

Research on Synergy Appraisalment of Regional Innovation Policy in China - Based on Objectives

Xiaobao Peng Yijun Zheng*

School of Public Affairs, University of Science and Technology of China, 96 Jinzhai Street, Hefei 230026, China

* E-mail of the corresponding author: zhengyj@mail.ustc.edu.cn

The research is financed by the Natural Science Foundation of Anhui under Grant Nos. 1508085QG143, and the Philosophy and Social Science Foundation of Anhui under Grant Nos. AHSKZ2016D07.

Abstract

Based on objectives, this study constructs the synergy analysis model of regional innovation policy in china and appraises the synergy of regional innovation policy. First, based on the theory of process, through the analysis of the whole life cycle of innovation activities, the paper divides regional innovation policy goals into five categories, namely independent innovation, intellectual property protection, technology introduction, capital introduction, and transformation of scientific and technological achievements. Secondly, the study elaborates the operational definitions and assignment standards of regional innovation policy objectives, and then quantifies the regional innovation policy objectives. Thirdly, the formula of the annual value of regional innovation policy objectives is developed. The annual value can be used to analyze the significance of regional innovation policy objectives in each year. Finally, the research applies synergetic function in economics to the synergy appraisalment of regional innovation policy. The formula of synergy degree between regional innovation policy objectives is developed. The value of synergy degree can be used to appraise the synergy of regional innovation policy.

Keywords: Regional innovation policy, Policy coordination, Synergy appraisalment, Policy objectives

1. Introduction

Regional innovation policy is a comprehensive policy system that includes a wide range of policies. Whether these regional policies are coordinated? How to improve the synergy of regional innovation policies? The research on synergy appraisalment of regional innovation policy is necessary. Existing research on innovation policy coordination has analyzed the importance and mechanism of innovation policy coordination, however, there are few researches on synergy appraisalment. Furthermore, the indicators and methods in these few researches on synergy appraisalment are supposed to be improved.

Based on the objectives, this study constructs the synergy analysis model of regional innovation policy in China and appraises the synergy of regional innovation policy, improving the existing indicators and methods of synergy appraisalment. First of all, based on the theory of process, through the analysis of the whole life cycle of innovation activities, the paper divides regional innovation policy goals into five categories, namely independent innovation, intellectual property protection, technology introduction, capital introduction, and transformation of scientific and technological achievements. Secondly, the study elaborates the operational definitions and assignment standards of regional innovation policy objectives, and then quantifies the regional innovation policy objectives. Thirdly, the formula of the annual value of regional innovation policy objectives is developed. The annual value of regional innovation policy objectives can be used to analyze the significance of regional innovation policy objectives in each year. Finally, the research applies synergetic function in economics to the synergy appraisalment of regional innovation policy. The formula of synergy degree between regional innovation policy objectives is developed. The value of synergy degree between regional innovation policy objectives can be used to appraise the synergy of regional innovation policy.

There are four contributions of the study. First, the paper conducts synergy appraisalment of regional innovation policy, and improves the research on regional innovation policy coordination. Second, the study improves the indicators of synergy appraisalment, from the perspectives of policy objectives. Thirdly, the research applies synergetic function in economics to the synergy appraisalment of regional innovation policy and improves the methods of synergy appraisalment. Fourthly, the study can guide the government and other public sectors to appraise the synergy of regional innovation policy, to scientifically make regional innovation policy, and to establish an efficient innovation policy system.

2. Classification and Definition of Regional Innovation Policy Objectives in China

2.1 Classification of Regional Innovation Policy Objectives in China

The process theory points out that the development of things is its own purpose. In the evolution of things, when things face different external environment, there will be different interactions and feedback. In this way, things get access to different experiences and development. Therefore, there is no fixed objective that can separate from

the development of things, and the development of things is its own purpose. Based on the theory of process, this research analyzes the whole life cycle of innovation activities. On one hand, it needs to generate new knowledge, new technology, new product or new process. The way of generating can be independent innovation or can be external technology introduction. On the one hand, it needs to turn knowledge, technology, products, processes and other scientific and technological advantages into commercial value, that is, the need of the transformation of scientific and technological achievements. To guarantee and promote the transformation of knowledge, technology, products or processes and other scientific and technological advantages into business advantages in the market, intellectual property protection is needed, which can provide legal protection for innovation. Furthermore, during the whole life cycle of innovation activities, there is the need for financial support. The source of funds can be the financial funds from the policy maker, or can be the capital introduced from external. Through the analysis of the whole life cycle of innovation activities, we come to the conclusion that to promote regional innovation, independent innovation, intellectual property protection, technology introduction, capital introduction, and transformation of scientific and technological achievements are five essential aspects. Therefore, these five aspects have become the objectives of regional innovation policy.

Based on the above analysis, this study divides regional innovation policy objectives into five categories: independent innovation, intellectual property protection, technology introduction, capital introduction, and transformation of scientific and technological achievements. Independent innovation refers to the original innovation, and is the source of other objectives. Intellectual property protection is the legal protection of turning technological innovation into commercial value. Intellectual property is the guarantee of independent innovation and also is one of the indicators of independent innovation. Technology introduction reflects the idea of china government that trading market share for technology, aiming at driving independent innovation by the introduction of foreign technology. Capital introduction is also one of the objectives of regional innovation policy. The introduction of external capital will stimulate regional innovation activities, and thus promote the realization of other regional innovation policy objectives. In china, the transformation of scientific and technological achievements has been paid more and more attention in recent years. The commercialization and industrialization of scientific and technological achievements will benefit regional economic development, promote regional industrial upgrading and realize the business value of regional innovation.

2.2 Operational Definition of Regional Innovation Policy Objectives in China

The classification of regional innovation policy objectives and the operational definition of the five regional innovation policy objectives are shown in Table 1.

Table 1. The Classification and Operational Definition of Regional Innovation Policy Objectives

Objectives	Operational Definition
Independent Innovation	Promote independent and original innovation. Establish regional innovation system.
Intellectual Property Protection	Protect the intellectual property of the innovation, and arouse the enthusiasm of engaging in innovative activities.
Technology Introduction	Provide preferential policy for technology introduction. Simplify procedures. Introduction of advanced technology.
Capital Introduction	Provide preferential policy for capital introduction. Simplify procedures. Attract foreign investment.
Transformation of Scientific and Technological Achievements	Promote the commercialization and industrialization of scientific and technological achievements. Create suitable environment for the transformation of scientific and technological achievements.

3. Quantification of Regional Innovation Policy Objectives in China

In order to more accurately reflect the implications of regional innovation policy and ensure the content validity of the regional innovation policy in China, this study quantifies the regional innovation policy in China from the aspects of strength of regional innovation policy and clarity of regional innovation policy objectives, and combines the strength of regional innovation policy and the clarity of regional innovation policy objectives. The reason is that the higher level of policy, the more macro and abstract of policy objectives, the weaker impact of regional innovation policy has on innovation activities, the less clear of policy objectives. Singly using the strength of regional innovation policy or the clarity of regional innovation policy objectives is hard to accurately reflect the actual effect of policy objectives. Therefore, this paper multiplies the the degree of policy strength and the degree of objectives clarity, and takes the obtained product to represent the actual effect of regional innovation policy objectives.

3.1 Assignment Standards of Regional Innovation Policy Strength

Based on the research of Liu Fengchao and Sun Yutao (2007) and Peng Jisheng et al. (2008), this study makes a

5-point assignment to regional innovation policy in China according to the policy type and the state administrative power structure. The following specifically describes the assignment standards of regional innovation policy strength. 5 points: the laws and regulations enacted by the provincial (city) people's congress and its standing committee. 4 points: the planning, decision, regulations, regulations approved or promulgated by the provincial (city) people's government. 3 points: the programs, methods, opinions, plans, interim provisions, and provisional regulations promulgated by the provincial (city) people's government; the planning, decisions, regulations, and regulations promulgated by the provincial (city) people's government departments. 2 points: the approach, opinions, interim regulations, and temporary regulations promulgated by provincial (city) people's government departments. 1 point: the notice, interim views, and temporary measures promulgated by provincial (city) people's government departments.

3.2 Assignment Standards of Regional Innovation Policy Objectives

As mentioned above, this paper divides regional innovation policy objectives into five categories: independent innovation, intellectual property protection, technology introduction, capital introduction, and the transformation of scientific and technological achievements. Based on the research of Peng Jisheng (2008), Shengya and Sun Jin (2013), this paper makes a five-point assignment of regional innovation policy objectives according to the clarity of policy objectives. The following describes the assignment standards of five regional innovation policy objectives.

The assignment standards of independent innovation: 5 points: encourage the original innovation; establish regional technological innovation system; provide strong support for innovation activities from various aspects. 4 points: provide financial and tax support for innovative activities; develop regional innovation plan. 3 points: develop annual regional innovation plan; provide financial support for innovative activities. 2 points: provide certain financial or tax support for innovative activities; put forward suggestions on innovation. 1 point: only mention independent innovation, innovation and other related terms, and lack specific policies.

The assignment standards of intellectual property protection: 5 points: a clear statement that intellectual property protection is an important objective of innovation policy and is one of the core power to promote regional innovation; protect intellectual property in the whole process from policy making to policy implementation. 4 points: formulate how intellectual property protection is implemented in various areas. 3 points: emphasize the protection of intellectual property in various fields; formulate how intellectual property protection is implemented in certain areas. 2 points: emphasize the protection of intellectual property, but do not formulate how intellectual property protection is implemented. 1 point: only refer to intellectual property protection and other related terms, and lack specific policies.

The assignment standards of technology introduction: 5 points: provide green channel for administrative approval; provide special concessions; provide various support in the whole process of technology introduction. 4 points: simplify the administrative examination and approval procedures; provide preferential treatment; provide support in the introduction of technology. 3 points: provide certain preferential treatments; encourage the introduction of external technology. 2 points: complicate approval procedures; provide few preferential treatment; encourage the introduction of technology in specific areas. 1 point: complicate approval process; limit the introduction of low-end technology.

The assignment standards of capital introduction: 5 points: simplify the administrative procedures; provide external investment special concessions; strongly encourage external investment. 4 points: simplify administrative procedures; provide preferential treatments in many ways; encourage foreign investment. 3 points: simplify administrative procedures; provide preferential treatments on tax or finance; allow external investment. 2 points: strict administrative licensing requirements; no preferential treatment; allow external investment. 1 point: limit foreign investment.

The assignment standards of the transformation of scientific and technological achievements: 5 points: emphasize the transformation of scientific and technological achievements at the policy-making level; provide various support in the whole process of the transformation of scientific and technological achievements. 4 points: provide support of the transformation of scientific and technological achievements; emphasize the commercialization and industrialization of science and technology. 3 points: provide certain support in the transformation of scientific and technological achievements; pay attention to the importance of the transformation of scientific and technological achievements. 2 points: pay attention to the promotion and application of technology. 1 point: only refer to the transformation of scientific and technological achievements or related concepts, and lack specific policies.

Since each regional innovation policy generally has a number of policy objectives, we need to assign values to each objectives, according to the assignment standards. Some policies may not involve all types of policy objectives, and the policy objective that does not be involved in the regional innovation policy will be assigned the value of zero.

4. Calculation of annual value of regional innovation policy objectives

After the quantification of regional innovation policy objectives in china according to the above-mentioned assignment standards, it is necessary to calculate the annual value of the regional innovation policy objectives, and then we can carry out the follow-up synergy appraisalment.

In reality, the influence of different policy maker or different policy type is distinct. The higher the level of policy maker, the greater the degree of policy strength, the more important of this policy objective. Thus, this study defines the annual values of regional innovation policy objectives as the sum of the products of the values of policy objectives and the value of policy strength for all regional innovation policies in this year. The formula is as shown in formula (1):

$$TPG_i = \sum_{j=1}^n PG_{ij} \times P_{ij} \quad (1)$$

In the above formula, TPG_i represents the annual value of a regional policy objective in year i . J represents the regional innovation policy j . I represents the year i . N represents the number of regional innovation policies promulgated in year i . P_{ij} represents the strength value of the regional innovation policy j promulgated in year i . PG_{ij} represents the value of a policy objective of the regional innovation policy j promulgated in year i .

5. Calculation of Synergy Degree between Regional Innovation Policy Objectives

5.1 Calculation of state synergy degree between regional innovation policy objectives

In this study, we apply the method of calculating the synergy degree in economics (Zhang Jianzhong, 2012) to calculate the synergy degree of regional innovation policy, and construct the state synergy function in order to calculate the state synergy degree between regional innovation policy objectives. The state synergy function is shown in formula (2).

$$u\left(\frac{e}{f}\right) = \exp\left[-\frac{(TPG_i - TPG_i')^2}{S^2}\right] \quad (2)$$

In the above function, $u(e/f)$ represents the state synergy degree of the regional innovation policy objective e relative to the regional innovation policy objective f . TPG_i represents the actual annual value of the regional innovation policy objective e in the year i . TPG_i' represents the fitting value that the annual value of regional innovation policy objective f requires the annual value of the regional innovation policy objective e to be. S^2 represent the variance of the annual value of the regional innovation policy objective e .

In order to calculate $u(e/f)$ the state synergy degree of the regional innovation policy objective e relative to the regional innovation policy objective f , it is necessary to solve TPG_i' the fitting annual value that the annual value of regional innovation policy objective f requires the annual value of the regional innovation policy objective e to be. The solution of the fitting value is as follows: First, x and y respectively represent the annual value of the regional innovation policy objective f in year i and the annual value of the regional innovation policy objective j in year i . Let y represent the dependent variable, and x represent the independent variable. Construct the regression equation $y = kx + b$. Second, put the actual annual values of the regional innovation policy objective f in each year and the actual annual values of the regional innovation policy objective e in each year that are calculated according to the above-mentioned quantification method into the equation for regression analysis to solve the fitting coefficient k . This coefficient represents that when the annual value of the regional innovation policy objective f changes one unit, the annual value of the regional innovation policy objective e correspondingly need to change k units in the same direction. Third, put TPG_i the actual annual value of the regional innovation policy objective e in the year i into the formula (2), and then we can solve TPG_i' the fitting value that the annual value of regional innovation policy objective f requires the annual value of the regional innovation policy objective e to be.

It can be seen from the formula (2) that when TPG_i the actual annual value of the regional innovation policy objective e in the year i is close to TPG_i' the fitting value that the annual value of regional innovation policy objective f requires the annual value of the regional innovation policy objective e to be, the value of $u(e/f)$ the state synergy degree of the regional innovation policy objective e relative to the regional innovation policy objective f is higher. It means that the degree of synergy of the regional innovation policy objective e relative to the regional innovation policy objective f is higher. On the contrary, when TPG_i the actual annual

value of the regional innovation policy objective e in the year i is far from TPG_i' the fitting value that the annual value of regional innovation policy objective f requires the annual value of the regional innovation policy objective e to be, the value of $u(e/f)$ the state synergy degree of the regional innovation policy objective e relative to the regional innovation policy objective f is lower. It means that the degree of synergy of the regional innovation policy objective e relative to the regional innovation policy objective f is lower. When TPG_i' the actual annual value of the regional innovation policy objective e in the year i is equal to TPG_i' the fitting value that the annual value of regional innovation policy objective f requires the annual value of the regional innovation policy objective e to be, the value of $u(e/f)$ the state synergy degree of the regional innovation policy objective e relative to the regional innovation policy objective f is one, indicating that relative to regional innovation policy objectives f , regional innovation policy objectives e is fully synergistic.

5.2 Calculation of synergy degree between regional innovation policy objectives

After calculating the state synergy degree between regional innovation policy objectives, the paper constructs the formula of synergy degree to solve the synergy degree between regional innovation policy objectives, and the formula is shown in formula (3).

$$U(e, f) = [\min\{u(e/f), u(f/e)\} / \max\{u(e/f), u(f/e)\}] \quad (3)$$

In the above formula, $U(e, f)$ represents the synergy degree between the regional innovation policy objective e and the regional innovation policy objective f . $u(e/f)$ represents the state synergy degree of the regional innovation policy objective e relative to the regional innovation policy objective f . $u(f/e)$ represents the state synergy degree of the regional innovation policy objective f relative to the regional innovation policy objective e .

Through the formula (3), we can find that when $u(e/f)$ the state synergy degree of the regional innovation policy objective e relative to the regional innovation policy objective f is close to $u(f/e)$ the state synergy degree of the regional innovation policy objective f relative to the regional innovation policy objective e , the value of $U(e, f)$ the synergy degree between the regional innovation policy objective e and the regional innovation policy objective f is higher. It means that the degree of synergy between the regional innovation policy objective e and the regional innovation policy objective f is higher. In the contrast, when $u(e/f)$ the state synergy degree of the regional innovation policy objective e relative to the regional innovation policy objective f is far from $u(f/e)$ the state synergy degree of the regional innovation policy objective f relative to the regional innovation policy objective e , the value of $U(e, f)$ the synergy degree between the regional innovation policy objective e and the regional innovation policy objective f is lower. It means that the degree of synergy between the regional innovation policy objective e and the regional innovation policy objective f is lower. When $u(e/f)$ the state synergy degree of the regional innovation policy objective e relative to the regional innovation policy objective f is equal to $u(f/e)$ the state synergy degree of the regional innovation policy objective f relative to the regional innovation policy objective e , the value of $U(e, f)$ the synergy degree between the regional innovation policy objective e and the regional innovation policy objective f is one, indicating that the regional innovation policy objective e is fully synergistic with the regional innovation policy objective f and vice versa.

References

- Asheim B T, Smith H L, Oughton C. (2011), Regional innovation systems: theory, empirics and policy. *Regional studies*, 45(7): 875-891.
- Barras R. (1990), Interactive innovation in financial and business services: the vanguard of the service revolution. *Research policy*, 19(3): 215-237.
- Barras R. (1986), Towards a theory of innovation in services. *Research policy*, 15(4): 161-173.
- Dodgson M, Bessant J R. (1996), *Effective innovation policy*. International Thomson Business Press.
- Edler J, Georghiou L. (2007), Public procurement and innovation—Resurrecting the demand side. *Research policy*, 36(7): 949-963.
- Fagerberg J, Srholec M. (2008), National innovation systems, capabilities and economic development. *Research policy*, 37(9): 1417-1435.
- Freitas I M B, von Tunzelmann N. (2008), Mapping public support for innovation: A comparison of policy alignment in the UK and France. *Research Policy*, 37(9): 1446-1464.

- Huang C, Amorim C, Spinoglio M, et al. (2004), Organization, program, and structure: an analysis of the Chinese innovation policy framework. *R&D Management*, 3(1): 35-43.
- Iglesias G, del Río P, Dopico J Á. (2011), Policy analysis of authorization procedures for wind energy deployment in Spain. *Energy Policy*, 39(7): 4067-4076.
- Kim Y H. (2011), International policy coordination mechanism with respect to the moral hazards of financial intermediaries. *Economic Modelling*, 28(4): 1914-1922.
- Laranja M, Uyarra E, Flanagan K. (2008), Policies for science, technology and innovation: Translating rationales into regional policies in a multi-level setting. *Research Policy*, 37(5): 823-835.
- Lengrand L. (2003), Innovation tomorrow: innovation policy and the regulatory framework: making innovation an integral part of the broader structural agenda. Office for Official Publications of the European Communities.
- Liu Fengchao, Sun Yutao. (2007), The Process, Trend and Suggestion of the Evolution of Science and Technology Policy to Innovation Policy in China - An Empirical Analysis Based on 289 Innovation Policies in China. *Chinese Journal of Soft Science*, 5: 34-42.
- Meijers E, Stead D. (2004), Policy integration: what does it mean and how can it be achieved? A multi-disciplinary review. Berlin Conference on the Human Dimensions of Global Environmental Change: Greening of Policies-Interlinkages and Policy Integration. Berlin.
- Mickwitz P, Kivimaa P. (2007), Evaluating Policy Integration the case of policies for environmentally friendlier technological innovations. *Evaluation*, 13(1): 68-86.
- OECD. (2000), Government coherence: The role of the center of government. OECD Public Management Service/ Public Management Committee.
- OECD. (1982), Innovation Policy. OECD.
- Peng Jisheng, Zhong Weiguo, Sun Wenxiang. (2008), Policy Measurement, Policy Collaborative Evolution and Economic Performance: An Empirical Study Based on Innovation Policy. *Management World*, 9: 25-36.
- Rogers D L, Whetten D A. (1982), Interorganizational coordination: Theory, research, and implementation. Ames, IA: Iowa State University Press.
- Rothwell R, Zegveld W. (1982), Innovation and the small and medium sized firm.
- Rothwell R. (1986), Public Innovation Policy: To Have or to Have Not? *R&D Management*, 16(1): 25-36.
- Rothwell R. (1983), The difficulties of national innovation policies. *The Trouble with Technology*, 11(1).
- Sørensen C H, Longva F. (2011), Increased coordination in public transport—which mechanisms are available? *Transport Policy*, 18(1): 117-125.
- Sheng Ya, Sun Jin. (2013), Comparison of Regional Innovation Policies in China - Based on the Research of Zhejiang Province, Guangdong, Jiangsu, Beijing and Shanghai. *Science and Technology Progress and Countermeasures*, 30 (6): 93-97.
- Tödtling F, Trippl M. (2005), One size fits all? Towards a differentiated regional innovation policy approach. *Research policy*, 34(8): 1203-1219.
- Zhang jianzhong. (2012), An Empirical Study on the Degree of Coordinated Development of Trade, Investment and Environment in China-ASEAN Free Trade Area. *Eco-Economy*, 9: 004.