Research on China's manufacturing policy based on topic model and synergy network

Minghao Zhu[a], Xueqiao Wu*[a], Yue Su[b], Zhibo Zhang[a]
[a]Department of Information Management, School of Economics and Management, Beijing Jiaotong University, Beijing, China; [b]Department of Management Information System, School of Economics and Management, Beijing Jiaotong University, Weihai, Shandong, China

ABSTRACT

Since the reform and opening up, China's manufacturing industry has experienced considerable development. This paper divides the development of China's manufacturing industry from 1978 to 2020 into three periods: recovery period, adjustment period and intelligent development period. This paper collects 855 manufacturing policies issued by the Chinese government in these three periods, uses LDA topic model and synergy network to study the policy evolution trend in these periods, and studies policy synergy combined with the classification of policy instruments. The results show that the first period of China's manufacturing industry mainly focuses on reform and opening up, and pays more attention to technology renewal, product manufacturing and process improvement. The second period pays more attention to product quality, technology, enterprise development, industry informatization and standardization. The third period focuses on the development of intelligence, informatization, technology and production process, enterprise management and so on. The results of policy synergy analysis show that the use of China's environmental policy is redundant. There are some deficiencies in demand policy. At the same time, policies should pay more attention to basic industries.

Keywords: Manufacturing, industrial policy, topic evolution, policy synergy

1. INTRODUCTION

Since the reform and opening up, China's manufacturing industry has developed rapidly, and the level of industrial chain has improved rapidly. According to relevant research, China's manufacturing industry has gone through three stages: recovery period (1978-2005), adjustment period (2006-2014), intelligent development period (2015-2020)[1]. At present, there are few studies on the topic and synergy of manufacturing policies. This paper uses text mining method to analyse the topic evolution of manufacturing policies and visualize it, so as to better sort out the development process of China's manufacturing industry.

2. LITERATURE REVIEW AND THEORY

2.1 Development of China's manufacturing industry

China attaches great importance to the development of the real economy. As an important part of the real economy, manufacturing industry has received high attention in the early days of the founding of New China. At present, China's policies focus on the high-quality development of industries and the dual optimization of structure and innovation[2]. As one of the seven strategic emerging industries in China, the central and local governments have formulated a large number of policies to encourage enterprise innovation and industrial development[3]. However, unilateral acts of enterprises cannot effectively promote the development of manufacturing. In order to reduce the long-term mismatch between R&D investment and economic growth and realize the sustainable development of China's manufacturing industry, the Chinese government has strengthened its guidance on the industry in recent years. At the same time, it has promulgated a series of policies to improve the allocation efficiency of the manufacturing industry and realize the green reform of enterprises[4]. With the rapid development of manufacturing industry, the government's regulation and control efforts have increased, and the types of policies have become diverse. The research on the synergy of manufacturing policies is of great significance for optimizing the structure of policy control.

*20120616@bjtu.edu.cn

International Conference on Computer Application and Information Security (ICCAIS 2021), edited by Yingfa Lu, Changbo Cheng, Proc. of SPIE Vol. 12260, 1226026 · © The Authors.
 · doi: 10.1117/12.2637479

2.2 LDA topic model

Topic model is a probabilistic generation model, which mainly includes latent semantic analysis[5] (LSA), probabilistic latent semantic analysis (PLSA)[6] and implicit Dirichlet distribution[7] (LDA). LDA topic model is a probability extraction method which includes document, topic and word three-layer Bayesian structure, and generates and extracts its implicit topic from discrete data[8]. According to the generated three-level Bayes, the mixed topic words are obtained, and each topic is represented by the probability distribution of the words. On this basis, the topic summary is obtained[9]. At present, LDA is widely used in text topic mining, text classification and clustering, semantic recognition evolution and other fields[10].

3. EVOLUTION OF POLICY TOPICS

This paper uses the "*beidafabao*" database as the source of policies data, and uses keywords such as "machinery", "industry", "manufacturing", "equipment", "electronics", "components" and "components" for full-text retrieval, then selects 855 manufacturing policies issued by different departments from 1978 to 2020, including departmental regulations, administrative policies, personnel mobilization and industrial planning. Then, we use Python language to build LDA topic model, independently model the policy of each stage, extract the topic category and policy focus of each stage, and build a synergy network between topics. The tightness of the relationship between topics is shown in the depth and thickness of the network line. Based on the topics of the previous stage, the topics of the next stage are extracted to obtain the topic synergy network of three stages, as shown below.

3.1 Recovery period

Figure 1 depicts the topics of China's manufacturing policies in the recovery period (1978-2005). The management and development of enterprises is the centre, and the national automobile project is attached to the management and development of enterprises. The "quality of products and technologies" and "equipment manufacturing design technology" are in a relatively important position. In this period, China paid more attention to product quality, manufacturing process and related technologies. In the sixth Five-Year Plan, China has put forward a series of requirements for the development of manufacturing, such as improving the technology of the textile industry, improving the energy utilization rate of the metallurgical industry, mining new minerals, and replacing old chemical industrial equipment. The focus of policies in this period is to lay a solid foundation for manufacturing, especially on equipment quality and industrial technology.

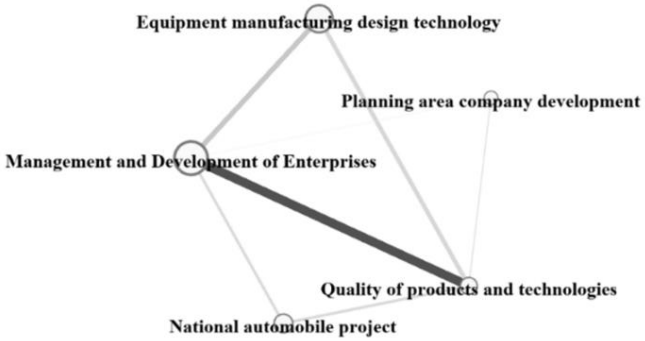

Figure 1. Co-occurrence map of policy topics in recovery period.

3.2 Adjustment period

Figure 2 depicts that the focus of China's manufacturing policies has gradually shifted from the "management and development of enterprises" to the "industrial technology informatization and standardization". At the same time, with the deepening of policies connotation and the deepening of the connection between products, industries, technologies, enterprises, standards and processes, China is pursuing the transformation of manufacturing industry from the general development mode of large and large to the coordinated development mode of high quality, high level and high standards. Generally speaking, the policies focus at this stage is divided into two aspects: on the one hand, it focuses on the development of products, mainly on the construction of automobile and related industrial parks and companies; on the other hand, it focuses on the macro development of the industry, including technology, process, quality, standard and informatization.

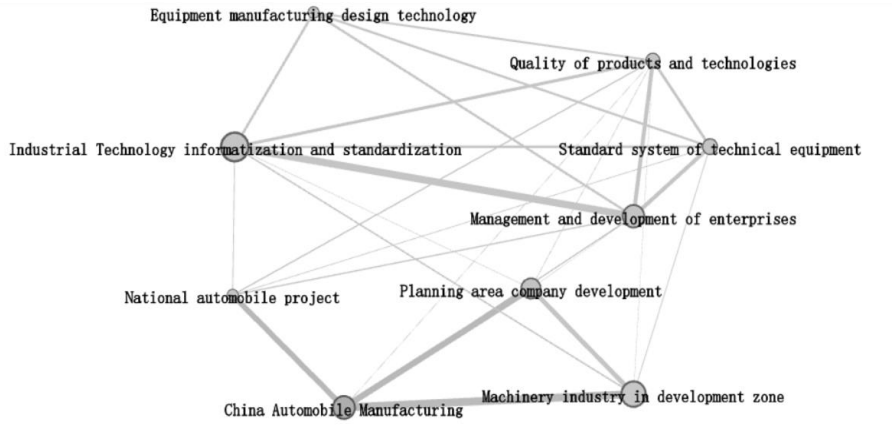

Figure 2. Co-occurrence map of policy topics in adjustment period.

3.3 Intelligent development period

After the recovery and adjustment period, China's manufacturing industry stepped into the intelligent development period. As shown in Figure 3, the topics of manufacturing policies in the intelligent development period include informatization, standardization, enterprise management, product quality and technology. The policies connotation of this period is very rich and the content is very extensive. Close links between topics. As can be seen from Figure 3, "industrial technology informatization and standardization", "quality of products and technologies", and "national automobile project" are located in the centre of the network diagram, which are more related to other topics. It also indicates that automobile in this period is still an important part to the development of manufacturing equipment. Moreover, the overall connotation of informatization and standardization is deepened, not only limited to products and technologies, but also involved in automobile manufacturing, enterprise management, transportation and storage.

Figure 3. Co-occurrence map of policy topics in intelligent development period.

4. ANALYSIS OF POLICY SYNERGY

4.1 Analysis of policy instruments

From the perspective of policy objectives and policy types, according to Rothwell and Zegbeld's theory, policies are divided into three dimensions of supply, environment and demand according to its role[11]. The results are shown in Table 1.

Table 1 demonstrates that environment policies accounted for 54%, demand policies and supply policies accounted for 15% and 31% respectively. The government issued environment policies to build a benign industrial cycle and create

suitable external conditions for industrial development, resulting in excessive use of environment policies. Environment policies have a long time to come into effect and high uncertainty, which makes it difficult to play a substantial role in the short term. Demand policies can better mobilize the enthusiasm of enterprises and achieve a balance between government intervention and market competition. However, demand policies cannot bring fresh blood to stagnant industries in the short term. Supply policies can provide basic support for the industry, necessary conditions and talent for enterprise operation. Supply policies need continuous resource input, and it is easy to cause enterprise inertia.

Table 1. Policy dimension and its distribution.

Policy dimension	Policy connotation	Number of policies	Inner proportion	Proportion
Supply	Education and Training	32	12%	31%
	Information Support	68	25%	
	Infrastructure Construction	168	63%	
Environment	Goal Programming	361	78%	54%
	Financial Support	46	10%	
	Tax Preference	54	12%	
Demand	Government Procurement	64	51%	15%
	Consumer Subsidies	32	25%	
	Overseas Organization Management	30	24%	

Infrastructure construction accounts for 63% of the supply policies. While promoting the development of manufacturing industry, the government pays more attention to infrastructure construction. Goal programming in environment policies accounts for 78%. Goal programming policies play a guiding role in the development of manufacturing. But too much goal programming policies may lead to unclear direction of industrial development. Government procurement accounts for half of demand policies. The Chinese government attaches importance to the introduction of core technology and equipment, and encourages the absorption of international high-end technology. However, the role of the market is weakened, and it is difficult to achieve healthy competition between enterprises.

4.2 Policy synergy

4.2.1 Policy redundancy. The mainly policy types are environment and supply. Environment policies play a great role in building a good industrial environment and promoting a virtuous circle within the industry, which is in line with China's long-term development needs. The distribution of supply policies indicates that China attaches great importance to the infrastructure construction of manufacturing industry. These two types of policies have a certain degree of redundancy, and there is excessive use of policy. Due to the excessive use of supply and environment policies, policies allocation space is squeezed, and the use of policy instruments lacks overall balance.

4.2.2 Policy deficiency. Table 1 demonstrates that demand policy instruments accounted for relatively low, only 15 %. The government should improve the Utilization rate of demand policies. The use of demand policies in government procurement is far greater than that of the other two instruments, and the focus of government procurement is major technical equipment, advanced industrial technology, and core basic components. The reasons for this phenomenon may be related to the industrial structure of China's manufacturing industry, that is, the technical level is weak, the product added value is low, the competitiveness is not high, and the lack of core technology is still unable to overcome in the short term. It is necessary to introduce foreign countries to keep pace with the international advanced level.

4.2.3 Policy dislocation. At present, the overall development of China's manufacturing industry is rapid, but some major technical equipment, high-end technology and advanced manufacturing technology still need to be introduced from abroad, and the supporting ability of industrial foundation to the whole machine is weak. The development of industrial foundation and manufacturing industry is not coordinated, synchronized and unbalanced, and there is a lack of core technology and products with independent intellectual property rights, and the potential for industrial progress is weak. When making policies, it is necessary to pay attention to the development of industrial foundation at the same time, improve the attention

and support to enterprises, promulgate policies suitable for the development of different types of enterprises, and improve the pertinence of policies.

5. CONCLUSION AND FORECAST

This part uses LDA topic model to mine the topic evolution of China's manufacturing policies in each period since 1978, and uses *gephi* to visualize the policies focus on each stage. From the perspective of policy instruments, this paper makes a synergy analysis of these policies. The results indicate that China's manufacturing policies from 1978 to 2005 mainly focuses on three aspects: basic manufacturing technology, enterprise management and automobile manufacturing. During this period, China's manufacturing industry mainly operated around the reform and opening up, focusing on production and product quality. Industrial construction should be in line with international standards. In the middle and later stage, it puts forward the development requirements of various industries, such as improving the resource utilization rate, improving the technical level, improving the manufacturing process, and speeding up the development of the whole machine. From 2006 to 2014, industrial policies mainly focused on product quality, technology, enterprise development, industrial informatization and standardization. Industrial informatization is the new subject in this period. The government hopes to improve the development mode of manufacturing industry by means of information technology, strengthen the integration of information technology and production, and comprehensively improve product quality. From 2015 to now, the policies focus on the development of intelligence, informatization, technology and production process, enterprise management, etc. Compared with the previous two periods, the content of topics in this stage is richer and the relationships between them are closer. Intelligence is an important topic in this period, mainly through artificial intelligence technology for production test, process improvement and quality control, to improve the operation mode of manufacturing industry. The results of policies synergy analysis demonstrate that the use of environment policies in China is redundant. There are some deficiencies in the demand policies. At the same time, the policies should pay more attention to the basic industry.

This paper studies the topic evolution and policy synergy of China's manufacturing policies. In the future, we can study different types of manufacturing policies and their impact on the industry, such as whether the policies for manufacturing informatization can promote the informatization construction of China's manufacturing enterprises, and the input-output efficiency of manufacturing innovation policies

ACKNOWLEDGMENTS

Thanks to the Major Project of the Chinese Academy of Engineering (2020-HYZD-8-11) for funding this paper.

REFERENCES

[1] Han, H. X. and Li, S. C., "Chinese experience: From "Made in China" to "Made with Intelligence in China"—The paradigm evolvement of Chinese manufacturing policy since reform and opening-up," South. Chin. Univ. Technol. (Soc. Sci. Ed), 22(06), 105-16 (2020).
[2] Zhang, M. Z. and Yao, P., "Industrial policy and high-quality development of manufacturing," Stud. Sci. Sci., 38(08), 1381-89 (2020).
[3] Liu, L. J., Zhang, T. and Moulan, Z. W., "An empirical study of the evaluation of innovation policies on the advanced equipment manufacturing industry," Sci. Res. Manage., 41(01), 48-59 (2020).
[4] Wang, F. R. and Wang, K. S., "Green policy and allocative efficiency of green finance: Evidence from Chinese manufacturing listed enterprises," Financ. Econ., 05, 1-14 (2018).
[5] Scott, D., Susan, T. D., George, W. F., Thomas, K. L. and Richard, H., "Indexing by latent semantic analysis," J. Am. Soc. Inf. Sci., 114(2), 211-244 (1990).
[6] Hofmann, T., "Probabilistic latent semantic analysis," Proc. 22nd. Ann. Int. SIGIR. Conf. on Research and Development in Information Retrieval, 50-57 (1999).
[7] David, M. B., Andrew, Y. N. and Michael, I. J., "Latent Dirichlet allocation," J. Mach. Learn. Res., 3(2), 993-1022 (2003).
[8] Xu, Z., Eric, G., Mei, C. and Reginald, R. S., "Identifying secondary crashes using text mining techniques," J. Transp. Saf. Secur., 12(10), (2020).

[9] Nicola, B., Giuseppe, M., Ettore, R., Marco, C. and Antonio, B., “Probabilistic topic models for sequence data,” Mach. Learn., 9(1), 5-29 (2013).
[10] Lan, D., Wray, B., Jin, H. D. and Chen, C. Y., “Sequential latent Dirichlet allocation,” Knowl. Inf. Syst., 31(3), 475-503 (2012).
[11] Rothwell, R. and Zegveld, W., “An assessment of government innovation policies,” Rev. Pol. Res., 3(3-4), 19-35 (1984).