signifies the year, with t ranging from 1 to 16. The explanatory variable Ent denotes the entrepreneurial activity in the region; the explanatory variables Inf is the information infrastructure building index, Int is the integration infrastructure building index, and Inn is the innovation infrastructure building index.

4.2. Variable Definitions

4.2.1. Explained Variables

The explained variable Ent is the entrepreneurial activity of a region, which the author chooses to measure with the China Entrepreneurial Activity Index (CPEA), i.e., CPEA Index = Cumulative Number of New Private Enterprises in the Region / Regional Labor Force.

4.2.2. Explanatory Variables

The core explanatory variables of this paper include the following three:

Information infrastructure construction index (Inf), referring to the study by Yaru Pan (2020) [15], which measures the level of innovation infrastructure construction by the amount of fixed asset investment in information transmission, software and IT services.

Integration infrastructure construction index (Int), referring to the index system researched and established by Kong Fangxia [5] (2022), is measured by the product of the integration coefficient of "new" infrastructure and "old" infrastructure and the traditional infrastructure construction investment. Among them, the integration coefficient is

measured by the product of the level of "old" infrastructure (the composite index calculated by the entropy weight method for the fixed asset investment in gas, electricity, heat, water, etc., transportation, warehousing and postal services, and water conservancy project, environmental management industry and the management of public facilities) and the level of "pure" new infrastructure (the level of gas, electricity, heat, water, etc.) and the level of traditional infrastructure. The level of new infrastructure is measured by the coupling of the "pure" level of new infrastructure (the entropy-weighted composite index of investment in fixed assets in information infrastructure and innovation infrastructure).

The Innovation Infrastructure Development Index (Inn), referring to the study by Kong Fangxia [5] (2022), uses the amount of fixed asset investment in scientific research and technology services and the amount of fixed asset investment in health and social work as the measurement indicators.

Before conducting the empirical analysis, we assigns weights to the three explanatory variables through the entropy weighting method and obtains the following weights:

Inf 's weight 0.5728

Int 's weight 0.2093

Inn 's weight 0.2179

Among them, Inf has the largest weight and has the greatest influence on the results.

Table 1. Setting of explanatory and interpreted variables

Explained Variables	Entrepreneurial Activity (Ent)	Number of new private enterprises per 10,000 persons
Explanatory variables	Information infrastructure construction index (Inf)	Fixed-asset investment in the information transmission, software and information technology services industry
	Integration infrastructure construction index (Int)	Results obtained by multiplying the coefficient of integration of "new" and "old" infrastructure by the amount of investment in traditional infrastructure development
	Innovation infrastructure construction index (Inn)	Fixed-asset investment in scientific research and technology services and fixed-asset investment in health and social work

4.3. Data Sources

This study uses fixed asset investment in infrastructure construction in China's 30 provincial-level administrative regions, excluding Tibet, Hong Kong, Macao and Taiwan, from 2007-2022, and involves a wide range of data sources, including the China Fixed Asset Investment Statistical Yearbook, the CSMAR database, the EPS Statistical Database, the statistical yearbooks of each province and city from 2007-2022, and the National Economic and Social Development

Statistical Bulletin, and many other sources. For individual values missing in the data collection process, this paper uses the ARIMA model to fill them in. We have enough technical ability to implement our research program, and at this stage, we use relevant software and model building to find the relevant laws easily and effectively.

5. Empirical Analysis

5.1. Regression Analysis

The estimation results of the dynamic panel model shown in Table 2 indicate that the regression coefficient of the variable Inf is 0.0122 with a p-value of 0.040. This value falls short of the predetermined statistical significance level, which is set at 0.05. This result indicates that the construction of the information infrastructure has a significant positive impact on regional entrepreneurial activity.

Possible explanations for this phenomenon are: firstly, the development and application of information technology has given rise to new economic activities and practice patterns, and the increase in investment in fixed assets in information infrastructure not only promotes the development of innovative industries, but also lowers the threshold of entry into the market, which effectively enhances the vitality of regional innovation and entrepreneurship. Secondly, according to the theory of network externality, once the user base of an application is expanded, its value and utility are also increased. When an application reaches the critical point of network effect, its impact on the economy will increase exponentially. Therefore, the efficacy of regional network infrastructure is largely dependent on the number of Internet applications and their user activity in the region, which to some extent explains the positive impact of information infrastructure construction on entrepreneurial activity. Finally, information infrastructure construction accelerates the accumulation and circulation of social capital by optimizing the information dissemination network and enhancing social interactions, thus contributing to the formation of a favorable entrepreneurial environment, which in turn enhances regional entrepreneurial activity.

The regression coefficient of variable Int is 0.0677 with a p-value of 0.000, which is also less than the significance level of 0.05. The result indicates that there is a significant effect of integration infrastructure development on the dependent variable.

The reasons for this result can be attributed to the following:

(1) The digital upgrading of infrastructure in the transportation, storage and postal sectors, coupled with the construction of intercity rail transit, has facilitated the enhancement of interregional linkages and interactions, which in turn has facilitated the flow of economic and capital flows. (2) The upgrading of water infrastructure not only promotes the flourishing development of agriculture and its related industries, but the favorable conditions and conducive environment it provides also helps entrepreneurs in the region to start their own businesses. It also plays a key role in enhancing the efficiency of water allocation and utilization within and across regions. (3) The digital upgrading of power infrastructure development can provide a stable power supply to the region, especially for manufacturing and high-tech industries, and provide entrepreneurs with more advanced technological conditions and a better production environment. Overall, the integration of infrastructure development has had a significant positive impact on the increase in entrepreneurial activity by facilitating interregional economic factor mobility and synergistic development, and by providing better production and technological conditions for entrepreneurs.

The results in Table 2 show that for every one unit increase in fixed asset investment in innovation infrastructure, entrepreneurial activity in the region grows by 0.0140, with a p-value of 0.002, which is less than the significance level of 0.05, indicating that the contribution of innovation infrastructure development to the growth of entrepreneurial activity is more significant.

Possible explanations for this result are that the inputs and applications of new technologies help firms to improve product quality, increase productivity and develop new entrepreneurial opportunities. Innovation infrastructure development contributes to strengthening intellectual property protection, which in turn incentivizes innovation. In addition, the building of innovation infrastructure itself includes a large number of innovation resources, which cover a variety of resource conditions such as R&D resources, market research, talent pool and capital investment, all of which are essential parts of the innovation and entrepreneurship process. From a comprehensive point of view, the continuous improvement of innovation infrastructure can effectively attract high-quality talents and research teams, thus strengthening the competitive advantages of the regional innovation system, and ultimately realizing the enhancement of regional entrepreneurial activity through the optimization of the innovation ecology.

Table 2. Fixed effects model estimation results

Ent	Coefficient	Std. err.	t	P> t	[95% conf. interval]
Inf	0.0122	0.0059	2.08	0.040	0.0006 0.0239
Int	0.0677	0.0163	4.15	0.000	0.0354 0.1000
Inn	0.0140	0.0044	3.15	0.002	0.0052 0.0228
-cons	2.8017	0.1741	16.10	0.000	2.4570 3.1464
F test that all u_i=0: F(29, 117)=4.33					Prob>F=0.0000

The intercept term is 2.8017 with a p-value of 0.000, which is less than the significance level of 0.05. It suggests the presence of substantial disparities in entrepreneurial activity

across provinces. The F-test results show a significant individual fixed effect (p-value of 0.0000), which indicates that there is a significant difference in entrepreneurial

activeness among different provinces.

A comprehensive evaluation of the data in the entirety of the table indicates that $\text{Prob} > F$, thereby signifying that new infrastructure development exerts a substantial influence on entrepreneurial activity.

5.2. Robustness Check

In order to verify the robustness of the results of the regression analysis, a robustness test is conducted from the following two aspects.

(1) A random effects model was used to test the raw data and the results are shown in Table 3. p-values were 0.030, 0.001, and 0.001. The results indicate that all three aspects of infrastructure development contribute significantly to the growth of entrepreneurial activity.

(2) We tested the findings for robustness by varying the study sample and the results are presented in Table 4. The theoretical basis for implementing this test is that the gross regional product (GDP) is usually considered to be an

important indicator of the level of economic development of a region. Theoretically, an increase in GDP may have the potential to exert a positive influence on regional entrepreneurial activity, as higher levels of economic development are usually accompanied by more business opportunities and a better entrepreneurial environment. The coefficient is 0.0001 with a significant p-value of 0.003. It indicates that for every 1 unit increase in regional GDP, regional entrepreneurial activity increases by 0.0001 units on average.

The positive impact of the core explanatory variables information infrastructure development, integration infrastructure development, and innovation infrastructure development on regional entrepreneurial activity remains significant despite the use of a random effects model and changing the research sample. This result is consistent with the previous benchmark regression results and verifies the robustness of our findings.

Table 3. Random effects model test results

Ent	Coefficient	Std. err.	z	$P > z $	[95% conf. interval]
Inf	0.0126	0.0058	2.17	0.030	0.0012 0.0240
Int	0.0529	0.0155	3.42	0.001	0.0226 0.0832
Inn	0.015205	0.0044	3.48	0.001	0.0067 0.0238
-cons	2.8545	0.3049	9.36	0.000	2.4257 3.4521

Table 4. Results of altered sample test

Ent	Coefficient	Std. err.	t	$P > t $	[95% conf. interval]
GDP	0.0001	0.0000	3.03	0.003	0.0003 0.0002
-cons	-0.3597	1.2761	-0.28	0.779	-2.8866 2.1672
F test that all $u_i = 0: F(29, 119) = 2.51$					$\text{Prob} > F = 0.0003$

6. Results

Overall, new infrastructure has a significant and stable positive contribution to boosting entrepreneurial activity. Information infrastructure plays a particularly important role in driving the growth of entrepreneurial activity; at the same time, integration infrastructure and innovation infrastructure also contribute significantly to the growth of entrepreneurial activity.

In addition, the impact of new infrastructure development on entrepreneurial activity shows regional variability, depending on the level of economic development of each region. Specifically, the effect of new infrastructure development on entrepreneurial activity is significant in more economically developed regions, while it is relatively insignificant in less economically developed regions. The possible explanations are: on the one hand, although less economically developed regions already have better new infrastructures, local entrepreneurs may not fully realize the value of these resources or fail to utilize them effectively; on the other hand, entrepreneurs lack the motivation or willingness to enter the market due to the lack of a good

business environment and cultural atmosphere. Although new infrastructure development can provide broader market space and more advanced technical support for entrepreneurship, the development of new industries often relies on highly specialized human capital, sufficient financial inputs, and efficient resource allocation systems, which are often more readily available in highly developed market environments. In addition, regions that are relatively lagging behind in economic development often suffer from insufficient policy openness and an underdeveloped business ecology, and these factors may also be an important obstacle to constraining the development of innovation infrastructure to promote entrepreneurial activity. Therefore, continuous improvement of the business environment and policy system is a key path to enhance regional entrepreneurial activity.

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