



Can the Development of Digital Economy Stimulate Regional Entrepreneurial Vitality?

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Abstract. The development of digital economy has facilitated the digital transformation of traditional industries, accelerated industrial restructuring, and fostered the emergence of new digital industries and business models. This, in turn, provides opportunities, resources, and reduces the costs associated with entrepreneurship. Against this backdrop, this paper employs the Ordinary Least Squares (OLS) method within econometrics, utilizing panel data from 31 provinces in China from 2011 to 2020, to examine the relationship between digital economy and regional entrepreneurial vitality. The study further explores whether there are regional differences in the impact of the digital economy on entrepreneurial vitality by categorizing the economic regions. The results indicate that digital economy has a significantly positive impact on regional entrepreneurial vitality, with variations due to differences in regional economic development levels and resource endowments. Specifically, the positive influence of digital economy on entrepreneurial vitality is greater in regions with higher levels of economic development, whereas in less economically developed regions, the effect is relatively weaker. This study contributes to the understanding of the effectiveness, mechanisms, and regional disparities of the digital economy in stimulating entrepreneurial vitality, providing policy insights for economically underdeveloped areas to leverage the digital economy to enhance entrepreneurial vitality.

Keywords: Digital economy; Entrepreneurial vitality; OLS; Regional heterogeneity; Economically underdeveloped areas

1 Introduction

Since the reform and opening up, China's economy and society have developed rapidly, achieving a transformation from high-speed economic growth to high-quality development. Against this backdrop, innovation and entrepreneurship have become catalysts and driving forces for connotative economic growth. As a result, the country has put forward the slogan of "mass entrepreneurship and innovation" and subsequently introduced relevant encouragement measures, such as the "Guiding Opinions of the General Office of the State Council on Developing Maker Spaces and Promoting Mass Innovation and Entrepreneurship" (State Council issued

[2015] No. 9) and the “Opinions of the State Council on Vigorously Promoting Mass Entrepreneurship and Innovation” (General Office of the State Council issued [2015] No. 32), aiming to mobilize all members of society to actively participate in innovation and entrepreneurial practices, thereby injecting new vitality into economic growth.

However, in the process of mass entrepreneurship, various difficulties and obstacles are encountered, such as funding shortages, fierce market competition, difficulties in recruiting talent, and insufficient market awareness. These factors weaken the enthusiasm for nationwide entrepreneurship and limit the ability to empower economic growth through entrepreneurship. With the rapid development of the internet and information technology, digital technology has become increasingly mature, and digital economy has become an important part of China’s national economy, having a profound impact on various fields of society. Among them, the impact of the digital economy on entrepreneurship is particularly significant, as it can identify entrepreneurial opportunities, provide entrepreneurial resources, reduce entrepreneurial costs, and support mass entrepreneurship, thereby stimulating the entrepreneurial vitality of market entities. Therefore, digital economy plays a crucial role in unleashing entrepreneurial vitality.

Can digital economy indeed enhance regional entrepreneurial vitality? If so, through what mechanisms does it stimulate entrepreneurial vitality? Does its impact on regional entrepreneurial vitality vary with different regional resource endowments? What policies should the government adopt to help underdeveloped regions fully leverage the benefits of the digital economy? Currently, there is no research addressing these questions. Against this backdrop, this paper focuses on studying the relationship between the development of digital economy and regional entrepreneurial vitality to answer the above questions. This is of significant theoretical and practical importance for China to use the digital economy to promote “mass entrepreneurship and innovation” and empower high-quality economic development. The innovation of this paper lies in not only using econometric methods to confirm that the development of digital economy can stimulate regional entrepreneurial vitality but also further dividing regions to explore whether the impact of the digital economy on entrepreneurial vitality varies with regional resource endowments and economic levels. The results show that the impact of the digital economy on entrepreneurial vitality is much greater in economically developed regions than in underdeveloped ones. Consequently, this paper also discusses the obstacles and potential policy support measures for economically underdeveloped regions to utilize digital economy to promote entrepreneurship, aiming to help these regions stimulate entrepreneurial vitality and drive economic growth through entrepreneurship.

2 Related Works

At present, the academic community has conducted in-depth research on the factors influencing entrepreneurship. Yin Zhichao et al. [1] believe that improving financial knowledge can significantly promote household participation in entrepreneurial ac-

tivities and substantially enhance proactive household entrepreneurship. Guo Yuanyuan et al. [2] analyzed from the perspective of the entrepreneurial environment, stating that the urban entrepreneurial environment is a major factor influencing entrepreneurial vitality. Timmons & Spinelli [3] consider that entrepreneurial opportunities, entrepreneurial teams, resources are core elements of entrepreneurship. Ba Shu-song [4] analyzed from a market perspective, suggesting that the capital market incentivizes entrepreneurial vitality. Qian Yonghong [5] analyzed from the perspective of individual entrepreneurial intentions, arguing that an individual's assessment of the resources needed for entrepreneurship and their assessment of entrepreneurial returns are positively correlated with individual entrepreneurial intentions. Additionally, some scholars have explored the industrial level and found that industrial structure upgrading brings numerous entrepreneurial opportunities in new industries or fields. However, it may also lead to increased economic fluctuations and entrepreneurial risks, negatively impacting regional entrepreneurial vitality (Zheng Xiaoting and Li Meitang,) [6-23].

Most existing literature explores the relationship between digital economy and regional entrepreneurial vitality from a theoretical perspective, providing guidance for understanding their relationship. However, few studies delve into the empirical investigation of the correlation and causality between the two. Therefore, based on entrepreneurship theory, this paper further studies using econometric methods to empirically validate the role of digital economy in promoting entrepreneurial vitality. The study also divides regions to analyze the differences in the impact of the digital economy on entrepreneurial vitality across different economic regions. Furthermore, this paper focuses on economically underdeveloped regions, exploring the barriers and solutions to leveraging the digital economy to stimulate entrepreneurial vitality in those areas. It aims to call on all social members to care for vulnerable groups and support the economic development of impoverished regions.

3 Theoretical Analysis and Research Hypotheses

3.1 The Meaning of Digital Economy

Today, with the rapid development of information technology globally, digital economy has emerged and evolved continuously. Digital economy is a new economic form that is based on digital technology, virtualization, and sharing, the digital economy transcends the time and space limitations of traditional economies. It reshapes production methods and business models based on digital technology, promotes the optimization and upgrading of industrial structures, and brings new momentum to economic development. The digital economy has become the primary engine of current and future economic growth.

The digital economy facilitates the digital transformation of traditional industries, accelerates the pace of industrial restructuring, and fosters emerging digital industries and business models such as e-commerce and the sharing economy. The integration of the digital economy with entrepreneurial activities has extended traditional entrepreneurship into digital entrepreneurship, which has gradually become a new trend of the

times. Based on the above understanding of the digital economy, this paper posits that the digital economy has a profound impact on entrepreneurship both in theory and practice. Therefore, the following section will discuss the specific mechanisms through which the digital economy influences entrepreneurial vitality.

3.2 Analysis of the Mechanisms Through Which the Digital Economy Affects Regional Entrepreneurial Vitality

This paper explores the mechanisms by which the digital economy influences regional entrepreneurial vitality from three perspectives: entrepreneurial opportunities, entrepreneurial resources, and entrepreneurial costs.

Entrepreneurial Opportunities.

Firstly, digital economy has created a wealth of entrepreneurial opportunities. Emerging digital technologies such as artificial intelligence and the Internet of Things (IoT) have given rise to numerous new industries and business opportunities. The development of the digital economy drives consumption upgrades, with digital industrialization and industrial digitization pushing consumer demand towards personalization and diversification. The mode of consumption has shifted from offline markets to online platforms. Additionally, the digital economy enhances the effectiveness of market consumption information, meets the diverse needs of products, and promotes the transformation and upgrading of the consumption market. This, in turn, optimizes the industrial structure, generates numerous new industries and fields, and significantly increases entrepreneurial opportunities. This surge in opportunities stimulates entrepreneurial enthusiasm among market entities, thereby boosting regional entrepreneurial vitality.

Entrepreneurial Resources.

Secondly, digital economy enriches entrepreneurial resources. The integration of digital technology with traditional industries accelerates the pace of industrial restructuring. Uncompetitive old industries are forced out of the market, creating more space for the development of emerging industries and releasing many production factors. This provides resources for market entrepreneurs. Moreover, digital platforms can offer financial support for entrepreneurial projects, such as raising funds through crowdfunding websites or attracting venture capital, helping entrepreneurs to start and expand their businesses. Information technology and tools provided by the platforms, such as big data and cloud computing, improve entrepreneurial efficiency by giving entrepreneurs better insights into the consumer market. Additionally, the talent and knowledge gathered on these platforms offer professional guidance, helping entrepreneurs avoid pitfalls.

Entrepreneurial Costs.

Lastly, digital economy can significantly reduce entrepreneurial costs. Using digital platforms can eliminate substantial infrastructure costs, while digital channels like social media and e-commerce considerably lower marketing and sales expenses. Entrepreneurs can leverage the internet to access entrepreneurial resources and facilitate team communication, reducing the costs of resource acquisition and team communication. Furthermore, digital finance, characterized by its inclusiveness, breaks the temporal and spatial limitations of traditional finance, enabling remote areas to enjoy convenient financial services, thereby promoting local entrepreneurial activities. Digital finance can also assess the risks of small and micro enterprises at a lower cost, reducing their financing costs and helping them overcome financial constraints. Its digital and networked advantages drastically reduce financial transaction costs.

Conclusion.

To sum up, this paper posits that the development of digital economy in a region can enhance its entrepreneurial vitality. This enhancement mechanism operates by altering the three key elements of entrepreneurial opportunities, resources, and costs, thereby stimulating the entrepreneurial enthusiasm and motivation of market entities. Based on the above analysis, the following hypothesis is proposed:

4 Research Design

4.1 Model Setting

In order to test whether the development of digital economy can enhance entrepreneurial vitality, this paper establishes the following OLS regression model:

$$LnEntrep_{i,t} = \alpha_0 + \alpha_1 * nE_i + \sum \alpha_2 * controls_i + \alpha_3 * Province + \alpha_4 * Year + \alpha_5 * \varepsilon_{it} \quad (1)$$

Among them, the subscript i represents the province, and t represents the year. $LnEntrep_{i,t}$ represents the entrepreneurial vitality of province i in year t ; nE_i represents the digital economy development level of province i in year t ; Controls represents the control variable; Year means the time is fixed; Province means fixing the province; ε is all the factors that can affect the entrepreneurship except the control variables, namely the residual difference.

4.2 Variable Measurement and Description

Dependent Variable.

Entrepreneurial Vitality: For the measurement of this variable, the study adopts the approach of Ye Wenping et al. (2018), utilizing data from the China Research Data Services Platform (CNRDS). It involves capturing the number of new private enterprises established at the urban level, and then taking the logarithm of this number to derive a measure of entrepreneurial vitality, denoted as $LnEntrep$.

Independent Variable.

Digital Economy Level: Following the methodology of Zhao Tao et al. (2020) and considering the availability of city-level data, the measurement of digital economy level encompasses aspects of internet development and inclusive digital finance. For measuring internet development at the city level, indicators such as internet penetration rate, the proportion of employees in the computer services and software industry relative to urban unit employees, per capita telecommunication volume, and mobile phone penetration rate per hundred people are used. For digital finance development, the China Digital Inclusive Finance Index, compiled jointly by the Digital Finance Research Center of Peking University and Ant Financial Group, is used. By employing principal component analysis, the data from these five indicators are standardized and dimensionally reduced to create a composite index of digital economic development, denoted as *LnDEL*.

Control Variables.

To comprehensively analyze the mechanisms through which the development of digital economy affects entrepreneurial vitality, it is necessary to include control variables that may impact entrepreneurial vitality. The following control variables are selected:

a.Economic Development Status (ED): Represented by local per capita GDP.

b.Human Capital Level (HCL): Indicated by the proportion of higher education students relative to the total city population.

c.Loan Balance (LB): Represented by the ratio of the year-end balance of loans from financial institutions to GDP.

d.Fiscal Intervention (FI): Measured by the proportion of fiscal expenditure to GDP.

e.Transport Infrastructure (Infra): Determined by the ratio of regional passenger transport volume to GDP.

4.3 Data Sources and Descriptive Statistics

This paper conducts an empirical test using panel data from various provinces and cities in China from 2011 to 2020. The data sources primarily include the “China City Statistical Yearbook” and the China Research Data Services Platform CNRDS. presents the descriptive statistical results for the main variables used in this study.

The results indicate that the mean value of entrepreneurial vitality (*LnEntrep*) is 116.9, with a minimum value of 15.95 and a maximum value of 1398, and a standard deviation of 104.9. This substantial variation suggests significant disparities in entrepreneurial vitality across different regions. The level of the digital economy (*LnDEL*) shows characteristics of a low average with large regional differences.

Regarding the control variables, there are also noticeable differences among different cities in terms of regional economic development status (*ED*), human capital level (*HCL*), loan balance (*LB*), degree of fiscal intervention (*FI*), and transportation infrastructure (*Infra*). These variations underline the importance of considering regional

differences when analyzing the impacts of the digital economy on entrepreneurial vitality.

5 Empirical Testing of the Impact of Digital Economy on Entrepreneurial Vitality

To investigate the impact of the development of digital economy on entrepreneurial vitality, this paper explores the relationship between the two from the following aspects:

5.1 Intuitive Graphing

By examining scatter plots, it can be observed that entrepreneurial vitality and the development of digital economy change in the same direction. As the level of the digital economy increases, there appears to be a continual enhancement in entrepreneurial vitality. From this observation, we hypothesize that there exists a strong correlation between the two variables.

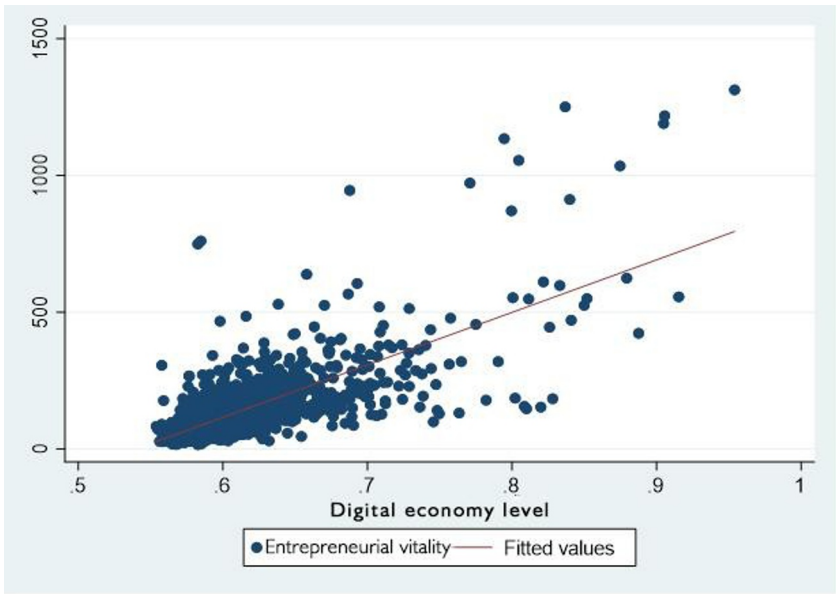


Fig. 1. Scatter chart of digital economy level and entrepreneurial vitality

5.2 Statistical Analysis of Variable Correlation

Following the visual assessment in Fig 1 that suggested a similar trend between the digital economy level and entrepreneurial vitality, further investigation is required to determine whether there is a significant correlation between the two variables. This section of the paper conducts a statistical correlation analysis on these variables, and

the results are presented in as follow. This result indicates a substantial correlation between the digital economy level and entrepreneurial vitality, with a correlation coefficient of 0.679. This suggests that as the digital economy develops, there tends to be an associated increase in entrepreneurial vitality, or vice versa. However, the direction of causality, whether the development of digital economy promotes an increase in entrepreneurial vitality or if thriving entrepreneurship drives the improvement of digital economy, requires further investigation.

5.3 Analysis of OLS Regression Results

There is a significant correlation between the level of digital economy and entrepreneurial vitality. To further explore the causal relationship between these two variables, this paper tests the OLS regression equation (1), with results shown. Column (1) of presents the regression results without control variables, whereas column (2) includes control variables. It is evident from that, regardless of whether control variables are included, the estimated coefficient of digital economy level on entrepreneurial vitality is positive and significant at the 1% level. This indicates that the development of digital economy can enhance entrepreneurial vitality. Examining the regression results of other control variables, the coefficient of economic development (*ED*) is significantly negative, albeit small, suggesting that while the overall economic volume grows, entrepreneurial vitality does not effectively improve; the coefficient of human capital level (*HCL*) is significantly negative and larger, possibly due to factors such as employment stability, risk aversion, attractiveness of job opportunities, and resource allocation; the coefficient for loan balance (*LB*) is significantly positive, indicating that the development level of financial loans has a positive impact on business entrepreneurship, reflecting the importance of building a high-level financial market to enhance entrepreneurial vitality. However, the coefficient for fiscal intervention (*FI*) is significantly negative, possibly because government intervention can affect people's enthusiasm for entrepreneurship, leading to a decline in entrepreneurial spirit. Finally, the regression coefficient for transportation infrastructure(*Infra*) is significant, indicating it has impact on entrepreneurial vitality.

These empirical results validate the hypothesis of this paper, that the development of digital economy indeed enhances entrepreneurial vitality, and the digital economy has a distinctly positive effect on mass entrepreneurship.

5.4 Further Expansion: Analysis of Regional Heterogeneity

Due to the varying economic development condition across different regions, the impact of digital economy on entrepreneurial vitality may also differ by region. To explore whether there are regional differences in the effects of the digital economy on entrepreneurial vitality, this paper divides the total regional sample in the baseline model into four categories: Eastern, Central, Western, and Northeastern regions. The specific division criteria refer to China's four major economic regions, as shown

in Based on the aforementioned regional division criteria, the regression model was retested, and the specific regression. In this table, column

(1) represents the regression results for the Eastern region, with a regression coefficient of 3.547, significant at the 1% level, indicating that the development of the digital economy has the greatest impact on entrepreneurial vitality in the Eastern region. Column (2) shows the results for the Central region, with a regression coefficient of 3.458, also significant at the 1% level, suggesting that the impact of the digital economy on entrepreneurial vitality is second only to the Eastern region. Column (3) presents the results for the Western region, with a regression coefficient of 2.362, significant at the 5% level, indicating a lower impact of the digital economy on entrepreneurial vitality. Finally, column (4) shows the results for the Northeastern region, with a regression coefficient of 1.252, which did not pass the significance level test, suggesting that although the digital economy has a positive impact on entrepreneurial vitality, this positive effect is not significant due to the lower level of economic development in the region.

Overall, it can be seen that the impact of the digital economy on regional entrepreneurial vitality varies with the level of economic development in the region; the better the economic condition, the higher the impact.

6 Further Analysis of the Economically Underdeveloped Areas

6.1 Obstacles to Stimulating Entrepreneurial Vitality through Digital Economy

According to the above regional heterogeneity regression results, this study finds that the impact of the digital economy on entrepreneurial vitality is lower in economically underdeveloped regions. Next, this paper will further discuss the obstacles to using the digital economy to promote entrepreneurial vitality in these underdeveloped areas. (The following data are sourced from the China Economic and Financial Research Database CSMAR.)

First of all, these regions are economically backward and unable to provide the necessary funding required for entrepreneurship. Although the digital economy can effectively reduce the cost of starting a business, initial financing costs are still needed, and the meager disposable income of local residents is insufficient to support any costs. 2022 in China's four major economic zones. It shows that the per capita disposable income in the Western and Northeastern regions is lower than that in the Eastern and Central regions, meaning that residents in economically underdeveloped areas do not have sufficient startup funds to establish their own businesses. Therefore, the digital economy cannot fully stimulate entrepreneurial vitality in these areas.

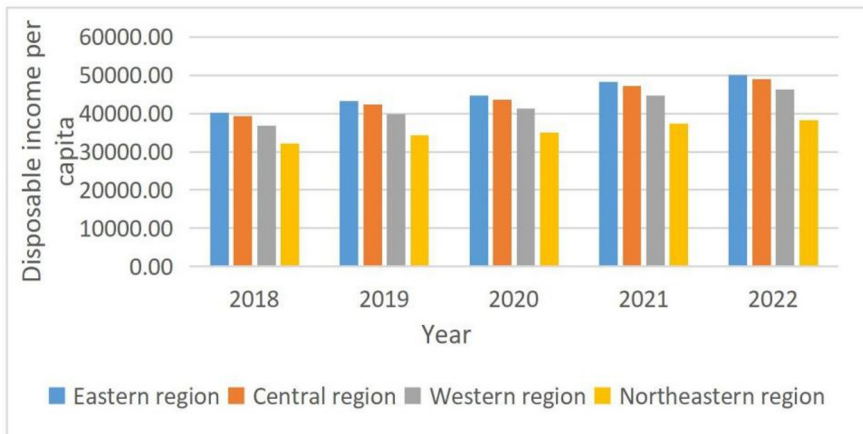


Fig. 2. Per capita disposable income in China's four major economic zones

In addition, the development of the digital economy in these regions is relatively slow. Backward network infrastructure results in low internet accessibility, significantly limiting the release of digital economy dividends. Many residents do not even have smart devices and are completely cut off from the internet, making it impossible for them to access entrepreneurial information online or enjoy inclusive financial services provided by digital finance. The following chart compares the level of digital infrastructure in China's four major economic regions from 2018 to 2022. It shows that the digital infrastructure level in the Western and Northeastern regions is lower than that in the Eastern region, indicating that the development degree of the digital economy in these economically underdeveloped areas is low and cannot effectively stimulate regional entrepreneurial vitality.

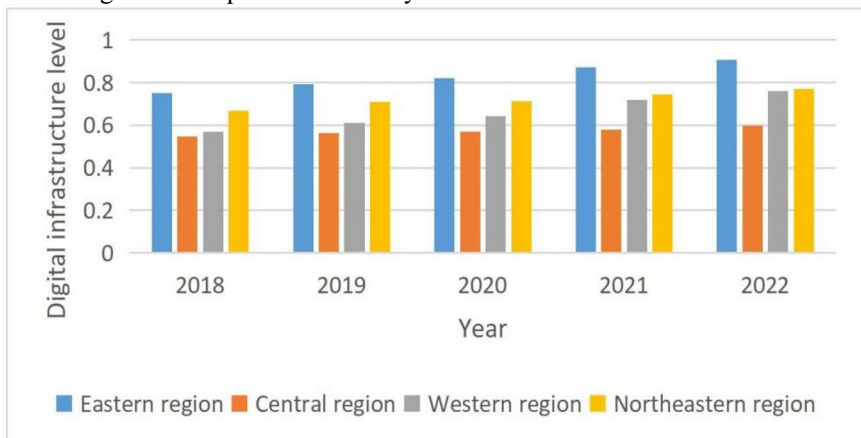


Fig. 3. Level of digital infrastructure in China's four major economic regions

Last but not least, as shown in Fig 2 and Fig 3, these regions lack entrepreneurial resources. A lack of quality education results in a low level of educational attainment

among the population, which in turn leads to a low level of human capital. Most people do not possess the knowledge and skills required for entrepreneurship. The following chart compares the number of college students per 100,000 people in China's four major economic regions from 2018 to 2022. It shows that the number of students in higher education per 100,000 people in the Western region is lower than in the Eastern region, indicating that the Western region does not have sufficient human capital to stimulate regional entrepreneurial vitality. Additionally, the industrial structure of these regions is relatively simplistic, with the market still dominated by old industries. Emerging industries do not have enough room for development, resulting in minimal entrepreneurial enthusiasm and motivation among the populace.

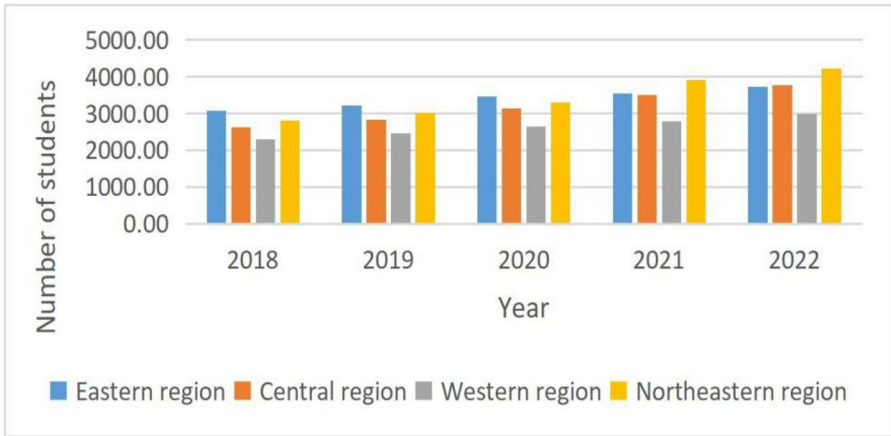


Fig. 4. Number of college students per 100,000 people in China's four major economic regions

6.2 Policy Recommendations for Stimulating Entrepreneurial Vitality through Digital Economy

As it is widely recognized, as shown in Fig 4 and Fig 5, the government plays a crucial role in various sectors of national economic development. The level of digital economy development in a region is largely influenced by the policies of the local government. The higher the focus on digital initiatives by the government, the faster the development of the digital economy in the region, thereby enabling a better release of the digital economy dividend. Taking Shanghai and Heilongjiang, two major provincial administrative regions, as examples, and referring to the data from the Social Science Data Comprehensive Service Platform PPMANDATA, a comparison of the digital attention of the provincial governments over the past five years yields the following chart:

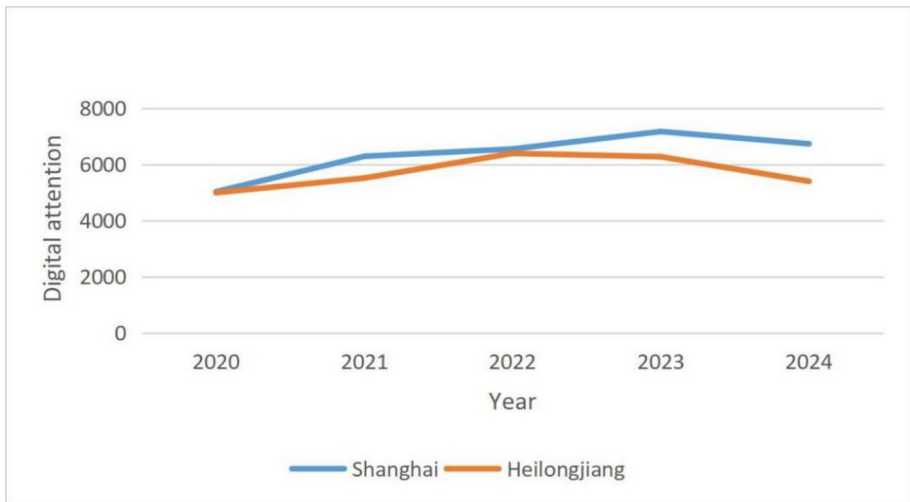


Fig. 5. Digital attention of the provincial governments

The chart clearly shows that the digital focus of the Shanghai government has consistently been higher than that of Heilongjiang. This, to some extent, explains why regions with less developed economies experience slow development in the digital economy, unable to fully unleash dividends and thus stimulate regional entrepreneurial vitality.

Therefore, to address the barriers to using the digital economy to promote entrepreneurship in economically underdeveloped regions, the government can take appropriate measures to help these areas better release the benefits of the digital economy and stimulate regional entrepreneurial vitality. (The following policy examples are sourced from the official website of the Heilongjiang Provincial Government.)

To begin with, governments can provide subsidies to economically underdeveloped regions to improve their economic development conditions, allowing potential entrepreneurs sufficient funds to support the financing costs needed in the initial stages of entrepreneurship. Governments can tailor specific subsidy policies based on the specific needs of economically underdeveloped areas and the capital requirements of potential entrepreneurs. For instance, subsidy programs that provide start-up capital, equipment, and technological support to nascent enterprises, or offer low-interest loans and financial assistance to entrepreneurs. When distributing subsidies, measures must be taken to ensure the rational allocation and effective use of resources, as transparent and fair application and approval procedures are key to ensuring that subsidy funds are utilized correctly. More funding means potential entrepreneurs can invest more freely in aspects such as infrastructure, human resources, and project promotion, thereby increasing the success rate of entrepreneurial projects. Taking Fuyu County in Heilongjiang Province as an example, in just the first half of 2024, the county issued 8.635 million yuan in entrepreneurial guarantee loans, supporting 61

entrepreneurs and leading to 75 new job opportunities. This initiative is worth emulating in other economically underdeveloped areas.

Moreover, governments should support the development of digital economy in these regions by improving network infrastructure, enhancing internet accessibility, and promoting smart devices among local residents, enabling them to use the internet to access relevant market information and engage in digital lending. Enhancing network infrastructure includes expanding broadband coverage, increasing internet speed and stability, ensuring that local residents and businesses can smoothly access the internet. Governments can reduce the cost of network access through subsidy programs or partnerships, making internet services more affordable for residents in economically underdeveloped areas. This will promote digital inclusivity, allowing more individuals to benefit from the opportunities brought by the digital economy.

Additionally, governments can introduce smart device popularization programs, offering price discounts or subsidies to residents in economically underdeveloped areas to assist them in purchasing and using electronic devices such as smartphones and tablet computers.

On top of that, the government can invest more in educational resources in these areas to enhance the level of education, thereby improving the educational attainment of the local population and equipping them with the fundamental knowledge and skills needed for entrepreneurship. As the level of human capital increases, the motivation for entrepreneurship is also strengthened. Specifically, the government can establish partnerships with local schools, vocational training institutions, and businesses to provide entrepreneurial education and training courses. These courses could cover knowledge in entrepreneurship management, marketing, financial management, and business planning, helping residents acquire the basic skills and knowledge required for entrepreneurship. Furthermore, the government can also promote the establishment of a comprehensive entrepreneurial ecosystem in economically underdeveloped areas, including business incubators, accelerators, and entrepreneurship competitions. These institutions and activities will provide a platform for residents to exchange, learn, and collaborate, stimulating entrepreneurial drive and innovation. Again, taking the government of Heilongjiang Province as an example, the Heilongjiang Province Digital Technology Engineer Cultivation Project was launched in recent years. It is dedicated to building a new pattern of “full-chain” and “integrated” digital technology talent cultivation that involves government policy-making, training institutions building platforms, enterprises and public institutions providing demands, and talents voluntarily participating in training and evaluation. This accelerates the training of digital technology skilled talents, promotes the industrialization of digital technology and the digitization of industries, and helps Heilongjiang create a new blue ocean in the digital economy. In addition, the Heilongjiang Provincial Government has also introduced a series of policies on cultivating digital technology talents, providing a model for other economically underdeveloped regions.

7 Conclusions

In the era of digital economy, digital technology continuously integrates with entrepreneurial activities, giving rise to a multitude of emerging digital industries and propelling the rapid development of new digital entrepreneurial activities. This paper utilizes panel data from 31 provinces and cities in China to explore the impact of digital economy development on regional entrepreneurial vitality and further conducts a regional heterogeneity analysis. The main conclusions are as follows:

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