International Journal of Emerging Trends in Social Sciences
ISSN: 2521-3539
Vol. 8, No. 1, pp. 10-16, 2020
DOI: 10.20448/2001.81.10.16

Biological Metaphor, Technological Innovation and Industrial Evolution in Jiangxi Province

Liang Huang[1*]
Shixiong Zhou[2]

[1,2]*School of Finance, Jiangxi Normal University, Nanchang, China.*
[1]*Email: 853920093@qq.com*

Abstract

From the perspective of the study of biological metaphor analysis, this article intends to explore a "high-quality" regional economic development path that fits the context of the economic transition period. This article first introduces the definition of biological metaphors in evolutionary economics. Second, analyzed the inherent logic of the biological metaphor of technological innovation and industrial evolution, and found that the concept of green development must be integrated into the technological innovation process of individual enterprises at the current stage in order to achieve the transformation and upgrading of the current industrial structure. Third, taking Jiangxi Province as an example, the theoretical framework of biological metaphors for creating a beautiful "Jiangxi model" in China was discussed, and the current state of industrial evolution, technological innovation, and environmental regulation in Jiangxi Province from 2011 to 2017 were described in detail. The rationality of the theoretical framework for the analysis of biological metaphors to create a beautiful Jiangxi model in China, that is, it is suitable for the needs of industrial development in Jiangxi Province. Finally, corresponding policy recommendations are given based on the relevant conclusions.

Keywords:
Biological metaphor
Industrial evolution
Technological innovation
Environmental regulation
"Jiangxi model".

Publisher:
Scientific Publishing Institute

Accepted: *19 December 2019*
Published: *6 January 2020*

Funding: Jiangxi Provincial Graduate Innovation Fund Provincial Project "Research on Biological Metaphors, Innovation Drive and Green Rise in Jiangxi Province" (YC2019-S148).
Competing Interests: The authors declare that they have no competing interests.

1. Introduction

After 40 years of rapid economic development in China, the current demographic dividend continues to decline, especially under the constraints of resources and environmental carrying capacity. Traditional industries relying solely on resources, labor, and energy to drive the development of Faced with major challenges, industrial competitiveness has gradually lost, and traditional industries such as China's manufacturing industry are at a "typhoon port" for structural transformation and upgrading. For the first time, the Fifth Plenary Session of the 18th Central Committee of the Party Central Committee systematically put forward the five development concepts of innovation, coordination, greenness, openness, and sharing. These five development concepts are the megatrends and the only way for China's economic and social development to follow at present and in the future. The report of the 19th National Congress of the CPC also pointed out that development must be a scientific development and the key to properly handling the "imbalance and inadequacy" problem existing in China's current economic development. It is fundamental to unswervingly implement the five development concepts and build a green industry system with an innovation-driven development strategy. To build a beautiful "Jiangxi model" in China, we need to drive the development of traditional industries with green ideas and innovations. This requires us to improve the ecological

environment for the purpose, to force traditional industries such as Jiangxi Province's manufacturing industry to achieve transformation and upgrading through innovation.

However, judging from the evolution of China's industry in the past ten years or so, the structural transformation and upgrading of traditional industries such as manufacturing in most regions of China have mainly focused on technological innovation and neglected the green development of the industry. In the period of economic transition, starting from the current actual situation in Jiangxi Province, it is necessary to integrate the new green development concept into the technological innovation and industrial evolution of traditional industries such as manufacturing in Jiangxi Province. This is because enterprises in the industry adjust their own organizational behaviors to carry out subversive technological innovation according to the current external conditions, so as to achieve a situation consistent with the concept of green development, and finally, Jiangxi Province achieved a green rise.

2. What is a Biological Metaphor?

With the development of the times, the biological metaphor is gradually applied to the research fields of natural sciences and social sciences. More and more scholars have begun to use Darwin's species origin to explain the study of related disciplines. The study of evolutionary economics strives to achieve a structural analogy between a biological process and an innovation process. Therefore, some are used to indicate innovation Conceptual biological terms gradually have special meanings such as genes, heredity, mutation, selectivity principles, and biological communities (Jia, 2004).These conceptual analogies are gradually formed in revealing the motivation, forming mechanism and process of innovation. Yang (2006) demonstrated from the perspectives of rationality, similarity and difference in the use of biological metaphors, respectively, that the application of biological metaphors in evolutionary economics should not be blind and dogmatic. In a formal way, economic life and human biological characteristics determine the similarity of metaphors, and the differences of metaphors are determined by human creativity. Cai (2008) introduced biological metaphors into engineering philosophy. He found that the engineering field is as diverse as the biosphere. There is always a preserved and innovative project in a specific historical period. The existence and development of engineering can reflect the specific order of the existence and development of a special biological system. Therefore, he believes that "engineering evolution" needs to seek breakthroughs from heterogeneity and "innovation" cannot be ignored. Xu and Wu (2017) found that government work reports in 2017 contain biological metaphors and appear more frequently. For example, better stimulating the vitality of the non-public ownership economy, improving the policy system for manufacturing a strong country, supporting technological transformation in various ways, and promoting the vitality of traditional industries, which reflects that the economy is likened to a living organism, showing a vigorous growth situation. Another example is to improve total factor productivity, transform and enhance traditional kinetic energy, cultivate and expand new kinetic energy, and promote the industry to enter the mid-to-high-end level and high-speed economic growth. Among them, "cultivation and growth" implies that it can cultivate and promote the development of organisms. The plasticity of the organism.

3. Biological Metaphors of Technological Innovation and Industrial Evolution

The differentiated technological innovation strategy of an enterprise can promote the generation and development of high and new technology. The stronger the degree of differentiation, the more it can promote the technological innovation of an enterprise (Llerena & Oltra, 2002). The differences between enterprises mainly come from technological innovation. Also, differences can have a profound impact on the competitiveness and competitive advantages of enterprises, and then promote the technological change of the industry. Sun (2010) based on the conventions, search, natural selection, and new issues (novelty) in biological metaphor technology innovation. From the perspective of dynamic evolution, he found that self-organizing and non-linear characteristics are embedded in the technological innovation process of enterprises. Under the premise of the "bounded rational person", he pointed out that heterogeneity among enterprises is caused by technological innovation, and technological innovation can drive the evolution of the industry by changing product quality and adjusting production costs.

At the micro-level of technological innovation, Chen (2018) pointed out that on the one hand, technological innovation is the foundation of enterprise development, bringing technical support and new development directions to enterprises, and is the source of vitality for enterprises. On the other hand, technological innovation can transform theoretical results into actual production processes and promote economic development, which promotes coordinated economic development and the generation of new technologies. Qi (2019) pointed out that the key to promoting the important mechanism of regional industrial upgrading lies in technological innovation, and the important mechanism of enterprise innovation driving industrial upgrading lies in the diffusion and spillover benefits of enterprise innovation in the region.

However, none of the above studies included ecological and environmental factors into the scope of heterogeneity and technological innovation and industrial evolution. Fortunately, as the problem of environmental pollution is getting worse, especially under the guidance of the new development concept, how to achieve “not only Jinshan Yinshan, but also green water and green mountains”, some scholars have begun

to pay attention to corporate technological innovation and environmental pollution. For example, Sun (2016) pointed out that the optimal path for technological selection and technological innovation to promote industrial upgrading must take into account both "high output" and "low emissions", and the development of the secondary industry must be based on the strengthening of ecological civilization, and ecological Civilization does not hinder the development of the secondary industry. Zhao and Xue (2019) analyzed the impact of the intensity of environmental regulations on the technological innovation of pollution-intensive manufacturing industries in China, and found that the intensity of environmental regulations has an stimulating effect on the technological innovation capabilities of pollution-intensive manufacturing industries and the promotion of industrial structure transformation and upgrading.

Through the collation of the existing literature, we find that: in the field of technological innovation and industrial evolution, too much consideration is given to technological innovation and enterprise heterogeneity to promote industrial evolution, neglecting the role of environmental regulations, such as Fan and Zhao (2019) did not include ecological and environmental factors in the analysis of the influencing factors in the process of studying the evolution of innovation efficiency of high-tech industries. To realize the green development of the industry, it is necessary to incorporate environmental regulations and other issues into technological innovation and industrial evolution. Zhang (2017) pointed out that under the guidance of the new development concept, the development of traditional industries in Jiangxi should take the development of green industries such as energy-saving and environmental protection equipment manufacturing as a breakthrough.

4. Create a Beautiful "Jiangxi Model" of China

4.1. Creating Biological Metaphors for "Jiangxi Model"

The biggest feature of biological metaphors is the specificity of the context that exists between individuals, that is, there is no universal standard rule for economic development. Because biological metaphors are dynamic, time irreversible, organic, and incompatible Deterministic analytical framework. Therefore, when analyzing the economic development status of a country or region, we should abandon this "deterministic" worldview and replace it with an "uncertain" worldview. We must not move from a rigid set and a "one size fits all" top-level design.

Starting from the premise of the "limited rational person", we can make the following analysis on the mechanism of creating a "Jiangxi model" as shown in Figure 1: At this stage, Jiangxi Province's industrial development method cannot reach the high-quality development of the industry (this is also the logical starting point). Due to the "feeling of frustration" in reality, enterprises in the industry must make judgments on existing knowledge and enter a dynamic process of search, trial and error, and selectivity. Different from the natural selection in the biological world, the changes that occur in enterprises in the industry emphasize the change of individual enterprises, that is, the adaptive learning of enterprises is an efficient and high-return learning method that replicates the past. And natural selection is a process that belongs to the economic system, and companies that do not meet external environmental standards will be gradually eliminated. In the dynamic process of adaptive learning of enterprises in the industry, it was found that the integration of green development concepts into technological innovation is an opportunity for a "mutation", which fits the development path of Jiangxi's industries to move towards high quality. Therefore, the concept of "Jiangxi model" is the result of the natural selection of individual groups, a series of systemic changes that occur from the inside to the outside, and from the bottom up, and is the basic requirement for the five development concepts. Although such a paradigm is not necessarily the "optimal solution" that enterprises in the industry are looking for, but only a "satisfactory" standard based on the judgment of the current economic situation, it does meet the current economic development situation in Jiangxi Province, which is also the most appropriate.

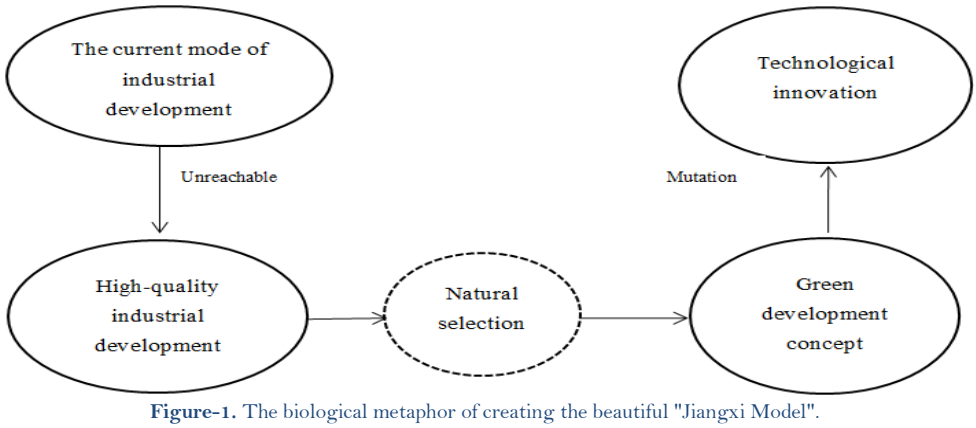

Figure-1. The biological metaphor of creating the beautiful "Jiangxi Model".

4.2. Status of Technological Innovation and Industrial Evolution in Jiangxi Province

The key to creating a beautiful "Jiangxi model" in China is to rely on ecological industry, which is like the arteries of the national economy, and can provide a steady stream of "new blood" to the regional economic development. Therefore, this section mainly discusses the technological innovation and evolution of Jiangxi's industry, and draws on the practice of Sun (2012) we selected the total industrial output, total sales, total output of new products, total sales of new products, and number of industrial enterprises in Jiangxi Province from 2011 to 2017 to indicate the evolution of the industry. Use the industrial "three wastes" (wastewater, waste gas and solid waste) emissions to represent the state of government environmental regulations, and use the number of valid patents and R&D activities to represent the level of industrial technological innovation in Jiangxi Province and make a descriptive analysis.

4.2.1. Status of Technological Innovation in Jiangxi Province

As shown in Table 1 by observing and comparing the relative data of R&D activities and the number of valid patents of industrial enterprises in Jiangxi Province from 2011 to 2017: the R&D expenditure of industrial enterprises above designated size, and the number of R&D projects of industrial enterprises above designated size and the number of valid invention patents of industrial enterprises above designated size. We find that the level of industrial technological innovation in Jiangxi Province is increasing in both quantity and proportion, and the increase rate is relatively large each year. Comparing the R&D activities in 2017 and 2011, both the R&D expenses of industrial enterprises and R&D projects have increased by nearly two times. It is worth mentioning that the number of valid invention patents rose very fast during this period, and the number of valid invention patents increased by 3,813 from 2016 to 2017, an increase of 54.5% in just one year. The above analysis shows that in recent years, Jiangxi Province has paid more and more attention to the role of technological innovation in driving industry, especially industrial development.

Table-1. Status of technological innovation activities of industrial enterprises above designated size in Jiangxi Province, 2011-2017.

Year	R&D funding for industrial enterprises (RMB 10,000)	Number of R&D projects of industrial enterprises (items)	Number of valid invention patents of industrial enterprises (pieces)
2011	769,834	2,608	975
2012	925,985	2,930	1,398
2013	1,106,443	4,288	2,333
2014	1,284,642	4,385	3,383
2015	1,474,968	4,403	4,765
2016	1,797,561	6,351	6,993
2017	2,216,865	7,504	10,806

Source: China statistical yearbook of science and technology.

4.2.2. Status of Industrial Evolution in Jiangxi Province

As far as the current research status of the academic circle is concerned, the industrial evolution mainly includes the total output of the industry, the total sales, the total sales of new products, and the number of industrial enterprises. As shown in Table 2: Through observation and comparison, the total output value of enterprises above designated size, industrial sales value of industrial enterprises above designated size, and total sales of new products of industrial enterprises above designated size, and the number of industrial enterprises above designated size, it is not difficult to see that the number of the above four indicators has shown a gradual upward trend in the time dimension. At the same time, from 2011 to 2017, whether it is the total industrial output, the total sales, the total sales of new products, or the number of industrial enterprises, Jiangxi Province has almost doubled in these 7 years.

It is worth noting that for the first time, the inflection point of the total output value of industrial enterprises above designated size and the number of industrial enterprises above designated size occurred in 2016-2017. Among them, the total output value of 2017 decreased compared with the number of business units in 2016. However, the industrial sales value of industrial enterprises above designated size and the total sales of new products of industrial enterprises above designated are still rising, and the total sales of new products among them have shown a significant increase in the past two years. We believes that this situation is in line with the "high-quality" economic development situation of our province and even the whole country in recent years. The five development concepts of innovation, coordination, development, greenness and sharing were put forward in the fifth plenary session of the 18th Central Committee of the Communist Party of China held in the second half of 2015. Considering the time lag of the policy, the two major indicators of the total output value of industrial enterprises above designated size and the number of industrial enterprises above designated size fell for the first time in 2017. The total output value of industrial enterprises above designated size decreased by 5.3% compared with last year, and industrial enterprises above designated size declined. The number of units decreased by 0.384% from last year. On the one hand, this shows that Jiangxi Province has unswervingly implemented and implemented the five major development concepts of the Party Central

Committee in terms of industry, especially in industrial development. And companies that make adjustments in time face the risk of being eliminated and shut down at any time. On the other hand, the sharp increase in the total sales of new products of industrial enterprises above designated size in 2016-2017 is also a sign that technological innovation has become the first driving force for promoting industrial development in our province now and for a period of time. The province's economic development is undergoing a profound change, and the "golden key" and direction of change is technological innovation.

Table-2. Industrial evolution of Jiangxi Province from 2011 to 2017.

Year	Gross output value of industrial enterprises		Total sales of new products by industrial enterprises	
	(RMB1,000,000)	Sales value of industrial enterprises	(RMB 1,000,000)	Number of industrial enterprise units
		(RMB 1,000,000)		(Units)
2011	1,988,933	1,775,418	94,196	6,481
2012	2,404,033	2,075,709	128,714	7,217
2013	2,872,288	2,460,316	168,295	8,126
2014	3,278,755	2,872,702	175,635	8,996
2015	3,475,404	3,061,843	205,867	9,941
2016	3,806,535	329,288	313,686	10,931
2017	360,399	338,145	385,721	10,889

Source: China industrial statistical yearbook.

4.3. Environmental Regulation and Technology Innovation in Jiangxi Province

The contents of the previous two sections mainly take the industry of Jiangxi Province as an example, and discuss the development status of both technological innovation and industrial evolution of Jiangxi Province. Combining statistical data Table 1 and Table 2 we can observe that there has been a significant upward trend between the two in the 7-year period from 2011 to 2017. These data indicate that the technological innovation of Jiangxi enterprises and their industrial evolution are a process of coordinated evolution. The main content of this article is whether there is a certain relationship between environmental regulation and technological innovation of enterprises, thereby promoting the industrial evolution of Jiangxi Province. Therefore, this section takes Jiangxi Province's industry as an example, in order to draw the internal relationship between the strength of environmental regulation, technological innovation and the evolution of Jiangxi's industry.

At present, most of the existing literatures describe environmental regulations mainly by measuring the discharge degree of three pollutants: wastewater, waste gas and solid waste. According to Jiangxi Province 's "three wastes" emissions from 2011 to 2017, as shown in Table 3 we use 2016 as the time node for the following analysis:

First of all, before 2016, which is the year before the introduction of the five major development concepts, China mainly focused on achieving rapid economic development. Therefore, in the previous period, the intensity of environmental regulations was not high, so the "three wastes" emissions values show an upward trend.

Secondly, after 2016 With the deepening of the five development concepts, China's economic development pointers point to a green "high-quality" development mode. Therefore, in the next few years, the "three wastes" emissions in Table 3 showed a rapid decline. It should be noted that the "three waste emissions" in 2017 showed a "cliff-like" decline year-on-year: industrial wastewater emissions decreased by 51.8%, industrial exhaust emissions decreased by 0.06%, and industrial solid waste emissions decreased by 93.7%.

Third, the number of effective invention patents of industrial enterprises above the designated size in Table 1 increased rapidly from 2015 to 2017. Among them, the number of effective invention patents of industrial enterprises above the designated size in 2016 increased by 46.76% over last year. The number of invention patents increased by 54.53% over last year.

Finally, we compared the value of the "three wastes" emissions of Jiangxi Province with the total output value of industrial enterprises above designated size in Table 2 for the first time in 2017 and the number of industrial enterprises above designated size. The first decline in 2017 can be considered that although the regulation of the ecological environment has somewhat inhibited the development of industry in Jiangxi Province, the number of "three wastes" emissions in the three years from 2015 to 2017 and the number of effective invention patents of industrial enterprises above designated size are relatively small. Obviously, the changing trend of these changes has indeed reflected to some extent that the ecological environment regulation can force individual industrial enterprises in Jiangxi Province to carry out technological innovations, thereby promoting the industrial evolution of Jiangxi Province.

Table-3. "Three wastes" emissions of Jiangxi province from 2011 to 2017.

Year	Industrial wastewater discharge(10,000 tons)	Industrial exhaust emissions (Million cubic meters)	Industrial solid waste discharge (10,000 tons)
2011	71,196	161,019,688	15.44
2012	67,871.404	148,140,961.4	2.4581
2013	68,230.1807	155,737,609.3	1.8428
2014	64,855.6237	156,133,801.6	3.1465
2015	76,412.3082	170,546,665.1	3.96
2016	85,526.5949	151,620,072.7	11.374
2017	41,206.5579	150,648,892.2	0.7191

Source: China environmental statistics yearbook.

5. Conclusion

Based on the analysis of the development status of Jiangxi Province's technological innovation, industrial evolution, and environmental regulation, and through comparison and description of various data and indicators of Jiangxi's industry from 2011 to 2017, we conclude: Fitstly, the rationality of the theoretical framework of biological metaphors for creating a beautiful Jiangxi model in China, suitable for the development needs of Jiangxi's industry. Secondly, to achieve the "high-quality" development of Jiangxi's industry, we should pay attention to combining it with the protection of the ecological environment. With the regulation of the ecological environment, it is necessary to force individual enterprises in Jiangxi Province to carry out technological innovation to further effectively promote the industrial evolution of Jiangxi. In summary, we will make the following policy recommendations based on the above conclusions:

First of all, Attach importance to technological innovation, focus on training and introduction of talents, and improve the quality of talents. Science and technology are the primary productive forces, and the key is technological innovation. Jiangxi Province must grasp the core breakthrough of technological innovation if it wants to realize the development strategy of "Central Rise". The main body of technological innovation is an individual enterprise. Therefore, enterprises need to further improve the talent introduction and training system, which is mainly reflected in the two aspects of not only introducing talents but also retaining talents to prevent brain drain. The increase of R&D projects in Jiangxi Province also reflects the willingness of enterprises to research and develop. The upgrading and replacement of enterprise products can simultaneously achieve "money-making benefits" and environmental benefits. Therefore, future policy trends should encourage more enterprises to engage in independent innovation and better play the main role of enterprises in independent innovation.

Secondly, Aiming at the industries in Jiangxi Province, especially the highly polluting manufacturing industries, diversified environmental regulations should be adopted. The Jiangxi Provincial Government should rationally use environmental regulations to curb high pollution from the source in order to prevent the development criticism of "development first, then governance" according to the characteristics of different types of enterprises. Specifically, it is necessary for enterprises to deeply understand the importance of protecting the ecological environment and the serious consequences of damaging the ecological environment, so that the enterprises really attach importance to the protection of the ecological environment. For example, for highly polluting industries, it is necessary to strictly detect the environmental pollution of enterprises. On the one hand, while appropriately subsidizing existing small and medium-sized enterprises, we must also strictly implement the phase-out system and impose strict disciplinary measures such as fines for enterprises that do not meet the emissions standards. Or suspend production, etc. On the other hand, appropriate subsidies or rewards will be given to enterprises with proper environmental protection. At the same time, on the one hand, we must raise the industry entry threshold and shut down high-polluting companies with excessive production capacity. On the other hand, we must increase capital investment in high-output enterprises and encourage them to develop through capital investment. Green industries such as energy-saving and environmental protection equipment manufacturing industry are used as breakthrough points to carry out technological innovation and new product research and development, thereby further reducing environmental pollution problems, thereby forming a benign green ecological circular economy.

Finally, pay attention to ideological and political education. The concept of green development needs to rely on the strength of the masses if it wants to "take root". Therefore, the implementation of Jiangxi Province's policies after the introduction of related policies is also a very important link. Environmental issues are closely related to the public interest, and the reasonable use of the power of the public is a powerful guarantee for the implementation of environmental protection policies. We must strengthen the educating role of ideological education, increase public awareness of environmental protection through publicity and education, and fully mobilize the public's enthusiasm for environmental protection. In this way, it can not only promote the masses of Jiangxi Province to start with themselves and build a green lifestyle, but also stimulate the spirit of the protagonist of the public, and actively monitor the environmental pollution of the surrounding enterprises through Internet public opinion and other methods, so that the pollution behavior of enterprises is highly transparent.

References

Cai, Q. (2008). The rationality of introducing biological metaphor into engineering philosophy. *China Dialectics of Nature Research Society: China Dialectics of Nature Research Society, 2008*(2), 99-101.

Chen, Y. (2018). Re-validation of the "Strong porter Hypothesis" under Fiscal Decentralization: From the Perspective of Enterprise Environmental Innovation and Non-Environmental Innovation. *Business Research, 2018*(01), 143-152.

Fan, C., & Zhao, Y. (2019). *Analysis on the evolution of high-tech industry innovation efficiency and its Influencing Factors——Taking Zhongguancun Science Park as an Example. Modern Management Science, 2019*(01), 6-8.

Jia, G. (2004). Evolutionary Economics and Darwinism: A Literature Review. *Political Economy Review, 2004*(02), 184-196.

Llerena, P., & Oltra, V. (2002). Diversity of innovative strategy as a source of technological performance. *Structural Change and Economic Dynamics, 13*(2), 179-201. Available at: https://doi.org/10.1016/s0954-349x(01)00036-4.

Qi, Q. (2019). Research on the related mechanisms of environmental Regulation, Technology Innovation and Regional Industrial Upgrade. *Modern Trade Industry, 40*(14), 11-13.

Sun, X. (2010). A Review of Research on Evolutionary Economics of Technology Innovation. *Scientific Management Research, 28*(02), 15-19.

Sun, L. (2016). *An optimal path model of industrial upgrade from the perspective of ecological civilization: Evidence from Shanghai. Technology Economy and Management Research, 2016*(01), 114-118.

Sun, X. (2012). *Technology Innovation and Industrial Evolution: Theory and Empirical.* Beijing: Renmin University of China Press, 2012(10):34-66.

Xu, D., & Wu, L. (2017). *An analysis of economic metaphors in China's Government Work Report (2017). Northern Economy and Trade, 2017*(07), 17-18.

Yang, H. (2006). Biological Metaphors in Evolutionary Economics: Rationality, Similarity and Difference. *Academic Monthly, 2006*(06), 89-94.

Zhang, L. (2017). *New development concept leads the breakthrough of green industry development in Jiangxi Province. Journal of Jiangxi University of Finance and Economics, 2017*(06), 9-10.

Zhao, L., & Xue, Y. (2019). Environmental Regulation Strength and Technology Innovation——Empirical from Pollution-intensive Manufacturing. *Science and Technology Progress and Countermeasures, 36*(10), 59-65.