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Digital Infrastructure on the Digital Industry: A Digital Entrepreneurial Ecosystem Perspective

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Abstract

Accelerating the new wave of digital infrastructure construction is critical for fostering technological innovation, driving industrial transformation, and optimizing entrepreneurial ecosystems. Drawing on Digital Entrepreneurial Ecosystem (DEE) theory, this paper establishes a theoretical framework to characterize how digital infrastructure reshapes the ecosystem of the digital industry. It then empirically tests the impact of digital infrastructure on the entrepreneurial vitality of core digital technology industries. The findings indicate that digital infrastructure significantly promotes the entry of new digital firms at the district-county-industry level, thereby stimulating regional digital entrepreneurial vitality. Mechanism analysis reveals that digital infrastructure optimizes the regional digital entrepreneurial ecosystem by enhancing technology accessibility, talent availability, and access to financial capital. Furthermore, extended analysis demonstrates that digital infrastructure effectively reduces industry concentration and entry barriers. It also attracts "patient capital," providing sustainable funding for high-risk core digital technology enterprises. In addition, digital infrastructure significantly boosts firm survival capabilities, accelerates the speed of technological iteration, and hastens the market exit of inefficient firms, thereby achieving a systemic optimization of the industry's dynamic structure. Heterogeneity analysis indicates that the positive effects on new firm entry are more pronounced in non-resource-based regions, areas with higher road network density, and regions with greater government attention to digitalization. This paper underscores the pivotal role of digital infrastructure and data elements in digital enterprise development, providing new insights for accelerating the formation of new quality productive forces and promoting high-quality development.

1 Introduction

According to the *2025 Global Digital Economy Report* released by the International Data Center Authority (IDCA), the global digital economy accounted for approximately 15% of nominal GDP in 2024, underscoring its indisputable status as a "new engine" for global economic growth. Meanwhile, the current competitive landscape of the global digital economy presents a "tri-polar" configuration involving China, the United States, and the European Union. The U.S. attempts to consolidate its technological leadership through technical alliances, while the EU strengthens data sovereignty through regulatory barriers such as the *Digital Markets Act* and the *Digital Services Act*. This implies that the development of the digital economy is directly linked to a nation's discourse power and competitiveness in the future global system. As a critical component of the digital economy, digital industrialization facilitates the market entry and flourishing of digital firms, acting as the continuous fuel injected into this engine (He et al., 2024). These firms are not only pioneers of technological innovation but also pivotal forces in promoting economic structural upgrading and unlocking the value of data (Sose et al., 2023). In this regard, China has conducted extensive exploration in advancing digital industrialization. In the *Measures on Strengthening the Cultivation of Innovative Digital Economy Enterprises* issued in 2025, the Chinese government formally proposed the concept of "Digital Innovation Enterprises" for the first time. It also announced the establishment of a nationally unified and dynamically adjusted cultivation pool for these enterprises to provide precise support for innovation entities in the digital economy. Therefore, cultivating and developing digital enterprises with global competitiveness is not only crucial to a nation's core competitiveness in the digital age but also serves as a vital cornerstone for driving global technological progress, economic growth, and innovation cooperation.

Digital infrastructure, emerging from the evolution of new-generation information technology with a primary focus on data computing facilities (Deng and Zhong, 2024), effectively dismantles information, knowledge, and spatial boundaries across production sectors. It inherently possesses the foundational attributes required to support the vitality of digital enterprises. In recent years, Chinese policymakers have increasingly recognized the critical importance of constructing digital infrastructure. Numerous studies have found that digital infrastructure construction exerts a positive influence on promoting industrial structure upgrading (Wu and Shao, 2022; Liu et al., 2025), facilitates business model innovation (Tian and Lu, 2023), and enhances the efficiency of government market regulation (Ain et al., 2025). However, amidst the rapid evolution of digital infrastructure and the widening digital divide, academic and industrial attention has increasingly shifted toward the impact of digital infrastructure on the digital industry itself, particularly in terms of stimulating the vitality of

digital enterprises. In this context, the supporting and empowering roles of digital infrastructure have become increasingly pivotal. Therefore, a systematic exploration of the driving effect of digital infrastructure on the digital industry has emerged as an important and urgent research topic. As a key pillar of the digital economy era, digital infrastructure is profoundly reshaping the entrepreneurial environment, innovation modes, and long-term performance of enterprises. In terms of entrepreneurial activities, digital infrastructure significantly reduces information asymmetry and entry barriers by providing widely accessible resources such as the internet, data centers, and artificial intelligence, thereby creating favorable conditions for individual entrepreneurship and internet-based enterprises (Li et al., 2024). At the national level, digital infrastructure reinforces the link between individual entrepreneurial self-efficacy and entrepreneurial behavior, prompting more potential entrepreneurs to translate their intentions into practice (Schade & Schuhmacher, 2022). It is worth noting that this promoting effect exhibits group and regional heterogeneity. For instance, female entrepreneurs with children in rural areas benefit more from digital infrastructure, a mechanism primarily driven by the promotion of gender equality, enhanced information acquisition, and broadened financing channels (Caceres-Diaz et al., 2019). Regarding innovation, digital infrastructure not only reshapes the external innovation environment but also profoundly influences internal corporate innovation processes. Empirical evidence from China's "Broadband China" strategy indicates that digital infrastructure significantly enhances corporate innovation efficiency. The underlying mechanisms include alleviating financing constraints and elevating human capital levels (Zhao & Dong, 2025). This positive impact is more pronounced in non-state-owned enterprises (non-SOEs), non-high-tech firms, and enterprises in non-eastern regions, reflecting the "inclusive" nature of digital innovation. Furthermore, digital infrastructure helps construct dynamic and intelligent innovation networks, enhancing the capability of firms to integrate internal and external resources and facilitating their integration into global innovation networks, thereby improving collaborative innovation performance (Tian et al., 2025). In terms of operational performance, digital infrastructure effectively boosts labor productivity by driving technological innovation and industrial upgrading, offering a pathway to counter growth challenges such as population aging (Zhao & Liu, 2025). Despite controversies such as the "Solow Paradox," the majority of empirical studies support its net positive effect on productivity. Meanwhile, the construction of information facilities, represented by 4G base stations, significantly enhances corporate market value. The primary pathways include promoting digital transformation, improving innovation levels, and optimizing production efficiency (Lu et al., 2024). Such effects are particularly significant in large enterprises, non-SOEs, and highly competitive industries.

Although existing research has extensively focused on the impact of digital infrastructure on macroeconomic growth and individual firm performance, it has failed to fully reveal how digital infrastructure drives high-quality development by reshaping the entrepreneurial ecosystem and innovation networks at the industry level. More importantly, few studies have focused on the specific domain of the core digital technology industry to systematically examine how digital infrastructure incubates a digital entrepreneurial ecosystem; in particular, there is a lack of in-depth exploration regarding the mechanisms and boundary conditions through which it promotes the entry of new digital firms. This absence limits our deep understanding of the transmission paths and structural functions of digital infrastructure in promoting high-quality development from a meso-dimension. Furthermore, selecting China as the research sample holds strong typicality and realistic urgency. On one hand, as the world's largest and fastest-growing emerging economy, China possesses advanced, ultra-large-scale network infrastructure. Specifically, the implementation of the "Eastern Data, Western Computing" project marks the formation of a new computing power network system (Zhang et al., 2025), positioning digital infrastructure as a key engine of national competitiveness. On the other hand, unlike developed economies in Europe and the United States, China's massive population base and unique institutional background present specific opportunities and challenges in stimulating the vitality of digital entrepreneurship (Zhang et al., 2025). This tension between "strong infrastructure" and "entrepreneurial vitality waiting to be unleashed" provides an excellent quasi-natural experimental field for this study. Accordingly, this paper conducts empirical research on the impact of digital infrastructure on new firm entry in the core digital technology industry. Utilizing an unbalanced panel dataset based on year-district-industry dimensions from 2015 to 2022, we construct a district-level digital infrastructure index using geographical location data of 4G and 5G base stations from the OpenCelliD database, and measure digital firm entry at the district-industry level based on national business

registration big data. This study aims to empirically test the effects of digital infrastructure construction on digital entrepreneurial vitality and its underlying mechanisms by addressing four core propositions: first, whether the level of digital infrastructure significantly drives the market entry of new digital firms; second, if such a promoting effect exists, what the underlying transmission mechanisms are; third, whether digital infrastructure achieves a systemic optimization of the dynamic industrial structure by lowering industry entry barriers and introducing "patient capital"; and fourth, what heterogeneous characteristics digital infrastructure exhibits across cities with different attributes.

The potential marginal contributions of this paper are threefold:

First, regarding the research perspective, based on the intrinsic characteristics of DI, this paper integrates DI and the vitality of digital firms into a unified framework, thereby enriching the literature on the industrial driving effects of DI. While existing studies have largely focused on the environmental effects (Li & Diao, 2025) and innovation effects (Guo & Chen, 2023) of DI, there remains a lack of exploration regarding the entrepreneurial vitality of digital firms. In particular, there is a scarcity of systematic examinations—from the perspective of the digital entrepreneurial ecosystem—of the driving role of DI on entrepreneurial vitality in core digital technology industries and its structural mechanisms.

Second, regarding research methodology, prior studies have mostly operated at the provincial or city level, utilizing external policy shocks such as "Broadband China" or "Big Data Pilot Zones" to proxy for digital infrastructure construction (Jiang et al., 2025; Yang et al., 2025); however, these approaches fail to precisely and comprehensively reflect the essential connotation of digital infrastructure. This paper extracts over 50 million geographical location records of 4G and 5G base stations from the OpenCelliD database and matches them to calculate the number of base stations per 10,000 people across 1,866 districts and counties in China from 2015 to 2022. This allows for a precise identification and examination of the impact and mechanistic pathways of digital infrastructure on new digital firm entry, providing empirical support to guide specific practices in digital industrialization development.

Third, from a theoretical perspective, this study innovatively incorporates "Digital Entrepreneurial Ecosystem Theory" into the discussion of digital infrastructure construction. It profoundly reveals how digital infrastructure enhances the entry activity of new digital firms within a region by comprehensively uplifting "technology accessibility, talent availability, and financial resource reachability," thereby offering a novel theoretical framework for understanding the relationship between digital infrastructure and the spatial layout of digital enterprises.

2 Theoretical Hypotheses

2 .1 The Impact of Digital Infrastructure on Digital Enterprise Entrepreneurship

The dynamic process of firm entry and exit (i.e., the extensive margin) is an indispensable driver of economic growth (Samila and Sorenson, 2011). As an infrastructure system formed by the integration, evolution, and iterative accumulation of new-generation information technologies—such as mobile communication facilities, artificial intelligence, and cloud computing—digital infrastructure leverages its attributes as General Purpose Technologies (GPTs) and public goods. Through permeation, fusion, and network interconnection, it is capable of reshaping every aspect of people's lives and possesses immense potential to drive economic growth (Acemoglu and Restrepo, 2019). The development of digital infrastructure has gained rapid momentum, playing an increasingly pivotal role in enhancing productivity and stimulating economic growth (Liu et al., 2021). On the one hand, in the process of supporting the digital transformation of traditional industries, digital infrastructure helps drive the emergence of new business models and products, improves corporate performance, and increases investment. On the other hand, the establishment of new digital ventures plays a critical role in fostering innovation, securing employment, and driving growth (Herman, 2022). Therefore, whether digital infrastructure can effectively elevate the entrepreneurial enthusiasm of potential digital entrepreneurs and increase the level of digital entrepreneurial activity is undoubtedly a critical issue worthy of in-depth research at present.

The widespread deployment of digital infrastructure has profoundly altered modes of production and organizational forms, thereby reshaping industrial structures. On the demand side of digital entrepreneurship, digital infrastructure provides indispensable channels for digital startups to acquire digital technologies. Digital technologies such as cloud computing, big data, and artificial intelligence offer standardized interfaces and modular services. This enables digital enterprises to access advanced digital capabilities without the need to construct expensive proprietary infrastructure. For instance, startups can rapidly deploy AI algorithms via platforms like AWS or Alibaba Cloud, substantially lowering entry barriers in the digital industry and thereby attracting more potential digital entrepreneurs to enter the market. Furthermore, compared to traditional entrepreneurship, digital enterprises face increasingly stringent financing constraints (Du and Wang, 2024). Since the commercial application of digital enterprises is still in an exploratory and developmental stage, uncertainty remains regarding market acceptance and application prospects. In addition, the urgent need for substantial funds for technological R&D in AI enterprises exacerbates the challenge of high financing costs. However, the construction of digital infrastructure can improve capital allocation efficiency by reducing transaction costs and shortening the temporal distance of capital flows. This facilitates smoother cross-regional capital allocation and minimizes capital loss during circulation. It also facilitates the influx of Venture Capital (VC) and Angel Investment into the digital economy, providing diverse financing options for startups and offering sufficient financial support for their R&D activities, market expansion, and technological iteration. In fact, the industrial value and Return on Investment (ROI) associated with digital technologies such as AI have consistently remained at high levels. Graetz and Michaels (2018) found that the average annual rate of return on investment in the robotics industry ranges from 25% to 200%, with a relatively short payback period of 2 to 18 months. High anticipated investment returns and short payback periods act as strong drivers for potential digital entrepreneurs to enter the target market.

On the supply side of entrepreneurship, the development of digital infrastructure facilitates the widespread application of digital technologies such as artificial intelligence. The employment substitution effect of AI technology tends to crowd out certain low-skilled laborers. Consequently, structural unemployment forces this segment of the workforce to opt for entrepreneurship when lacking suitable employment opportunities (Bergholz et al., 2025). Furthermore, laborers not yet replaced by robots also face the predicament of weakened bargaining power and declining wage levels, resulting in income falling below expectations (Acemoglu and Restrepo, 2020). To seek better compensation and career development opportunities, such groups may turn to self-employment. Concurrently, high-skilled laborers can more keenly perceive the immense commercial value and investment appeal emerging in the AI sector. Market signals indicate that AI has entered a stage of large-scale commercial monetization, with leading tech giants investing in AI startups with unprecedented intensity. For instance, NVIDIA saw a surge in its AI-related investments in 2023, spanning the entire industry chain. This explicit expectation of high returns on innovation and market expansion potential will significantly ignite the entrepreneurial enthusiasm of high-skilled talents, thereby elevating the vitality of digital entrepreneurship (Liang et al., 2025).

Based on this, this paper proposes Hypothesis H1:

Hypothesis H1: Digital infrastructure construction significantly promotes the entry of new digital firms and stimulates regional digital entrepreneurial vitality.

2.2 Mechanism Analysis

The mechanism through which digital infrastructure influences the entrepreneurial behavior of digital firms can be understood through the lenses of the Resource-Based View (RBV) and Dynamic Capabilities Theory. The RBV posits that a firm's sustainable competitive advantage stems from its ability to identify, acquire, and effectively integrate critical resources (Barney, 1991). Dynamic Capabilities Theory further emphasizes that in a rapidly changing environment, firms must possess the capabilities to sense external changes, configure resources, and achieve organizational reconfiguration (Teece et al., 1997). As an innovative infrastructure system that is data-driven, centered on communication networks, and supported by data computing facilities (MIIT, 2021), digital infrastructure does more than merely enhance capabilities in

information processing, digital knowledge accumulation, and predictive judgment. By optimizing the acquisition efficiency and allocation modes of key factors such as technology, talent, and capital, it also strengthens the responsiveness of digital entrepreneurs to environmental changes and their resource recombination capabilities. Evidently, digital infrastructure not only optimizes the external resources and institutional conditions upon which digital entrepreneurship relies but also deepens the internal mechanistic foundations of the digital entrepreneurial ecosystem by restructuring the entrepreneurs' capability structure regarding environmental sensing, resource integration, and dynamic adjustment, thereby increasing the likelihood of new digital firm entry.

In this paper, "Digital Entrepreneurial Ecosystem" refers to the constellation of resource environments and institutional systems that affect the emergence, development, and sustainability of digital entrepreneurial activities. It encompasses key elements such as technological foundation, talent supply, capital market information acquisition, institutional safeguards, and resource allocation efficiency (D'Angelo et al., 2024; Autio et al., 2018; Satalkina and Steiner, 2020). Unlike the traditional perspective that views entrepreneurship merely as individual decision-making behavior, the digital entrepreneurial ecosystem emphasizes the synergistic effects of regional digital resource endowments, institutional support, and externalities, highlighting the institutional and spatial environments in which digital entrepreneurial activities are embedded. This paper defines "Digital Entrepreneurial Ecosystem Optimization" as the improvement of fundamental conditions for digital enterprise entrepreneurship, characterized by enhanced digital technology accessibility, increased digital talent mobility, greater financial capital availability, and lowered entry barriers in the digital industry. Building upon the core elements of the entrepreneurial ecosystem, this definition incorporates the reshaping logic of digital infrastructure on local modes of resource organization within the context of China's digital development, thereby providing a theoretical basis and an operable empirical identification framework for the subsequent mechanism analysis. In summary, regarding the influence mechanism, this paper posits that the optimization of the digital entrepreneurial ecosystem is a critical factor through which digital infrastructure drives the increase in digital entrepreneurial activities. Specifically, digital infrastructure enhances the availability of entrepreneurial resources for digital enterprises primarily by increasing digital technology accessibility, digital talent availability, and financial capital reachability, thereby optimizing the digital entrepreneurial ecosystem.

2.2.1 Digital Technology Accessibility

Technology accessibility refers to the ability and ease with which potential entrepreneurs acquire, utilize, and integrate critical technological resources. It emphasizes the availability and usability of external technological resources for potential entrepreneurs (Elia et al., 2020) and serves as a vital prerequisite for the initiation of entrepreneurial activities. Compared to traditional enterprises, digital enterprises face challenges such as high explicit and implicit costs in acquiring digital technologies, as well as barriers to accessing core digital technologies. Autio et al. (2018) posit that the "Digital Affordances" of digital technologies provide new opportunities for entrepreneurs, emphasizing the role of digital technology within the entrepreneurial ecosystem. Digital infrastructure, by enhancing digital technology accessibility, can generate more digital entrepreneurial opportunities for potential entrepreneurs. On one hand, digital infrastructure delivers emerging digital technologies through standardized interfaces and modular services, enabling digital enterprises to access high-end digital capabilities without the need to build expensive proprietary infrastructure. On the other hand, it transforms costly hardware investments and complex software licensing into "on-demand" and "pay-as-you-go" public services. This allows entrepreneurs to bypass massive upfront capital expenditures (CAPEX) in favor of operating expenses (OPEX), thereby lowering the financial threshold for digital entrepreneurship. Meanwhile, the opportunity-based view of entrepreneurship proposed by Shane and Venkataraman (2000) argues that entrepreneurship is essentially the identification, evaluation, and exploitation of entrepreneurial opportunities. Generally, there are two primary sources of entrepreneurial opportunities: opportunity creation and opportunity discovery (Schumpeter, 1934). Digital infrastructure not only facilitates potential entrepreneurs in creating opportunities for themselves by leveraging combinatorial emerging digital technologies—thereby enhancing the competitiveness of potential entrants—but also empowers them with robust

capabilities to identify entrepreneurial opportunities. This helps entrepreneurs discern market changes and seize potential business opportunities, consequently igniting entrepreneurial enthusiasm. In conclusion, digital infrastructure enhances both the digital technology accessibility for potential entrepreneurs and their ability to identify and grasp opportunities, thereby providing the technological underpinning for the surge in digital entrepreneurial activities.

Building upon this foundation, digital infrastructure can also form an intelligent network, further enhancing the capability of potential entrepreneurs to acquire emerging digital technologies. From the perspective of public goods attributes, digital infrastructure facilitates the construction of a dynamic intelligent innovation network involving multiple stakeholders, including universities and research institutes (Henningsson and Eaton, 2023). This networked technology diffusion helps promote the transformation of technological achievements and enhances inter-regional digital technology spillover effects, thereby effectively lowering the threshold for startups to acquire advanced digital technologies and further improving technological accessibility. Furthermore, the enhancement of digital technology accessibility by digital infrastructure manifests as a reduction in entry barriers within core digital industries. Advancements driven by digital infrastructure in communication networks, computing platforms, and big data processing capabilities significantly improve the efficiency and transparency of information flow. This, in turn, assists entrepreneurs in more efficiently acquiring startup-related information, assessing market potential, and identifying collaborative resources (Xiong et al., 2024). In this process, digital infrastructure effectively mitigates the institutional constraints and market uncertainty faced by entrepreneurs, creating a more attractive entrepreneurial environment and facilitating the entry of new digital firms.

Based on this, this paper proposes Hypothesis H2:

Hypothesis H2: Digital infrastructure promotes the entry of new digital firms by optimizing the regional digital ecosystem through enhanced digital technology accessibility.

2.2.2 Digital Talent Availability

According to the innovation theory of entrepreneurship proposed by Schumpeter (1934), the crux of innovative entrepreneurship lies in the recombination of factors of production, with the innovator being the linchpin of entrepreneurial activities. Generally, the quantity and quality of talent directly determine a region's entrepreneurial level and innovation vitality. Queiró (2022) points out that entrepreneurial human capital is a key driver of dynamic firm adjustment, noting that companies founded by highly educated entrepreneurs tend to have a larger scale at entry and faster growth rates. This highlights the foundational role of human capital in entrepreneurial activities. Compared to traditional enterprises, digital enterprises exhibit high dynamism in their skill requirements, demanding that talent possess strong self-directed learning capabilities and a high accumulation of digital knowledge. The establishment of digital infrastructure gradually reshapes the regional talent ecosystem. First, by spawning new industries and new business models, digital infrastructure increases opportunities for high-end employment and entrepreneurship. For instance, the construction and operation of facilities like big data platforms inherently require a vast influx of high-caliber digital talent. These high-skill, high-wage positions exert a direct attraction on top-tier digital professionals. Second, digital infrastructure, anchored by data centers and leveraging applications such as cloud-based AI models and big data analytics tools, enhances the technical proficiency and work efficiency of non-routine and innovative tasks. This, in turn, unleashes the innovation potential of the workforce (Rehan, 2024) and prompts workers to rapidly master digital skills. Finally, as digital infrastructure continues to improve, a tighter synergistic relationship forms between emerging digital technologies and high-skilled labor. This generates a multitude of emerging skill-intensive positions, driving the agglomeration of high-end talent through the increase in skilled jobs, thereby establishing an advantage in talent availability. Consequently, regions with higher levels of digital infrastructure development exhibit a stronger demand for digital technical talent, which in turn triggers a talent agglomeration effect. This promotes the formation of a virtuous cycle: "improved digital infrastructure — digital talent agglomeration — active digital entrepreneurship." Therefore, digital infrastructure serves as a potent force driving new digital firm entry by improving digital talent availability and effectively optimizing the digital entrepreneurial ecosystem.

Based on the above analysis, this paper proposes Hypothesis H3:

Hypothesis H3: Digital infrastructure promotes the entry of new digital firms by optimizing the regional digital ecosystem through enhanced digital talent availability.

2.2.2 Digital Talent Availability

According to the innovation theory of entrepreneurship proposed by Schumpeter (1934), the crux of innovative entrepreneurship lies in the recombination of factors of production, with the innovator being the linchpin of entrepreneurial activities. Generally, the quantity and quality of talent directly determine a region's entrepreneurial level and innovation vitality. Queiró (2022) points out that entrepreneurial human capital is a key driver of dynamic firm adjustment, noting that companies founded by highly educated entrepreneurs tend to have a larger scale at entry and faster growth rates. This highlights the foundational role of human capital in entrepreneurial activities. Compared to traditional enterprises, digital enterprises exhibit high dynamism in their skill requirements, demanding that talent possess strong self-directed learning capabilities and a high accumulation of digital knowledge. The establishment of digital infrastructure gradually reshapes the regional talent ecosystem. First, by spawning new industries and new business models, digital infrastructure increases opportunities for high-end employment and entrepreneurship. For instance, the construction and operation of facilities like big data platforms inherently require a vast influx of high-caliber digital talent. These high-skill, high-wage positions exert a direct attraction on top-tier digital professionals. Second, digital infrastructure, anchored by data centers and leveraging applications such as cloud-based AI models and big data analytics tools, enhances the technical proficiency and work efficiency of non-routine and innovative tasks. This, in turn, unleashes the innovation potential of the workforce (Rehan, 2024) and prompts workers to rapidly master digital skills. Finally, as digital infrastructure continues to improve, a tighter synergistic relationship forms between emerging digital technologies and high-skilled labor. This generates a multitude of emerging skill-intensive positions, driving the agglomeration of high-end talent through the increase in skilled jobs, thereby establishing an advantage in talent availability. Consequently, regions with higher levels of digital infrastructure development exhibit a stronger demand for digital technical talent, which in turn triggers a talent agglomeration effect. This promotes the formation of a virtuous cycle: "improved digital infrastructure — digital talent agglomeration — active digital entrepreneurship." Therefore, digital infrastructure serves as a potent force driving new digital firm entry by improving digital talent availability and effectively optimizing the digital entrepreneurial ecosystem.

Based on the above analysis, this paper proposes Hypothesis H3:

Hypothesis H3: Digital infrastructure promotes the entry of new digital firms by optimizing the regional digital ecosystem through enhanced digital talent availability.

2.2.3 Financial Resource Reachability

The Resource-Based View (RBV) posits that a firm is a collection of unique resources, and non-substitutable resources form the foundation for building sustainable competitive advantage (Barney, 1991); financial resources are precisely one of these critical corporate resources. Financial resources are regarded as a crucial driver of entrepreneurial activities and innovation. Research indicates that adequate financial resources enable firms to overcome funding shortages in the early stages, thereby facilitating technological R&D and market expansion (Colombo et al., 2024; Santos et al., 2024). Unlike traditional enterprises, the commercial applications of digital enterprises are often in an exploratory and developmental phase. The uncertainty surrounding market acceptance and application prospects exacerbates investor risk. Furthermore, the rapid iteration of digital technologies necessitates substantial R&D capital, resulting in the dilemma of high financing costs for digital firms. However, digital infrastructure expands the reachability of regional financial resources by increasing the scale of regional investment, alleviating information asymmetry between banks and enterprises, and promoting

regional digital financial inclusion. First, digital infrastructure is a form of capital-intensive investment. Its large-scale deployment directly stimulates fixed-asset investment related to the region, thereby further expanding the regional capital pool. Second, by leveraging its attributes as a General Purpose Technology (GPT), digital infrastructure enables digital firms to access capital market dynamics, financing information, and risk assessments in a more timely manner. Simultaneously, it allows banks to evaluate the development status of digital firms more accurately, avoiding erroneous decisions caused by information lag or distortion. This consequently ameliorates the degree of information asymmetry between banks and enterprises and lowers investment risk. Third, the establishment of digital infrastructure provides indispensable underlying technical support for the development of digital financial inclusion. Digital financial inclusion not only broadens external financing channels for digital firms but also offers diversified entry points for equity financing. Moreover, empowered by digital technology, digital financial inclusion resolves the "last mile" problem of the traditional financial industry, extending the effective reach of financial resources. Therefore, by expanding financial resource reachability, digital infrastructure effectively optimizes the digital entrepreneurial ecosystem, becoming a pivotal force in driving the entry of new digital firms.

Based on the above analysis, this paper proposes Hypothesis H4:

Hypothesis H4: Digital infrastructure promotes the entry of new digital firms by optimizing the regional digital ecosystem through enhanced financial resource reachability.

3 Data and Methodology

3.1 Variable Selection

3.1.1 Dependent Variable

Entry of Core Digital Enterprises (Entry). Referencing the *Statistical Classification of the Digital Economy and Its Core Industries (2021)*, we selected five major sectors within the core digital technology industries: (1) Computer, communication, and other electronic equipment manufacturing; (2) Telecommunications, broadcast television, and satellite transmission services; (3) Internet and related services; (4) Software and information technology services; and (5) Radio, television, film, and recording production. Drawing on the measurement strategy of Tang et al. (2025), we utilized the Industrial and Commercial Registration Database, characterized by its long time span, broad coverage, and comprehensive enterprise information, to identify firm entry. The data were aggregated by industry and the county where the enterprises are located to construct a panel dataset at the county-industry-year level. In the process of identifying firm entry, we conducted rigorous data cleaning: we excluded anomalous samples where the business termination date preceded the establishment date, as well as samples where the registered enterprise address could not be accurately pinpointed to the county level. The variable is defined as follows: The firm entry rate is the ratio of the number of newly established firms in the current year to the total number of firms at the end of the period.

3.1.2 Core Explanatory Variable

Digital Infrastructure Construction Level (DI). In this study, we adopt the "number of 4G/5G base stations per 10,000 people" in Chinese county-level administrative regions from 2015 to 2022 as the proxy variable for the level of digital infrastructure construction. The specific calculation process draws on the methodology of Chao (2024). First, from OpenCelliD—the world's largest open mobile cell tower database—we collected over 49.35 million global base station records. We filtered for records with the Mobile Country Code (MCC) of 460 (corresponding to China) and ensured the broadband cellular network technology standards complied with LTE (Long Term Evolution, i.e., 4G) and 5G NR (New Radio, i.e., 5G), thereby forming the raw dataset of Chinese 4G/5G base stations. Second, the cleaned base station samples contained UNIX timestamps; we first converted these to Beijing Time (UTC + 8). Subsequently, the year a base station was first recorded by OpenCelliD was defined as its year of operational inception. Based on this, we selected base stations that

entered service between 2015 and 2022 for empirical analysis. Third, utilizing ArcGIS software, we performed coordinate projection transformation on the latitude and longitude coordinates of the base station observations, adopting a coordinate system consistent with the standard map of China. We then employed the spatial join function to match the base station coordinates with the vector map of Chinese county-level administrative regions, allowing for the precise identification of the county jurisdiction for each 4G/5G base station. Consequently, we aggregated the total number of 4G/5G base stations at the county level for each year from 2015 to 2022. Finally, the total number was divided by the total population of the corresponding county-level administrative region in the respective year to obtain the number of 4G/5G base stations per 10,000 people.

3.1.3 Control Variables

To mitigate the potential interference of other county-level factors on the impact of digital infrastructure on AI enterprise density, and drawing on the study by Lin (2023), this paper controls for a set of characteristic variables at the county level that are relevant to digital infrastructure development. Specifically, these include: (1) *LnGDP* (measured by the logarithm of county-level GDP); (2) *Ind* (measured by the proportion of the value added of the tertiary industry to GDP); (3) *Consume* (measured by the ratio of total retail sales of consumer goods to GDP); (4) *Medical* (measured by the number of beds in hospitals and health centers per 10,000 people); (5) *Mobile* (measured by the number of mobile phone users per capita multiplied by 100); (6) *GovSize* (measured by the ratio of local general public budget expenditure to GDP); and (7) *Innov* (measured by the logarithm of the number of students in secondary vocational schools per 10,000 people). Simultaneously, to control for the influence of relatively invariant factors at the individual and year levels on the empirical results, the regression analysis in this paper separately controls for individual fixed effects and year fixed effects, and all variables are distributed within reasonable ranges.

3.2 Model Specification

This paper constructs Model (1) to conduct the benchmark regression for examining the impact of the level of digital infrastructure on firm entry within core digital technology industries. The specific model is established as follows:

$$\mathrm{Entry}_{ijt} = \beta_0 + \beta_1 \mathrm{DI}_{ijt} + \beta_{control} * contorls_{ijt} + \mu_{ij} + \gamma_t + \lambda_{\substack{jt \\ t}} + \epsilon_{ijt}$$

1

Equation (1) represents a two-way fixed effects model, where $Entry_{ijt}$ denotes the entrepreneurial activity intensity of county i, industry j, in year t, measured by the new firm entry rate. β_0 is the constant term; DI_{ijt} represents the level of digital technology infrastructure in county i, industry j, in year t, with the number of 4G/5G base stations per ten thousand people as the core explanatory variable. $Controls_{ijt}$ represents the control variables, and μ_{ij}, γ_t, and λ_{jt} denote the industry-county fixed effects, year fixed effects, and industry-year fixed effects, respectively. ϵ_{ijt} represents the random disturbance term. In this context, β_1 is the coefficient of the variable of interest. If the coefficient β_1 is significantly positive, it can be inferred that the level of digital technology infrastructure has a stimulating effect on firm entry in digital core technology industries, supporting the theoretical expectation of this paper.

In Eq. (2), this study employs a two-step method for mediation analysis to explore potential mediating effects:

$$\mathrm{MECHANISM}_{ijt} = \beta_0 + \beta_1 \mathrm{DI}_{ijt} + \beta_{control} * contorls_{ijt} + \mu_{ij} + \gamma_t + \lambda_{\substack{jt \\ t}} + \epsilon_{ijt}$$

2

In this specification, $MECHANISM_{ijt}$ denotes the mechanism variable, while all other components are defined consistently with Eq. (1).

3.3 Model Specification

This paper selects the entry of new firms in core digital technology industries at the county-industry level from 2015 to 2022 as the research sample. Data on new firm entry are obtained from the National Industrial and Commercial Registration Database. Data on 4G and 5G base stations are sourced from the OpenCelliD database. Data on innovation patents are derived from the IncoPat Patent Database. Data regarding the entry, exit, and survival of digital enterprises are sourced from the Industrial and Commercial Registration Database. Data on road network density are acquired from the OpenStreetMap (OSM) database. County-level variables are collected from the *China County Statistical Yearbook* and statistical yearbooks of various districts and counties. Firm-level data are sourced from the China Stock Market & Accounting Research (CSMAR) Database and the Chinese Research Data Services (CNRDS) Platform. Missing values for certain variables were imputed using the linear interpolation method. Data processing and analysis were conducted using STATA 18.0. Descriptive statistics of the variables are presented in the Appendix.

4 Empirical Results and Discussion

4.1 Benchmark Regression Results

Table 1 reports the benchmark regression results regarding the impact of the digital infrastructure level on the entry of new firms. All models control for year fixed effects and industry-county fixed effects, and estimates are calculated using robust standard errors. As shown in Column (1), in the absence of any control variables, the coefficient for the DI level is 0.0054, which is significantly positive at the 1% level, preliminarily indicating that digital infrastructure exerts a promoting effect on firm entry. After introducing a series of control variables in Column (2), the coefficient of DI rises to 0.0061 and remains significant at the 1% level, suggesting that the promoting effect of digital infrastructure remains robust even after controlling for regional economic characteristics and other factors. Column (3) further controls for industry-year interaction fixed effects to absorb time-varying unobservable industry-level factors. In this specification, the coefficient of DI further increases to 0.0067 with the significance level unchanged, demonstrating that the benchmark results hold even under stricter fixed effects specifications. These findings confirm that the level of digital infrastructure has a significant positive impact on the entry of new digital firms, thereby validating Hypothesis 1.

Table 1
Results of the baseline model regression

Variables	(1)	(2)	(3)
DI	0.0054***	0.0061***	0.0067***
	(0.0009)	(0.0010)	(0.0009)
Controls	NO	YES	YES
Year FE	YES	YES	YES
Industry -County FE	YES	YES	YES
Industry- Year FE	NO	NO	YES
_cons	0.2344***	-0.1830*	0.0236
	(0.0010)	(0.0988)	(0.0948)
N	43170	43170	43170
r2_a	0.3655	0.3663	0.4297
Standard errors in parentheses			
* $p < 0.1$, ** $p < 0.05$, *** $p < 0.01$			
(Data sources are consistent with the above)			

4.2 Endogeneity Test

Given the potential reverse causality between the level of DI and new firm entry, this study adopts the method of Hossain et al. (2023) and employs the Instrumental Variable (IV) approach to address the potential endogeneity. Specifically, we select the interaction term between Year and Terrain Ruggedness (IV1) as the instrumental variable. Drawing on the approach of Liu and Ma (2020), we choose the city's terrain ruggedness as the IV for DI. Terrain ruggedness satisfies two key conditions as an instrumental variable. Regarding the relevance condition, there is a significant negative correlation between terrain ruggedness and DI. This is because greater terrain ruggedness increases the cost and technical difficulty of laying network optical fibers and setting up base stations, thereby affecting the progress and quality of DI. Thus, a correlation exists between the city's terrain ruggedness and DI. Regarding the exogeneity condition, terrain ruggedness is determined by natural geographical factors and is unaffected by human factors or economic activities; therefore, it does not directly influence the location decisions of AI enterprises. The results in Table 2 indicate that the regression coefficient in the first stage of the IV estimation passes the robustness test at the 1% significance level, confirming the relevance between the explanatory variable and the instrumental variable. Furthermore, the second-stage estimation results show that the Anderson Canon. Corr. LM statistic and the Cragg-Donald Wald F statistic significantly reject the null hypotheses of "under-identification" and "weak identification," respectively, suggesting that the selection of the instrumental variable is valid. Meanwhile, the impact of DI on Entry remains significantly positive, reaffirming that the benchmark regression conclusions are credible and supporting the findings of this paper.

Table 2
Analysis of Endogeneity Test Results

Variables	First stage	Second stage
DI		0.3711***
		(0.1040)
IV1	-0.0206***	
	(0.0057)	
Controls	YES	YES
Year FE	YES	YES
Industry -County FE	YES	YES
Industry- Year FE	YES	YES
Kleibergen-Paap rk LM F-statistic		12.784
		(0.00)
Cragg-DonaldWald F-statistic		161.591
		(16.38)
N		43090

4.3 Robustness Testing

This study conducts the following robustness checks. First, adjusting the clustering level of standard errors. Considering that unobservable factors such as shared policy environments and business cycles may exist among counties within the same city, the benchmark regression clusters standard errors at the city level. This allows for correlations in the error terms across different counties within the same city in the same year, thereby improving the accuracy of statistical inference. Second, controlling for high-dimensional fixed effects. Building on the benchmark model, we further simultaneously controlled for year fixed effects and county fixed effects. This is done to absorb the influence of time-invariant county characteristics and individual-invariant time trends on the estimation results, thereby identifying the causal effect of DI on new digital firm entry more cleanly. Third, addressing potential reverse causality. To mitigate the potential bidirectional causality between DI and digital firm entry, we re-estimated the model using the core explanatory variable DI lagged by one period. This specification helps attenuate the bias caused by DI that might be induced by expectations of firm entry. Fourth, excluding outlier samples. Considering that municipalities directly under the Central Government differ systematically from ordinary prefecture-level cities in terms of administrative level, policy resources, and economic structure—which may limit the external validity of the estimation results—we re-ran the regression after excluding all samples from these municipalities to test whether the baseline conclusions hold within a more homogeneous sample. Fifth, using an alternative measure for the variable. We re-estimated the benchmark regression by using the standardized number of new digital firm entries (as the dependent variable). Sixth, regression at the prefecture-city level. Since data for certain variables in the mechanism analysis are only available at the prefecture-city level, we aggregated the main variables to the city level and re-estimated the model. The regression results in Table 3 indicate that, under consistent control variables and fixed effects settings, the estimated coefficient of DI remains significantly positive at the 1% statistical level. Thus, the empirical results of this paper remain robust after the aforementioned robustness checks.

Table 3
Robustness Test

	(1)	(2)	(3)	(4)	(5)	(6)
	City Clustering	High-Dimensional Fixed Effects	One-Period Lag	Exclude Municipalities Directly Under the Central Government	Replace Dependent Variable	City-Level Regression
DI	0.0067***	0.0067**	0.0073***	0.0067***	0.0028***	0.0028***
	(0.0014)	(0.0020)	(0.0014)	(0.0009)	(0.0011)	(0.0010)
Controls	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Industry - County FE	YES	YES	YES	YES	YES	YES
Industry-Year FE	YES	YES	YES	YES	YES	YES
_cons	0.0236	0.0236	0.0029	0.0656	-0.7273**	-0.0579
	(0.1581)	(0.1756)	(0.1431)	(0.0969)	(0.3707)	(0.1425)
N	43170	43170	17670	42362	43170	11601
r2_a	0.4297	0.4296	0.3854	0.4304	0.0128	0.5822

5 Mechanism Verification of DI Promoting Firm Entry

The theoretical analysis presented earlier demonstrates that DI improves the entrepreneurial ecosystem and enhances the availability of entrepreneurial resources, thereby driving the entry of new firms in core digital industries. Specifically, technology accessibility, talent availability, and financial resource reachability are not only crucial factors through which DI fosters entrepreneurship (Kim & Orazem, 2017; Qin & Kong, 2021; Queiró, 2022) but also constitute the core elements of optimizing the entrepreneurial ecosystem (Elia et al., 2020; Sorenson, 2017). Therefore, this section primarily adopts the perspective of entrepreneurial resource availability—encompassing technology, talent, and finance—to conduct an in-depth analysis of how DI facilitates the entry of new regional digital firms by enhancing the availability of these resources. It aims to explore the underlying mechanisms and provide policy recommendations and an empirical basis for decision-making regarding regional digital economic development.

5.1 Digital Technology Accessibility

In core digital industries, the entry of new firms is often constrained by the availability of digital technology and innovation capabilities. Digital technology accessibility directly determines whether firms can effectively acquire and apply advanced technologies, thereby gaining a competitive advantage in the market. Based on the theoretical analysis presented earlier, DI, given its public good attributes, facilitates the construction of collaborative smart innovation networks involving multiple stakeholders. This promotes the diffusion and application of emerging core technologies, such as artificial intelligence, thereby providing technical support for new firms. Simultaneously, DI enhances the intensity of Industry-University-Research (IUR) collaboration, creating more opportunities for enterprises to access advanced technologies and R&D support, which effectively drives the entry of digital firms.

First, Accessibility of AI Technology. The innovation and diffusion of AI technology significantly depend on the support of DI. Facilities such as cloud computing and big data platforms provide the necessary computing resources and data foundations for development. This enables enterprises and R&D teams to store, process, and analyze massive amounts of

data more efficiently, thereby driving the widespread diffusion and implementation of AI applications (Rawat et al., 2023). This effective integration of resources not only optimizes the conditions for technological innovation but also empowers more firms to engage in innovation within the AI domain, thereby laying a solid technical foundation for the entry of new enterprises. Therefore, drawing on the approach of An et al. (2025)[1], we obtained the number of AI patent grants and adopted their natural logarithm as the proxy variable for regional technology accessibility. Furthermore, we categorized AI patents into four types: perception technologies, underlying algorithms, platform-based technologies, and industry-application technologies. Columns (1)–(5) of Table 4 report the regression estimation results. Column (1) presents the results for the aggregate AI technology; the findings indicate that DI exerts a significant promoting effect on the diffusion and development of AI technology, providing a solid technical basis for regional core digital firms. Columns (2) through (5) report the results for perception technologies, underlying algorithms, platform-based technologies, and industry-application technologies, respectively. The results demonstrate that DI has a significant positive impact on all four categories of AI technologies, thereby accelerating the rapid entry and innovation of digital firms in these related fields.

Second, Accessibility of Key Digital Technology Patents. Unlike general AI technologies, key digital technology patents emphasize the control of foundational technologies and the establishment of industry leadership. These patents typically influence not merely the competitiveness of a single firm or product but dictate the technological trajectory of the entire industry (Bekkers & Martinelli, 2012). By securing core technology patents, enterprises can occupy a dominant position within the industry, thereby acquiring stronger market power and long-term competitive advantages. DI, by constructing a standardized and open innovation ecosystem, facilitates the diffusion and application of key patented technologies, transforming them into high-impact nodes within the innovation network. This not only lowers the barrier for new entrants to access core technologies but also injects vitality into the market through technology spillovers, fostering an environment conducive to entrepreneurship. Based on the *Classification System for Key Digital Technology Patents (2023)* released by the China National Intellectual Property Administration (CNIPA), we identified key digital technology patents. These data were aggregated to the county level, and the natural logarithm was taken to serve as the proxy variable for key digital technologies. The results in Column (6) of Table 4 indicate that DI has a significantly positive impact on key core technologies, thereby enhancing digital technology accessibility.

Finally, Industry-University-Research (IUR) Collaboration Intensity. The sharing of innovative knowledge among diverse innovation actors allows for the leveraging of respective specialized expertise in resolving complex technical issues. This guarantees the sustainable innovation demands of digital industry enterprises and provides differentiated knowledge sources for breakthroughs in digital technologies (Henningsson & Eaton, 2023). The refinement of DI, particularly through the acceleration of information flow and the construction of collaborative platforms, creates a highly efficient environment for technological cooperation between universities and enterprises. Drawing on the methodology of Zhou et al. (2025), we extracted patent application and grant records for universities and listed companies (including their subsidiaries) from 2015 to 2022 via the CNIPA patent database. Subsequently, we identified patents jointly applied for by universities and listed companies that were eventually granted. These were aggregated and matched to the county level based on the grant year and the enterprise's registered address. We then calculated the natural logarithm of the count plus one to construct the IUR collaboration intensity index at the county-year level. The results in Column (7) of Table 4 indicate that DI significantly promotes the intensity of IUR collaboration. This further validates its pivotal role in fostering technological innovation, enhancing regional innovation knowledge spillovers, and providing a vast reservoir of innovative knowledge for the entry and development of regional digital enterprises.

Table 4
Mechanism Verification: Technology Accessibility

	(1)	(2)	(3)	(4)	(5)	(6)	(7)
	Total AI Patents	Perception Technologies	Underlying Algorithms	Platform Technologies	Industry-application Technologies	Key Digital Technologies	IUR Collaboration Intensity
DI	0.0421***	0.0143***	0.0228***	0.0303***	0.0185***	0.0169**	0.0500***
	(0.0070)	(0.0029)	(0.0042)	(0.0054)	(0.0048)	(0.0082)	(0.0088)
Controls	YES	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES	YES
County FE	YES	YES	YES	YES	YES	YES	YES
_cons	-0.3108	0.0830	-0.0372	-0.3242**	-0.1276	1.8036***	0.3109
	(0.1912)	(0.0677)	(0.1589)	(0.1415)	(0.1139)	(0.5805)	(0.2239)
N	14928	14928	14928	14928	14928	14928	14928
r2_a	0.6374	0.5563	0.3299	0.6097	0.5021	0.8674	0.5310

5.2 Talent Availability

Human capital and skilled talent are pivotal to entrepreneurial activities. Schumpeter (1934) pointed out that entrepreneurial activity involves the recombination of factors of production or production conditions to achieve innovation, with talent serving as the primary agent of such activity. Entrepreneurs are often individuals possessing general skills who achieve entrepreneurial goals by assembling teams and integrating resources and capital. Generally, entrepreneurs with higher levels of education are likely more adept at innovation and technology adoption. This endows them with strong resource allocation capabilities, often making them excellent managers (Queiró, 2022). In this process, public sector science expenditure provides critical support for the accumulation and empowerment of high-quality human capital. Multiple studies indicate that science expenditure has a significant positive effect on the inflow of high-quality labor (Ganguli, 2017; Jacob & Lefgren, 2011). On one hand, through sustained investment in education and research systems, science expenditure directly facilitates the cultivation of high-level, innovative talent, creating a reserve of core agents for entrepreneurial activities. On the other hand, it promotes knowledge production and technology diffusion, fostering a vibrant regional innovation ecosystem. This not only enhances the skill levels and cognitive horizons of potential entrepreneurs but also provides them with richer technological opportunities and knowledge spillovers, thereby strengthening their ability to identify and exploit entrepreneurial opportunities. Therefore, this paper selects the level of government science expenditure (the ratio of science and technology expenditure to local general public budget expenditure) as a proxy variable for talent availability[2]. Column (1) of Table 5 shows that DI has a significant positive impact on science expenditure, laying a solid foundation for firm entry in core digital technology industries. To comprehensively measure regional talent availability, we also compiled statistics on the number of digital job openings and recruitment frequency of listed companies[3], as well as the number of employees in the information transmission, computer services, and software industries[4]. Columns (2)–(4) of Table 5 indicate that DI significantly boosts corporate demand for talent related to core digital technologies and enhances regional talent agglomeration capabilities, providing robust talent support for entrepreneurial vitality.

Table 5
Mechanism Verification: Talent Availability

	(1)	(2)	(3)	(4)
	Government Science Expenditure	Digital Recruitment Frequency	Digital Job Openings	Information Industry Employees
DI	0.0010***	0.1229***	0.1487***	0.0416***
	(0.0003)	(0.0277)	(0.0341)	(0.0137)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
County FE	NO	YES	YES	NO
Urban FE	YES	NO	NO	YES
_cons	-0.1025***	-0.6100	-0.5600	1.2127
	(0.0167)	(0.5234)	(0.6777)	(0.8007)
N	2368	14928	14928	2368
r2_a	0.8548	0.7665	0.7427	0.3845

5.3 Financial Resource Availability

Based on the theoretical analysis presented earlier, financial resources serve as the critical support for converting market opportunities into commercial practices within entrepreneurial activities. The financial system provides the necessary credit and purchasing power for innovation, constituting the core condition for entrepreneurs to realize "new combinations" (Atsu & Adams, 2023). By optimizing the regional financial ecosystem and expanding the coverage of financial resources, DI can effectively enhance capital accessibility for potential entrepreneurs. Its impact is manifested not only in driving the expansion of the overall regional investment scale but also in mitigating information asymmetry between banks and enterprises and promoting the deepening and diffusion of digital financial inclusion. Together, these factors strengthen the financing capabilities of new startups, providing substantive support for identifying and seizing entrepreneurial opportunities.

First, Government Fixed Asset Investment. As a crucial component of modern fixed asset investment, the construction and upgrading of DI directly drive the intensity of government investment in this field. According to public capital theory, government fixed asset investment not only directly improves regional hardware facilities but also generates a "signaling effect" that guides the flow of social capital (Aschauer, 1989). This forms usable "capital pools" and "asset pools," significantly optimizing the entrepreneurial environment and lowering barriers to entry and operation for new firms. We use total fixed asset investment per capita to measure government fixed asset investment. Column (1) of Table 6 shows that DI has a significant positive impact on this indicator, providing a solid foundation of capital and facilities for fostering the entrepreneurial ecosystem. Second, Bank Competition. The General Purpose Technology (GPT) attributes of DI significantly reduce costs associated with information search and risk assessment, enabling new firms to access information on financial products and services at a lower cost. Simultaneously, the real-time interconnection and sharing of government data and credit information weaken the traditional barriers maintained by large banks through information asymmetry. This creates space for differentiated competition for small and medium-sized banks as well as emerging financial institutions, effectively mitigating the information asymmetry problem between banks and enterprises. We measure the level of bank competition at the county level, primarily using the concentration ratios of the top three, top four, and top five bank branches (denoted as CR3, CR4, and CR5, respectively)[5]. Columns (2)–(4) of Table 6 indicate that DI promotes bank

competition, bringing more financing options and lower capital costs for firm entry in core digital technology industries. Finally, Development of Digital Financial Inclusion. Internet finance, which relies on innovative technologies such as IT, big data, and cloud computing, offers immense development space for reducing financial transaction costs and expanding the scope and reach of financial services. It provides the possibility of "first-time loans" and sustainable operations for a greater number of startups and private entities, becoming a significant financial force driving the continued vitality of entrepreneurship in recent years. Drawing on the research of Guo et al. (2020), we constructed a comprehensive development index for digital financial inclusion[6]. This index effectively captures the overall development level of digital financial inclusion in terms of service breadth, depth, and benefits. Column (5) of Table 6 shows that DI has a significant positive impact on the development of digital financial inclusion, providing a sustained and inclusive financial driving force to stimulate regional entrepreneurial vitality.

Table 6
Mechanism Test: Accessibility of Financial Resources

	(1)	(2)	(3)	(4)	(5)
	Govt. Fixed Asset Investment	**CR3**	**CR4**	**CR5**	**Digital Financial Inclusion**
DI	0.5546***	-0.0007*	-0.0043***	-0.0068***	0.6912*
	(0.1025)	(0.0004)	(0.0008)	(0.0011)	(0.4029)
Controls	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES
County FE	YES	YES	YES	YES	YES
_cons	6.9675	0.7237***	0.3336***	0.4721***	59.1608***
	(4.8214)	(0.0488)	(0.0955)	(0.0947)	(15.6233)
N	14928	14928	14928	14928	14928
r2_a	0.7933	0.9759	0.9028	0.8979	0.8302

6 Extensions

This paper has confirmed the positive impact of DI on new firm entry, identifying the optimization of the entrepreneurial ecosystem as a potential channel driving corporate entrepreneurship. To further characterize the specific manifestations of this ecosystem optimization, we conduct an analysis from the following three perspectives: First, we verify the channels through which DI improves the entrepreneurial ecosystem from the perspective of reducing industry entry barriers. Second, we examine the impact of DI on patient capital, analyzing whether it attracts the retention of long-term capital by enhancing information transparency. Third, we focus on the industrial dynamics of core digital industries to refine the assessment of the metabolism and health of the corporate ecosystem.

From the perspective of industry entry barriers, an entrepreneur's decision to start a business involves a trade-off between the present value of expected profits and entry costs (Cui & Li, 2023). Fundamentally, the marginal impact of DI on entrepreneurship depends on the magnitude of entry obstacles and costs. When entry barriers are high, DI lowers the entry threshold, triggering future profit opportunities that drive more new firms to enter the market. In this study, the optimization of the entrepreneurial ecosystem is identified as a crucial channel through which DI empowers entrepreneurship. The most intuitive manifestation of enhanced technology accessibility, talent availability, and financial resource reachability is the reduction of entry thresholds for new firms. This section provides further clarification from the perspective of weakening industry barriers. To measure industry entry barriers, we use industry concentration to characterize the degree of industry monopoly; higher concentration implies greater obstacles for new entrants. Following this logic, we utilized firm-level data

within counties to construct the Herfindahl-Hirschman Index (HHI) at the "county-industry" dimension. Column (1) of Table 7 reports the impact of the DI level on industry concentration. The dependent variable is the HHI calculated using market shares based on operating revenue. The results show that the estimated coefficient of DI is significantly negative, indicating that the level of digital infrastructure can effectively reduce industry concentration and weaken industry entry barriers.

From the perspective of venture capital in the digital industry, patient capital is characterized by long investment cycles and high risk tolerance. It can effectively alleviate corporate financing constraints (Dafe & Upadhyaya, 2024), constructing sustainable capital pools and strategic resource networks for the development of core digital enterprises. Drawing on the approach of Tian et al. (2025), we accurately identified enterprises supported by Corporate Venture Capital (CVC). On this basis, using industry codes for core digital industries, we screened for CVC-backed digital firms and aggregated them by industry and county to construct a panel dataset at the county-industry-year level. We then tested whether DI could introduce "patient capital" to the regional digital industry and mitigate external financing constraints affecting the development of regional core digital technology enterprises. The results in Column (2) of Table 7 indicate that DI effectively attracts the entry of venture capital in the digital industry. This suggests that the construction of DI enhances the efficiency of information circulation, significantly bolstering CVC investors' confidence in the long-term value of local core digital firms. Consequently, investors are more willing to commit to intertemporal, large-scale, and low-liquidity capital investments.

From the perspective of digital industrial dynamics, the entry, exit, and survival status of digital firms directly reflect the vitality and health of the regional entrepreneurial ecosystem. They serve as an important lens for observing whether DI can sustainably optimize the entrepreneurial environment and industrial structure. Following the measurement approach described earlier, we calculated the exit rate and the number of surviving firms in the digital sector. This was done to examine whether DI enhances regional entrepreneurial ecosystem development by improving the digital industry environment, serving as extended evidence for the underlying mechanism. As shown in Columns (3)–(4) of Table 7, the results indicate that DI exerts a promoting effect on the entry rate, exit rate, and survival of digital firms. This suggests that at the digital industry level, DI not only reduces information errors and the uncertainty faced by market entities through widespread connectivity and real-time interaction but also reshapes the dynamic evolution of the digital industry within counties by facilitating knowledge diffusion and cross-sector integration to create new knowledge. Specifically: First, DI significantly lowers technological barriers and entrepreneurial costs in the digital industry through computing power and data-sharing platforms. Furthermore, the public good attributes of DI ensure the widespread accessibility of innovative knowledge within the region, ultimately boosting the new firm entry rate. Second, the enhanced information transparency and rapid technological iteration driven by DI force inefficient firms to face stricter market selection, compelling them to exit and thereby optimizing the industrial structure. Third, the knowledge spillovers, scenario innovations, and capital linkages derived from DI effectively enhance the competitive resilience and profitability of surviving firms. This ultimately forms a virtuous cycle of digital industrial dynamics at the county-industry level, characterized by "Active Entry—Optimized Exit—Robust Survival." Such benign digital industrial mobility continuously provides a well-adapted digital industrial environment for AI enterprises, thereby elevating the overall AI development of the region.

Table 7
Extension Analysis

	(1)	(2)	(3)	(4)
	HHI	Patient Capital	Firm Survival	Firm Exit Rate
DI	-0.0177***	0.0035**	0.0131***	0.0013***
	(0.0063)	(0.0015)	(0.0020)	(0.0004)
Controls	YES	YES	YES	YES
Year FE	YES	YES	YES	YES
Industry -County FE	YES	YES	YES	YES
Industry- Year FE	YES	YES	YES	YES
_cons	1.0037	-0.0019	-1.1557***	0.3529***
	(1.1261)	(0.0127)	(0.3166)	(0.0505)
N	510	43170	43170	43170
r2_a	0.5018	0.3146	0.1707	0.1826

7 Heterogeneity Analysis of the Impact of DI on the Entry of Core Digital Firms

7.1 Heterogeneity of Natural Resource Endowment

An abundant and stable supply of natural resources serves as the foundation for the development of regional AI vitality. However, cities with high resource abundance are characterized primarily by monolithic production modes and exhibit path dependence on high-input production methods (Ploeg, 2011), which restricts the intelligent and green transformation of traditional industries. Therefore, to examine the impact of DI on regional AI development under different natural resource endowments, this section draws on the method of Liu et al. (2023) to divide the total sample into resource-based cities and non-resource-based cities for subsample testing. The results are presented in Columns (1) and (2) of Table 8. In non-resource-based cities, DI is conducive to enhancing the vitality of the entrepreneurial ecosystem for regional core digital firms. A probable reason is that resource-based regions have long relied on high-input, monolithic production modes, leading to industrial path lock-in. Strong path dependence hinders technological progress, making it difficult for DI to exert its intended effects. In contrast, non-resource-based regions possess flexible industrial structures and robust demand for innovation. Consequently, the bandwidth and computing power advantages of DI are more easily integrated with emerging manufacturing and service industries, generating a "multiplier effect." Furthermore, in regions with weak resource endowments, enterprises tend to leverage digital platforms to access remote technology, capital, and orders to break through factor constraints, thereby amplifying the vitality dividends of DI.

7.2 Heterogeneity of Transportation Infrastructure

Significant transportation advantages typically imply superior development potential and serve as a crucial underpinning for the spatial layout of regional economic activities. Does a traditional land transportation network, then, facilitate DI in better exerting its driving effect on the AI industry? To answer this question, drawing on the approach of Chen et al. (2022), we measured road network density using the ratio of the total length of the transportation network to the land area and divided the sample into groups based on the median. The results in Columns (3) and (4) of Table 8 indicate that the promoting effect of DI on the entrepreneurial vitality of core digital firms is significantly positive in the group with higher road network density, whereas it is not significant in the group with lower road network density. A probable reason is that the transportation network serves as a key "physical channel" for DI to exert its industrial driving effects. A well-developed

road network system not only significantly compresses the spatiotemporal distance for the flow of factors such as capital, talent, and data but also simultaneously reduces the costs of optical fiber laying, equipment transportation, and post-maintenance. Consequently, this expands the radiation range of DI, thereby strengthening its impact.

7.3 Heterogeneity of Transportation Infrastructure

As a form of public investment, the release of DI's economic efficacy depends on the institutional and policy environment in which it is embedded (Liu et al., 2025). Under China's development model combining a "capable government" and an "efficient market," the strategic orientation and attention allocation of local governments are key variables shaping the regional entrepreneurial environment. Drawing on the methodology of Xie Hongtao (2024), we conducted a text analysis of local government work reports. We counted the frequency of keywords related to "digital governance" to construct a government digital attention index, dividing the sample into high and low groups based on the median. The regression results in Columns (5) and (6) of Table 8 show that the promoting effect of DI on the entry of core digital firms is significantly positive in both groups. However, the coefficient in regions with high government digital attention is notably higher than in regions with low attention. This result indicates that an increase in government digital attention can significantly enhance the driving role of DI in digital firm entry, reflecting the positive impact of the synergy between "hardware facilities" and the "institutional environment" on the digital entrepreneurial ecosystem. Specifically: On one hand, higher attention often translates into clearer digital industrial planning and more targeted fiscal support and talent policies, effectively reducing institutional uncertainty for enterprises. On the other hand, the government's emphasis on digital technology accelerates its own digital transformation. For instance, by building "Digital Government" platforms and opening public data resources, the government provides important technology testing scenarios and initial market opportunities for digital firms.

Table 8
Heterogeneity Analysis

	(1)	(2)	(3)	(4)	(5)	(6)
	Resource-based Cities	Non-resource-based Cities	High Road Network Density	Low Road Network Density	High Govt. Digital Attention	Low Govt. Digital Attention
DI	0.0025	0.0065***	0.0044***	0.0033	0.0064***	0.0056***
	(0.0027)	(0.0009)	(0.0009)	(0.0036)	(0.0013)	(0.0014)
Controls	YES	YES	YES	YES	YES	YES
Year FE	YES	YES	YES	YES	YES	YES
Industry - County FE	YES	YES	YES	YES	YES	YES
Industry-Year FE	YES	YES	YES	YES	YES	YES
_cons	0.0067	-0.2514**	-0.3373***	0.5384***	-0.3601**	-0.1452
	(0.1551)	(0.1264)	(0.1266)	(0.1554)	(0.1438)	(0.1593)
N	14408	24607	21361	21191	18890	18875
r2_a	0.4401	0.4360	0.4562	0.4430	0.4392	0.4468

8 Research Conclusions and Policy Recommendations

Digital infrastructure construction has become a critical factor in optimizing the entrepreneurial ecosystem for the digital industry. Based on panel data at the county/district administrative region-industry level, this paper examines the impact of

digital infrastructure construction on the entry of new firms in digital core technology industries, revealing its central role in enhancing regional entry rates for new firms within these sectors. An empirical examination of the theoretical analysis was conducted from both regional (county/district) and industrial perspectives, leading to the following key conclusions:

First, digital infrastructure significantly promotes the entry of new firms in digital core technology industries. By providing enterprises with convenient access to technologies and efficient financing support, it lowers the barriers and costs associated with entrepreneurship. Simultaneously, the high expected investment returns and market opportunities generated by digital infrastructure stimulate entrepreneurial motivation, encouraging individuals with diverse skill sets to transition into entrepreneurship, thereby comprehensively enhancing digital entrepreneurial activity. Second, mechanism analysis indicates that digital infrastructure primarily improves the resource accessibility for digital entrepreneurship—specifically, the accessibility of digital technologies, the availability of digital talent, and the reachability of financial capital—thereby optimizing the digital entrepreneurial ecosystem. Furthermore, empirical tests confirm that digital infrastructure also plays a significant role in lowering industry entry barriers, improving the regional digital industry environment, and attracting venture capital to the digital industry, all of which contribute to enhancing the regional entrepreneurial ecosystem for the digital sector. Third, the impact of digital infrastructure on the entry of new digital firms exhibits heterogeneity across different types of regions. Its promotional effect is particularly more pronounced in non-resource-based regions, areas with higher road network density, and regions where the government demonstrates greater focus on digital development.

Based on the aforementioned research findings, this paper proposes the following policy recommendations:

First, deepen the "servitization" transformation and inclusive provision of digital infrastructure to effectively lower market entry barriers for digital core technology industries. Shift the focus of digital infrastructure construction from mere scale expansion to "service empowerment." By implementing policy tools such as cloud resource subsidies, reduce the marginal costs for startups to access underlying computing power and data resources, thereby breaking the bottleneck of "difficult technology acquisition." Leverage digital infrastructure to establish code development and public technical service platforms, lower professional technical barriers, stimulate entrepreneurial motivation among individuals with diverse skill backgrounds, and promote a shift in the entrepreneurial demographic from an "elite-centric" to a "mass-inclusive" model. Concurrently, establish an evaluation mechanism for the service efficacy of digital infrastructure to ensure that technological dividends translate into tangible entry facilitation for enterprises, thereby enhancing regional digital entrepreneurial activity at its source.

Second, strengthen the ability of digital infrastructure to aggregate "technology-talent-capital" factors, and build a digital entrepreneurial ecosystem characterized by all-factor synergy. Fully leverage the trans-spatial and temporal connectivity effects of digital infrastructure to break down the geographical constraints on high-end digital talent and core technical resources. Promote less-developed regions in flexibly introducing talent and technology through models like "cloud-based R&D" and "remote collaboration," thereby improving the accessibility of innovative factors. Focus on fostering the deep integration of digital infrastructure with technology finance. Utilize corporate digital footprints to improve credit evaluation systems, mitigate information asymmetry between banks and enterprises, and specifically guide "patient capital" and venture capital towards early-stage, high-risk digital core technology firms. By optimizing capital flow and resource allocation, accelerate the market-driven process of selecting the superior and eliminating the inferior, and construct a dynamic industrial evolution mechanism characterized by "orderly entry and exit and healthy sustainability."

Third, coordinate differentiated spatial layout strategies for digital infrastructure, implementing targeted measures and classified guidance based on urban endowment characteristics. Given that digital infrastructure exhibits stronger empowering effects in non-resource-based cities, transportation hub areas, and regions with high government attention, a "one-size-fits-all" approach to homogeneous construction should be avoided. For non-resource-based areas and regions with dense road networks, implement a "dual-network synergy" strategy, prioritizing the deployment of high-performance computing networks to create growth poles for digital industry agglomeration. For resource-based regions, the focus

should shift towards upgrading facilities for industrial digital transformation to avoid resource misallocation. Furthermore, incorporate the optimization of the digital business environment and digital governance capabilities into the performance evaluation system for local governments. This will strengthen local governments' focus on and guidance for the digital ecosystem, ensuring that policy dividends are maximized across cities with different characteristics and promoting the high-quality and coordinated development of the regional digital economy.

Declarations

Author Contribution

Tian Cheng and Junjie Ruan wrote the main manuscript text. Xingxing He provided technical guidance and revised the manuscript. All authors reviewed the final version of the manuscript.

Data Availability

The datasets generated and analysed during the current study are available from the corresponding author on reasonable request.

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Footnotes

1. Specific steps are detailed in the Appendix.
2. Due to missing county-level data, this indicator is calculated at the prefecture-city level, sourced from the *China City Statistical Yearbook*.
3. Specific steps are detailed in the Appendix.
4. Due to missing county-level data, this indicator is calculated at the prefecture-city level, sourced from the *China City Statistical Yearbook*. The natural logarithm of the result plus one was used.
5. Specific steps are detailed in the Appendix.
6. Specific steps are detailed in the Appendix.
7. The reduction in the number of observations primarily stems from the significant **spatial agglomeration** characteristics of core digital technology industries (which are mostly concentrated in districts of **first- and second-tier cities** rather

than counties) and the data aggregation process from micro-level firms to the county-industry level during the construction of the HHI indicator.

Supplementary Files

This is a list of supplementary files associated with this preprint. Click to download.

- data.zip
- Appendix.docx