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Digital Villages Construction Accelerates High-Quality Economic Development in Rural China through Promoting Digital Entrepreneurship

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Abstract: "Digital villages construction" and "high-quality economic development" are both key topics to the sustainable development in China. Chinese has attached great importance to agriculture and rural development in recent years, thus exploring the connections between the two topics from a rural perspective is of practical importance. This paper aims to see if there is a connection between digital village construction and high-quality economic development, and how the digital village construction accelerates the high-quality development of the rural economy. After building the index system, this paper evaluates present development level of digitalization and high-quality economy in rural areas by the Entropy Weight TOPSIS method and empirically tests the direct and indirect effect of rural digital construction on the high-quality rural economic development relatively based on the fixed effect model and the mediation effect model. To study deeply, four major regions and five influence paths are analyzed, respectively. The results show that there is a positive correlation between the construction of digital villages and the high-quality development of rural economy. Meanwhile, the entrepreneurial activity of digital industries is a crucial mechanism for digital villages construction to promote the high-quality development of rural economy. This paper innovatively builds relevant index systems and analyzes the transmission mechanism of digitalization to high-quality development from a rural perspective, though it analyzes at the provincial level, which is less specific. Overall, it will be beneficial for economics researchers who study digital economy and rural development and policy makers who give counsel for economic development.

Keywords: digital villages; entrepreneurial activity of digital industry; high-quality development of rural economy; mediation effect

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1. Introduction

The economic development has maintained a high level of growth and has established a global development paradigm over the past 30 years. People's living quality has been greatly improved. However, sharing with most countries globally, economic growth has brought China some socioeconomic problems: energy inefficiency, environmental pollution, imbalances, and inequality. These problems are particularly acute in rural areas. As a result, with the trend that the sustainability and high-quality of economy become the key point, Chinese government pays more attention to the quality and efficiency of economic growth than to the quantity and speed [1]. In economic terms, sustainability tends to be defined as the economy's ability to maintain itself and continue to operate without jeopardizing the very purpose of its existence over time: managing resources from nature for people [2]. The definition is perfectly close to the concept of the high-quality economy—innovation, coordination, green, openness, and sharing. As Innovation [3], green [4], and reducing economic inequality [2] are of great significance to sustainable economic development, the high-quality economy can lay a good foundation for economic sustainability.

In the modern age, the high-quality development should rely more on the improvement of production efficiency, structural optimization, and innovation brought by science

and technology [5], rather than the traditional factor-dependent growth mode. That is because from the perspective of economic sustainability: economy (employment), environment and equity [6], the development of digital economy is conductive to resolving the "internal conflict" of economic interests, namely the conflict between profit and equity (social justice). Compared with the cities, this contradiction is more obvious in the countryside. Therefore, the high-quality development of China's economy is inseparable from the priority development of agriculture and rural areas, and the development of small villages or digital villages plays an important role in sustainable development society in the future [7]. At present, digitization, networking, and intelligence are accelerating their penetration into the industrial system, production system, and management system of agriculture and rural areas, finally injecting new momentum into the sustainable growth of China's rural economy.

At present, studies have defined high-quality development in different angles and have analyzed the factors driving the high-quality economic diversely. According to existing researches, the influencing factors are as follows: foreign direct investments [8], finance [9], institutional and technology innovation [3,10], infrastructure [11], environmental regulation [10,12], etc. Jin, B. [13] pointed out that the main driving factors are scientific discovery, technological invention and industrial innovation. In terms of the development in China, technological innovation is conductive to promoting the high-economic economy. It can help economic development transform from "quantity growth" to "quality growth" [14]. Scholars have studied high-quality economy from various angles. However, the academic community has not paid enough attention to it from a rural perspective.

Digital village construction has a profound impact on the rural economy by promoting the comprehensive application of emerging digital technologies in agriculture and rural areas. As a result, is the construction of digital villages driving the high-quality economic development in rural China? How does it drive the high-quality development? What is the mechanism of the action? How does it effect on different paths of the high-quality development, and what are the differences among them? These questions have been significant and inescapable issues in rural economic development. Based on these questions, this paper evaluates the level of digital villages and the high-quality development of rural economy by the data use of 30 provinces (excluding Tibet) from 2001–2020 with the Entropy Weight TOPSIS method and tests the effect of the digital villages on the high-quality development of rural economy, aiming to find a transmission mechanism between them and compare the effect of different paths and of different regions. It can provide new ideas and paths to the rural construction, and eventually promote the economic development in China.

Compared with the existing related literature, the two marginal contributions of this paper are as follow. First, from a rural perspective, this paper takes the high-quality economic development in rural areas as a starting point and constructs an evaluation index system for the level of digital villages construction. At the same time, from the perspective of digital industry activity, it analyzes the effective promotion mechanism of digital villages construction of driving the high-quality development of rural economy, and reveals the internal mechanism. Second, this paper conducts a heterogeneity test on the mechanism in a regional manner, and explores the differences in the effect of digital villages construction on the high-quality development of rural economy among eastern, central, western, and northeastern China.

The content of this research is below. The second section provides a theoretical analysis and research design based on existing literatures and analyzes the direct and indirect mechanism. The third section provides the research design, including the construction of the model and the index system and the description of variables. The fourth section provides the empirical tests, including benchmark regression, robustness test, regional heterogeneity, and effects tests of different paths. The last section presents the conclusions, suggestions, and limitations of the paper.

2. Theoretical Analysis and Research Design

At present, the proportion of China's rural population to the world's rural population is approximately 17%. According to the World Bank, 770 million people in China have been lifted out of poverty. China's poverty reduction population accounted for more than 70% of global poverty during the same period. China has solved the poverty problem of hundreds of millions of people and has made a great contribution to the stability of the world. At present, in the context of China's booming digital economy, rural digitization has become one of the main means of China's rural economic transformation and modernization. Meanwhile, as one of the fastest-growing economies, China has invested in many countries, which were finally incorporated into China-centered development plans through projects such as the BRI and the MSRI [15]. Countries that the Chinese government have invested in can learn from China's development experience and achieve their own development. As a result, the strategy and situation of economic development in China can have a great importance worldwide. Thus, realizing high-quality development in rural China is necessary.

Modern economic growth is the key to Lewis's approach [16]. The current study slightly restates that the economy consists of modern and non-modern sectors [17]. Unlike most dual economies, the non-modern sector, a sector with substantial labor surplus, contains not only the subsistence agriculture, and the modern sector—a high-productivity sector—encompasses manufacturing and related industries, such human capital intensive services industries. Digital villages have spawned a number of digital industries and digital-related service industries in rural areas. As scholars put forwards that technological advancement is a further important source of economic modernization [17], to some extent, rural economy can be improved by the modernization.

China has reached the first point of Lewis Turning Point and has been experiencing the process between the first point and the second point of Lewis Turning Point [18,19]. However, only by realizing agriculture modernization, rural urbanization, and equalization of urban and rural incomes can China cross Lewis's second point and finally eliminate the dual economic structure. China has eliminated absolute poverty in 2020 and aims to create long-term mechanisms for raising famers' income and reducing relative urban and rural poverty during the 14th FYP period. However, the issue related to the urban-rural income gap remains to be solved. As improved digital connectivity can compensate for the remoteness of rural communities [20], the digital construction in rural areas is crucial.

Through the construction, China will promote the digitalization of agriculture and bridge the digital divide between regions, urban and rural areas, and achieve economic development [21,22]. Many scholars worldwide show that digital technologies are playing a transformational role in the world economy [23]. Some pointed out that digital applications, such as an electronic government, could contribute to the development and transition of economies [24]. As mutual interactions between the government and citizens have become more engaged, appropriate e-government development is of great significance to the overall economic growth [25].

After the analysis above, we can see that digitalization is essential for the economic development. Rural development is the difficult focal point of harmonious and coordinative development of economy, especially in China. Therefore, this paper explores the mechanism framework for the digital village construction promoting the high-quality development of rural economy.

2.1. The Construction of a Mechanism Framework

Digital Villages is a model that villages rely on digital economy and use modern information networks as the carrier to realize the digitalization of rural production, governance and life, and it is an application result produced by networking, informatization and digitization in the development of agriculture and rural areas [26]. Its construction and development are accompanied by the profound adjustment and reconstruction of the rural economic and social structure and production relations, which can solve the

problems of poor information exchange, low productivity, imbalance between industries and insufficient innovation ability in the high-quality development of rural economy. It can be seen from the Figure 1 that in addition to the direct impact on the high-quality development of rural economy by virtue of its own rapid development, digital villages construction can also affect the entrepreneurial activity of digital industries in rural areas, thereby having an indirect impact on the high-quality development of rural economy.

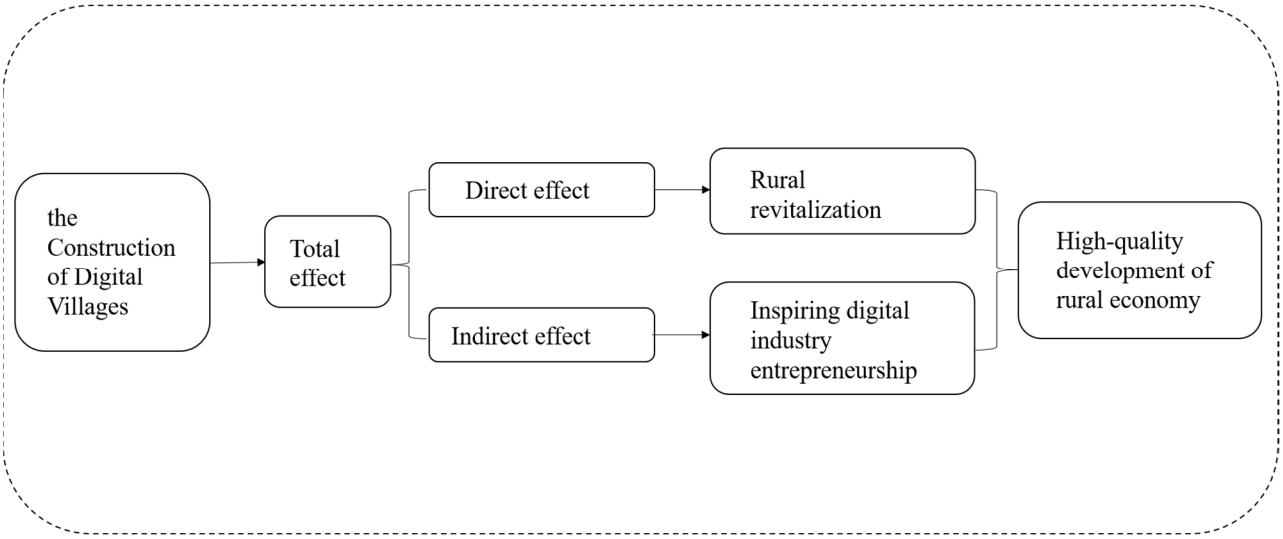

Figure 1. Theoretical and Mechanism Framework of Digital Villages Construction to High-quality Rural Economic Development. Source: The figure is summarized by the authors.

As a leader in various industries, the digital industry has the characteristics of leadership, strategy, and high penetration. Under the background of the national digital villages construction strategy, the entrepreneurial activity of rural digital industries, which can finally promote high-quality economic development in rural areas, has risen rapidly. Entrepreneurial activity of rural digital industry is not only a critical part of enabling rural economy to realize high-quality development, but also an important support point for the formation of rural high-quality economic development.

As is shown in Figure 2, the construction of digital villages can provide a good atmosphere, policy support, infrastructure construction, and other leading factors for the rural digital entrepreneurial activities.

(a) Digital Villages construction helps to promote the dissemination of information in the market. The technology "Internet+" brought about by the construction can strengthen the exchange of information between regions and enhance the ability of farmers to use the information to connect with the market, which breaks the information barriers in urban and rural markets and domestic and foreign markets, helps rural digital entrepreneurship empower farmers to connect with a wider market, and finally expands the "upward" sales channels of rural products. Conversely, the development of rural digital industry entrepreneurial activities can also help farmers obtain more useful information in a shorter time, seizing the opportunity to change the traditional agricultural sales method and to develop new sales models. By expanding sales channels of agricultural products, their real income can be increased [27,28]. Zhao Tao et al. [29] also found through empirical testing that stimulating entrepreneurship can not only empower the high-quality development of the regional economy, but also help propel the integration of the digital economy and industry, finally creating more employment opportunities for the region.

(b) Digital village construction is conducive to improving the digital infrastructure construction in rural areas. Digital supporting facilities, such as the rural Internet of Things, big data analysis, 5G, cloud computing and artificial intelligence, brought

about by it will propel the application of advanced digital technologies in industries of rural areas, promote the upgrading and improvement of rural industrial technology, and equip rural digital industry entrepreneurial activities with advanced technology. It helps realize the digital transformation and the sustainability of traditional industries and the optimization of rural industrial structure [30].

(c) The construction of digital villages can bring about the emergence and development of service industries related to digital industries. When digital industries-related industries in rural areas are driven by digital villages and industries with outdated production capacity are eliminated, traditional industries can also be upgraded and transformed with the emerging industries. The development of digital industries becomes an endogenous driving force for the healthy and coordinated development of rural agriculture [31]. It provides a solid industrial foundation for the development of rural digital industrial entrepreneurship, which eventually can promote the development of rural non-agricultural industries and optimize the structure of rural employment.

(d) The construction of digital villages is beneficial to introduce talents with professional digital technology to rural areas. A large number of talents related to digital economy are required in the process of digital villages construction [1]. Under the support and guidance of the policy, local governments encourage timely training for local residents in rural areas to accumulate outstanding talents to provide sufficient human support [22] for rural digital entrepreneurship. With the launch of numerous innovation and entrepreneurship activities [32], new technologies, new products and new models have emerged successively, bringing more excellent and attractive jobs and promoting the return of high-quality talents to rural areas [33,34].

(e) Digital villages construction can promote the upgrading of rural residents' consumption structure. Rural consumption demand is an important foundation for the formation of the current domestic cycle in China. The construction has enriched channels for rural residents to obtain information, enabling them to have extensive access to modern digital technology and high-quality commodities. The new consumption demand released in rural can create new opportunities [35] and help the rural digital industrial entrepreneurship tap potential customer needs. The digital industry entrepreneurial activities will have a huge spillover effect [36] through the "acquaintance effect" in rural areas, driving surrounding areas to share development opportunities.

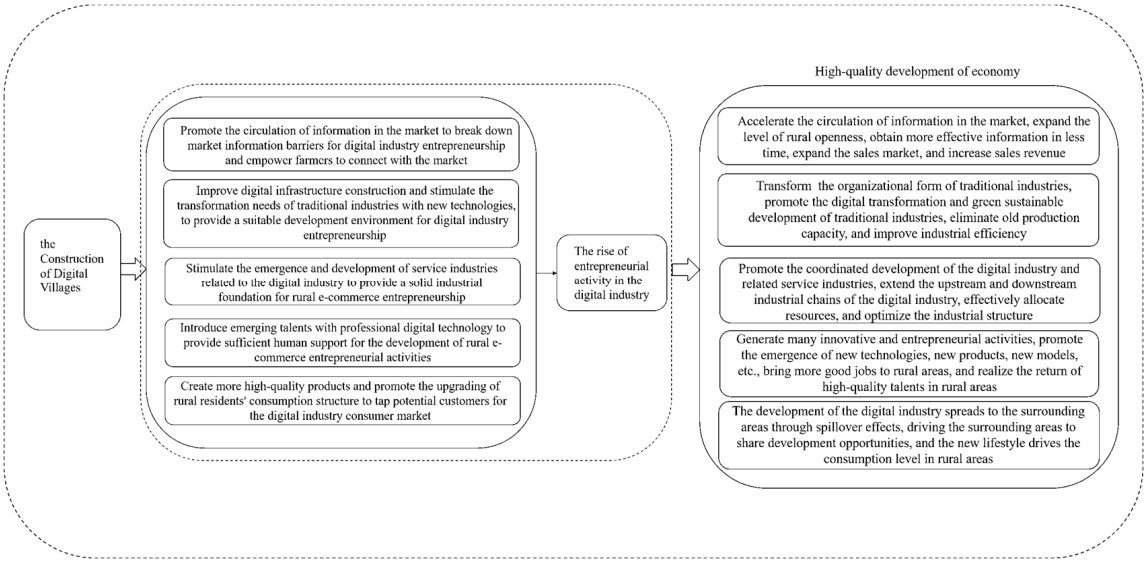

Figure 2. The mechanism of digital villages construction to promote high-quality rural economic development. Source: The figure is summarized by the authors.

Therefore, this paper believes that timely information exchange, suitable development environment, solid industrial foundation, sufficient human support, and potential customer resources brought about by digital villages provide favorable conditions for entrepreneurial activities in rural digital industries, which eventually promotes the high-quality development of rural economy.

2.2. The Research Hypothesis of This Paper

First of all, according to the analysis framework of the above theoretical mechanism, this paper supposes that digital village construction can break the "information island" in the development of rural industries by leading digital industries development [22], realize the three-dimensional linkage of multiple subjects, and further promote the coordinated development of rural economy and the construction of a green ecological agricultural industry system [21]. It will finally allow farmers to share the development results of digital villages construction. Based on this, the research hypothesis H1 is proposed:

H1: *Digital village construction promotes the high-quality development of rural economy by increasing the entrepreneurial activity of rural digital industries, and has a positive driving effect.*

Secondly, digital industry entrepreneurial activities can promote the circulation and exchange of various types of information in the market, which is in favor of the expansion of the scale of product import and export flow, the investment of a large amount of foreign capital, thereby improving the level of openness [23] in rural areas. The construction and popularization of various information platforms brought about by rural digitalization have strengthened the exchange of information between the supply and demand sides of the market [37], and played an important role in promoting information collection before and after starting a business, reducing the cost of information search and transaction. The drop in cost creates a great advantage for external market development, which is conducive to the expansion of product export scale. In addition, thanks to this, the digital industry can contact the external market in a timely manner when it is developed in rural areas, thereby promoting the expansion of the import and export scale, the increase of foreign direct investment [38], and the further expansion of the opening-up of rural areas. Based on this, the research hypothesis H2a is proposed:

H2a: *Digital villages construction plays a positive role in promoting the opening-up and development of rural areas by increasing the entrepreneurial activity of rural digital industries.*

Thirdly, digital industry entrepreneurial activities can promote the upgrading and transformation of rural traditional industries and the sustainability of rural primary, secondary and tertiary industries. The emergence of emerging digital industries represented by e-commerce has challenged the survival and development of some traditional industries in rural areas [39], but at the same time, the opportunities and challenges brought by emerging technologies, such as artificial intelligence, big data, and cloud computing, have forced the traditional real economy to carry out digital upgrading and transformation, advancing the high-quality development of rural economy. This is because the development of a new generation of digital technology helps to optimize the employment structure [40,41], promotes the further improvement of labor remuneration and labor protection, so as to continuously improve the employment environment and provide new opportunities for the high-quality employment. Meanwhile, in this process, rural areas will realize the transformation of old and new kinetic energy by prompting the traditional industrial economy to produce new economic forms and changing the traditional rural industrial mode. Thus, it will propel the construction of modern agriculture management system as well as the transformation and green development of rural entrepreneurial activities and eventually will improve economic efficiency. Based on this, the research hypothesis H2b is proposed:

H2b: *Digital villages construction can positively promote rural green development by increasing the entrepreneurial activity of rural digital industries.*

Fourthly, digital industry entrepreneurial activities can promote the coordinated development of different rural industries and optimize the rural industrial structure. The emergence and development of emerging digital industries not only promotes the digital transformation of traditional industries, but also successfully drives the development of other industries related to the digital industry in rural areas and the extension of industrial chains by virtue of its high technology [42], high added value [37], and environmental friendliness. For example, the agglomeration of the rural e-commerce industry has promoted the coordinated development of digital services such as agricultural logistics, information, and finance, as well as infrastructure and related industries, and has driven the development of rural e-commerce derivative service industries such as transactions, operations, warehousing, marketing, training, and the Internet of Things. In the emerging digital industry chain, two new leading forces, "consumer business" and the industrial Internet, bring to the emergence of new service models, such as service-based and networked collaboration. The inter-industry complementarity of traditional industries, emerging Internet industries and extended innovative industries promotes the coordinated development of extended industries and emerging industries and achieves optimal allocation of resources in rural areas and coordination among multiple industries. Based on this, the research hypothesis H2c is proposed:

H2c: *Digital villages construction has a positive effect on the coordinated development of rural areas by increasing the entrepreneurial activity of rural digital industries.*

Fifthly, rural digital innovation and entrepreneurship activities burst out because of the digital industrial entrepreneurship, thereby increasing high-quality employment opportunities in rural areas, and realizing the return of human resources in rural areas. The new generation of digital technology promotes the innovation and development of emerging digital industries, promotes the adjustment of China's industrial structure, the transformation of new and old kinetic energy, industrial chain innovation and high-quality development. Taking innovation as the driving force can effectively improve the development level of the old industrial chain and bring new demands for markets, talents, and products. At the same time, due to the "acquaintance effect" of rural society, the continuous development of rural digital industries is often accompanied by social innovation effects, such as leadership by entrepreneurial leaders and neighborhood demonstrations [43]. Therefore, the development of various digital industry innovation and entrepreneurship activities can create a large number of high-quality jobs for rural residents, not only attracting a large number of outstanding talents, but also improving the enthusiasm of farmers to participate in digital learning, and provide more entrepreneurship and employment channels for returning farmers [44]. Based on this, the research hypothesis H2d of this paper is proposed:

H2d: *Digital villages construction has a positive effect on rural innovation and development by increasing the entrepreneurial activity of rural digital industries.*

Finally, digital industry entrepreneurial activities can bring spillover effects [45], promote consumers to change their traditional lifestyles, and allow everyone to share development dividends. The strong network effect of the digital industry and the characteristics of almost zero marginal cost make some digital industries less restrictive. For example, the emergence of "Internet +" has enhanced the impetus for endogenous development in poverty-stricken areas [46], and its application and promotion in rural areas have brought to the formation of a large-scale poverty alleviation pattern with the participation of the whole society in "Taobao Villages" [30]. The transformation of new lifestyles driven by the digital industry has increased the consumer demand of residents. The rapidly developing

digital industry cannot only promote the economic development of the region, but also stimulate the consumption of local rural residents. Meanwhile, the spillover effects, such as information circulation and technology diffusion brought by it can effectively radiate to the surrounding areas, drive the digital industry construction in these areas and thus enable everyone to share the opportunities. Based on this, the research hypothesis H2e is proposed:

H2e: *Digital villages construction can positively promote rural shared development by increasing the entrepreneurial activity of rural digital industries*.

3. Methodology and Materials

Few existing literatures carried out systematic and in-depth theoretical analysis and quantitative research on digital villages, digital entrepreneurship, and high-quality development of rural economy. Nevertheless, researchers related to the connection among the three topics become more and more valuable to developing countries such as China. Thus, in order to explore the connection among them and the impact of digital villages on high-quality development of rural economy, the systematic index system of the digital village and the high-quality rural development is constructed in this section. The methods of this paper, the construction of the index systems, sources, and processing methods of data are presented below.

3.1. Model Building

In terms of direct effects, the following basic models are firstly constructed for the direct transmission mechanism to test the above research hypotheses:

$$RHQED_{i,t} = \alpha_0 + \alpha_1 DV_{i,t} + \alpha_c X_{i,t} + \mu_i + \varepsilon_{i,t} \quad (1)$$

In Formula (1), $RHQED_{i,t}$ is the high-quality development level of rural economy of the province i in the period t; $DV_{i,t}$ represents the development of digital villages of the province i in the period t; the vector $X_{i,t}$ represents the set of control variables. The financial decentralization level, the urbanization level, the financial development level, the regional scientific and technological innovation capacity, industrial structure development status, the number of E-commerce pilots in rural areas and the number of Digital Villages pilots are used as control variables; μ_i represents the individual fixed effect of the province i that does not change with time, and $\varepsilon_{i,t}$ represents the random disturbance term.

In terms of indirect effects, in order to discuss the possible internal mechanism of "digital villages" on the high-quality development of rural economy, according to the theoretical mechanism described above, this paper tests whether the entrepreneurial activity of digital industries in rural areas is an intermediary variable between the two. The specific test steps are as follow. In the linear regression model (1) of the digital villages development index $DV_{i,t}$ to the high-quality rural economic development index $RHQED_{i,t}$, if the significance of the regression coefficient α_1 passes the test, then a linear regression equation of $DV_{i,t}$ for the mediating variable digital industry entrepreneurial activity $Ecentre_{i,t}$, respectively, as well as the regression equation of $DV_{i,t}$ and the mediator variable $Ecentre_{i,t}$ to $RHQED_{i,t}$ will be established. The mediation effect is judged by the significance of the regression coefficients such as β_1, γ_1, and γ_2. The specific settings of the above regression model are as follow.

$$Ecentre_{i,t} = \beta_0 + \beta_1 DV_{i,t} + \beta_c X_{i,t} + \mu_i + \varepsilon_{i,t} \quad (2)$$

$$RHQED_{i,t} = \gamma_0 + \gamma_1 DV_{i,t} + \gamma_2 Ecentre_{i,t} + \gamma_c X_{i,t} + \mu_i + \varepsilon_{i,t} \quad (3)$$

In order to further test the specific path of digital industry entrepreneurship to promote the high-quality development of rural economy, the indicators of five dimensions of high-quality development are incorporated into the regression model:

$$index_{i,t} = \alpha_0 + \alpha_1 Ecentre_{i,t} + \alpha_c X_{i,t} + \mu_i + \varepsilon_{i,t} \quad (4)$$

Among them, $index_{i,t}$ respectively represents the development level of openness, green, coordination, innovation, and sharing of the province i in the period t.

3.2. Indicator Selection

A. The development level of digital villages. As an important part of the construction of digital China, digital villages construction has diversified development goals. A single evaluation index cannot systematically reflect the development level of digital villages. Therefore, we measure the level of digital development by building a multi-dimensional indicator system. Based on the above theoretical analysis framework, references to relevant literature [47–49], and the availability of rural data at the province level, this paper constructs a multi-dimensional evaluation system consisting of seven secondary indicators, including agricultural production informatization, agricultural management informatization, informatization infrastructure construction, rural governance informatization, rural service informatization, regional development environment, and farmers' informatization literacy. Besides, fourteen third-level indicators are also constructed (see Table 1). The development level of digital villages in 30 provinces (in addition to Tibet) in China from 2001 to 2020 were calculated, and the obtained results were recorded as $DV_{i,t}$.

Table 1. The evaluation index system of digital villages development and the high-quality development of rural economy.

First-Level Indicator	Second-Level Indicator	Third-Level Indicator	Indicator Properties
the Construction of Digital Villages	Agricultural production nformation	agricultural machinery power (kw)	+
		the number of people employed in scientific research and technical services	+
	Agricultural management informatization	the number of provincial demonstration family farms	+
		county-level annual online retail sales (10,000 yuan)	+
		the number of Taobao Villages	+
	Informatization infrastructure construction	domestic highway mileage	+
		collection of books in public libraries (10,000 volumes)	+
		county area telecommunications business income (10,000 yuan)	+
	Rural governance informatization	the capacity of online government affairs and the number of government websites	+
		the ranking of the number of government websites	−
	Rural service informatization	the number of people engaging in information transmission, software and information technology services in non-private units	+
		receipts from information service	+
	Regional development environment	per capita disposable income of rural residents	+
		the index of Digital Financial Inclusion	+
		total retail sales of consumer goods (100 million yuan)	+
	Information literacy of farmers	the number of broadband users at the end of the year (10,000 households)	+
		the average number of mobile phones owned by rural residents per 100 households	+

Table 1. *Cont.*

First-Level Indicator	Second-Level Indicator	Third-Level Indicator	Indicator Properties
the High-quality Development of Rural Economy	Openness	gross imports of agricultural products	+
		gross value of agricultural exports	+
	Regional coordination	urban and rural disposable income ratio	−
		urbanization rate	+
	Ecological Green	damage rate (crop affected area/total crop area)	−
		the green coverage rate of the built-up area of the county	+
		pesticide use intensity	−
	Research and innovation	number of inventions per capita	+
		number of agricultural technicians per 10,000 rural population (number of agricultural technicians in public economic enterprises and institutions/total rural population)	+
	Achievement sharing	unemployment insurance rate	+
		Engel's coefficient of rural households	−
		rural Minimum Living Security Expenditure	+

The Table is summarized by the authors.

(1) Agricultural production information and agricultural management informatization. The development of digital agriculture is an indispensable part of digital villages construction. We divide digital agriculture into agricultural production informatization and agricultural management informatization according to the production and sales of agricultural products. When the degree of informatization and digitization in agricultural production is higher, the labor force necessary for agricultural production will gradually be liberated, the corresponding mechanical power will gradually increase, and the liberated labor force can be transferred to the scientific and technological research and development and modern management of agricultural production [50]. With the improvement of the informatization and digitization of agricultural operations, large-scale and intensive production-oriented family farms will form in the county. The online retail sales of products in the county area will increase [51]. New farmers imitate and learn internally and finally promote the formation of Taobao villages that rely on special products to go out of the region.

(2) Informatization infrastructure construction, rural governance informatization, rural service informatization and regional development environment. The construction of digital countryside is the key task of developing digital villages. The transformation of rural construction to digital development must improve the infrastructure in the countryside and promote the digitalization of rural government affairs to rural residents. Besides, the construction of e-government is of great significance [24]. Digital services can be more efficient. Finally, a good economic development environment is also an important part of the digital countryside [22]. The total number of books in the county, the popularity of Internet broadband, and the mileage of road construction can reflect the level of the infrastructure in rural areas of the province. The level of digital government affairs is represented by the usage of the capacity of online government affairs and the number of government websites. The informatization of rural services is carried out by examining the number of service employees in the information technology industry and

receipts from information service. The appropriate regional development environment is represented by the commodity sales status, the index of Digital Financial Inclusion and farmers' income status within the county.

(3) Information literacy of famers. Economic development must adhere to the people-oriented [52]. The improvement of famers' information is the basic task and the inevitable requirement for the sustainability of digital villages. To cultivate new generations with digital skills, farmers must use various conditions to obtain digital information resources. The emergence and development of modern technologies such as the Internet and information technology have enabled farmers in remote areas to draw useful information from the Internet [53]. As an important carrier of information dissemination on the Internet, the popularization of smart phones in rural areas has greatly improved the informatization quality of farmers.

The Entropy Weight TOPSIS method is used for the calculation of the digital village development index and the high-quality rural economic development index. The Entropy Weight TOPSIS method is an improvement of the traditional TOPSSIS based on the Entropy Weight method. The Entropy method uses the amount of information reflected by the variation degree of each evaluation value to determine the index weight, which can highlight the time change trend of the index weight and avoid subjective bias to a certain extent. TOPSIS is a multi-objective decision-making method [54]. The distance between the evaluation object and the positive ideal solution and the negative ideal solution is obtained, and the relative closeness of each evaluation object to the ideal solution is obtained to sort the pros and cons. The improved TOPSIS evaluation method can determine the weight according to the amount of information reflected by the degree of variation of each index, and calculate its closeness to the optimal solution through the difference between the evaluation object and the positive and negative ideal solutions. The Entropy Weight TOPSIS method has certain scientific nature [55]. Its calculation formula is as follows.

Assuming that there m evaluation objects, and each evaluation object has n evaluation indicators, construct a judgment matrix:

$$\mathrm{index}_{i,t} = \alpha_0 + \alpha_1 \mathrm{Ecentre}_{i,t} + \alpha_c X_{i,t} + \mu_i + \varepsilon_{i,t} X = \left(x_{ij}\right)_{m\times n} (i = 1, 2, \ldots, m; j = 1, 2, \ldots, n)$$

Standardize the judgment matrix, x_{ij} is the original value of the i-th index in the j-th year:

$$x_{ij} = \frac{x_{ij} - \min x_{ij}}{\max x_{ij} - \min x_{ij}} \text{ (positive indicator)}$$

$$x_{ij} = \frac{\max x_{ij} - x_{ij}}{\max x_{ij} - \min x_{ij}} \text{ (negative indicator)}$$

The indicators are normalized to calculate the proportion of the i-th indicator in the j-th year:

$$x_{ij} = \frac{x_{ij}}{\sum_{i=1}^{n} x_{ij}}$$

Calculate the information entropy e_j, and use the IF statement to find $\ln x'_{ij} = \mathrm{IF}\left(x_{ij} = 0, 0, \ln x'_{ij}\right)$:

$$e_j = \frac{1}{\ln n} \times \sum_{j=1}^{n} \left(x_{ij} \times \ln x'_{ij}\right)$$

Calculate the difference coefficient g_j of each indicator and the indicator weight W_j:

$$\begin{cases} g_j = 1 - e_j \\ W_j = \frac{g_j}{\sum_{j=1}^{m} g_j} \end{cases}$$

Construct Weighted Normalized Decision Matrix V_{ij}, $V_{ij} = W_j Z_{ij}$, $Z = (Z_{ij})_{m \times n}$:

$$Z_{ij} = \frac{x_{ij}}{\sqrt{\sum_{i=1}^{m} x_{ij}^2}}, \; j = (1, 2, \ldots, n)$$

Determine the positive and negative ideal solutions, the larger the element value V_{ij} in the decision matrix V, the better the solution:

$$V_j^+ = (V_1^+, V_2^+, \ldots, V_m^+) = \{\max V_{ij} | j = 1, 2, \ldots, m\}$$

$$V_j^- = (V_1^-, V_2^-, \ldots, V_m^-) = \{\min V_{ij} | j = 1, 2, \ldots, m\}$$

Calculate the distance S_i^+ of each measure object to the positive ideal solution and the distance S_i^- to the negative ideal solution:

$$S_i^+ = \sqrt{\sum_{j=1}^{m} \left(V_j^+ - V_{ij}\right)^2}$$

$$S_i^- = \sqrt{\sum_{j=1}^{m} \left(V_j^- - V_{ij}\right)^2}$$

Calculate the relative proximity of each measure object:

$$c_i = \frac{S_i^-}{S_i^+ + S_i^-}$$

In the formula, $0 < c_i < 1$, and the larger the value of c_i, the better the evaluation object.

B. The high-quality development level of rural economy. Like the development goal of digital villages construction, the goal of high-quality rural economic development also has multi-dimensional characteristics. Thus, a corresponding indicator system must be constructed from its multiple attributes. Barror (2000) [56] points out that the quality of economic growth encompasses narrow growth indicators and social development indicators. In the new era, the growth mode of an innovation-driven economy, is an innovative, high-efficient, energy-saving, environmentally friendly, and high-value-added growth mode [12,57], which is defined as high-quality economic development can be the trend. As a result, this paper proposes five categories: opening-up, regional coordination, ecological green, scientific research innovation, and achievement sharing. The index system of the high-quality rural economic development consists of secondary indicators and twelve tertiary indicators (see Table 1). At the same time, the high-quality development level of rural economy in 30 provinces in China from 2001 to 2020 were measured, and the obtained digital rural development level was recorded as $RHQED_{i,t}$.

(1) Open to the outside world. Openness is the only way to achieve high-quality economic development. At some level, the proportion of imports and exports in GDP can reflect the level of economic development of a region [8]. The larger the proportion of imports and exports in GDP, the higher the level of economic development and the wider the degree of regional opening. This paper examines the degree of opening-up in rural areas through the import and export volume of agricultural products in rural areas.

(2) Regional coordination. Coordinated regional development [14], especially the development between urban and rural areas [38], is an endogenous feature of RHQED (High-Quality Economic Development of Rural Economy). The higher the level of high-quality economic development in districts and counties, the

more rural residents' lifestyles and living environment are closer to the urban living standards, the smaller the gap between the per capita disposable income of urban residents and rural residents, the faster the urbanization development process in rural areas, and the higher the urbanization rate.

(3) Ecological Green. Ecological green development will eventually become a common form of high-quality economy [58]. The built-up area is the main residence. The larger the proportion of green coverage, the more the economic development meets the requirements of green economic development. When rural areas realize the high-quality economic development, the final development mode of high pollution and high consumption there is green and sustainable. In this paper, the disaster rate and pesticide use intensity are used to measure the sustainable development.

(4) Research and innovation. Innovation is the key driver for high-quality economic development [59]. In a certain period of time, the more inventions per capita in a county, the higher the development of science and technology in the region, and the stronger the atmosphere of scientific research and innovation. Besides, the higher the proportion of scientific and technological practitioners in social workers, the more the development meets the requirements of innovation and development in high-quality economy. This paper chooses the proportion of agricultural technicians per 10,000 rural population to measure the development of scientific research in rural areas.

(5) Achievement sharing. The sharing of development achievements is the fundamental goal of high-quality economy. The sharing of regional achievements is reflected in the fact that more people can enjoy the improvement of living standards brought about by RHQED. Unemployment insurance and rural minimum living security expenditure are important social benefits. The higher the unemployment insurance ratio and rural minimum living security expenditure, the more people enjoy shared development benefits. Engel's coefficient is an important indicator to measure the living standard of residents, which generally decreases with the improvement of residents' family income and living standard. The Engel's coefficient of rural residents continues to decline, indicating that the economic income of rural residents is increasing, and their lives are more prosperous.

C. Calculation of entrepreneurial activity in digital industries. Drawing on the research method of Ye W.P., this paper selects the number of newly registered Internet and information industry enterprises at the county level in 30 provinces from the enterprise database of Qichacha. After filtering out the companies that have been cancelled and moved out, we take the logarithm to get the entrepreneurial activity of the digital industry, which is recorded as $Ecentre_{i,t}$.

D. Control variables. For a more comprehensive analysis, it is of vital importance to set control variables that may have an impact on the high-quality development of the rural economy. They are as follows: The financial decentralization level (DFD) is expressed as the budget expenditure; the urbanization level (Urban) is taken from the logarithm of the population density; the financial development level (Finance) is expressed by the ratio of the balance of deposits and loans of financial institutions at the end of the year to the regional GDP; the regional scientific and technological innovation capacity (Innovate), which is expressed by the ratio of the number of patent applications authorized to the number of patent applications accepted; the industrial structure development status (Structure), which is expressed by the ratio of the output value of the tertiary industry to the regional GDP. The development of digital villages pilots (DVP) and comprehensive demonstration counties for e-commerce in rural areas (ECP) can apply the dividends released by modern technology to real rural construction actions, which greatly promotes the internal vitality of agricultural and rural development. Therefore, this paper also takes them as control variables.

3.3. Data Sources and Descriptive Statistics

This paper takes the development level of digital villages and high-quality economic of 30 provinces in China (excluding Tibet) as the research object, collects the data of each indicator from 2001 to 2020, forming a strongly balanced panel composed of 8400 data. The data involved are mainly from National Bureau of Statistics, the Statistical Yearbooks, and the official websites of Provincial Department of Agricultural and Rural Affairs of each province, China Rural Statistical Yearbook, Monthly Statistical Report on China's Agricultural Products Import and Export (December) over the years, and the previous *China Internet Development Status* issued by CNNIC. Statistical Report", E-Government Research Center of Party School of the Centra Committee of C.P.C, Ali Research, Ministry of Commerce, EPS database, and Qichacha database, and individual missing data are supplemented by the multiple imputation method.

Table 2 shows the descriptive statistics of the main variables in the above models (1)–(4). The results show that the mean value of the Digital Village Development Index (DV) is 0.221, the maximum value is 1, the minimum value is 0, and the standard deviation is 0.255, indicating that the digital village development status varies greatly between different regions. The index of High-Quality Rural Economic Development (RHQED) and the Digital Industry Entrepreneurial Activity (Ecentre) also show the characteristics of small mean and large standard error. From the perspective of control variables, different provinces are also different in terms of fiscal decentralization (DFD), urbanization level (Urban), financial development level (Finance), regional technological innovation capability (Innovate), industrial structure development status (Structure), digital villages pilots (DVP) and comprehensive demonstration counties for e-commerce into rural areas (ECP).

Table 2. Variable descriptive statistics results.

	Variables	Number of Observations	Mean	Standard Deviation	Minimum	Maximum
Explanatory variables	DV	600	0.221	0.255	0	1
Mediating variable	Ecentre	600	2.784	1.198	0	6.254
Explained variables	Open	600	0.393	0.308	0	1
	Coordination	600	0.466	0.291	0	1
	Green	600	0.492	0.220	0	1
	Innovation	600	0.393	0.308	0	1
	Share	600	0.398	0.317	0	1.506
	RHQED	600	0.382	0.281	0.0179	1
Control variables	DFD	600	0.505	0.190	0.148	0.951
	Urban	600	5.430	1.273	1.978	8.281
	Finance	600	2.975	1.050	1.454	7.552
	Innovate	600	0.539	0.115	0.251	1.463
	Structure	600	0.454	0.0918	0.298	0.837
	DVP	600	0.178	0.807	0	5
	ECP	600	2.138	4.817	0	33

Table 2 is summarized by the calculated results of the data we selected in Section 3.3 by STATA.

4. Analysis of Empirical Results

The analysis of variable correlations, benchmark regression, and robustness check are shown in this section. This paper also innovatively explores the impact of five different paths to compare the effects brought by the digital villages construction.

4.1. Analysis of Variable Correlations

Firstly, a correlation analysis is performed on all explanatory variables. Table 3 shows that the correlation coefficients between the three important variables of the digital village development level, the high-quality development level of rural economy, and the digital industry entrepreneurial activity in the model all reached a significant level. The devel-

opment level of digital villages is significantly positively correlated with the high-quality development level of the rural economy, indicating that promoting the construction of digital villages can stimulate the high-quality development of the rural economy.

Table 3. The results of the variable correlation analysis.

Variables	RHQED	DV	Ecentre	DFD	Urban	FDL	INNOVATE	STRUCTURE	DVP	ECP
RHQED	1									
DV	0.842 ***	1								
Ecentre	0.504 ***	0.363 ***	1							
DFD	0.00200	−0.101 **	0.397 ***	1						
Urban	0.077 *	0.0580	0.314 ***	0.779 ***	1					
Finance	0.409 ***	0.247 ***	0.302 ***	0.304 ***	0.218 ***	1				
Innovate	0.180 ***	0.236 ***	0.088 **	0.00800	−0.0440	−0.00500	1			
Structure	0.502 ***	0.362 ***	0.375 ***	0.312 ***	0.273 ***	0.855 ***	0.0400	1		
DVP	0.419 ***	0.637 ***	0.070 *	−0.107 ***	−0.00100	0.083 **	0.255 ***	0.169 ***	1	
ECP	0.501 ***	0.467 ***	0.263 ***	−0.217 ***	−0.101 **	0.111 ***	0.0180	0.186 ***	0.187 ***	1

Note: ***, ** and * indicate that the regression results passed the significance test at 1%, 5% and 10% confidence levels, respectively. Table 3 is calculated by the data we selected in Section 3.3 by STATA.

Secondly, among the control variables, DFD, Urban, Finance, and other control variables have obvious correlations, and there may be a collinearity problem. In order to further test the collinearity between explanatory variables, the VIF test is performed below. After testing, all VIF values in Table 4 are less than 10. There is no serious multicollinearity problem, and the next step of regression can be performed.

Table 4. VIF test results.

Variables	VIF	1/VIF
Structure	4.320	0.231
Finance	3.900	0.256
DFD	3.530	0.283
Urban	2.780	0.360
DV	2.770	0.361
DVP	1.850	0.541
ECP	1.660	0.602
Ecentre	1.450	0.689
Innovate	1.120	0.895
Mean	VIF	2.600

Table 4 is calculated by the data we selected in Section 3.3 by STATA.

4.2. Benchmark Regression

This paper firstly selects a fixed effect model to estimate the model through model testing. Secondly, because different regions have differences in government policies, development opportunities, etc., the research effect may vary due to different research individuals. So the individual fixed effect model is selected in this paper.

Table 5 reports the linear estimation results of digital villages development on high-quality development of rural economy. In model (1) and (2), the estimated coefficient of the core explanatory variable Digital Villages Development Index (DV) is significantly positive, and the construction of digital villages promotes the high-quality development of rural economy at the county level. In addition, in the model (2) after adding control variables, the degree of fiscal decentralization (DFD) is not significantly related to the high-quality development level of the rural economy, which may be because the local government's own income decreases and its own expenditure increases, deepening the degree of vertical fiscal imbalance. However, the impact of fiscal decentralization on RHQED depends on the degree of vertical fiscal imbalance. When the vertical fiscal imbalance is at a high level, the positive impact of fiscal decentralization on RHQED will tend to weaken.

Table 5. Benchmark regression results of the impact of digital villages development on high-quality rural economic development.

Variables	(1)	(2)
	RHQED	RHQED
DV	0.960 ***	0.658 ***
	(0.023)	(0.036)
DFD		0.003
		(0.046)
Urban		0.503 ***
		(0.079)
Finance		0.120 ***
		(0.014)
Innovate		0.319 ***
		(0.113)
Structure		0.802 ***
		(0.160)
DVP		−0.025 ***
		(0.008)
ECP		0.004 ***
		(0.001)
Individual fixation	YES	YES
Constant	0.170 ***	−3.383 ***
	(0.008)	(0.394)
Observations	600	600
R-squared	0.754	0.867
F	1742.464	457.156

Note: Robust standard errors are reported in parentheses in the table, *** indicates that the regression results passed the significance test at 1% confidence level. Table 5 is calculated by the data we selected in Section 3.3 by STATA.

There is a significant positive correlation between the level of urbanization (Urban) and the level of financial development (Finance) and the high-quality development of the rural economy, and both remain significant at the level of 1%. The former shows that the improvement of the urbanization level helps to accelerate the high-quality development of rural economy. It is consistent with the research of An, X. et al. [60]. The latter shows that building a high-level capital market is vital to improve the high-quality economic development of the region [61]. At the same time, there is a significant positive correlation between regional scientific and technological innovation capability (Innovate) and the high-quality development of the rural economy, indicating that the development of scientific and technological innovation [58] has a significant effect in rural areas in the long run. There is a significant positive correlation between the industrial structure development status (Structure) and the high-quality development of rural economy, and it remains significant at the level of 1%, indicating that the development of the tertiary industry has an important role in promoting the high-quality economic development of the region. This is consistent with the conclusion of Song, M.; Lu, B. and Jiang, L. [62] on the impact of industrial structure changes. The number of digital villages pilots (DVP) is significantly negatively correlated with RHQED, which may be because the digital village pilot was launched in 2020 and has not yet fully achieved results. The number of e-commerce demonstration counties is significantly positively correlated with RHQED, indicating that e-commerce promotes the development of rural economy, promotes the coordinated development of urban and rural areas, and contributes to high-quality economic development.

The theoretical analysis and assumptions in the previous part of have analyzed the transmission mechanism of the impact of digital villages construction on the high-quality rural economic development from a theoretical point of view. In order to verify the assumptions made about this transmission mechanism, after referring to scholars' research on innovation and entrepreneurship by using mediation models in the economic field and

the introduction of mediation effect models by Wen Z.L. and Ye B.J. [63], in this paper, the mediation effect model is selected for empirical testing, and the regression results are shown in Table 6.

Table 6. Test results of the mechanism of digital villages construction affecting the high-quality development of rural economy.

Variables	(1)	(2)	(3)
	RHQED	Ecentre	RHQED
DV	0.658 ***	1.187 ***	0.587 ***
	(0.036)	(0.192)	(0.036)
Ecentre			0.058 ***
			(0.008)
Control variables	YES	YES	YES
Individual fixation	YES	YES	YES
Constant	−3.383 ***	−6.958 ***	−3.004 ***
	(0.394)	(2.087)	(0.383)
Observations	600	600	600
R-squared	0.867	0.558	0.879
F	457.156	87.975	450.322

Note: Robust standard errors are reported in parentheses in the table, *** indicates that the regression results passed the significance test at 1% confidence level. Table 6 is calculated by the data we selected in Section 3.3 by STATA.

Model (1) confirms that digital villages construction has a positive effect on the high-quality development of rural economy. Model (2) examines whether the construction of digital villages has an impact on digital industry entrepreneurial behavior. The regression coefficient is significantly positive at the 1% confidence level, indicating that the construction of digital villages has improved the entrepreneurial activity of digital industries in the province.

Finally, the mediating variable digital industry entrepreneurial activity is added to model (3), and the influence of core explanatory variables and mediating variables on the explained variables are also investigated. The results show that the entrepreneurial activity of the digital industry has a positive impact on RHQED, and has passed the significance test at the 1% level. Besides, compared with model (1), the influence coefficient of digital villages construction on the high-quality development of rural economy has decreased, indicating that the entrepreneurial activity of the digital industry has played a partial intermediary role in the mechanism of digital villages construction to promote the high-quality development of the rural economy. Entrepreneurial activity in digital industries is an indirect mechanism for improving the high-quality development of the rural economy. This empirical result confirms Hypothesis 1.

4.3. Robustness Check

In order to ensure the robustness of the research conclusions, three methods of regression model comparison, variable substitution and heterogeneity analysis are used to further estimate and test the model.

(1) Model comparison. In order to compare and test with different regression models, this paper selects the regression analysis results of random effects model and the regression results of fixed effects model for comparative analysis. As can be seen from Table 7, regardless of whether or not control variables are added, the results of the random effect and fixed effect models show that digital rural construction has a prominent positive effect on the high-quality development of rural economy.

Table 7. Comparison Results of Random Effects Model and Fixed Effects Model Benchmark Regression.

Variables	RE		FE	
	(1)	(2)	(3)	(4)
	RHQED	RHQED	RHQED	RHQED
DV	0.947 ***	0.881 ***	0.960 ***	0.658 ***
	(0.023)	(0.034)	(0.023)	(0.036)
Control variables	NO	YES	NO	YES
Individual fixation	NO	NO	YES	YES
Constant	0.173 ***	−0.155 ***	0.170 ***	−3.383 ***
	(0.011)	(0.057)	(0.008)	(0.394)
Observations	600	600	600	600
R-squared			0.754	0.867
F			1742.464	457.156

Note: Robust standard errors are reported in parentheses in the table, *** indicates that the regression results passed the significance test at 1% confidence level. Table 7 is calculated by the data we selected in Section 3.3 by STATA.

In Table 8, models (1), (2), and (3) represent the results of the mechanism of action test of the random-effects model. Compared with the models (4), (5), and (6) that represent the test results of the fixed-effects model, the construction of digital villages has a greater influence on the activity of digital industries. After adding the intermediary variable into the regression model of digital villages construction on the high-quality development of the rural economy, the positive impact of the digital industry entrepreneurial activity on the high-quality development of rural economy is positive and significant, and passed the significance test at the 1% level. It shows that the entrepreneurial activity of the digital industry is the mechanism for improving the high-quality development of rural economy. Therefore, the test results of the random effects model support the test results of the fixed effects model above.

(2) Variable substitution. In order to ensure the robustness of the research conclusions, this paper also use the method of replacing regression variables to perform regression testing on the model.

Table 8. The comparison results of the mechanism test of the random effect model and the fixed effect model.

Variables	RE			FE		
	(1)	(2)	(3)	(4)	(5)	(6)
	RHQED	Ecentre	RHQED	RHQED	Ecentre	RHQED
DV	0.881 ***	1.393 ***	0.771 ***	0.658 ***	1.187 ***	0.587 ***
	(0.034)	(0.188)	(0.035)	(0.036)	(0.192)	(0.036)
Ecentre			0.056 ***			0.058 ***
			(0.007)			(0.008)
Control variables	YES	YES	YES	YES	YES	YES
Individual fixation	NO	NO	NO	YES	YES	YES
Constant	−0.155 ***	−0.573	−0.182 ***	−3.383 ***	−6.958 ***	−3.004 ***
	(0.057)	(0.681)	(0.054)	(0.394)	(2.087)	(0.383)
Observations	600	600	600	600	600	600
R-squared				0.867	0.558	0.879
F				457.156	87.975	450.322

Note: Robust standard errors are reported in parentheses in the table, *** indicates that the regression results passed the significance test at 1% confidence level. Table 8 is calculated by the data we selected in Section 3.3 by STATA.

Table 9 is obtained by replacing the explanatory variable high-quality rural economic development index with the regional economic development status for a regression test. It can be seen from Table 9 that whether control variables are added or not, the impact of digital villages construction on regional economic development has a positive impact, and has passed the significance test at the 1% level.

Table 9. Benchmark regression results of the impact of digital rural construction on economic development.

Variables	(1) LNGDP	(2) LNGDP
DV	2.205 *** (0.082)	1.815 *** (0.135)
Control variables	YES	YES
Individual fixation	YES	YES
Constant	8.661 *** (0.027)	−7.867 *** (1.463)
Observations	600	600
R-squared	0.560	0.741
r2_a	0.537	0.724
F	724.107	201.493

Note: Robust standard errors are reported in parentheses in the table, and *** indicates that the regression results passed the significance test at 1% confidence level. Table 9 is calculated by the data we selected in Section 3.3 by STATA.

It can be observed from Table 10 that when the digital industry activity is added as an intermediary variable to the model of the impact of digital villages on regional economic development, the impact of digital villages on regional economic development is significant, but it has declined. The influence of regional economic development is significantly positive, indicating that the entrepreneurial activity of the digital industry is the mechanism for improving the high-quality development of rural economy. Therefore, after replacing the explained variables, the test results also support the original test conclusion.

(3) Heterogeneity analysis of the different effects from a regional perspective. The development of digital villages is accompanied by a digital divide and a gap between rich and poor [21]. Based on the classification and regression test of the economic regional division (eastern region, central region, western region, and northeast region) proposed in the report issued by the Sixteenth National Congress of CPC, this paper explores the impact effect of digital rural development level on the rural high-quality economic development of different regions.

Table 11 shows the effect of digital villages construction on the high-quality development of rural economy in eastern China. It can be seen from models (1) and (2) that, regardless of whether control variables are added or not, digital villages construction has significantly accelerated the high-quality development of rural economy. Model (3) shows that in the eastern region, digital villages construction has an insignificant promotion effect on rural digital industry entrepreneurship. After adding the intermediary variable—the activity of digital industry entrepreneurship, the correlation coefficient of the impact of digital villages construction on the high quality of rural economy in the eastern region is still significantly positive as the marginal effect has dropped from 0.474 to 0.469. Therefore, the direct effect of digital villages construction on the high-quality development of the rural economy in eastern regions is significantly positive, and the entrepreneurial activity of digital industries there has played a partial intermediary role as an indirect mechanism of digital villages construction and high-quality rural economic development.

Table 10. Test results of the mechanism of digital villages construction affecting regional economic development.

Variables	(1) LNGDP	(2) Ecentre	(3) LNGDP
DV	1.815 ***	1.187 ***	1.455 ***
	(0.135)	(0.192)	(0.127)
Ecentre			0.305 ***
			(0.027)
Control variables	YES	YES	YES
Individual fixation	YES	YES	YES
Constant	−7.867 ***	−6.958 ***	−5.809 ***
	(1.463)	(2.087)	(1.350)
Observations	600	600	600
R-squared	0.741	0.558	0.788
F	201.493	87.975	229.283

Note: Robust standard errors are reported in parentheses in the table, and *** indicates that the regression results passed the significance test at 1% confidence level. Table 10 is calculated by the data we selected in Section 3.3 by STATA.

Table 11. Test results of the mechanism of digital villages construction affecting the high-quality development of rural economy in the eastern region.

East Variables	(1) RHQED	(2) RHQED	(3) Ecentre	(4) RHQED
DV	0.987 ***	0.474 ***	13.087	0.469 ***
	(0.040)	(0.058)	(33.316)	(0.057)
Ecentre				0.000 ***
				(0.000)
control variables	NO	YES	YES	YES
Individual fixation	YES	YES	YES	YES
_cons	0.193 ***	−4.477 ***	−1507.275 ***	−3.900 ***
	(0.013)	(0.666)	(380.955)	(0.679)
N	200.000	200.000	200.000	200.000
r2	0.765	0.914	0.294	0.918
r2_a	0.752	0.906	0.228	0.910

Note: Robust standard errors are reported in parentheses in the table, and *** indicates that the regression results passed the significance test at 1% confidence level. Table 11 is calculated by the data we selected in Section 3.3 by STATA.

Table 12 shows the results of digital rural construction on digital rural construction in rural economy. From the models (1) and (2), it can be seen that before and after the addition of control variables, the digital village construction has significantly promoted the high-quality development of rural economy. In model (3), the impact of digital villages in the region's entrepreneurship in rural digital industries is forward and effective. Meanwhile, the digital village construction and digital industrial in the model (4) play a significant propulsive role in rural economic high-quality development.

As can be seen from the empirical results, digital villages construction has been momentous to rural economic high-quality development under this model. After the addition of intermediary variables, it has been weakened, but it remains at a level of 1%. As the indirect mechanism of digital villages construction promoting rural high-quality development, the entrepreneurial activity of digital industry plays a part of the intermediary in the central regions.

Table 12. Test results of the mechanism of digital villages construction affecting the high-quality development of rural economy in the central region.

Central Variables	(1) RHQED	(2) RHQED	(3) Ecentre	(4) RHQED
DV	0.908 ***	0.719 ***	42.761 ***	0.616 ***
	(0.046)	(0.089)	(9.936)	(0.094)
Ecentre				0.002 ***
				(0.001)
control variables	NO	YES	YES	YES
Individual fixation	YES	YES	YES	YES
_cons	0.136 ***	−8.735 **	516.580	−9.979 ***
	(0.016)	(3.598)	(400.233)	(3.510)
N	120.000	120.000	120.000	120.000
r2	0.775	0.854	0.495	0.864
r2_a	0.763	0.836	0.433	0.846

Note: Robust standard errors are reported in parentheses in the table, and *** and ** indicate that the regression results passed the significance test at 1% and 5% confidence levels, respectively. Table 12 is calculated by the data we selected in Section 3.3 by STATA.

Table 13 shows the effect of digital villages construction on rural high-quality developed economy in the western regions. Model (1) and (2) present us that whether or not control variables are joined, the effect digital villages construction on rural economic high-quality development is striking. The role effect of digital rural construction in model (3) in this region is significantly positive. In model (4), digital villages construction and digital industrial entrepreneurial activity play a forward advancement of high-quality development of rural economy, but the effect of entrepreneurial activity in digital industry is not marked. Therefore, in the direct mechanism, digital villages construction in the west is significantly effective to high-quality development of rural economy. The entrepreneurial activity of digital industry plays a partial intermediary role as the indirect mechanism in the region.

Table 13. Test results of the mechanism of digital villages construction affecting the high-quality development of rural economy in the western region.

West Variables	(1) RHQED	(2) RHQED	(3) Ecentre	(4) RHQED
DV	0.988 ***	0.691 ***	44.897 ***	0.671 ***
	(0.040)	(0.068)	(15.272)	(0.070)
Ecentre				0.000
				(0.000)
control variables	NO	YES	YES	YES
Individual fixation	YES	YES	YES	YES
_cons	0.156 ***	−4.619 ***	−351.050 **	−4.462 ***
	(0.013)	(0.739)	(164.813)	(0.745)
N	220.000	220.000	220.000	220.000
r2	0.745	0.877	0.425	0.879
r2_a	0.732	0.866	0.374	0.867

Note: Robust standard errors are reported in parentheses in the table, and *** and ** indicate that the regression results passed the significance test at 1% and 5% confidence levels, respectively. Table 13 is calculated by the data we selected in Section 3.3 by STATA.

Table 14 shows the impact of digital rural construction in the northeast China on high-quality development of rural economy. As is consistent with China's eastern, central, and western regions, after the addition of control variables, digital villages construction in northeastern regions also has a significant effect on the high-quality development of rural economy. However, in the model (3), the effect of digital rural construction on the entrepreneurial activity presents an unspeakable forward relationship. But the digital

village construction and digital industrial entrepreneurial activity play a forward propelling role in high-quality developed economy in rural areas in the model (4), and the effects are significant at 1% and 5%, respectively. Therefore, in the northeast, digital rural construction on the direct mechanism of the high-quality development of rural economy is positive and digital industrial entrepreneurship, which acts as its indirect mechanism, plays the role of partial intermediary.

Table 14. Test results of the mechanism of digital villages construction affecting the high-quality development of rural economy in the northeastern region.

Northeast Variables	(1) RHQED	(2) RHQED	(3) Ecentre	(4) RHQED
DV	0.908 ***	0.438 ***	9.949	0.408 ***
	(0.075)	(0.119)	(11.785)	(0.116)
Ecentre				0.003 **
				(0.001)
control variables	NO	YES	YES	YES
Individual fixation	YES	YES	YES	YES
_cons	0.207 ***	0.888	259.614	0.095
	(0.029)	(2.831)	(279.157)	(2.751)
N	60.000	60.000	60.000	60.000
r2	0.724	0.897	0.688	0.906
r2_a	0.709	0.876	0.624	0.885

Note: Robust standard errors are reported in parentheses in the table, and *** and ** indicate that the regression results passed the significance test at 1% and 5% confidence levels, respectively. Table 14 is calculated by the data we selected in Section 3.3 by STATA.

The empirical results above show that the digital villages construction has a forward effect on the eastern, central, western, and northeastern regions in China, and the effect are all impressive at a level of 1%, indicating that digital villages in eastern, central, western, and northeastern regions can promote high-quality development in rural areas. From the point of view of the impact effect, before the addition of control variables, digital villages construction has similar effects on high-quality development of rural economy in all regions as the correlation coefficients are all about 0.9; after the addition of control variables and the intermediary variable, there is a significant difference in the influence of digital villages on rural economic high-quality development between the four regions. The correlation coefficients in sequence are 0.469, 0.616, 0.671, and 0.408.

The marginal rewards in economics can explain this phenomenon. The economy of the east is more developed, and the level of rural modernization and farmers' living standards are generally higher than that of the mid-west. Therefore, to the eastern regions, the development of digital villages is more than the camps. Compared with the east and northeast China, the information infrastructure level, rural governance capacity, and other rural development environment and economic construction in the mid-west are relatively poor. In addition, rural areas are mainly based on traditional agriculture. Objective conditions there, especially in middle and western regions, such as geographic location, physical transportation, tend to limit the economic development. The promotion of digital villages narrowed the urban-rural digital divide and income gap, providing low-cost and high efficiency services for the central and western regions through laying the foundation of digital transformation and development there. Eventually, it accelerates the urban-rural integration in these rural areas. Therefore, according to the law of diminishing marginal remuneration, compared to the east and the northeast, the effects of digital villages on rural economic high-quality development in middle and western areas are stronger.

(4) Further inspection. In order to further test the internal mechanism of digital villages construction on the high-quality development of rural economy, while constructing

the high-quality development index system of rural economy, this paper classifies 12 indicators according to the five development principles of "openness, coordination, greenness, innovation, and sharing", and constructs the opening-up development index, regional coordinated development index, ecological green development index, scientific research innovation development index, and the achievement sharing development index related to rural areas of each province. They are included in the model as explained variables for empirical test to explore the internal mechanism of digital villages construction on the high-quality development of rural economy.

Tables 15 and 16 report the results of the transmission mechanism of digital villages construction on regional coordination, green ecology, and achievement sharing development. It can be seen from Table 15 that regardless of whether control variables are added or not, the regression coefficients of digital rural construction on regional coordination, green ecology, and achievement-sharing development are all significantly positive, and all have passed the significance test at the 1% level. It shows that the construction of digital villages has significantly promoted the development of regional coordination, green ecology, and achievement sharing. Based on the test results in Table 15, combined with the increase in the digital industry entrepreneurial activity shown in Table 16, it can significantly improve the coordination, green ecology, and achievement sharing in the region. It can be concluded that the entrepreneurial activity of the digital industry can be used as an indirect mechanism for the development of digital villages to promote regional coordination, green ecology, and achievement sharing. The empirical result confirms the previous theoretical assumptions of H2b, H2c, and H2e.

Table 15. Benchmark regression results of digital villages construction and regional coordination, green ecology, and achievement sharing development.

Variables	(1) Coordination	(2) Coordination	(3) Green	(4) Green	(5) Share	(6) Share
DV	0.952 ***	0.924 ***	0.629 ***	0.499 ***	1.085 ***	0.954 ***
	(0.021)	(0.044)	(0.020)	(0.044)	(0.019)	(0.038)
Control variables	NO	YES	NO	YES	NO	YES
Individual fixation	YES	YES	YES	YES	YES	YES
Constant	0.179 ***	−1.212 **	0.303 ***	−1.589 ***	0.072 ***	−3.493 ***
	(0.009)	(0.495)	(0.008)	(0.489)	(0.007)	(0.423)
Observations	600	600	600	600	600	600
R-squared	0.777	0.812	0.635	0.656	0.856	0.884
F	1983.548	304.381	990.406	134.253	3377.032	533.712

Note: Robust standard errors are reported in parentheses in the table, and *** and ** indicate that the regression results passed the significance test at 1% and 5% confidence levels, respectively. Table 15 is calculated by the data we selected in Section 3.3 by STATA.

After adding entrepreneurial activity to models (3) and (9), the impact of digital villages on regional coordination and achievement sharing in rural areas is still significant, and the marginal effect has declined, indicating that digital industry entrepreneurial activity plays a role in regional coordination and shared development. The mechanism plays a part of the intermediary role, and the entrepreneurial activity of the digital industry is an indirect mechanism to enhance the coordinated and shared development of rural areas. In models (4)–(6), the correlation coefficients of digital villages on the entrepreneurial activity of digital industries and the impact on rural green development before and after adding intermediary variables are significantly positively correlated. The impact of digital industry activity on rural green sustainable development is significantly positive. The correlation coefficient is significantly negatively correlated. In model (6), the digital village has a significant impact on rural green sustainable development [64], and the marginal effect increases. According to the research of MacKinnon, D.P.; Krull, J.L.; Lockwood, C.M. [65], it can be seen that there is a Suppression Effect, which indicates that the development

of digital villages inhibits the green and sustainable development of rural areas when promoting the activity of digital industries.

Table 16. Test results of the mechanism of digital villages construction affecting regional coordination, green ecology, and achievement sharing development.

Variables	(1) Coordination	(2) Ecentre	(3) Coordination
DV	0.924 ***	1.740 ***	0.806 ***
	(0.044)	(0.182)	(0.046)
Ecentre			0.069 ***
			(0.010)
Control variables	YES	YES	YES
Individual fixation	YES	YES	YES
Constant	−1.212 **	−3.357	−0.931 *
	(0.495)	(2.039)	(0.481)
Observations	600	600	600
R-squared	0.812	0.595	0.828
F	304.381	102.423	296.680

VARIABLES	(4) Green	(5) Ecentre	(6) Green	(7) Share	(8) Ecentre	(9) Share
DV	0.499 ***	1.740 ***	0.541 ***	0.954 ***	1.740 ***	0.845 ***
	(0.044)	(0.182)	(0.047)	(0.038)	(0.182)	(0.040)
Ecentre			−0.025 **			0.060 ***
			(0.010)			(0.009)
Control variables	YES	YES	YES	YES	YES	YES
Individual fixation	YES	YES	YES	YES	YES	YES
Constant	−1.589 ***	−3.357	−1.810 ***	−3.493 ***	−3.357	−3.317 ***
	(0.489)	(2.039)	(0.493)	(0.423)	(2.039)	(0.412)
Observations	600	600	600	600	600	600
R-squared	0.656	0.595	0.662	0.884	0.595	0.893
F	134.253	102.423	121.144	533.712	102.423	516.240

Note: Robust standard errors are reported in parentheses in the table, and ***, **, and * indicate that the regression results passed the significance test at 1%, 5%, and 10% confidence levels, respectively. Table 16 is calculated by the data we selected in Section 3.3 by STATA.

Tables 17 and 18 report the results of the transmission mechanism of digital villages construction on opening-up and technological innovation. Table 17 shows that regardless of whether control variables are added or not, the regression coefficients of digital villages construction on the opening-up and technological innovation in rural areas are all significantly positive, and all have passed the significance test at the 1% level, indicating that digital rural construction has significantly improved the development of scientific and technological innovation and economic openness in rural areas.

In the model (3) of Table 18, the effect of digital villages construction on opening-up is significantly positive, but the effect of digital industry entrepreneurial activity on opening-up is not significant. After the Bootstrap test, the direct effect of digital villages development on opening-up is significant, indicating that there may be other intermediaries in addition to the entrepreneurial activity of the digital industry. It shows that the construction of digital villages has promoted the development of opening to the outside world, and the entrepreneurial activity of the digital industry has played a part of the intermediary role. In model (6), after adding entrepreneurial activity, the impact of digital villages on the development of scientific and technological innovation in rural areas is still significant, and the correlation coefficient has declined, indicating that the entrepreneurial activity of the digital industry has played a partial intermediary role in the mechanism of technological innovation, and is an indirect mechanism for promoting the development of scientific and technological innovation in rural areas.

Table 17. Benchmark regression results of digital villages construction, opening to the outside world, scientific research, and innovation development.

Variables	(1) Open	(2) Open	(3) Innovation	(4) Innovation
DV	0.931 ***	0.943 ***	1.040 ***	0.866 ***
	(0.025)	(0.050)	(0.020)	(0.039)
Control variables	NO	YES	NO	YES
Individual fixation	YES	YES	YES	YES
Constant	0.113 ***	−4.193 ***	0.080 ***	0.631
	(0.010)	(0.552)	(0.008)	(0.440)
Observations	600	600	600	600
R-squared	0.709	0.777	0.830	0.868
F	1388.189	245.045	2773.159	460.208

Note: Robust standard errors are reported in parentheses in the table, and *** indicates that the regression results passed the significance test at 1% confidence level. Table 17 is calculated by the data we selected in Section 3.3 by STATA.

Table 18. Test results of the mechanism of digital villages construction affecting opening to the outside world, scientific research, and innovation development.

Variables	(1) Open	(2) Ecentre	(3) Open	(4) Innovation	(5) Ecentre	(6) Innovation
DV	0.943 ***	1.740 ***	0.925 ***	0.866 ***	1.740 ***	0.806 ***
	(0.050)	(0.182)	(0.054)	(0.039)	(0.182)	(0.042)
Ecentre			0.010			0.037 ***
			(0.012)			(0.009)
Control variables	YES	YES	YES	YES	YES	YES
Individual fixation	YES	YES	YES	YES	YES	YES
Constant	−4.193 ***	−3.357	−4.200 ***	0.631	−3.357	0.913 **
	(0.552)	(2.039)	(0.561)	(0.440)	(2.039)	(0.438)
Observations	600	600	600	600	600	600
R-squared	0.777	0.595	0.777	0.868	0.595	0.872
F	245.045	102.423	215.200	460.208	102.423	422.466

Note: Robust standard errors are reported in parentheses in the table, and *** and ** indicate that the regression results passed the significance test at 1% and 5% confidence levels, respectively. Table 18 is calculated by the data we selected in Section 3.3 by STATA.

5. Conclusions and Policy Recommendations

After constructing the digital village development index and the high-quality rural economic development index and adding the digital industry entrepreneurial activity as an intermediary variable, based on the rural data at provincial level of 30 provinces (excluding Tibet) in China from 2001 to 2020, this paper empirically tests the effect of digital villages construction on the high-quality development of rural economy, and analyzes its internal mechanism by using the individual fixed effect model and the mediation effect model. The problems of how the construction of digital villages affect the high-quality rural economy and what is the differences of the effects among the five paths are answered. The main conclusions are as follows.

- The construction of digital villages can significantly accelerate the high-quality development of rural economy.
- Stimulating digital industry entrepreneurship is an important indirect mechanism for the construction of digital villages to promote the high-quality development of rural economy, and entrepreneurial activities in the digital industry act as a partial intermediary.
- The regional heterogeneity test shows that the development of digital villages has a forward effect on the eastern, central, western, and northeastern regions in China. Compared with the east and northeast, the effect of digital villages and digital indus-

trial entrepreneurship on rural economic high-quality development in the midwestern regions is stronger.

- Digital industry entrepreneurship plays a significant and direct role in promoting regional coordination, achievement sharing, and technological innovation required for high-quality rural economic development as well as local opening-up. Stimulating digital industry entrepreneurship is an important indirect mechanism for digital villages construction to promote regional coordination, achievement sharing, scientific and technological innovation and opening to the outside world.
- The entrepreneurial activity of the digital industry has no significant inhibitory effect on the existence of green and sustainable development required by the high-quality development of the rural economy. Stimulating digital industry entrepreneurship cannot be used as an indirect mechanism for digital villages to promote green and sustainable rural development.

Since the "implementation of digital village" was proposed in 2018, relevant policies have emerged one after another. China first established a pilot project of digital village, explicitly proposing to develop the rural digital economy and drive, and improve the modernization level of agricultural and rural areas. China has a vast territory, and there are great differences in regional location conditions, resources and environment, and economic and social development basis. Therefore, the government should take measures according to local conditions and proceed from the local reality to promote the construction of digital countryside in different regions. For example, regions with relatively developed industrialization and urbanization have taken the lead in achieving high-quality economic development by building a digital industrial system. In major agricultural production areas, digital infrastructure construction and digital services will be improved to promote the digital transformation of the entire agricultural product chain and the improvement of farmers' information literacy, so as to realize the organic connection between small farmers and the development of modern agriculture. In addition, China should be introduced in the construction of digital rural innovation entrepreneurship related policies, to encourage and facilitate entrepreneurial activities in rural areas, promote the traditional industry and the integration of the digital service industry and other emerging industry development, resolve the problem of inadequate rural development, and expand the digital industry to boost rural poverty alleviation and attract talent, accelerate the non-agricultural transfer of small farmers and the process of urbanization, so as to narrow the urban-rural income gap and realize the modernization of agriculture and rural areas. China can actively promote the construction of digital countryside through pilot demonstration and training guidance, innovation and improvement of policy systems, and strengthening of network infrastructure, which can bring replicable experience to the world, especially to developing countries.

The research theoretically and empirically confirms that digital village construction accelerates the high-quality economic development of rural areas by promoting digital entrepreneurship. However, there are still some limitations in the paper. Firstly, the paper tests the development of digital villages and high-quality economic development in rural China at the provincial level, which is less specific than at the county level. From this macro angle, we conclude that the digital village construction accelerated the high-quality development of rural economy by promoting the openness, achievement sharing and so on, which can finally increase people's living standards. However, from a micro angle, will the digital villages construction cause inequality between people or increase the social division? These questions also are worthy to be discussed and need to be answered. Secondly, the transmission mechanism between the construction of digital villages and high-quality economic development in rural areas needs to be further explored to provide more specific and unique suggestions for the policy-making. Eventually, the process of digitalization in China is dynamic and diverse in different regions. As a result, the long-term implications can be considered. Meanwhile, different digital features and patterns in different regions will be considered in further research.

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