

**EMPIRICAL RESEARCH ON THE COUPLING RELATIONSHIP  
BETWEEN INNOVATION AND ENTREPRENEURSHIP AND  
INDUSTRIAL STRUCTURE UPGRADE**

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**ABSTRACT**

Under the background of mass entrepreneurship and innovation, innovation and entrepreneurship have become a new research hotspot, and the research on industrial structure upgrading has been keeping a high degree of heat. However, few scholars have integrated the two and studied their coupling relationship. By establishing a coupling relation model between innovation and entrepreneurship and industrial structure upgrading, this paper calculates the comprehensive scores of innovation and entrepreneurship system, comprehensive scores of industrial structure upgrading system, coupling correlation degree and coordination degree of each province from 2009 to 2017, and carries out spatial autocorrelation analysis of the calculated coupling coordination degree. The research shows that there is a coupling relationship between innovation and entrepreneurship system and industrial structure upgrading system in each province, and the coupling coordination degree in the east and the west presents a decreasing trend, and has a significant spatial autocorrelation.

**Keywords:** Innovation and entrepreneurship; Industrial structure optimization; The coupling mechanism

**I. INTRODUCTION**

"Popular entrepreneurship, innovation by all people" (hereinafter referred to as "double innovation") is an important measure taken to realize the innovation-driven development strategy under the background of the new normal of economic development<sup>[i]</sup>. The "Government Work Report" in 2015 proposed to "new innovation" to release new demand, create new supply, promote the development of new technologies, new industries, and new business forms. Through joint efforts of enterprises, universities, governments and other parties to promote "double innovation" into an economy Development of "new power", "new engine"<sup>[iii]</sup>. Since the creation

of "Double Innovation", hundreds of documents have been received from the central government to the local government. Innovation and entrepreneurship have effectively promoted supply-side reforms and made China's economy develop more smoothly. However, due to China's vast territory and different economic development foundations, the vitality released by innovation and entrepreneurship also shows differences. The upgrading of the industrial structure is the result of innovation and entrepreneurship, and it also affects the development of innovation and entrepreneurship. The development status of the two is different in different regions. Therefore, studying the coupling relationship between innovation and entrepreneurship in various regions and the upgrading of industrial structure has important theoretical and practical significance.

Schumpeter et al. Believe that innovative entrepreneurship is to promote economic growth through technology through the introduction of new products, the introduction of new production methods, and the discovery of new markets. There is a substantial difference between innovative entrepreneurship and general entrepreneurship. Innovation entrepreneurship is more concentrated in knowledge-intensive industries, which has a significant impact on the optimization and upgrading of regional industrial structures. Most of the current impacts of innovation activities on regional industrial structure are unidirectional <sup>[iii]</sup>. Cai Yurong and Wang Huiling (2018) empirical research pointed out that innovation input has a significant positive driving effect on the upgrading of industrial structure, the degree of effect weakened in turn in the order of eastern, central and western, showing obvious regional differentiation characteristics <sup>[iv]</sup>. Li Weiqing (2015) proposed that industrial upgrading has a significant positive spillover effect on China's overall independent innovation. The more obvious the innovation spillover effect of industrial upgrading, the stronger China's independent innovation capability, but the greater the independent innovation effect on the eastern, central and western regions. The difference<sup>[v]</sup>. Acs and Virgill (2009) believe that there is a linear relationship between entrepreneurial activity and economic growth, and entrepreneurial activity will promote economic growth <sup>[vi]</sup>. Minniti (2010) believes that entrepreneurship and economic growth are a two-way circular relationship. Entrepreneurial activities promote economic growth by affecting personal investment, and economic growth in turn promotes technological progress and innovation by changing culture, social environment, and consumption propensity<sup>[vii]</sup>.

Most of the existing literature focuses on the impact of innovation and entrepreneurship on economic development, and gradually studies from the perspective of economic development speed to the quality of economic development. Although some scholars have begun to explore the two-way relationship between innovation and entrepreneurship and economic development, no scholar has From the perspective of the coupling effect of innovation and entrepreneurship and industrial structure upgrading in the eastern and western regions, a comprehensive analysis is conducted. Therefore, from this perspective, this paper studies the coupling and development

relationship between innovation and entrepreneurship and industrial structure upgrading in each province, calculates the degree of coupling and coordination in each province, and performs an autocorrelation analysis on the degree of coupling and coordination. Finally, it provides targeted opinions based on the development of each region.

## **II. EMPIRICAL ANALYSIS**

### **2.1 Data source**

This paper studies the coupling relationship between innovation and entrepreneurship in 30 provinces in mainland China except Hong Kong, Macau, and Taiwan (excluding Tibet 's autonomous region data, so Tibet is not counted) in 2009-2017. The data used in this article are basically derived from China Statistical Yearbook, China Statistical Yearbook of Science and Technology, and statistical yearbooks of provinces and statistical bulletins of economic and social development. The data in this article follow the objective principle, based on the data in the statistical yearbook, and then according to the specific statistical methods, the original data is standardized for use in the dissertation.

### **2.2 Empirical analysis**

Measurement of Coupling Degree and Coordination Degree between Innovation and Entrepreneurship and Industrial Structure Upgrade System

According to the research methods mentioned above, after the raw data is standardized, the corresponding weights of the indicators of the innovation and entrepreneurship system and the industrial structure upgrade system are measured. According to the method for measuring the coupling degree described above, the coupling degree between the innovation and entrepreneurship and the industrial structure upgrading system is measured. Table 2 shows the degree of coupling and coordination between the system of innovation and entrepreneurship and the optimization and upgrading of the industrial structure.

From the specific scores of the various systems and the degree of coupling and coordination, in 2009, the comprehensive scores of the innovation and entrepreneurship system were all lower than the comprehensive scores of the industrial upgrade system, and the comprehensive scores of the two systems differed greatly. Development of upgrades. From the index of coupling and coordination, it can be seen that except for Beijing, Tianjin, Shanghai, Jiangsu, Zhejiang, Fujian, Shandong, and Guangdong in the eastern region, which are mildly imbalanced, the other provinces are all highly imbalanced, and the development of the two systems is very uncoordinated. After the 2008 financial crisis, the economic development of China as a whole

was severely affected. The awareness of innovation and entrepreneurship is not strong, and the investment of R & D personnel and materials is not high. Overall, innovation and entrepreneurship lags behind the development of industrial structure upgrades. A lower level of innovation and entrepreneurship also brings a lower overall score for industrial structure upgrades. In particular, the situation of innovation and entrepreneurship in the central and western regions is worse, forming a highly unbalanced coupling state. From 2009 to 2017, the comprehensive scores of the two subsystems of the innovation and entrepreneurship system and the industrial structure upgrade system have significantly improved, and it is no longer a single innovation and entrepreneurship system that lags behind the industrial structure upgrade system. The development between the two systems The state is more diverse. The overall scores of the innovation and entrepreneurship systems in the eastern regions of Hebei, Jiangsu, Zhejiang, Shandong, and Guangdong are higher than the industrial structure upgrade system, indicating that the innovation and entrepreneurship system no longer lags behind the industrial structure upgrade system, and these provinces have increased their investment in innovation and entrepreneurship. In addition, most of these provinces are located in the developed coastal areas with relatively strong vitality for innovation and entrepreneurship. They have advantageous geographical locations, rapid economic development, and talent gathering, and they accept the concept of innovation and entrepreneurship relatively quickly, which provides a good foundation for the development of innovation and entrepreneurship. At the same time, the degree of coupling and coordination between Jiangsu and Zhejiang has reached a mild state of coordination, and the development of innovation and entrepreneurship has also brought about the upgrading of the industrial structure. Driven by the rise of the central region, the central region has changed from a highly imbalanced state to a slightly unbalanced state in Anhui, Henan, Hunan, and Hubei. It can also be seen from the comprehensive scores of the subsystems that the comprehensive scores of Anhui, Henan, Hunan, and Hubei have improved significantly. It can be seen that the coupling of the two systems plays an important role in promoting the overall economic development. The western region is still a region with weak coordinated development. Except for Sichuan and Chongqing in the southwestern region, there is a slight imbalance, and all other provinces are in a highly imbalanced state. Sichuan and Chongqing belong to the provinces with more universities in the southwest region and relatively good economic development. After Chongqing was established as a municipality, more policy development and support were obtained. The increase in talent introduction and R & D investment also provided important development opportunities. support. The development of the cultural tourism industry has a certain role in promoting the upgrading of the industrial structure. This is also an important reason for the economic development and upgrading of the industrial structure in Chongqing and Sichuan.

To sum up, the innovation and entrepreneurship and industrial upgrade systems have developed

from 2009 to 2017, and the comprehensive scores of the innovation and entrepreneurship system and the industrial structure upgrade system have shown an almost simultaneous increase and decrease trend, indicating that between the innovation and entrepreneurship and the industrial structure upgrade system There is a relationship of coupled development. And from a national perspective, the development of the system coupling coordination degree in the eastern region is significantly better than that in the central and western regions, and the three provinces of Jiangsu, Zhejiang and Guangdong have the most prominent development.

#### 4.2 Analysis of the spatiotemporal characteristics of the degree of coupling and coordination between the innovation and entrepreneurship and the industrial upgrading system

Spatial autocorrelation refers to a variable with a certain attribute, which has a certain correlation in space. The main purpose is to measure the spatial correlation and degree of this variable. When the value of this variable in space has a similar trend, it shows a positive correlation; when the value of this variable in space shows a negative trend, it has a negative correlation. When studying the spatial autocorrelation of variable values, it is mainly studied from two aspects: global correlation and local correlation.

By using Geoda software, a global spatial autocorrelation analysis is performed on the degree of coupling and coordination between innovation and entrepreneurship and the optimization and upgrading of the industrial structure in each province. Global Moran's I index,

The statistics of the global correlation coefficients of all provinces are positive numbers, indicating that there is a positive correlation and a clustered state in space. Judging from the standardized statistical Z (I) values, the Z (I) values from 2009 to 2017 were all greater than the critical value of the 0.05 confidence level of 1.96, indicating that the 95% confidence interval was highly significant. The degree of coupling and coordination among the provinces is obviously concentrated in space, and the Moran 's I Index has shown an overall increase year by year. As can be seen from Figure 2, although some years in the middle have decreased, in general, 2009-2017 is still showing an increase. In general, the degree of coupling and coordination between innovation and entrepreneurship and industrial upgrading in each province shows a strong positive correlation in space, and there is an obvious agglomeration effect.

### **III CONCLUSION AND INSPIRATION**

This article uses 2009-2017 China's provincial index data to calculate the comprehensive score of the innovation and entrepreneurship system, the comprehensive score of the industrial structure upgrade system, the degree of coupling and coordination between the two systems. The study found that since 2009, the overall scores of the innovation and entrepreneurship and

industrial structure upgrading systems in all provinces have basically increased. The degree of coupling is relatively moderate, but the degree of coupling coordination is generally low, and most provinces In 2009, it was in a highly unbalanced state, but with the optimization of innovation and entrepreneurship and the upgrading of the industrial structure, the degree of coupling and coordination gradually developed to a mild degree of coordination and optimization. From the analysis of the spatiotemporal characteristics, it can be seen that the attribute of coupling coordination degree from 2009 to 2017 has a significant autocorrelation; from the perspective of spatial distribution, the significance of the middle and lower reaches of the Yangtze River is more prominent, showing a "high aggregation" The state, and the "highly clustered" provinces continued to extend from the eastern coastal regions to the central inland provinces from 2009 to 2017, and the policy of undertaking the Yangtze River Delta has obvious effects. The insignificant areas are mainly concentrated in the northeast and inland areas, and are mainly affected by the geographical location and development base.

According to the comprehensive score, coupling coordination degree and autocorrelation analysis of the two major subsystems, different suggestions are proposed for different regions. By subtracting the comprehensive evaluation scores of each system, it can be concluded that the lower degree of coupling and coordination in various provinces in China is mainly caused by the co-loss of the two major systems. Lower levels of overall coordination. In 2009, the overall scores of the innovation and entrepreneurship system and the industrial structure upgrading system were both low. Although the degree of coupling was high, a low degree of coupling coordination was formed. Mainly at that time, the innovative entrepreneurial enterprises relying on the Internet had just risen. Most of the current Internet giants have developed in the golden decade of entrepreneurship from 2008 to 2018. The input of R & D personnel and R & D materials is an important factor for China's innovation and entrepreneurship and the optimization and upgrading of the industrial structure. Therefore, suggestions are made: (1) We must continue to strengthen research and development funding and investment in research and development personnel, especially for basic research and development, and increase the salary of research and development personnel. At the same time, the central and western regions must do a good job in introducing talents. The central government has increased its support for the research and development base in the central and western regions. The regions with more developed and innovative businesses in the east should do well in personnel and resource circulation and knowledge sharing with the central and western regions. For example, mature innovation and entrepreneurial enterprises in the Yangtze River Delta region can set up branches in the central and western regions. The headquarters will lead technical staff to train outstanding R & D personnel for the local area, forming a situation of knowledge sharing, personnel sharing, and staff inheritance; (2) From the perspective of coupling coordination, until 2017, most provinces in the central and western regions were still in a state of high imbalance. The overall scores of

innovation and entrepreneurship systems in these provinces were generally low, and the northwest and southwest regions showed a state of innovation and entrepreneurship lagging in industrial structure upgrading. The overall scores of the innovation and entrepreneurship systems of the three provinces are higher than the industrial upgrading system. For the northwest and southwest regions, the geographical location is relatively remote, education development is backward, but there is a good environment for resources. For these provinces, it is necessary to focus on the development of education, especially higher education, while making full use of local resources and resources to develop tourism and unique innovation and entrepreneurship activities. Developed areas in the east can carry out gang-to-court support with these provinces to promote the development of the northwest and southwest regions. For the three eastern provinces, they have a good industrial foundation and a good education basic industry. These provinces are mainly lagging in industrial upgrading systems and the development of innovation and entrepreneurship systems. They should actively adjust the industrial structure, develop high-tech industries, and revitalize the old industrial bases in Northeast China. , Injecting old industrial bases with innovative vitality and blood, actively absorbing foreign investment, promoting foreign exchanges and industrial exchanges with Jiangsu, Zhejiang, and Shanghai regions; (3) The "high-gathering" areas in the Yangtze River Delta should develop their own, Form a pattern of radiating eastward, westward, and southward, connected by dots and formed by lines, forming a situation that promotes coordinated development among the central, local, and provinces, and continuously narrows the development gap between the central and western regions.

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