Analysis of the Coupling Coordination Degree of Innovation and Entrepreneurship and Economic Development in Guangdong Province under the New Normal

Wei Zheng

Business School, Hohai University, Nanjing 210000, China.

denniszheng@hhu.edu.cn

Abstract

The construction of the new normal economy is an important proposition of Guangdong's economic development, putting innovation and entrepreneurship in the core of overall situation of Guangdong's economic development and implementing innovation and entrepreneurship-driven strategy are the inevitable choice for the new normal development of Guangdong's economy. In order to explore the coupling degree between innovation and entrepreneurship and economic development in Guangdong Province, based on the establishment of evaluation index system of innovation and entrepreneurship and economic development, the coupling coordination model is used to measure coordination degree of system, through the calculation of the capacity coupling coefficient model, the coupling degree between innovation and entrepreneurship and economic development in Guangdong Province is obtained, so the level of coupling coordination degree between the two can be determined. Empirical studies show that Guangdong's innovation and entrepreneurship and economic development all had substantially increased in 2006-2015, and the effect of innovation and entrepreneurship for economic development is more obvious; the system coupling degree between innovation and entrepreneurship and economic development is within 0.3 and 0.5, it shows that both are in common development state.

Keywords

New normal; innovation and entrepreneurship; economic development; coupling coordination degree; Guangdong Province.

1. Introduction

In order to better adapt to the new normal strategy, Guangdong's economic development has entered a new normal with medium-high speed economic growth, middle-high end economic structure, and medium-high quality development benefits. According to the statistics of Human Resources and Social Security Department of Guangdong Province, the first half of 2014 is compared with the first half of 2015, the employment increased from 831,000 to 884,000, and ranked first in the country; the number of market entity increased from 621,972 to 677,281, and ranked second in the country; the number of domestic invention patents per 10,000 people was 10.56 every year, ranked third in the country, and the economy showed a prosperous development trend. Promoting innovation and entrepreneurship is an inevitable choice for Guangdong to take the initiative to adapt to the new normal and lead the economic development of new normal; it is an important measure to implement the “innovation, coordination, green, openness and share” development concept proposed by the Party Central Committee, and it is necessary way to expand employment and realize the prosperity of the country.

2. Research Status at Home and Abroad

In recent years, the research on the model relationship between innovation and entrepreneurship and regional economic development mainly includes: Xia Weili (2017) focused on the connotation of innovation and entrepreneurship environment, constructed indicators to carry out ''cluster-factor-weight'' comprehensive analysis, and obtained geographical spatial distribution pattern of innovation and entrepreneurship environment in 31 provinces of China in 2014. Komlosi (2015), took Hungary as an example, based on the research of Global Entrepreneurship and Development Index (GEDI) on regional quality differences, found that it helps decision makers weigh and balance different strategic scenarios and the related allocation of policy resources. Guerrero (2016) used equation of structure model to study the impact of innovation and entrepreneurship of 56 universities on regional economic development in 12 European countries, the results show that human capital is the main influencing factor. Moutinho (2015) went beyond the “black box of innovation”: transform R&D investment into employment and economic growth. The increase of technical capacity is the most effective means to reduce youth unemployment, and it is a policy that has a considerable impact on sustainable economic development.

According to previous scholars' research, most of the research focuses on the correlation between innovation and entrepreneurship and regional economy, and does not conduct in-depth research on the coupling coordination effect between the two. For this reason, this paper takes Guangdong Province as an example, studies the coupling degree and correlation mechanism between innovation and entrepreneurship and regional economic system, and analyze the effect of innovation in regional economy and the interaction between the two.

3. Construction of Coupling Model of Innovation, Entrepreneurship and Regional Economy

The coupling degree is used to measure elements of the system in economics and interaction degree in system. As a theory for studying the internal correlative mechanism of different subjects in the socio-economic system, coupling theory has developed rapidly in recent years. Therefore, Guangdong Province constructs the coupling coordination evaluation index system of innovation, entrepreneurship and economic development, on this basis, this paper uses the coupling development coordination model to measure the correlative condition between innovation and entrepreneurship and economic development, and then calculates the coupling degree between innovation and entrepreneurship and economic development through the coupling model, attempts to reveal the law of the coordinated development of the innovation and entrepreneurship and economic development system in Guangdong Province, and provides data support and decision-making basis for the coordinated growth of innovation, entrepreneurship and economic cooperation in Guangdong Province, details are as follows:

3.1. Pretreatment Evaluation Index

Standardization of positive index:

$$Z_{ij} = \frac{x_{ij} - \min X_{ij}}{\max X_{ij} - \min X_{ij}} \tag{1}$$

Standardization of negative index:

$$Z_{ij} = \frac{\max X_{ij} - x_{ij}}{\max X_{ij} - \min X_{ij}} \tag{2}$$

Among them: xij is the i-th index value of j year, and Zij is the i-th index standard value of j year.

Determine the weight of the evaluation index. This paper uses the AHP method to determine the weight.

Calculation of coupling development degree, it is assumed that the development function of the system has strict quasiconcave and the returns to scale are unchanged, f(x) represents the development level of the innovation and entrepreneurship subsystem, g(y) represents the development level of the regional economic subsystem, and the effect function is established:

$f(x)=\sum a_i x_i$, xi and ai represents the standardized value of the innovation and entrepreneurship indicators and their corresponding weights, respectively;

$g(y)=\sum b_i y_i$, yi and bi represent the standardized values of regional economic indicators and their corresponding weights, respectively.

T represents the total system coupling development degree formed by the combination of the two subsystems, and reflects the overall effect of the two subsystems.

$$T = \alpha f(y) + \beta g(y) \tag{3}$$

Among them, α and β are undetermined parameters, reflect the importance of the two subsystems to the total system. The importance of the two is the same for the relationship between innovation and entrepreneurship and the regional economy, so α and β take value of 0.5, respectively.

4. Calculation of coupling coordination degree. It is improved on the basis of the deviation coefficient, and the coordination degree of the definition system is:

$$C = \frac{4 f(x) g(y)}{[\mathrm{f(x)} + \mathrm{g(y)}]^2} \tag{4}$$

C represents the average deviation degree of the innovation and entrepreneurship and regional economy two subsystems. The improved coordination degree makes the integrated system comparable and can better demonstrate the system coordination characteristics. When C=1, f(x)=g(y), and the system is in the optimal coordination state.

5. Measurement of coupling degree. The measurement of system coupling degree is a comprehensive consideration of the two dimensions of “development” and “coordination” of the system. The capacity coupling coefficient model is used to measure the coupling degree of the system in this paper:

$$D = (C \cdot T)^{\theta} \tag{5}$$

Among them, C is the coordination degree of system (4), T is the development degree of system (3), and θ is the undetermined parameter. The values of the undetermined parameters are different, and the coupling results are slightly different, but the overall trend is consistent. In order to the convenience of calculation, the value of θ is 0.5, and the calculation formula of coupling degree is:

$$D = \sqrt{C \cdot T} \tag{6}$$

Obviously, the coupling degree takes value 0≤ D≤ 1.0. When D=1, the coupling degree is the largest, the system is ordered, and it is in resonant coupling; when D=0, the coupling degree is the smallest, and the system or the internal elements are in an unrelated; when 0<D≤0.3, the system is in the low-level coupling phase; when 0.3<D≤0.5, the system is in the antagonistic phase; when 0.5<D≤0.8, the system is in the integrative stage; when 0.8<D<1.0, the system is in a high-level coupling phase, [5-6] as shown in Table.1.

Table 1. The evaluation criteria of and division types of coupling degree

negative coupling(unbalanced development)		positive coupling (coordinated development)	
D value	type	D value	type
0.00-0.009	extreme disorder decline	0.50-0.059	inadequate coordinated development
0.10-0.019	serious disorder decline	0.60-0.069	junior coordinated development
0.20-0.029	moderate disorder decline	0.70-0.079	middle coordinated development
0.30-0.039	mild disorder decline	0.80-0.089	good coordinated development
0.40-0.049	on the verge of disorder decline	0.90-0.099	high-quality coordinated development

4. Empirical Analysis

4.1. Construction of the Evaluation Index System and Calculation of Weight

The coupling coordinated development system of innovation, entrepreneurship and economic development in Guangdong Province is divided into innovation and entrepreneurship subsystem and economic development subsystem, as shown in Table 2.

4.2. Source of Data

It mainly analyzes the coupling and coordination relationship between innovation and entrepreneurship and economic development in Guangdong Province from 2006-2015 data. The data comes from the "Statistical Bulletin of Guangdong's National Economic and Social Development", " Statistical Yearbook of Guangdong Province", "Guangdong Province Financial Final Report" and relevant statistical data and planning reports of Guangdong Province.

4.3. Analysis of the Results

4.3.1. Comprehensive Evaluation of Innovation and Entrepreneurship and Economic Development

The comprehensive evaluation value of innovation and entrepreneurship and economic development level is calculated by using the coupling coordination degree model of Guangdong Province's innovation and entrepreneurship system and economic development system established in this paper, the results are shown in Table 2. According to Table 2, sequential variation diagram of the comprehensive evaluation value of innovation and entrepreneurship and economic development level in Guangdong Province is drawn (as shown in Figure.1). It can be seen from Figure 1 that the condition of innovation, entrepreneurship and economic development are generally on the rise in Guangdong Province, economic development is maintaining a growing trend, and innovation and entrepreneurship have a large fluctuation. Combine Table 3 and Figure.1, the development trend of the two systems is ananlyzed.

Table 2. Comprehensive evaluation index system for the coordinated development system of innovation, entrepreneurship and economic development in Guangdong province

aim layer	functional layer	criterion layer	index layer	weight
innovation and entrepreneurship and indicator system of regional economic	innovation and entrepreneurship subsystem	investment	R&D personnel	0.0829
			R&D funds	0.0855
			R&D project	0.0833
			R&D industrial enterprise	0.0865
		potential	higher education gross enrollment rate number of students in colleges and universities per 10,000 population	0.0802
			all levels of institutes and agricultural technology associations	0.0813
			number of scientific research institutions	0.0838
			provincial and superior science and technology awards	0.0821
		output	business volume of technical contract	0.0789
			patent application numbers	0.0857
			patent application approval numbers	0.0852
			GDP	0.0847
	economic development subsystem	scale	local general public budget revenue	0.0857
			total fixed assets investment	0.0865
			total import and export of goods	0.0862
		structure	ratio of third industry in GDP	0.0857
			ratio of secondary industry in GDP	0.0809
			non-agricultural employment ratio	0.0805
			urbanization rate	0.0805
		ratio	water consumption per 10,000 Yuan GDP	0.0804
			total energy consumption	0.0842
			per capita disposable income	0.0835
			Engel coefficient	0.0851
				0.0807

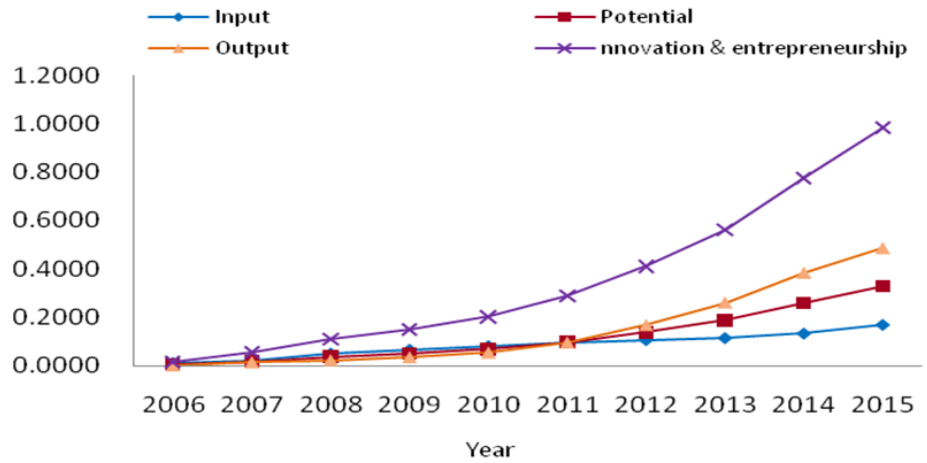
Innovation and entrepreneurship system, innovation and entrepreneurship grew rapidly in 2013-2015, in 2013, the comprehensive effect of comprehensive innovation and entrepreneurship, life innovation and entrepreneurship, production innovation and entrepreneurship, and ecological innovation and entrepreneurship in Guangdong Province led to a sharp rise in innovation and entrepreneurship, the comprehensive evaluation value rose

from 0.5609 in 2013 to 0.9827 in 2015. The reason: (1) governmental governance capacity is improved. Conduct pilot demonstration applications of big data, (2) many indicators of incubator and creative space rank the first in the country. Guangdong Province gives entrepreneurship incubation subsidies according to per household no more than 3,000 Yuan and the number of successful incubators; the newly-established enterprises of the entrepreneurship incubation base (startup park) hosted by the government, Rents are reduced in proportion to not less than 80% in the first year, not less than 50% in the second year, and not less than 20% in the third year. By the end of 2016, the number of technology business incubators in the province that included innovation-driven assessment statistics reached 634, ranked first in the country, increased by 59% than the last year, the province has totally 500 creative spaces, totally 178 have been included in the national incubator management system, the indicators ranked first in the country, (3) cities, counties and districts are fully covered and developed. At present, the municipal cities of province has achieved full coverage of incubators and public creative space, the innovation and entrepreneurship of the Pearl River Delta region is strong, and innovation and entrepreneurship have penetrated into counties and districts, achieve coverage of incubators and creative space in more than 70% of county (district). Since 2015, incubators in Shantou, Qingyuan, Jieyang and Heyuan high-tech districts had been identified as state-level technology enterprise incubators, and achieved ''zero'' breakthrough in the state-level incubators in the eastern and western regions of Guangdong, (4)create a large number of jobs. By the end of 2016, the number of incubator enterprises in the province had exceeded 26,000, increased by 41% than 2015, average incubator hatched about 42 start-up enterprises, and the number of jobs created by the incubators reached 247,000. The entrepreneurship has a significant role in employment and has become an important way to solve employment, (5) the internationalized development level of entrepreneurial carriers has been continuously improved. Our province has actively set up an innovative and entrepreneurial service platform for ''both sides and four places'', a group of high-level technology enterprise incubators and creative space for Hong Kong, Macao and Taiwan accelerate development, and multiple incubators by "go out", incubation and exchange platforms are established in the United States, Israel, Hungary and other countries, gathered a number of international innovation resources, and enhanced the international status and influence of the province's incubators.

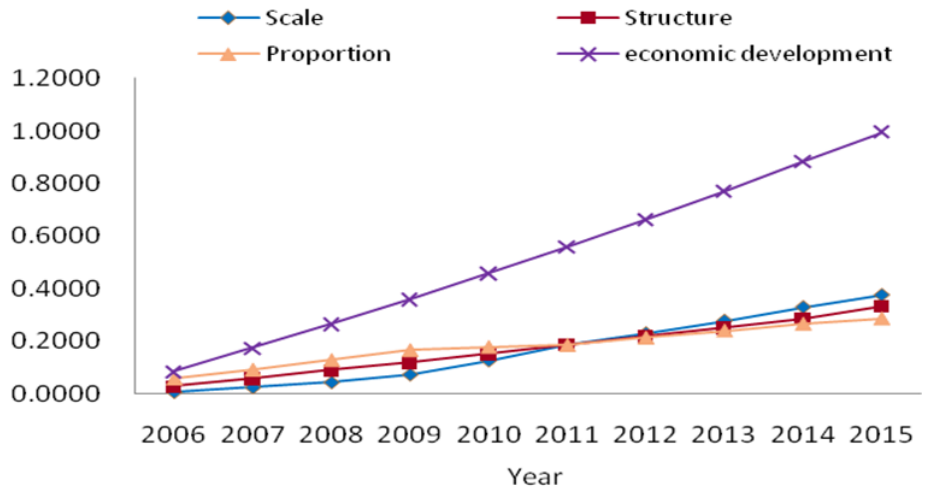
Economic development system, the comprehensive evaluation value of economic development increased from 0.0859 in 2006 to 0.9942 in 2015, it showed a steady growth trend. Among them, the scale of economic development is the most obvious, which is increased from 0.0258 in 2006 to 0.3365 in 2015, and drove the rapid development of economic development. Moreover, the Guangdong Province incubator closely focuses on innovation-driven development needs, and the incubator as a platform to promote the organic integration of the innovation chain, capital chain and industrial chain. By the end of 2016, the provincial incubators had absorbed more than 240,000 employments, in 2016, there were 3,877 new enterprises, of which more than 30% were enterprises with annual incomes more than 10 million Yuan; more than 70% of enterprises applied for intellectual property protection in incubators, patent obtained reached 35%. More than 80% of the “The Recruitment Program of Global Experts” entrepreneurial talents in the province settled in the incubator. The social value of the incubator in promoting innovation, entrepreneurship, promoting economic development of our province, optimizing economic structure, increasing employment, and creating tax revenue is fully manifested.

Table 3. Comprehensive evaluation results of Guangdong's innovation and entrepreneurship system and economic development system

year	input	potential	output	innovation & entrepreneurship	scale	structure	proportion	economic development
2006	0.0049	0.0049	0.0051	0.0149	0.0258	0.0292	0.0309	0.0859
2007	0.0177	0.0173	0.0173	0.0523	0.0537	0.0587	0.0626	0.1749
2008	0.0379	0.0363	0.0339	0.1081	0.0831	0.0891	0.0940	0.2662
2009	0.0527	0.0497	0.0466	0.1490	0.1130	0.1205	0.1261	0.3596
2010	0.0698	0.0671	0.0643	0.2012	0.1460	0.1529	0.1587	0.4575
2011	0.0990	0.0960	0.0929	0.2879	0.1814	0.1855	0.1918	0.5587
2012	0.1398	0.1369	0.1331	0.4098	0.2188	0.2183	0.2259	0.6630
2013	0.1910	0.1869	0.1830	0.5609	0.2587	0.2514	0.2609	0.7710
2014	0.2628	0.2583	0.2539	0.7750	0.3005	0.2863	0.2969	0.8837
2015	0.3328	0.3275	0.3224	0.9827	0.3365	0.3314	0.3265	0.9942



(a) innovation and entrepreneurship system



(b) economic development system

Figure 1. Comprehensive evaluation value of Guangdong's innovation and entrepreneurship system and economic development system

4.3.2. Gap of Innovation and Entrepreneurship and Economic Development

It can be seen from Table 3 that the gap between innovation and entrepreneurship and economic development in Guangdong Province is basically stable and unchanged after the fluctuations are reduced. It was in an unstable fluctuation stage from 2006 to 2011, the level of innovation and entrepreneurship development lagged behind economic development, the gap between innovation and entrepreneurship and economic development is growing, it shows the

improvement of economic development through innovation and entrepreneurship. It was relatively stable 2011-2015. At this stage, the two influence each other, and the improvement of innovation and entrepreneurship promotes economic development, at the same time, good and fast economic development also provides guarantee for rational allocation and efficient use of innovation and entrepreneurship.

4.3.3. Coupling Coordination Degree of Innovation and Entrepreneurship System and Economic Development System

The calculation results of the coupling degree and coupling coordination degree of the innovation and entrepreneurship system and the economic development and system are shown in Table 4. According to Table 4, the sequential variation diagram of coupling degree and coupling coordination degree of Guangdong Province's innovation and entrepreneurship system and economic development system are drawn, as shown in Fig.2.

Table 4. Evaluation results of the coupling coordination development of the innovation and entrepreneurship system and economic development system in Guangdong Province

year	coupling degree	coordination	Coupling coordination degree	Coupling stage	Coupling development type
2006	0.0504	0.3549	0.1337	low	Serious maladjustment
2007	0.1136	0.4209	0.2187	low	Mild maladjustment
2008	0.1872	0.4532	0.2912	antagonistic	maladjustment brink
2009	0.2543	0.4551	0.3402	antagonistic	low coordinated development
2010	0.3294	0.4606	0.3895	integrative	low coordinated development
2011	0.4233	0.4737	0.4478	integrative	Primary coordinated development
2012	0.5364	0.4859	0.5105	integrative	Intermediate coordinated development
2013	0.6660	0.4937	0.5734	high	Well coordinated development
2014	0.8294	0.4989	0.6433	high	high coordinated development
2015	0.9885	0.4999	0.7030	high	high coordinated development

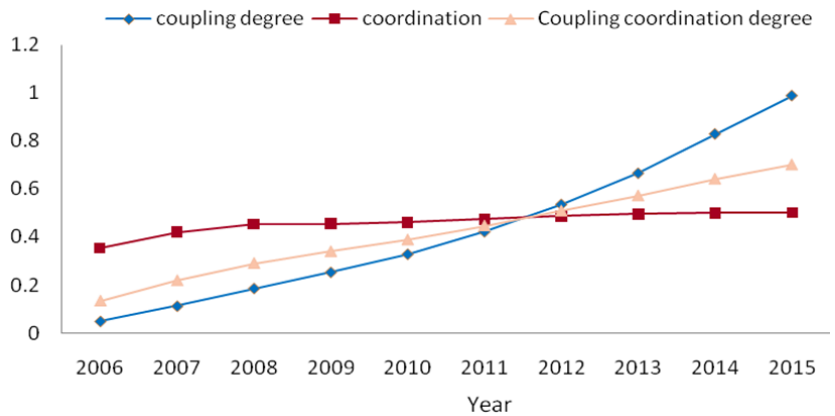


Figure 2. Time series of coupling coordination degree of innovation and entrepreneurship system and economic development system in Guangdong Province

It can be seen from sequential variation of coupling degree that the overall coupling degree is slightly improved in the fluctuation, the coupling degree between the innovation and entrepreneurship system and the economic development system is between 0.3 and 0.5 from 2006 to 2015, it shows that the two are in the antagonistic stage, namely innovation and entrepreneurship and economic development are in the common development state. Because the coupling degree gradually approaches 0.5, it shows that the relationship between the two is gradually moving towards coordination and entering the integrative stage. From 2006 to

2010, innovation and entrepreneurship are strong support for economic development. After the development of innovation and entrepreneurship gradually returned to normal in 2011-2015, the healthy development of the innovation and entrepreneurship system promoted the sustainable development of economy.

As can be seen from the sequential variation of coupling coordination degree, the value of the coupling coordination degree of innovation and entrepreneurship system and economic development system had been increasing continuously from 2006 to 2015, it shows that the relationship between innovation and entrepreneurship and economic development in Guangdong Province had been continuously improved and gradually become more coordinated. From 2006 to 2010, due to the inconsistent curve of innovation and entrepreneurship and economic development, causes coordination degree or coupling between the two to be decreased, and the value of coupling coordination degree is fluctuating larger. From 2011 to 2015, the curve of innovation and entrepreneurship and economic development gradually converge, and the coupling degree and coordination degree all show a steady upward trend, which promotes the increase of coupling coordination degree, and it shows that innovation and entrepreneurship and economic development have entered a highly coordinated coupling stage.

Therefore, on the whole, during the development process of the Guangdong innovation and entrepreneurship system and the economic development system in the past ten years, the two systems through continuous integration and common development, and the changes in the economic development structure have optimized innovation and entrepreneurship environment; the level of coupling and coordination is still low, mainly because effect of economic interference factors which hinder the innovation and entrepreneurship development in the process of economic development continuously strengthen, thus reducing the enthusiasm of innovation and entrepreneurship. If the future we can guarantee the improvement of innovation and entrepreneurship and economic development simultaneously, it is expected to bring the development of the two systems into an extremely coordinated coupling stage.

5. Conclusion

This paper measures the coordination degree of innovation and entrepreneurship and economic development based on the coupling coordination degree model in Guangdong Province from 2006 to 2015, through quantitative analysis, it is found that Guangdong's innovation and entrepreneurship and economic development levels have increased substantially, The increment speed of economic development is higher than the increase speed of innovation and entrepreneurship before 2012, and it has a good promotion role in the development of innovation and entrepreneurship. After 2012, innovation and entrepreneurship develop rapidly and exceed the level of economic development to promote faster economic development.

The coupling degree between the innovation and entrepreneurship system and the economic development system is between 0.3 and 0.5, which is in the antagonistic stage and gradually approaches the integration stage, it shows that innovation and entrepreneurship and economic development are in common development state. The coupling coordination degree between the innovation and entrepreneurship system and the economic development system gradually increases in the fluctuation, and gradually change from low coordination coupling to good coordination coupling stage, it is expected to enter into the stage of high quality coordination and coupling in the future.

The employment, market vitality and innovation vitality in Guangdong Province have achieved certain effects under the guidance of relevant policies, however, there is still space for further improvement based on the reference to other provinces and cities, the future development of

Guangdong Province should continue to attach importance to economic development and improve the ability of innovation and entrepreneurship.

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