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The Influence of Entrepreneurship and Social Networks on Economic Growth—From a Sustainable Innovation Perspective

Feng-Wen Chen [1,*], Long-Wang Fu [1], Kai Wang [2,*], Sang-Bing Tsai [2,3,*] and Ching-Hsia Su [4,*]

1 School of Economics and Business Administration, Chongqing University, Chongqing 400030, China; fulongwang@cqu.edu.cn
2 College of Business Administration, Capital University of Economics and Business, Beijing 100070, China
3 Zhongshan Institute, University of Electronic Science and Technology of China, Zhongshan 528400, China
4 College of Tourism and Service Management, Nankai University, Tianjin 300071, China
* Correspondence: wangkai@cueb.edu.cn (K.W.); chenfengwen@cqu.edu.cn (F.-W.C.); sangbing@hotmail.com (S.-B.T.); maysky566@gmail.com (C.-H.S.)

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Abstract: A large body of evidence demonstrates the key role played by entrepreneurship in promoting economic growth. However, the potential connections between entrepreneurship, social networking, and economic development still require in-depth exploration and discussion. This paper first establishes a theoretical framework combining entrepreneurship capital theory, resource dependence theory and transaction cost theory, then examines the possible associations between entrepreneurship, social networks, and economic growth based on the dynamic panel data model. To achieve the research objectives, the investigators collected data spanning the period between 2007 and 2016 from 31 provinces and cities in China. The authors adopted the enterprise employment rate as a measure of entrepreneurship and used the information sharing rate to assess social networks, which were then both introduced into the economic growth model. Additionally, by using the system of generalized method of moments (GMM) estimation, this article measures the influence of entrepreneurship and social networks on the economic growth of a local area. The empirical results reveal that both entrepreneurship and social networking significantly promote regional economic growth in China. Further, the effect of entrepreneurship is significantly enhanced after introducing the joint effects of entrepreneurship and social network. The findings also expound that entrepreneurship of the eastern zone and social networking of the central section exhibit the strongest potential for economic development of the respective areas. Conversely, entrepreneurship may actually hinder the economic advancement of the central areas of China. Corresponding to the findings, the researchers suggest that it is necessary to devise flexible policies for heterogeneous entrepreneurial environments and to appropriately utilize interpersonal networks to maximize the efficiency of the outputs of economic activity, which are likely to strengthen the role of entrepreneurship and social networks in contemporary economic and business milieu.

Keywords: entrepreneurship; social network; regional economic growth; generalized method of moments; sustainable innovation; innovation

1. Introduction

Since the 1980s, entrepreneurship has gradually been acknowledged as a crucial factor for regional economic development, especially from a macroeconomic perspective [1,2]. Research initiatives on entrepreneurship have shifted steadily from micro to macro perspectives in the last few decades [3,4]. Economists believe that there is a close relationship between entrepreneurship and economic

growth, including both positive impacts [2,5] and negative impacts [6]. However, current research pays more attention to the influence of entrepreneurship in developed economies on regional comprehensive output, with a lack of theoretical and empirical research on emerging economies [7,8]. Besides, the definition of entrepreneurship varies across different countries, an in-depth analysis needs to be conducted on the impact of entrepreneurship on the economic growth of developing countries. Hence, combining situational incentives to explore this relationship in emerging economies will have a higher research value [7].

At present, research on China's economic problems has gradually become a representative issue explaining the growth of the world's emerging economies. China's economic development is at a stable stage and the transformation of the economic structure is an important factor at this juncture in sustaining this growth [9,10]. The entrepreneurship capital accumulation represented by new enterprise is an indispensable element in the transformation of China's financial structure. The accumulation of entrepreneurship capital can bring more technological innovations to the forefront [11] and can also effectively enhance industrial productivity to further improve regional structures [12]. Compared to the labor-intensive industries of the past, technological innovation can really promote the sustainable development of China's regional economy. The emergence of entrepreneurship also makes up for the over-simplification of China's industrial structure. Based on entrepreneurship capital theory the paper introduces entrepreneurship into macroeconomic theory, with entrepreneurship capital reflecting a number of different legal, institutional, and social factors and forces which constitute the entrepreneurship capital of an economy and promote the spillover effect of knowledge to create a capacity for entrepreneurial activity [13]. To a certain extent, it will improve the ability of macroeconomic theory to explain regional economic growth [14].

Although entrepreneurship capital theory provides a conceptual analysis of entrepreneurialism in regional economic growth, current research still lacks examinations of the contextual factors between China's regions on the internal mechanism of action, namely, the process by which entrepreneurship can play a role in promoting knowledge spillovers may be influenced by other regionalized social factors. Temple and Johnson indicate that the social network theory is likely to play an important role in the development of macroeconomic research [15]. The social network theory can explain economic growth from the perspective of production factors [16]; it can also complement economic theories from the perspective of resource acquisition [17]. The current economic development of China has gradually weakened the influence of traditional relationship networks of Chinese culture, but these connections still play an important role in economic activities [11,18]. The social network theory can better demonstrate the interaction among various economic participants, and at the same time, can effectively improve the efficiency of resource acquisition within interactive networks. This interpersonal network is sure to affect the speed of transformation of China's regional industries [19]. Furthermore, based on resource dependence theory and transaction cost theory [20,21], it is considered that regional economic development of emerging economies is more constrained by their own resource defects [8,22], and whether the accumulation of entrepreneurship capital which can exert the maximum effect depends on the intensity of network synergy between regions. That is, the frequency with which individuals or clusters rely on social networks to interact with resources in the external environment will be affected by differences in social network levels between different regions [23,24]. Meanwhile, with the consideration of social networks in the regional context of China, it is believed that the Guanxi in society will help reduce the cost of knowledge transfer, access and spillovers, thereby promoting the accumulation of entrepreneurship capital and accelerating the entrepreneurial spirit to play an economic role [25].

In all, entrepreneurship provides technological innovation with the improvement of knowledge spillovers, while social networks bring resource channels. The manner in which these are utilized by local players can become a key feature of the metamorphosis of China's economic structure and can form an assurance of sustainable development for regional economies. Therefore, in order to better explain the reasons for regional economic growth and to find the factors that influence the

sustainable development of the regional economy, this paper discusses the links between entrepreneurship, social networks, and regional economic growth in China, and uses dynamic panel data models to validate the different types of influence mechanisms created by the new enterprises and their community associations. By employing innovative means to analyze the effects of entrepreneurship and social networks on the growth of China's local economies with a combination of entrepreneurship capital theory, resource dependence theory and transaction cost theory, the paper provides a corresponding reference for the overall economic restructuring and development of the country. The following section of this article discusses the relationship between entrepreneurship, social networks and regional development or growth in the light of previously published studies. In the third section of this article, the theoretical framework and empirical model with entrepreneurship, social networks and their interactions effect on economic growth is explained. The fourth section is the analysis of empirical results, including regression findings from the national sample and individual regions. The final portion summarizes the research outcomes and the theoretical contributions of the paper.

2. Literature Return and Problem Presentation

2.1. Research on Entrepreneurship and Economic Growth

Entrepreneurship is an important element of management theory. The existing research has a variety of definitions about entrepreneurship on multiple levels. From the micro-perspective, the initial entrepreneurship was defined as "entrepreneurs who can help companies acquire resources, take risks, have self-confidence, capabilities of innovation, and achievement needs as well as their internal control behaviors" [26]. The related studies emphasize the influence of entrepreneurial traits on firm performance, such as entrepreneurial gender, personality traits, growth experience, family business background [27–30], and the impact of entrepreneurial individual behavior on performance, including the interaction with team members, individual decision style, etc. [31,32]. From the meso-perspective, researchers pay more attention to corporate entrepreneurship, which is defined as "the strategic actions, the scope of product innovation, and the behavioral tendency to pursue technology leadership of enterprises when faced with the investment decision-making and uncertainty, as well as the process of creating new business or updating the current ones" [33,34]. Furthermore, as entrepreneurship is gradually introduced into economics-related areas, its role at the macro-level has become more prominent [5,7,13]. Li et al. believes that entrepreneurship at the macro level can reflect the sum of its microscopic effects to some extent [35] and can also be an input factor [13,36] which will stimulate regional production efficiency. Hence, the development of regional economies is largely influenced by entrepreneurship [37]. Hébert and Link first defined entrepreneurship from two perspectives: as a commercial spirit and as innovation [38]. In order to better analyze the impact of entrepreneurship on economic growth, Wenneckers et al. extant research results on the influence of entrepreneurship on economic growth and posited three schools of thought in studying the role of the diverse characteristics of entrepreneurship in their ability to deal with risk and to identify opportunities for commercial activities from the perspective of innovation: the German school, the Neo-classical school, and the Austrian school [39].

According to the definition of entrepreneurship in the macro level, scholars measure entrepreneurship from different principles and try to explore the relationship with regional output [40,41]. On one hand, considering the reality of the developing country and the availability of relevant data, a large number of domestic researchers use self-employment rate to measure potential productive entrepreneurship. For example, Li et al. used data from the National Bureau of Statistics of China to build the entrepreneurial employment rate, including self-employed and private companies and the number of patented inventions, to measure the attitude of enterprise and the essence of novelty, and emphasized that the spirit of entrepreneurship and innovation could positively affect economic growth [35]. By introducing the per capita rice acreage 30 years ago as an IV (Instrumental Variable) for China's regional entrepreneurship, Li et al. found that the positive impact of entrepreneurship as measured by self-employment rates on

China's provincial regional economic development remains robust [40]. Chen et al. constructed a model with the influence of entrepreneurship measured as private companies' employment on economic growth from a corporate growth perspective, and found that novel enterprises could promote the development of regional economies and that local markets could demonstrate this mechanism of influence from a macro perspective [42]. Yang et al. proposed that entrepreneurship was spatially related. They established that entrepreneurial ventures in disparate locations had significant spatial spillover effects and that the entrepreneurial activities of adjacent regions could also be positively interacted and promoted by such enterprises [43]. It can be seen that the regional context of Chinese entrepreneurship has a significant impact on the role of entrepreneurship, and how to analyze its mechanism from multiple perspectives has been a new and popular research topic.

On the other hand, many western researchers emphasize that entrepreneurship is an activity with the process of discovering new opportunities or establishing new businesses based on the data from questionnaire surveys. For instance, Audretsch and Fritsch incorporated the replacement rate of enterprises in the study of entrepreneurship and examined its impact on the regional economy from a quantitative perspective [44]. Wong et al. employed entrepreneurial activities and the number of patents as indicators of the GEM (Global Entrepreneurship Monitor) database to measure enterprising spirit and originality, and they found that entrepreneurship and innovation could play significant roles in promoting economic growth [45]. Foss and Klein highlighted the discovery of opportunities and measured entrepreneurship in terms of actual investments dedicated to the pursuit of imagined opportunities [46]. Foss, Lyngsie and Zahra applied a count measure for entrepreneurship based on questions to CEO respondents regarding the number of opportunities they successfully realized in the previous three years [47].

This paper draws on the entrepreneurship capital theory proposed by Audretsch and Keilbach [13], which considers entrepreneurship at the regional level as a specific subset of social capital which facilitates the commercialization of new ideas by improving the efficiency of knowledge spillovers and eventually stimulates regional economic growth. Audretsch and Keilbach argued that entrepreneurship capital is different from Solow's physical and human capital [48] as well as Romer's traditional knowledge capital [49], regarding entrepreneurship as process-based rather than position-based. Besides, it also differs from generalized social capital, because not all social capital may be conducive to economic performance, let alone entrepreneurial activity [13,50]. Some types of social capital may be more focused on preserving the status quo and not necessarily directed at creating challenges to the status quo [51], while there at least exists a strict positive correlation between entrepreneurship capital and entrepreneurial activities. Therefore, from the perspective of entrepreneurship capital, combined with other contextual factors, it makes more sense to explore the impact of entrepreneurship on the regional economy.

2.2. Research on Social Network and Economic Growth

Besides entrepreneurship, social networks also play an important role in economic theories. Present research has focused on the impact of individual social networks or corporate social networks on output, performance and efficiency on a resource-based view [12,24,25]. It is believed that social networks constitute a valuable resource, including the construction of valuable connections (structural holes) [52], and the coordination and resource sharing in intensive networks [50], which in turn can help the members achieve their individual or organizational goals [53]. Generally, the social network theory focuses on the strength and interaction of relationships among network members. Extant social network research has gradually centered on the degree of closeness between enterprises, the size of the enterprise network, the ability of the venture to identify opportunities, and the network structure [54,55]. From a corporate level, social networks play a key role in the process of resource acquiring and opportunity identifying. The entrepreneurial spirit and innovative spirit can be greatly enhanced in relationship networks [56,57].

With the popularity of mobile Internet and the development of information technology, researchers start to pay more attention to social networks at the macro- or regional level. On one hand, existing studies focus on how social networks at the regional level are measured, for example, Zhang and Ke employed trust as an indicator to express the strength of social networks in different provinces and found that the level of trust could directly affect the development path of enterprises [18]. Sjoerd and Ton constructed the social capital index of 54 regions in Europe based on data from multiple databases such as EVS (European Values Survey), WVS (World Values Survey) and EVSSG (the European Value System Study Group), and found that social networks significantly differ among regions [58]. Additionally, some researchers selected the "frequency of visiting friends and relatives on Spring Festival" as an indicator to measure the strength of social networks of different regions in China and analyzed the impact of social networks on regional per capita income, finance and savings levels [59]. Chong et al. used social media data from the Weibo API (Application Programming Interface of Weibo) and the geo-information of enterprises and constructed the Weibo network and enterprise network to examine the influence of environmental regulation on industrial structure and the role that social networks play in the spillover effect on the Yangtze River Delta and the Pearl River Delta in China [60].

On the other hand, more researchers started to explore how social networks determine regional economic growth. For example, Putnam et al. pointed out that social networks included trust, regulation, and relationship networks, which, when combined, promoted the operational efficiency of social organizations [51]. Additionally, a lot of research related to economic studies define the social network from the perspective of capital and then study its impact on economic development [11,16]. Guiso et al. used the perspective of the social network of capital to analyze its impact on regional financial development and indicated that social networks could promote regional economic development [61]. Deng et al. examined the impact of social networks on economic growth from the viewpoint of human resources and government efficiency, and these investigators found that strong interpersonal networks could increase the utilization rate of human capital, and thus help the government improve management efficiency and create a positive effect on economic growth [62]. Durlauf and Fafchamps believed that the core of social networking was shaped from information sharing, team cognition, and group cooperation, which were the key factors in their ability to promote economic growth [63]. Yang and Shen divided social capital according to various characteristics of social networks, analyzed the impact of different types of social capital on economic growth, and found that trust could have a significant positive effect on economic growth, but the network scale cannot [64]. Jin et al. used the density of civil organizations to describe the impact of regional social network level on economic growth and found that the central and western regions have a stronger intensity than the eastern region in China [65].

However, despite the rich conclusions of the current studies, the internal mechanism of social networks' influence on regional economic development is insufficiently explained, especially when regarding social networks as position-based inventory which could be capitalized or structured. There lacks a process perspective to examine the aggregative results. Therefore, based on resource dependence theory and transaction cost theory, this paper combines the path that social networks play a role with the process of entrepreneurship promoting knowledge spillover, and believes that social networks can help individuals or organizations in the region to establish dependent relationships with the subjects holding resources in the external environment. Meanwhile, it will reduce the multilateral transaction costs in the process of knowledge accumulation and transmission and further enlarge the economic promotion effect of entrepreneurial activities, accelerate the transformation and upgrading of China's industrial structure, and eventually achieve rapid and sustainable growth of the regional economy.

3. Model Construction and Variable Selection

3.1. The Associations between Entrepreneurship, Social Network, and Regional Economic Growth

This paper attempts to interpret the process of the sustainable development of the regional economy from the perspective of both entrepreneurship and social networks, and examines the results from a three-dimensional assessment of the micro-level, meso-level, and macro-level effects of the combination of these factors [66]. The conceptual framework is shown in the Figure 1 as follows.

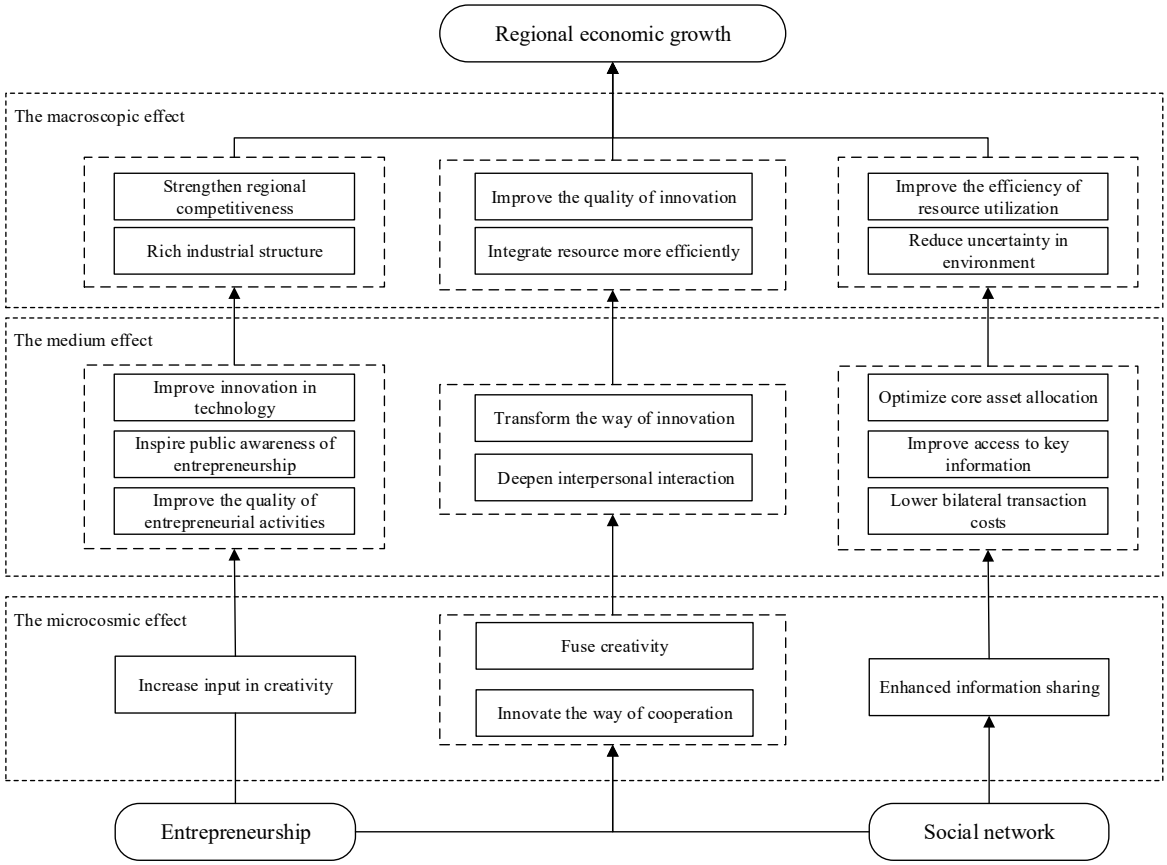

Figure 1. Conceptual analysis framework between entrepreneurship, social network, and regional economic growth.

Specifically, the embodiment of entrepreneurship at the micro-level is based on the individual and entrepreneurial team [66] by continuously stimulating the emergence of individual creativity and enhancing the integration of ideas with practices to build the underlying framework induced by technological innovation [29]. Harper et al. complemented the entrepreneurial team's ability to compensate for the shortcomings of individual entrepreneurs in choosing their entrepreneurial direction and responding to environmental uncertainty, thereby enhancing the quality of creativity [67]. Based on the entrepreneurship capital theory [13], we can map its mechanism of function at the meso-level regarding enterprise clusters or industries as the carrier [4,66]. The role it plays is to further stimulate the entrepreneurial consciousness by promoting knowledge spillover effects [32], to enhance the vitality of technological innovation by promoting entrepreneurial atmosphere [45], to improve the quality of entrepreneurial activities through industrial practice integration, and to build a prototype of entrepreneurial economy [14]. Furthermore, the entrepreneurship's external manifestation at the macro-level consists of an intrinsic influence on the sustainable growth of the regional economy through the regional enhancement of competitiveness and the enrichment of industrial structure, namely, the accumulation of entrepreneurship capital brought by knowledge spillover effects in

various industries eventually led to the outbreak of the entrepreneurial economy [36,41], which allows regional economic development to gain a new vitality.

In addition, the social network is more manifested at the micro-level as an enhancement in information sharing and the reduction of information asymmetry among individuals [55], which is also conducive to information sharing and optimal decision-making in entrepreneurial teams [24,56]. Certainly, it is in line with the current trend assessing the impact of information technology on the web of individual relationships [34]. At the same time, the increase in the quantity of information resulting from the deepening of interpersonal communication provides individuals with references for meeting their own value expectations [13]. Based on resource dependence theory [20], the social network at the meso-level is manifested as the optimization of the core assets of enterprises [25,33]. It can also be seen in the efficiency enhancement of enterprises or enterprise clusters in obtaining key external information [24]. Based on transaction cost theory [21], social networks at enterprise clusters and at the industry level could reduce the bilateral transaction costs between multiple entities [21,53], and coordinate the operation of various departments as well as building core competitiveness [25]. Ultimately, the effects of social networks at the macro-level will interact with the institution [8,37]. The organizational structure along with the embedding of networks and operational logic will further improve the current situation of resource utilization at the regional level. Entrepreneurial initiatives are likely to continue to build dynamic network capabilities to meet the high uncertainty of the external environment and to achieve the objective of sustainable regional economic growth [64,68,69].

Obviously, there exists an interactive effect between entrepreneurship and social networks which is conducive to sustainable regional growth; social networks especially emphasized a theoretical impact on the process of entrepreneurship playing a role as entrepreneurship capital [70]. The micro-level's foundation, with the fusion of social networks and entrepreneurship, is mainly based on the differentiation of individual's creativity which through the network could transfer the value to other actors or levels [71]. Besides, the attribute of resource transfer through social networks turns the individual's innovation activities into a collaborative innovation process to further enlarge an individual's innovation effectiveness [47]. As explained in the previous section, this article will take advantage of the core ideas of these three theories. That is to say, the interaction between entrepreneurship and social networks at the meso-level is manifested as the process change of knowledge spillover effect, leading to the transformation of innovative ways inside enterprise clusters or various industries [53], including more open creative activities, more inventive core values, more inspired results, and deeper human interaction [32,36], as well as richer value interaction, and more dimensional trading methods [40]. Eventually, the interaction, from a macro-level perspective, deeply stimulates potential improvement in the quality of ingenuity and efficiency in the integration of resources, which contributes to the regional economy a more complex value attribute [21,24]. Ultimately, these two elements combine to create a significant impact on the process of industrial restructuring and provides a powerful driving force and references for the second stage of innovation, as well as the transformation of emerging economies [11,19].

3.2. Measure of Entrepreneurship and Social Network

3.2.1. Measure of Entrepreneurship

According to extant entrepreneurship research, there are three common forms of indicators to measure entrepreneurship: turnover rate; employment rate; and number of patented inventions. These three markers connotate entrepreneurship in terms of the enterprising spirit and the innovative spirit. By comparing different definitions and considering the theoretical connotations of entrepreneurship capital, it is believed that the increase of regional output in developing countries brought by the promotion of knowledge spillovers [13] mainly reflects entrepreneurial economic growth, which consists of the improvement of the regional entrepreneurial atmosphere and the strengthening of innovation consciousness. Besides, the development of the entrepreneurial economy

is extremely uneven in China's regions [19], which exactly provides an opportunity for this paper to explore the differences in the path of regional growth between different regions caused by entrepreneurial development.

However, due to the lack of a scientific and normative long-term research database, statistical caliber can only be guaranteed by using the official ones provided by the National Bureau of Statistics of the People's Republic. Based on the previous analysis and existing literature, this paper calculates the proportion of named individual and private enterprise self-employment rate—which consists of "owners of private enterprises", "individual heads of households", "employed ones by private enterprises and individual heads" (excluding rural employed ones)—as a percentage of the total employed population in each Chinese province, which is consistent with the current research concerning Chinese issues [35,40]. The calculation method is as follows:

$$ENT_{i,t} = \frac{pworker_{i,t}}{worker_{i,t}} \times 100\% \quad (1)$$

where $ENT_{i,t}$ indicates the individual and private enterprise self-employment rate, i indicates the i province, t indicates denotes the t year, and $pworker_{i,t}$ indicates the number of employees employed by the regional private enterprise and individual heads of households, $worker_{i,t}$ indicates designates the number of employees in the area. Using corporate employment as an indicator of entrepreneurship can demonstrate the overall level of regional entrepreneurship from a macro perspective. Compared to the innovative spirit gauged by the number of patented inventions, the self-employment rate of individual and private enterprise can better reflect entrepreneurial spirit contained in the overall economy and can avoid the potential impact of varying regional educational levels on the number of patented inventions.

3.2.2. Measure of Social Networks

The authors of the current study found that the measures adopted by different scholars in researching social networks are varied. Common measurements of social networks are the level of trust, civil society organizations, network scale, and level of information interaction. Different metrics have different focuses which emphasize the different attributes of social networks. In order to better demonstrate the overall concentration of regional social networks, this paper refers to the information sharing rate proposed by Ishise and Sawada [72] and the usage index of internet used in Yan's study to reflect the connectivity and sharing of social networks [73]. The calculation method is as follows:

$$SOCIAL_{i,t} = \frac{netuser_{i,t}}{people_{i,t}} \times 100\% \quad (2)$$

where $SOCIAL_{i,t}$ indicates denotes the information sharing rate, i indicates designates the i province, t indicates the t year; $netuser_{i,t}$ signifies the number of i Internet users in the region; $people_{i,t}$ signifies the regional population. Using information sharing rates to represent regional social networks can characterize the attributes of social networks from the perspective of the entire society and can thus maintain consistency with the measurement of entrepreneurship. In addition, due to the continuous development of internet information technologies, it is difficult to demonstrate the overall connectivity characteristics by only applying the usage rate of mailboxes or the number of telephone users to measure the level of social networks, but the usage rate of the internet can better reflect the characteristics of the interpersonal relationship networks. Therefore, this paper uses information sharing rate to measure social networks.

3.2.3. Model Construction

In order to ameliorate the examination of the influence of entrepreneurship and social networks on economic growth in different provinces, this study refers to the production function whose capital and labor factors are improved by Duranton and Puga [74]. These authors believe that the indicator of entrepreneurship reflects the characteristics of labor in the development of the regional economy, and that

the indicator of social networks has an impact on the level of regional technology. Further, the regional per capita gross domestic product (GDP) can better reflect the level of regional economic growth and can avoid the influence of population factors on the output of economic activities. Therefore, the per capita GDP has been chosen to measure regional economic growth. However, the capital factor is affected by the level of government intervention, quality of government institutions, and level of education in the economic development process. Therefore, this paper combines first-order lagged variables of economic growth to construct the dynamic panel data model as follows:

$$\begin{aligned} PERGDP_{i,t} = \beta_0 + \beta_1 PERGDP_{i,t-1} + \beta_2 ENT_{i,t} + \beta_3 SOCIAL_{i,t} + \beta_4 GOV_{i,t} \\ +\beta_5 GI_{i,t} + \beta_6 EDU_{i,t} + \mu_{i,t} \end{aligned} \quad (3)$$

where the dependent variable $PERGDP_{i,t}$ is the regional economic growth, which is measured by the logarithm of per capita GDP of the t year and the i province; the independent variable $ENT_{i,t}$ refers to the entrepreneurship level, measured by the self-employment rate of individual and private enterprise of the t year of the i province. The independent variable $SOCIAL_{i,t}$ indicates the social network level, calculated by the logarithm of the information sharing rate of the t year in the i province. The control variable $GOV_{i,t}$ signifies the degree of government intervention, which means that the government's interference in the economic development of the t year and the i province, measured by the logarithm of the government's fiscal expenditure as the proportion of GDP. The control variable $GI_{i,t}$ specifies the quality of government institutions, indicating the quality of the government system in the t year and the i province, measured by the logarithm of the government's fiscal expenditures excluding education and technology expenditure as a percentage of GDP. Control variable $EDU_{i,t}$ denotes the level of education, representing the quality of education in the t year and the i province and is measured by the logarithm of the number of students in the university. β_j, $j = 0, 1, \ldots, 6$ are coefficients. Formula (3) is a basic econometric model for studying the influence of entrepreneurship and social networks on regional economic growth.

In order to further examine the impact mechanism of entrepreneurship and social networks on regional economic growth, this paper introduces the square items of entrepreneurship and social network respectively on the basis of Formula (3) to examine those two factors' non-linear effects networks will have a non-linear effect. The dynamic panel data model that examines the non-linear influence is as follows:

$$\begin{aligned} PERGDP_{i,t} = \beta_0 \quad & +\beta_1 PERGDP_{i,t-1} + \beta_2 ENT_{i,t} + \beta_3 ENT_{i,t}^2 + \beta_4 SOCIAL_{i,t} \\ & +\beta_5 SOCIAL_{i,t}^2 + \beta_6 GOV_{i,t} + \beta_7 GI_{i,t} + \beta_8 EDU_{i,t} + \mu_{i,t} \end{aligned} \quad (4)$$

In addition to the linear influence and non-linear influence mechanisms, entrepreneurship and social networks may affect regional economic growth at the same time. Therefore, this paper improves Formula (3) and introduces cross terms between entrepreneurship and social networks. The dynamic panel data model for synergy is shown below:

$$\begin{aligned} PERGDP_{i,t} = \beta_0 \quad & +\beta_1 PERGDP_{i,t-1} + \beta_2 ENT_{i,t} + \beta_3 ENT_{it} * SOCIAL_{it} + \beta_4 GOV_{i,t} \\ & +\beta_5 GI_{i,t} + \beta_6 EDU_{i,t} + \mu_{i,t} \end{aligned} \quad (5)$$

3.3. Variable Selection and Descriptive Statistics

This paper selects samples from 2007 to 2016, and the data include the per capita GDP, self-employment rate of individual and private enterprises, information sharing rate, level of government intervention, quality of government agency, and education level in 31 provinces across the country. Among them, the real production value per capita is the total actual production value of each province divided by the total number of people at the end of the year (in order to avoid the price effect, this article uses 2006 as the base period, and calculates the constant price for the GDP of each province, and then obtains the actual gross value); the self-employment rate of individual and private enterprises and information sharing rate of the company are calculated respectively by using Formulas (1) and (2) in Section 3.2; the degree of government intervention is measured by the proportion of each

province's government expenditure on GDP. The government institutions' quality is obtained by the ratio of fiscal expenditure after deducting expenditure on education, technology, and science to GDP; the level of education is obtained by calculating the number of students in regular higher educational institutions in each province. All the symbols, names, and definitions of variables in dynamic panel data model are shown in the following Table 1.

Table 1. The Introduction of Variables.

Abbreviations	Variables	Style	Definition
PERGDP	Regional economic growth	Independent Variable	The level of regional economic growth is measured by the logarithm of the per capita real GDP of each province.
ENT	Entrepreneurship level	Dependent Variable	Entrepreneurship level is measured by the self-employment rate of individual and private enterprise in Section 3.2.1.
SOCIAL	Social network level	Dependent Variable	The social network level is measured by the logarithm of the information sharing rate in Section 3.2.2.
GOV	Government intervention degree	Control Variable	The level of government intervention is measured by the logarithm of government fiscal expenditure as a percentage of GDP.
GI	Government institutions quality	Control Variable	The quality of government institutions is measured by the logarithm of the ratio of fiscal expenditure to GDP after eliminating education and technology.
EDU	Education level	Control Variable	The level of education is measured by the logarithm of the number of students in regular colleges and universities in each province.

All the data in this article have been collated from the website of the National Bureau of Statistics of China [75], the Chinese Statistical Yearbooks [76], and the statistical yearbooks of various provinces [77]. The descriptive statistics of all variables are shown in Table 2.

Table 2. Descriptive Statistics of Variables.

Variables	Observations	Mean	SE	Min	Max
PERGDP	310	1.05142	0.5320645	−0.3020472	2.330004
ENT	310	0.1547411	0.1344004	0.023509	0.8343002
SOCIAL	310	−0.1.065982	0.4994503	−0.2.785893	−0.2513802
GOV	310	−0.1.516892	0.4912286	−0.2.436857	0.3214755
GI	310	−0.1.721418	0.5165664	−0.2.691544	0.2051028
EDU	310	4.007374	0.96489	0.9858168	5.296265

The scatter plots demonstrate relationships between entrepreneurship, social networks and regional economic growth as following Figure 2 shows. Specifically, the scatter plot with entrepreneurship and regional economic growth conveys that there is a significant positive correlation between these two factors, which shows that the development of the entrepreneurial economy can promote regional economy growth, to some extent. Additionally, in the scatter plot between social networks and regional economic growth, it can be seen that there is also a significant positive correlation between these two factors, which shows that the improvement to efficiency of social resource acquisition would enhance the output of economic activities. In all, to some extent, the above results verify the theoretical framework proposed before, from the perspective of a qualitative analysis.

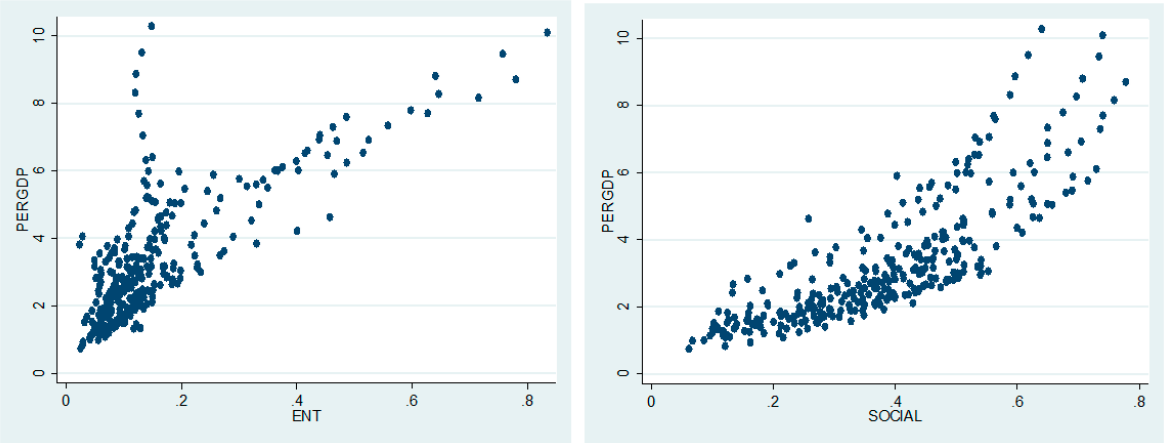

Figure 2. Scatter of entrepreneurship and social network vs. regional economic growth.

4. Empirical Analysis

4.1. Regression Results of the National Sample

In the analysis of the national sample, the linear effect, non-linear effect, and synergy effect of entrepreneurship and social networks are separately verified according to the dynamic panel data model constructed in Section 3.2, and Formulas (3)–(5) regression analysis of the impact mechanism. In order to avoid an endogenous effect on the regression process, this paper chooses Sys-GMM (Systematic generalized moment estimation) to perform a regression analysis on the different models. The results of the national sample regression obtained are shown in Table 3.

Table 3. General Sample System GMM Regression Results of Nation.

Variable	Mode11	Model 2	Model 3	Model 4	Model 5	Model 6
PERGDPt-1	0.9038 *** (0.0292)	0.8711 *** (0.0323)	0.8589 *** (0.0418)	0.7791 *** (0.0576)	0.9196 *** (0.0304)	0.9350 *** (0.0102)
ENT	0.0968 ** (0.0453)	0.0914 * (0.0510)	−0.3345 * (0.1945)	0.0661 (0.1028)	−0.0224 (0.0958)	0.1293 *** (0.0385)
SOCIAL	0.0326 * (0.0186)	0.0789 *** (0.2397)	0.1364 ** (0.0559)	0.2274 *** (0.0608)	−0.2494 (0.0737)	
GOV		−0.3540 ** (0.1440)	−0.2541 (0.2327)	−0.2622 (0.1826)	−2.430 ** (0.1034)	−0.0927 (0.1082)
GI		0.2804 ** (0.1329)	0.1137 (0.2055)	0.1581 (0.1669)	0.1786 * (0.0999)	0.0631 (0.1023)
EDU		−0.0089 (0.0078)	0.0145 (0.0730)	0.0607 (0.0763)	−0.0159 * (0.0087)	−0.0027 (0.0092)
ENT2			0.4545 ** (0.1807)		0.1353 * (0.0778)	
SOCIAL2				0.0340 ** (0.0163)	−0.0303 (0.0217)	
ENT*SOCIAL						0.1956 * (0.1147)
constant	0.2069 *** (0.0412)	0.2679 *** (0.0499)	0.1571 (0.3155)	0.1242 (0.3094)	0.1849 ** (0.0700)	0.1423 *** (0.0310)
AR(2)	0.118	0.124	0.349	0.107	0.320	0.286
Hansen test	0.203	0.152	0.140	0.178	0.230	0.130
Observations	279	279	279	279	279	279

Note: figures in parentheses are the *t*-statistics of estimated coefficients; ***, **, * represent the significance at the level of 1%, 5%, 10%, respectively.

Models 1 and 2 were constructed according to Formula (3), mainly to examine the linear effect of entrepreneurship and social networks on regional economic growth. In order to ensure the robustness of the regression results, Model 1 did not add control variables, while Model 2 added three control variables. The results of Model 1 show that entrepreneurship and social networks have a significant and positive effect on regional economic growth at a significant level of 5% and 10%, and that entrepreneurial spirit ($p < 0.01$) is more significant than social networks ($p < 0.05$). According to the results of Model 2, after adding the control variables, entrepreneurship and social networks have a significant positive effect on regional economic growth at a significant level of 10% and 1%. In addition, the effect of entrepreneurship is not more significant than in Model 1, while the effect of social networks has been significantly enhanced. The results of Model 1 and Model 2 demonstrate that entrepreneurship and social networks have a significant role in regional economic growth. Upon considering the level of government intervention, the quality of government institutions, and the level of education, the impact of social networks on regional economic growth is enhanced, which also confirms that social networks can enhance the regional network of interpersonal relationships and improve the efficiency of resource acquisition, thus, improving the output efficiency of regional economic activities.

Model 3 introduces the square item of entrepreneurship according to Formula (3) and examines the non-linear influence of entrepreneurship on regional economic growth. After the introduction of the square term, entrepreneurship has a positive effect on regional economic growth at a 5% significance level, and the effect is U-shaped. This shows that when entrepreneurship is greater than 0.5745, the effect of entrepreneurship on regional economic growth will continue to increase. Combined with the data in Table 2, it can be seen that the entrepreneurship of some provinces in China is already at 0.5745 and 0.8343. In the interval, entrepreneurship of these provinces has a strong driving effect on regional economic activities and can effectively enhance regional economic output.

Model 4 is based on Formula (3) to introduce the square item of social networks and examine the non-linear effects of social networks on regional economic growth. After the introduction of the square term, social networks have a positive effect on regional economic growth at a 5% significance level, and the effect is U-shaped. This shows that when social networks are greater than -0.1594, the social network's driving effect on regional economic growth will continue to increase. While the levels of social networks in different provinces of China vary between -2.7859 and -0.2514, it could gradually improve the promotion effect for regional economic growth. Continuously improving the level of social networks can really enhance the driving effect of social networks on regional economic growth.

Model 5 is based on Formula (4). It also examines the non-linear effect of entrepreneurship and social networks on regional economic growth. After introducing the square items of the two variables, it is found that only entrepreneurship has a positive effect on regional economic growth at a significance level of 10%, and the effect of the social network is not significant. This shows that in the context of simultaneously considering the non-linear influence of entrepreneurship and social networks, entrepreneurship can demonstrate a stronger positive promotion effect, and it can help improve the economic output efficiency of different provinces and achieve regional economic sustainability and reach the goal of development.

Model 6 is based on Formula (5) and examines the synergistic effects of entrepreneurship and social networks on regional economic growth. After introducing the multiplication item, entrepreneurship and social networks have a synergistic effect on regional economic growth at a significance level of 10%. Compared with the linear effect, it can be seen that the effect of entrepreneurship has been significantly enhanced. This shows that under consideration of the synergy between entrepreneurship and social networks, entrepreneurship not only has a stronger positive effect on regional economic growth, but also plays a corresponding role in promoting regional economic activities with social networks. This adequately confirmed that the introduction of social networks can effectively improve the efficiency of resource acquisition, and fundamentally improve the economic output of different provinces in China.

4.2. The Regression Results of the Groups in the Eastern, Central, and Western Regions

During the analysis of the national sample, it is found that entrepreneurship and social networks affect regional economic growth with varying degrees. Hence, this study adopts the method available on the National Bureau of Statistics website which divides samples into the central, eastern, and western groups based on geographical regions. The eastern region consists of 11 provinces including Beijing, Tianjin, Hebei, Liaoning, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, Guangdong, and Hainan; the central region includes eight provinces, including Shanxi, Jilin, Heilongjiang, Anhui, Jiangxi, Henan, Hubei, and Hunan; the western region is composed of 12 provinces including Inner Mongolia, Guangxi, Chongqing, Sichuan, Guizhou, Yunnan, Shaanxi, Gansu, Qinghai, Ningxia, Xinjiang, and Tibet. According to this division, the national samples are processed in groups and regression results are obtained for the eastern, central, and western regions.

In the regional regression model, system GMM method is used to analyze samples of the eastern, central, and western regions. The regression results of the three groups are shown in Models 7, 8, and 9 in Table 4 respectively. In the regression results of the eastern region sample, it is seen that entrepreneurship and social networks have a significant positive effect on regional economic growth, which is similar to the regression results of the national sample. In addition, in the western region's sample regression results, although the positive effect of entrepreneurship and social networks on regional economic growth is weaker than in the eastern region, there is a possibility to produce a significant positive effect. However, the regression results in the central region are rather special. Entrepreneurship has a significant negative impact on regional economic growth, and the impediment is far greater than the positive promotion of the other two regions. This regression result shows that entrepreneurship in the central region is affecting economic activity output and social networks have a significant positive impact on regional economic growth; its positive effect is the strongest among the three regions. This demonstrates that the interpersonal network in the central region plays an important role in economic activities.

Table 4. Grouping regression results in eastern, central, and western regions.

Variables	Model 7	Model 8	Model 9
PERGDPt-1	0.7772 *** (0.0771)	0.6872 *** (0.1125)	0.8063 *** (0.0252)
ENT	0.1451 * (0.0709)	−1.3089 *** (0.2907)	0.1298 *** (0.0343)
SOCIAL	0.2206 *** (0.0596)	0.4177 ** (0.1629)	0.1203 *** (0.0248)
GOV	−0.4294 * (0.2370)	−0.3163 (0.3173)	−0.6581 *** (0.1325)
GI	0.3134 (0.2003)	0.0583 (0.2463)	0.5866 *** (0.1249)
EDU	−0.0077 (0.0326)	−0.0371 *** (0.0092)	−0.0020 (0.0101)
constant	0.4138 *** (0.1212)	0.7274 *** (0.1936)	0.3897 *** (0.0419)
AR(2)	0.744	0.532	0.279
Hansen test	0.601	0.945	0.893
Observations	99	72	108

Note: figures in parentheses are the t-statistics of estimated coefficients; ***, **, * represent the significance at the level of 1%, 5%, 10% respectively.

By comparing the impact of entrepreneurship and social networks in the three regions on regional economic growth, it can be clearly seen that the entrepreneurship in the eastern region and the social network in the central region, respectively, have a strong positive effect on economic activities, while the effects of these two factors on regional economic growth in western region are moderate, showing that the region is still in a relatively conservative state. Thus, it shows that entrepreneurship and social networks do not, to their full potential, fulfill their roles of promoting sustainable development of the regional economy.

5. Conclusions and Suggestions

5.1. Discussion of the Results of the Research

Entrepreneurship and social networks originated from two different research areas and play significant roles in promoting economic growth. This article selects the self-employment rate of individual and private enterprises and information sharing rate as indicators to measure entrepreneurship and social networks. Samples of 31 provinces and cities in China during 2007–2016 are used. The dynamic panel data model was applied to establish the relationship between entrepreneurship, social networks, and economic growth. A regression analysis of national data samples was conducted using the system GMM method, and a regression analysis was performed on regions grouped according to the eastern, central, and western regions of China.

In the national sample, entrepreneurship and social networks play a significant role in promoting economic growth. After including government intervention, government agency quality, and educational factors, the effect of social networks on regional economic growth is correspondingly enhanced. The increase indicates that for the current overall economic development in China, the entrepreneurial economy represented by the entrepreneurship and the interpersonal networks represented by social networks, can have a continuous positive effect on economic activities in the macro level [5,8], which is consistent with some current studies [11,25]. However, in-depth analysis found that entrepreneurship and social networks have corresponding U-shaped non-linear effects on regional economic growth. Based on the entrepreneurship capital theory, in the early stage, entrepreneurship mainly played the role in accumulation process of knowledge capital [13], and only when knowledge accumulated to a certain limit could it induce spillover effects [24], thereby enhancing technological innovation and entrepreneurial activities in the region; there exists an incubation period for the function of entrepreneurship. In addition, reality shows that the entrepreneurship of some Chinese provinces has an ever-increasing positive effect on regional economic growth, and the effect of social networks in most provinces on regional economic growth is improving. As the level of information exchange in different regions of China increases, the social network will have a continuously positive effect on economic activities. Obviously, it demonstrates that social networks are likely to play a regulating role in the relationship between entrepreneurship and regional economic development. Moreover, the introduction of entrepreneurship and social networks will have an impact on regional economic growth. This will not only produce significant economic activities, but also enhance the effect of entrepreneurship. Based on the resource dependence theory and transaction cost theory, social networks build and improve the dependence of resources between actors and external environment in the regions [25,33], while reducing the multilateral transaction costs of knowledge transfer, acquisition and accumulation [24], so that the entrepreneurship plays an increasingly significant role in the framework of entrepreneurship capital, which is corresponding to the conclusions of some current studies [13,14]. At this point, it obviously shows that the economic development process of different regions in China is highly dependent on the interpersonal network factor. This phenomenon provides corresponding resource channels for economic activities, improves the efficiency of resource utilization, and ensures effective economic output [35,40]. More importantly, the entrepreneurial economy represented by entrepreneurship predominantly facilitates the economic restructuring process and is also an important guarantee for technological innovation. Promoting

the development of entrepreneurship tends to be more conducive to economic restructure [42,43], and fostering technological innovation will benefit the efficiency of economic output. At the same time, the regional network of interpersonal relationships represented by social networks also portrays the intensity of interaction among participants in economic activities at the macro level. The interpersonal relationships advocated by traditional Chinese culture plays an important role in the process of contemporary economic development [18,59]. The sustainable development of the regional economy should exploit the effective cooperation of the participants, which makes the role of the social network in the economic development process become particularly prominent, and thus becomes a key element in the sustainable development of the Chinese economy.

From the regression results of the eastern, central, and western regions, entrepreneurship and social networks of the eastern region and the central region have a strong positive effect on regional economic growth, which is similar to the national overall sample. However, the effects of entrepreneurship and social networks in western region is obviously weaker than that in the eastern region. This indicates that the economic development in the western region of China is still in a relatively conservative stage and the entrepreneurial economy and interpersonal networks fail to fully exert the potential of their economic pull [11,18]. Therefore, it is necessary to increase the economic construction in the western region of China to ensure that entrepreneurship and social networks can effectively promote the development of regional economies. However, entrepreneurship in the central region is a significant negative impediment to regional economic growth, partly because the region is too dependent on intensive industries, making the entrepreneurial environment unable to be guaranteed [40,43]. On the other hand, the concentrated distribution of universities in the region makes the distribution of educational resources unbalanced. In light of these two reasons, the entrepreneurial economy of the central region is temporarily difficult to promote transformation of the regional economic structure, and the entrepreneurship reflects a corresponding negative impact. However, it is worth noting that the effect of the social network in the central region on the promotion of regional economic growth is significantly stronger than that of the other two regions. This also reflects the influence of the interpersonal relationship network on the region on economic activities and the interaction between economic participants speeds up the use of different resources, so that regional economic output can be effectively guaranteed.

From the perspective of social practice, based on theoretical models and empirical analysis, we could consciously make the most of the different functions of entrepreneurship at three levels: to guide the entrepreneurial activities and encourage the sustainable development of our society, enterprises, even individuals. For example, financial management institutions could conduct some trainings, including entrepreneurial skills, mentality, process and behavior at the individual level or for entrepreneurs with entrepreneurial tendencies; and those at the organizational level, including entrepreneurial management, entrepreneurial mechanisms, entrepreneurial culture, etc.; even at the social level, such as on how to formulate entrepreneurial policies and create an entrepreneurial environment in the different regions. Moreover, regional policy makers should establish and improve the legal system for venture capital investment and promote the development of information technology as well as carrying out multi-level training and support for the realization of the "Internet-plus Economy". Besides, enterprises or individuals should actively build their own relationship networks in the context of a large networked society and establish more stable information resource channels. Ultimately, one could achieve synergy which is relevant to his own goals and sustainable regional development.

5.2. Theoretical Contributions and Limitions

The main contribution of this paper is to explore the impact of entrepreneurship and social networks on economic growth in different regions from the level of overall society, and use empirical models to verify the expected results, making them more reliable. In the course of China's overall economic development, the development of the entrepreneurial economy and the closeness of

the regional network of interpersonal relationships can all affect the speed of development in regional economy. Increasing the proportion of startup enterprises and strengthening the network of interpersonal relationship appropriately is significant for enhancing economic growth. In addition, a number of researchers have studied factors affecting economic growth from different perspectives, but the study of entrepreneurship on economic growth from the perspective of social networks is still scarce. This article chooses self-employment rate of individual and private enterprises to measure entrepreneurship. Hence, this indicator reflects the entrepreneurial spirit of entrepreneurship and remains consistent with the information sharing rate, which measures social networks in dimension measurement. These two indicators demonstrate entrepreneurship and social networks at a regional level respectively, making the empirical model a stronger coordination at the macro level.

There are mainly two theoretical contributions in this paper. First and foremost, integrating entrepreneurship capital theory, resource dependence theory and transaction cost theory together, we constructed a conceptual analysis framework. Among this, entrepreneurship affects regional economic growth as the main line of analysis and it accelerates the commercialization of knowledge by promoting its flow and spillover effects. Furthermore, through value creation, the regional economy would gain new development motivation, which complements existing neoclassical economic growth theories and the endogenous economic growth theory. It is conducive to deepening the understanding of entrepreneurship's function in the economic area. Secondly, since the process of the impact of entrepreneurship on regional economic growth involves a large number of actors and complex internal mechanisms, it is necessary to consider more diverse contextual factors. Therefore, taking advantage of the connection properties of social networks to complement the theoretical framework is valuable. In particular, by introducing resource dependence theory and transaction cost theory, this paper focuses on the process of regional social networks exerting influence on entrepreneurship capital, rather than treating it as static inventory.

There are three important limitations in concluding this article. First, although the panel data model is adopted, it is still difficult to form a multi-dimensional validity test because of the single source of data and short time span, which poses certain challenges on robustness. Second, the indicators selected for entrepreneurship and social networks may not be so rigorous that we should explore and examine better ones. Third, we focused on the mechanism of entrepreneurship affecting economic growth, but payed insufficient attention to the concept of capital in social networks. Future research could consider this as an input variable affecting the regional economy and examine the regulatory effect of entrepreneurship on the process, increasing the completeness of this paper.

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