A Comparative Regional Study of Key Core Technology Innovation Policies—-a Textual Analysis of 48 Blockchain Policies from China

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Abstract

Using a sample of 48 policies on the blockchain industry issued by central and local governments. To analyze the content of these documents, the researchers employed Nvivo12 software for coding through content analysis. Utilizing a comprehensive three-dimensional analysis framework encompassing supply, demand, and environment, this paper conducts a quantitative analysis of the Chinese blockchain industrial policy text. It was found that: (1) National-level policies not only focus on the implementation of regulatory measures but also prioritize research on blockchain technology policies. (2) There is geographical variability observed in the policies across the eastern, central, and western regions of the country. The eastern and central regions exhibit a greater emphasis on the utilization of environmental policy tools. Science and technology innovation centers like Beijing, Shanghai, and the Greater Bay Area provide extensive support for the growth of blockchain enterprises, particularly in the areas of finance, taxation, and regulation. On the other hand, the western regions tend to prioritize demand-based policies. For instance, the Chengdu-Chongqing Economic Circle emphasizes the importance of application scenario implementation and fostering cooperation at various levels. Finally, some suggestions are made for the construction and improvement of the key core technology innovation policy system in China, to provide theoretical support and decision-making reference for the collaborative development of China's key core technologies and regional industries.

Keywords: Key Core Technologies; Innovation Policy; Blockchain; Regional Comparison; Content Analysis

1 Introduction

In 2018 China deployed and implemented key core technology breakthroughs as a major national strategy. In October 2019, during the 18th collective study of the Central Political Bureau General Secretary Xi Jinping emphasized that blockchain should be used as an important breakthrough in independent innovation of core technologies. The Proposal of the Central Committee of the Communist Party in China on the Formulation of the Fourteenth Five-Year Plan for National Economic and Social Development and the Visionary Goals for 2035 states, "Adhere to the central position of innovation in the overall situation of China's modernization, and make scientific and technological self-reliance and self-improvement a strategic support for national development". Nonetheless, with the continued escalation of trade friction between China and America, we must be aware that the traditional technology innovation model, which relies on technology introduction, joint technology development, and technology absorption, is unsustainable (Chen Jin et al., 2022). There are obvious shortcomings in China's original innovation achievements from 0 to 1. Some of the key core technologies are seriously restricted to the "neck" dilemma. Achieving scientific and technological research and promoting independent control of key core technologies can not be separated from the innovation policy. Therefore, corresponding policies are issued from the national to the local.

Innovation policies are the sum of a series of public policies aimed at promoting the generation, utilization, and diffusion of innovation. Besides, they provide basic guarantees for the development of science and technology innovation at the institutional and legal levels (Chen Huiru et al., 2016). In response to the call of the nation, the reform of science and technology innovation systems and mechanisms has been actively explored in recent years. Central and local governments also introduce key core technology innovation policies. As a key technology, blockchain helps key core technology research and can also not be separated from the total support of innovation policies. By the end of 2020, at least 600 blockchain-related policies were issued by the central government, various ministries, and local governments. Thus, the ability of science and technology innovation has been rapidly and significantly improved. The scale of China's blockchain industry reached $2.78 billion in 2020, with a growth rate of 33.7% which exceeded the growth rate of the global blockchain industry. China becomes one of the countries with the highest potential for the development of blockchain industry in the world. Blockchain technology has a wide range of application scenarios and has been extended to many fields such as digital finance, Internet of Things, intelligent manufacturing, supply chain management, and digital asset trading. Therefore, a regional comparative analysis of 48 central and local blockchain policies in China helps to promote regional blockchain synergy and integrated development. Furthermore, it provides a reference for promoting synergistic research and technological leapfrogging of blockchain and other key core technologies.

2 Literature Review

Promoting key core technology innovation is conducive to promoting high-quality economic development, maintaining national security, and seizing global technological development opportunities (Ku Shengwei et al., 2018). Key core technologies include a large amount of tacit knowledge, which is difficult to imitate and replicate due to high barriers to breakthrough (Prahalad C K et al., 2016). First-move firms have established strict protection and exclusivity mechanisms to protect their core knowledge and technology from imitation, making it impossible for latecomers to understand the process of key core technology formation and technology "black box" (Frishammar J et al., 2015). Thus, the practical difficulties have accelerated the pace of promoting key core technology innovation in China. Blockchain technology is regarded as a disruptive innovation in the computing paradigm (Yuan Yong, 2016), which has strongly promoted the integration of finance, education,

government, agriculture, and other fields. Blockchain plays an important role in empowering the transformation and upgrading of traditional industries and accelerating the key core technologies. At present, blockchain has caused worldwide international competition where all the countries are paying more and more attention to blockchain technology research and development to occupy the right to speak.

Innovation policies aim to promote the generation, utilization, and diffusion of innovations. They not only focus on scientific and technological research and development but also emphasize the role of industrial and economic policies in promoting the commercialization of scientific and technological achievements (Liang Zheng et al., 2017). In recent years, academic research on technology innovation policies has been intensifying and focusing on the following three areas: Firstly, for the study of the development path of China's technological innovation policies, Fengzhao Liu analyzed the historical evolution path of China's innovation policy from 1980-2005 in terms of the effectiveness and category dimensions of innovation policy (Liu Fengzhao et al., 2007). Yi-Mei Feng further provided an in-depth analysis of the evolutionary features of China's technological innovation policy in the 21st century (Feng Yimei et al., 2017). Secondly, regarding the comparative study of technological innovation policy development paths, Zhanxin Li used an econometric analysis to compare and analyze the differences in technological innovation policies and their historical evolution paths between China and Korea (Li Zihanxin et al., 2017). Thirdly, based on different subdivisions and different policy instruments to analyze the application of technology innovation policies. Qu Wan constructed a systematic framework for innovation policy evaluation and verified the practicality of the constructed innovation policy evaluation framework by using tax incentives for high-tech enterprises (Qu Wan et al., 2017). Lanjian Liu sorted out and compared new energy vehicle innovation policies at home and abroad (Lanjian Liu et al., 2013). Then based on analyzing their similarities and differences strategic adjustment ideas are proposed.

Regional technological innovation policies can effectively catalyze and encourage enterprises to carry out technological innovation activities (Yan Junyin et al., 2014). The variability and unevenness of technological innovation policies in different regions are becoming more and more evident in the process of innovation-driven regional economic development, which has become a hot topic (Liu Shengyang et al., 2020). With the continuous development of national regional collaborative innovation, the policy synergy, industry synergy, and innovation chain synergy among regions are more able to consider the efficiency of industrial development.

The above-mentioned relevant academic studies have laid a certain foundation for this research, but there are still shortcomings. Although there have been studies analyzing technology innovation policies, little literature is about the regional comparison of innovation policies for key core technologies, the pattern of policy tool application, and policy choices. In this study, we take blockchain technology as an example and conduct a comparative analysis of China's key core technology innovation policy texts from the perspective of policy tools——supply, demand, and environment.

3 Research Design

3.1 Research Methods

Quantitative research on policy literature is a new direction for public policy research (Huang Cui et al., 2015). What's more, text mining and bibliometric methods are important ways to carry out quantitative research on policies (Song W et al., 2019). The content analysis method not can systematically and quantitatively describe sample texts (Zheng Wenhui et al. 2006), but also can conduct quantitative research on policy documents, academic literature, and other information. An effective and reproducible inference can be obtained by analyzing the amount of text information and

its changes (Qiu Junping et al., 2004). Consequently, this study first sorts out blockchain policy system framework and comprehensively grasps the contents of policy texts. Then it describes the characteristics of the use of policy tools in different geographic regions and also reveals the reasons.

3.2   Data Sources

Influenced by the regional development policy of opening up to the outside world from eastern to western, there are significant differences in China's regional economic and technological development (Guo Teng-Yun et al., 2002). Therefore, considering the existence of imbalance in the development of blockchain industry in different regions, this study categorizes 18 provinces according to the "Eastern, Western, Central and Northeastern Regions Dividing Method" released by the National Bureau of Statistics in June 2011. In December 2020, seven provinces and cities in China, including Hunan and Guizhou, issued blockchain-specific policies. Although other provinces and cities have not issued special policies, they have repeatedly emphasized the promotion of synergistic development of blockchain and the Internet, big data, artificial intelligence, and other technologies in industrial development and other related policy documents. Currently, scholars have selected blockchain policies from 2016-2020 and used quantitative policy analysis methods such as textual analysis and comparative analysis to study the trends and characteristics of blockchain policies and the construction of policy systems from policy tools and policy objectives, and industrial development dimensions, but none of them involved detailed comparison of regional policy texts (Gao S et al., 2019; Li Qian et al., 2021; Dong Shitao et al., 2021). To better study the trend of regionalization characteristics of China's blockchain policies in recent years, this study screens seven samples of national-level policies from the State Council, the Ministry of Industry and Information Technology, and others released during 2016-2020, as well as 41 samples of local-level policies from 18 provinces representing the eastern, central and western regions for this comparative study.

3.3   Analytical Framework Construction

Rothwell and Zegveld argued that government policies for emerging technology industries should take into account both technology and market factors and classify policy instruments in three dimensions: supply, environment, and demand (Wu Jun et al, 2020). Supply policies play a pushing role. Demand policies play a pulling role. Environmental policies play an indirect role. In this study, various policy tools are further defined according to the development characteristics of blockchain technology and the classification of various policy tools. Their names and corresponding meanings are shown in Table 1:

Tool Type	Tool Name	Meanings
Supply Policies	Public Infrastructure	Building professional public infrastructure to ensure the development of blockchain industry
	Technology Infrastructure	Provide R&D and research base for blockchain industry research, etc.
	Human Resource Management	Specific measures and preferential policies on the cultivation and introduction of talents
	Information Support	Provide support for blockchain industry development in terms of technology and information services
	Capital Investment	Provide financial support for related R&D activities
Environment Policies	Goal Planning	The overall plan for the expected goals and development vision of the blockchain industry market
	Regulatory Measures	A legal system developed to regulate the development of blockchain industry

	Strategic Measures	Various safeguards to promote the development of blockchain industry
	Financial Support	Provide financial support for blockchain industry in terms of loans and investments
	Tax Deductions	Provide tax support, including tax deductions, exemptions, etc.
	Public Opinion Environment	Create a social environment conducive to the growth of the blockchain industry
Demand Policies	International Cooperation	Measures to encourage enterprises to expand and cooperate overseas
	Multi-entity Cooperation	Collaboration among enterprises, universities, industrial parks, etc.
	Application Scenario Landing	Measures to promote existing industries to integrate blockchain technology and realize industrial applications
	Industry Chain	Support policies to promote upstream and downstream business development in the blockchain industry

Table 1: Classification of policy instruments, their names, and corresponding meanings

3.4 Text Analysis and Coding

In this study, the qualitative analysis software Nvivo12 is used to analyze and code the blockchain policy text. The different types of policies and issuing subjects determine the complexity and diversity, so we choose to use paragraphs as the analysis unit to avoid the coding omission phenomenon due to the different expressions (Yan Shimei et al., 2008). The policy analysis process is as followed: （1）Count the high-frequency keywords in the policy text. （2）Delete the invalid words such as "measures" based on the preliminary analysis results to form the word frequency statistics. (3) Combine the preliminary analysis framework, create parent nodes and child nodes, and encode the content with paragraphs as the analysis unit. (4) Adjust the subordination of parent and child nodes to enhance the integrity and systematization of the analysis framework structure. (5) Calculate the statistical results and analyze them.

4 Analysis Results and Research Discussion

4.1 Analysis of the Number of Policies in Different Regions

The number of policies issued reflects the government's emphasis on the local blockchain industry to a certain extent. At the same time, it also can reflect the government's refinement of the development of blockchain industry. In this study, we mainly analyze 7 policies promulgated by the state, 22 in the eastern regions, 9 in the central regions, and 10 in the western regions. Some policies are proposed by the government for a series of digital high technologies such as blockchain, big data, 5G, VR/AR, cloud computing, artificial intelligence, and Internet of Things. Therefore, the policies are further subdivided into special policies and related policies. The quantity statistics are shown in Figure 1.
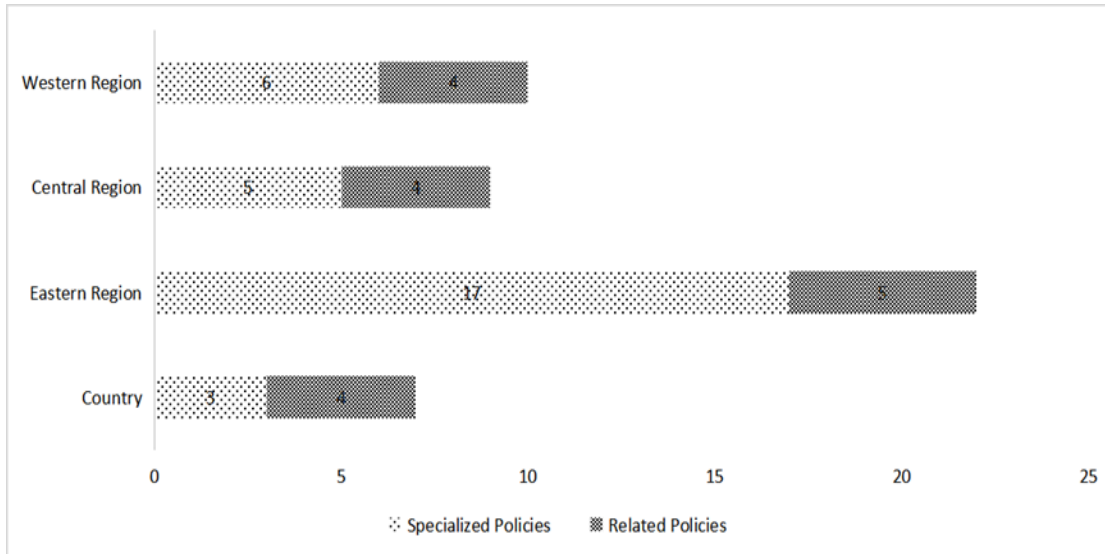
Figure 1: Comparison of the number of blockchain policies introduced by countries and regions

Based on the analysis from the perspective of policy quantity, the eastern provinces pay more attention to blockchain than other regions. The number of blockchain-specific policies issued in the eastern regions far exceeds the total number of blockchain-specific policies in the central and western regions, which is about three times of the number of blockchain-specific policies in the central and western regions. The reasons for this are analyzed by combining the policy texts and the development of blockchain industry distribution. The eastern regions are leading in economic development and have a high concentration of blockchain research bases, industrial parks, and small and medium-sized enterprises. So compared with the central and western regions, the eastern regions more urgently need to issue policy documents to effectively regulate, manage and promote the development of blockchain industry.

4.2   Analysis of Coding Results of Policy Instruments

Nvivo12 software is used to code the policy tools. Three parent nodes are constructed for "supply policies", "environmental policies" and "demand policies". Under the parent nodes of "supply policy", five sub-nodes are constructed, including "public infrastructure". Six sub-nodes are constructed under the parent node of "environment policy", including "regulation". Under the parent node of "supply policies", five sub-nodes are constructed under the parent node of "public infrastructure". Six sub-nodes are constructed under the parent node of "environment policies". Four sub-nodes are constructed under the "demand policies" parent node, including "international cooperation". The detailed statistics of the number of coded documents and reference points are shown in Table 2.

Parent Node	Child Node	Number of documents	Reference Points
Supply Policies	Public Infrastructure	15	25
	Technology Infrastructure	23	78
	Human Resource Management	25	53
	Information Support	23	79
	Capital investment	24	40

	Parent Node – Supply Policies	36	276
	Regulatory Measures	19	67
	Goal Planning	21	37
Environment Policies	Strategic Measures	23	62
	Financial Support	22	156
	Tax Deductions	6	8
	Public Opinion Environment	15	18
	Parent Node - Environment Policies	41	348
	International Cooperation	8	33
Demand Policies	Multi-entity cooperation	19	39
	Application Scenario Landing	32	200
	Industry chain upstream and downstream development	6	8
	Parent Node - Demand Policies	34	280

Table 2: Details of parent and child nodes

All four levels of governments, which are district/county-city-province-center governments, have paid great attention to the research and development of blockchain and have introduced specific targeted measures for each sub-category of policy tools. The results show that the parent node has the highest number of reference points for environment policies with 348, followed by demand policies with 280 reference points, and supply policies with 276 reference points. It necessarily takes into account that China's blockchain industry is still in a rapid development stage. Besides, the construction of creating a good environment is crucial to the development of blockchain. Over-reliance on the use of environmental policies and neglect of the push and pull effect of supply and demand policies will inevitably lead to the dilemma that the conditions of innovation infrastructure and the number of innovative talents in the field of China's blockchain can hardly meet the needs of innovation. The current number of supply and demand policies' reference points lag behind environmental policies. However, the gap is not large, indicating that our government is able to focus on the layout of both supply and demand policies to provide for the smooth and healthy development of the blockchain market. What's more, there is not yet a serious imbalance of policy tools.

4.3 Textual Analysis of Policy Instruments

In order to study the focus of national-level and local-level policies in depth, this study conducts a word frequency search and coding analysis of the content of blockchain policy documents. Firstly, word frequency analysis is conducted on blockchain-specific policies at the national level to further analyze the concerns and focus of blockchain policies at the national level. In the analysis, it queries by group and calculates the weighted percentage according to synonyms. The statistical results are organized into a word frequency table, as shown in Table 3.

Words	Length	Counting	Weighted percentage (%)
Technology	2	1191	2.32
Information	2	764	1.49
Data	2	763	1.49
Finance	2	583	1.14
Services	2	458	0.89
Industry	2	398	0.78
Enterprise	2	375	0.73
Institution	2	328	0.64
Security	2	313	0.61

Center	2	296	0.58

Table 3: Statistics of high-frequency words of blockchain policies at the national level (Top10)

From the word frequency table, it can be seen that the word "technology" appears the most frequently, counting more than 1000 times. Keywords such as "information", "data", "finance" and "service" also have high recognition in blockchain policy texts. It shows that blockchain technology can help the real economy reduce costs and increase efficiency, and empower traditional industries, especially the financial industry to develop in a standardized and efficient manner. Since it is impossible to make exact judgments about the meaning of word frequency in context, relying on word frequency analysis to understand policy connotations is biased and one-sided (Tian Zhilong et al., 2019). Therefore, we choose to code and analyze the content of policy texts at the national level and local level for text coverage in order to compare the connotations, paths, and content focus of policies in different regions.

4.3.1   General Overview

The use of supply, demand, and environmental policy tools by region is shown in Figure 2. Overall, the country, the eastern regions, and the central regions introduced the most environmental policies, with coverage rates of 90.23%, 403.72%, and 208.13% respectively. However, the country introduced the least supply-type policies, covering only 22.73%, while the eastern and central regions had the least demand-type policies and the western region introduced the most demand-type policies, accounting for 216.91%.
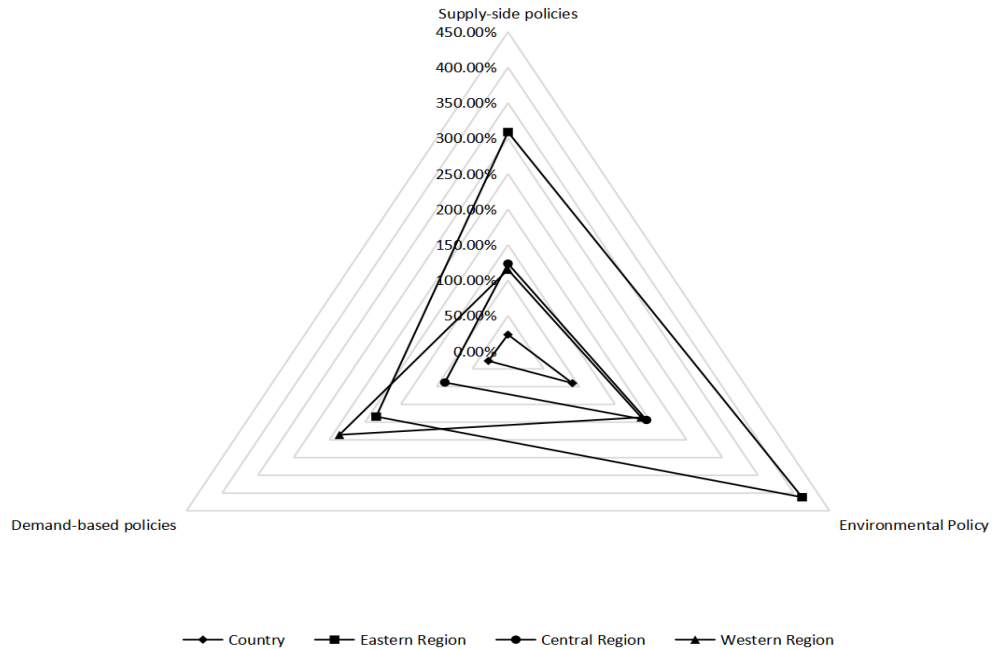

Figure 2: Policy instruments in general

The country, eastern and central regions pay more attention to the use of environmental policy tools, while the western regions pay more attention to the use of demand policy tools. The use of policy-type tools in different regions shows some differences, which are related to local economic development,

technology level, location advantages, and other factors. From the perspective of the national blockchain industry layout, relying on resources, facilities, and policy advantages, first-tier cities such as North, Guangzhou, and Shenzhen are still the main gathering places of the domestic blockchain industry. Therefore, the eastern and central provinces focus more on creating a favorable development environment for enterprises from the perspectives of finance, taxation, and supervision and control, while the western region focuses more on highlighting the role of blockchain in guiding economic development and its vertical applications in digital finance, government management and smart medical services.

4.3.2 Supply Policies

The use of supply-based policies, which are the driving force behind the industry's development, is shown in Figure 3.

	Public Infrastructure	Technology Infrastructure	Human Resource Management	Information Support	Capital investment
Western Region	13.52%	26.51%	39.69%	28.60%	42.52%
Central Region	8.96%	22.28%	45.86%	12.98%	33.27%
Eastern Region	17.81%	97.47%	101.65%	32.30%	59.59%
Country	0.20%	1.02%	0.25%	21.35%	0.51%

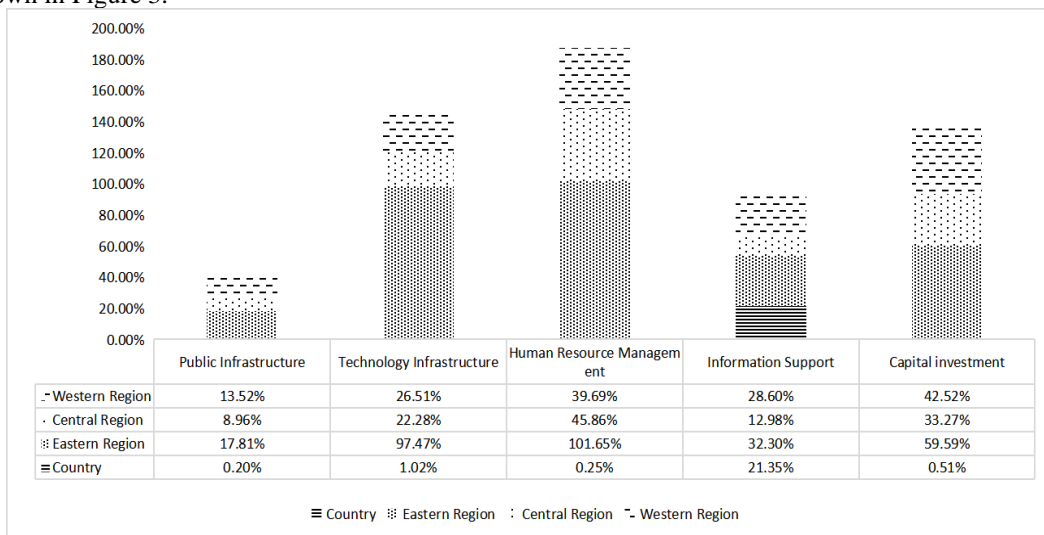Country · Eastern Region · Central Region · Western Region

Figure 3: Use of supply policies instruments

- National level: information support > technology infrastructure > capital investment > human resource management > public infrastructure. With the escalation of trade friction between China and the United States, China's core technologies are in the passive situation of "stuck neck" in the field of chips, sensors, system software, and so on (Xiao Guangling et al., 2019). Therefore, the state attaches great importance to the research of key core technologies of blockchain, as well as providing R&D support. The country also promotes the construction of scientific and technological platforms such as research institutes and scientific research institutions and forms a series of high-tech systems such as blockchain, artificial intelligence, Internet of Things, and big data. Meanwhile, the breakthrough of key core technologies cannot be achieved without funding and talent support. As a top-level designer, the state takes into account the needs of industrial development funds and talents. It also actively introduces policies for capital investment, talent training and talent introduction to provide guarantees for the development of the blockchain industry. Word documents (.docx), which can be produced by Microsoft Word.
- Eastern regions: human resource management > technological infrastructure > capital investment > information support > public infrastructure. From the results, the three policy tools such as human resource management, technology infrastructure and capital

investment in the eastern regions are at the top. The government attaches great importance to the training and introduction of talents to build a highland of blockchain talents. It also emphasizes the construction of science and technology infrastructure and platform, increasing capital investment. Strongly supporting the creation of a technology innovation center in Beijing, Shanghai and the Greater Bay Area, they will become a strategic fulcrum for China to build an innovative country and a world science and technology power.

- Central regions: human resource management > capital investment > technological infrastructure > information support > public infrastructure. The central regions are in the first place in terms of text coverage of HRM policy tools, which is reflecting the strong emphasis on talent in the central regions. For example, the "Three-Year Action Plan for the Development of Blockchain in Hunan Province" proposes to support the cooperation of universities, research institutes, industrial alliances and backbone enterprises, construction of R&D and practice bases for key industries. Meanwhile, the central regions have regional characteristics in the use of some sub-categories of policy tools to promote specialized agencies and platforms to provide funding, venue and infrastructure support for blockchain enterprises.

- Western regions: capital investment > human resource management > information support > technology infrastructure > public infrastructure. The direct investment of funds and talents is the key to promoting the development of the industry. The development of blockchain industry in the western regions started late and the support of talents are not enough. On the one hand, the capital investment relies on the government to provide financial support. On the other hand, through combing the project library of key areas, it creates an exchange platform to attract external investment. In terms of human resource management, we vigorously introduce talents through preferential policies and discover outstanding talent teams by holding innovation and entrepreneurship events so as to promote technological research and industrial development.

From the above analysis, it can be seen that both the eastern, central and western regions are in the top three in terms of capital investment and human resources management in terms of text usage coverage, while the country is more focused on the research of key core technologies of blockchain.

4.3.3   Environmental Policies

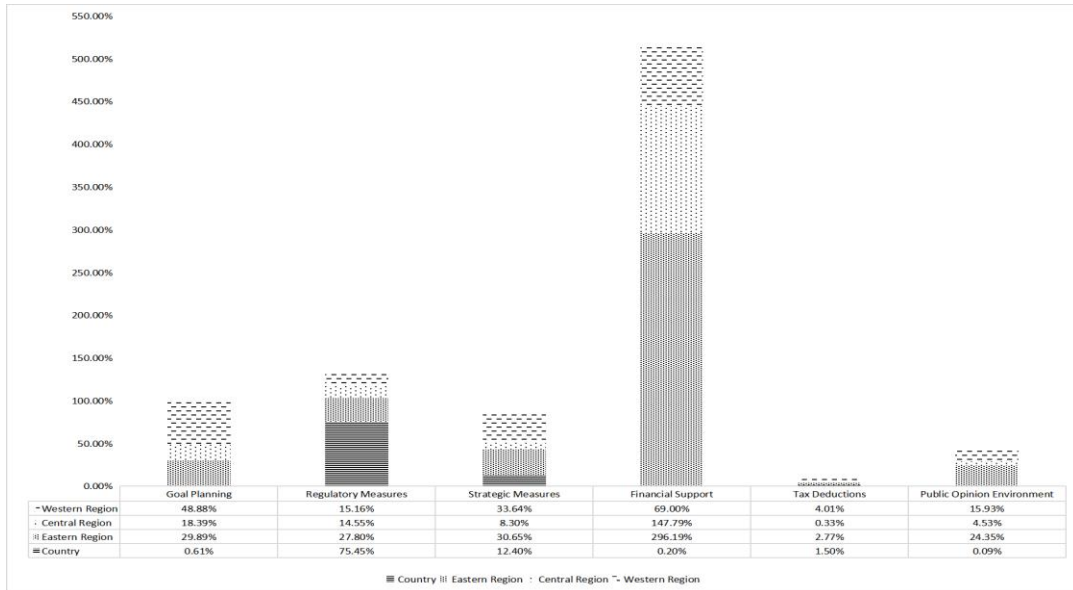The use of supply-based policies, which are the driving force behind the industry's development, is shown in Figure 3.

	Goal Planning	Regulatory Measures	Strategic Measures	Financial Support	Tax Deductions	Public Opinion Environment
⁻ Western Region	48.88%	15.16%	33.64%	69.00%	4.01%	15.93%
∙ Central Region	18.39%	14.55%	8.30%	147.79%	0.33%	4.53%
⫴ Eastern Region	29.89%	27.80%	30.65%	296.19%	2.77%	24.35%
≡ Country	0.61%	75.45%	12.40%	0.20%	1.50%	0.09%

≡ Country ⫴ Eastern Region ∙ Central Region ⁻ Western Region

Figure 4: Use of environmental policy tools

- National level: regulatory measures > strategic measures > tax deductions > goal planning > financial support > public opinion environment. From the results, due to the state as the top designer of policies, regulatory norms of policy text coverage comes first. From a technical point of view, blockchain is neutral. Its value and future are determined by the way and method of application of each subject. With the improvement of computational power and database, the prevalence of blockchain applications has increased, while revealing potential risks such as technical security, information security and network security and the government still needs to play a key guiding role in regulation and standardization. Secondly, strategic policies, tax deductions and goal planning, which put forward the general objectives for the future development of blockchain from the national level, provide the basis and standards for local governments and strategic measures policy tools and tax deductions policy tools to guarantee the successful completion of development objectives. The low text coverage of the two policy tools: financial support and public opinion environment, is in line with the country's character as a top-level system designer, where policies are mostly formulated from a global perspective, making it difficult to fully take into account the differences in the development of individual provinces and municipalities.

- Eastern regions: financial support > strategic measures > goal planning > regulatory measures > public opinion environment > tax deductions. Sufficient funds are the guarantee for the development of blockchain industry. The economy of the eastern regions is more developed and relies on their own economic volume. Therefore, the government attaches importance to the financial subsidies and incentive policies of blockchain industry, which stimulates various innovative subjects and entrepreneurial units to deeply research the core key technologies. The governments of the eastern provinces focus on the use of two types of policy tools, namely goal planning and regulatory measures to plan the overall goal and specific layout of future development. However, the government gives more supports in finance. If it continues to increase the tax deductions for blockchain enterprises,

it will lead to the duplication of two types of fiscal policies, finance and tax deduction, which is not conducive to sustainable development (Chu, Ruigang et al., 2018,).

- Central regions: financial support > goal planning > regulatory measures > strategic measures > public opinion environment > tax deductions. Similar to the use of environmental policy tools in the eastern regions, the central regions pay much attention to financial subsidies and encourage blockchain innovation subjects and enterprise institutions, such as the introduction of a special policy for financial support of blockchain industry development in Loudi City, Hunan Province, "Several Measures to Accelerate the Development of Blockchain Industry". The higher textual coverage of target planning and regulatory measures relative to strategic measures reflects that in the central provinces, governments are paying more attention to the overall planning and layout of the blockchain industry to provide direction and basis for its development.

- Western regions: financial support > goal planning > strategic measures > public opinion environment > regulatory measures > tax deductions. The western regions are dominated by the use of financial support policy instruments, which is also significantly more effective than other sub-categories of policy instruments. Taking "Guiyang City's Policies on Supporting the Development and Application of Blockchain" as an example, it points out that "enterprises meeting the supportive conditions can receive 100,000 yuan in subsidies, 200,000 yuan in tax incentives, and 200,000 yuan in loan support", which shows that for the western provinces, which is relatively backward in terms of development level. Increasing subsidies, preferences, and rewards can attract enterprises and talents from other regions. A side-by-side comparison of the use of policy tools and text content in the eastern and central regions reveals that the western provinces are more focused on creating a favorable public opinion climate.

From the above analysis, it can be seen that the use of environmental policy tools in the eastern, central and western regions is basically the same, with the highest text coverage being financial support. Target planning and strategic measures are also the focus of local government attention. But the national level places more emphasis on regulatory and strategic measures.

4.3.4   Demand Policies

Demand policies can reduce market uncertainty and expand market demand to promote the healthy and steady development of the blockchain industry. The use of demand policies tools is shown in Figure 5.
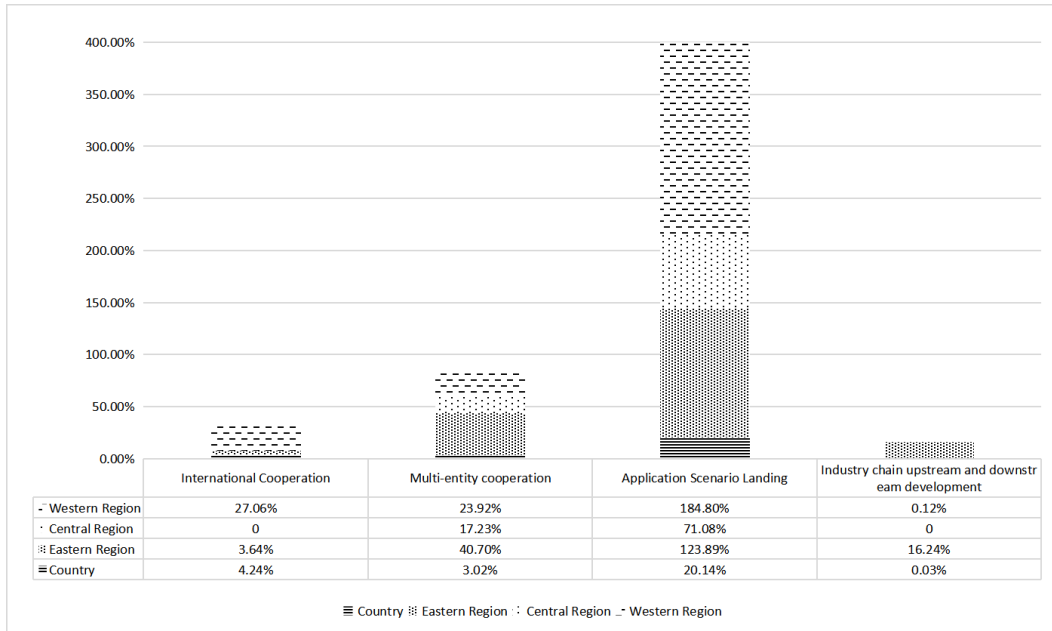
	International Cooperation	Multi-entity cooperation	Application Scenario Landing	Industry chain upstream and downstream development
Western Region	27.06%	23.92%	184.80%	0.12%
Central Region	0	17.23%	71.08%	0
Eastern Region	3.64%	40.70%	123.89%	16.24%
Country	4.24%	3.02%	20.14%	0.03%

≡ Country ⸭ Eastern Region ⁚ Central Region ˗ Western Region

Figure 4: Text coverage of demand policies tools in blockchain policy documents

- National level: application scenario landing > international cooperation >multi-entity cooperation > industry chain. The applied mining for blockchain technology is no longer purely limited to digital currency; the financial industry is undergoing a transformation and upgrading change by integrating blockchain, and the fields of identity verification and cross-border payment also show a tendency toward technology integration (He Pu et al., 2017). Nowadays, China vigorously develops blockchain technology and promotes its combination with the real economy, and promotes the transformation of traditional industries through a series of high and new technologies such as blockchain, Internet of Things, and cloud computing, gradually forming digital finance, smart government, smart agriculture, smart medical and smart transportation industrial systems. Major cities across the country have explored blockchain vertical industry landing application scenarios and the industry is booming. Internet companies led by Tencent have launched electronic signature platforms using blockchain technology, actively exploring the field of smart contracts and continuously gaining technical breakthroughs. However, against the benchmark of other countries, China has not been able to realize the large-scale application of blockchain technology on the ground.
- Eastern regions: application scene landing > multi-entity cooperation > industry chain > international cooperation. The eastern region actively responds to the national policy, combines the characteristics of regional development and actively explores new possibilities of blockchain data storage and flow applications. Beijing, Shenzhen, Zhejiang, and other eastern provinces have achieved a number of representative application results in foreign trade, public transportation, and government systems and put them into full use, with significant leading advantages compared to central and western regions. At the same time, the relevant policy emphasizes the cooperation of multiple subjects, attracting multiple subjects such as government, industry, academia, research, capital, and use to join and mobilize the participating subjects to jointly promote the development of

blockchain technology and industry. However, it is worth noting that in the context of globalization, the policy system in the eastern region still needs to be supplemented with measures to promote international exchange and cooperation, so as to more quickly promote the development of blockchain technology research and industrial integration.

- Central regions: application scenario landing > multi-entity cooperation. The text coverage rate of application scene landing is as high as 71.08%, much higher than the cooperation of multiple subjects. The layout differences between provinces are focused according to regional development plans and directions. Hunan Province focuses on the incubation role of industrial parks, focusing on the comprehensive exploration of blockchain technology applications, and has developed application projects such as notary confirmation, food traceability, smart travel, and project cloud supervision, and is far more active than the other five central provinces. Blockchain technology can be targeted to solve the problems faced by the current food traceability system, such as non-standard information collection, insecure data storage, and difficulty to guarantee the privacy of information exchange (Li M. J et al., 2019), and under the influence of the epidemic, Hubei Province has paid more attention to the mining of application scenarios for the characteristics of blockchain technology such as immutability and privacy protection and made a significant breakthrough in the food traceability problem.

- Western regions: application scenario landing > international cooperation > multi-entity cooperation > industry chain. From the results, the text coverage rate of application scenarios landing policy tools in the western region reached 184.80%, far exceeding that of the eastern and central regions, which reflects that the western provinces pay more attention to the application-oriented nature of blockchain technology for economic and social development. Under the guidance of the policy, the western provinces have successfully carried out the integration of blockchain technology in the fields of agriculture, tourism and other industries to land. However, compared with the eastern and central regions, there are large differences in development among western provinces. The Chengdu-Chongqing region, which shoulders the mission of western development and national strategies, has been making concerted efforts to build an innovation system, create innovation carriers, and vigorously promote the deep integration of industry, academia and research and the gathering, upgrading and effective use of various innovation resources, so it has made greater achievements in key core technology breakthroughs and industrial development, but other provinces have not been able to However, other provinces have not been able to realize the large-scale application of technology integration projects. With the gradual implementation of the national policy of opening up to the outside world, the western provinces have paid particular attention to the use of international cooperation as a policy tool. For example, the "Guangxi Zhuang Autonomous Region Blockchain Industry and Application Development Plan" clearly proposes to actively participate in blockchain international exchange and cooperation.

In summary, from the viewpoint of demand policies, both national and local governments pay great attention to the industrial application of blockchain technology on the ground. Besides, the integration of blockchain technology with existing industries under policy support will certainly accelerate and achieve breakthrough growth.

5 Policy Recommendations

Taking blockchain as an example, this study conducts a regional comparative analysis of innovation policies for key core technologies at the national and local government levels. It finds that China's

regional innovation policies for key core technologies uphold the goal-oriented principle, with different characteristics of regional innovation policy tool selection. However, regional policy synergy and degree of integration are minimal. Combined with the status of the economic development level of each region and industrial scale structure and layout etc., the following suggestions are made for the construction and improvement of China's key core technology innovation policy system.

5.1   Doing Top-Level Planning

Lin Yifu argues that emerging information technology empowers traditional industries to achieve convergent applications (Yifu Lin et al., 2010). In the early stage of promoting industrial upgrading, the role of policy is stronger than the market. At present, China's emerging digital industry is developing rapidly and talents and funds are constantly entering the market. Taking blockchain as an example, most provinces and cities have introduced relevant industrial support policies, but only seven provinces such as Hunan and Guizhou have introduced special action plans and programs. In general, the blockchain-specific policies introduced in the central and western regions as well as at the national level are not enough and do not form a complete policy system. The specific planning and requirements for key core technologies and industrial development need to be further strengthened. To actively respond to the "14th Five-Year Plan" period, a good job of blockchain, artificial intelligence, cloud computing, network security and other key core technologies and industry top-level design should be done. We should also accelerate the introduction of special support policies. For the key core technology frontier areas, we should provide guidance, planning, and supervision in industrial ecology and application scenarios to ensure the healthy development of the industry.

5.2   Taking Into Account the Use of Various Policy Tools and Paying More Attention to Basic Research on Technological Innovation

It finds that both the central and local governments focus on the use of demand policies tools in the sub-category of application scenario landing, which indicates that both the central and local governments emphasize the industrial nature of blockchain. Excessive selection bias will lead to the phenomenon of obvious short-term effects but insufficient long-term reserve power, so it is necessary to balance the use of various policy tools and continuously optimize the internal structure of policy tools. The root of scientific and technological innovation lies in basic research. General Secretary Xi Jinping pointed out that strengthening basic research is an inevitable requirement to achieve self-reliance and self-improvement in China's science and technology. While formulating policy guidelines to promote the development of industrial integration of key core technologies, the government should develop policy tools with visibility and effectiveness emphasizing rooted basic research, coordinate the construction of science and technology innovation platforms, mobilize the innovation vitality of the main bodies of industry and academic research, gather high-level scientific and technological talent and focus on winning the battle of key core technologies.

5.3   Strengthen Regional Integration to Create an Inclusive and Open Innovation Environment

The breakthrough of key core technologies requires a good innovation atmosphere and environment. By analyzing the content of policy texts, it is found that the blockchain industrial policies at the local level are slightly convergent, with obvious regional distinctiveness. The use of policy instruments at the national level as well as in the eastern and Central regions ranked high in terms of the share of environmental policies. As for the use of supply policies, the text coverage rate in the eastern regions is significantly higher than that in other regions. Demand policies involve less content and are mainly distributed in the western regions. As the integration process of the Guangdong-Hong Kong-Macao

Greater Bay area and Chengdu-Chongqing Economic Circle continues to accelerate, regional policies should also be synchronized and the government should adhere to an open and tolerant attitude so as to create an inclusive and open innovation environment and provide a boost to technological and industrial development. The eastern provinces and cities have obvious advantages in terms of location, but the type of policy tools introduced for international cooperation is less used. In the face of severe international competition, the eastern regions should take advantage of their own international resources and advantages. At the same time, they should take the initiative to carry out exchanges and cooperation with internationally developed countries and regions on talent and technology to focus on achieving innovation in "neck" technology.

In the 14th Five-Year Plan period, the key core technology policy development should take into full consideration both the supply-side structural reform, but also to do a good job of demand management based on their own needs to develop policies with operability and implementation and give full play to the demand for market pull utility. We should strengthen regional policy synergy and industrial synergy among Guangdong, Hong Kong, Macao, Yangtze River Delta, Pearl River Delta, and Chengdu-Chongqing dual-innovation economic circle to create a highland of key core technologies and industrial clusters and innovation curators. Creating an inclusive and open innovation environment not only can realize the connection among the innovation chain, application chain, and value chain but also will promote the integration and development of key core technologies such as blockchain, artificial intelligence, and Internet of Things.

Acknowledgments

References

Chen Jin, Yang Zhen, Zhu Ziqin. "Cracking the "neck" technology in the 14th Five-Year Plan period: identification framework, strategic shift and breakthrough path[J]. Reform, no.12,pp.5-15,2020.

Chen Huiru, Xiao Xiangze, Feng Feng. Research on weighted co-word networks of science and technology innovation policies - based on rooting theory and policy measurement[J]. Scientology Research,vol.34,no.12,pp.1769-1776,2016.

Ku Shengwei, Wu Huajun, Wu Qinqin, Yu Xianwen. Innovation-driven and core technology breakthrough are the cornerstone of high-quality development[J]. China Soft Science,no.10,pp.9-18,2018.

Prahalad C K, Mashelkar R A. Innovation's holy grail[J]. Harvard Business Review, vol.88,no.7-8,pp.132-141,2010.

Frishammar J, Ericsson K, Patel P C. The dark side of knowledge transfer: Exploring knowledge leakage in joint R&D projects[J]. Technovation, vol.41,pp.75-88,2015.

Yuan Yong, Wang Feiyue. Status and outlook of blockchain technology development[J]. Journal of Automation,vol.42,no.04,pp.481-494,2016.

Liang Zheng. From science and technology policy to science, technology and innovation policy-Transformation and reflection on policy paradigm under innovation-driven development strategy[J]. Scientology Research,vol.35,no.02,pp.170-176,2017.

Liu Fengzhao, Sun Yutao. The process, trend and suggestions of the evolution of China's science and technology policy to innovation policy--an empirical analysis based on 289 innovation policies in China[J]. China Soft Science,vol.4,no.05,pp.34-42,2007.

Feng Yimei,Li Zhaoyou,Sun Qingmei.Analysis of the evolution characteristics of China's technological innovation policy in the 21st century[J]. Science and Technology Management Research,vol.37,no.14,pp.46-51,2017.

Li Zihanxin, Zhu Guilong, Liu Aolin. A comparative study of technological innovation policies in China and South Korea - policy objectives, policy instruments and policy implementation dimensions[J]. Science and Technology Management,vol.36,no.04,pp.3-13,2015.

Qu Wan, Feng Haihong, Hou Qinjiang. Research on the evaluation method and application of innovation policy:taking the tax incentives for high-tech enterprises as an example[J]. Scientific Research Management,vol.38,no.01,pp.1-11,2017.

Liu Lanjian, Song Famiao. Combing and evaluation of domestic and foreign new energy vehicle technology innovation policies[J]. Science Management Research,vol.31,no.01,pp.66-70,2013.

Yan Junyin,Chen Xinxin,Hou Mengyang. Research on the evaluation of the effect of regional technological innovation policies--an empirical analysis based on 30 provinces and regions[J]. Industrial Technology Economics,vol.33,no.07,pp.139-145,2014.

Liu Shengyang. Mechanisms of technology innovation policies on regional innovation performance: the case of Henan Province[J]. Geographical Research and Development,vol.39,no.05,pp.30-35,2020.

Huang Cui, Tao Ren, Zhang Jian. Quantitative research on policy literature:a new direction for public policy research[J]. Journal of Public Administration,vol.12,no.02,pp.129-137+158-159,2015.

Song W, Xia F. A quantitative study of local government artificial intelligence industrial policy texts [J]. Science and Technology Management Research,vol.39,no.10,pp.192-199,2019.

Zheng Wenhui. A comparative study of bibliometrics and content analysis[J]. Journal of Intelligence,no.05,pp.31-33,2006.

Qiu Junping, Zou F. A study on content analysis method [J]. Chinese Journal of Library Science,no.02,pp.14-19,2004.

Guo Teng-Yun, Lu Da-Dao, Gan Guo-Hui. A comparative study of China's regional development policies and their effects in the past 20 years[J]. Geography Research,no.02,pp.504-510,2002.

Gao S., Qi X. C.. A study on the development trend of blockchain technology and regional differences based on policy texts[J]. Theory and Reform,no.06,pp.114-129,2019.

Li Qian,Li Haiqin,Guo Jianwei. Quantitative analysis of blockchain policy texts - based on the perspective of policy tools and policy objectives [J]. Finance and Accounting Monthly,no.02,pp.148-154,2021.Dong Shitao,Weng Yuyang,Chen Bofu. Tool structure and industrial development: a textual analysis of China's blockchain policy from the perspective of policy tools[J]. Comparative Economic and Social Systems,no.02,pp.149-161,2021.

Wu Jun, Jiang Shangyangfan, Li Xiaohua. A comparative study of regional 5G industrial policies in China - an analysis based on policy objectives, tools and implementation [J]. Journal of Intelligence,vol.39,no.06,pp.104-112,2020.

Yan Shimei, Yan Shizhi, Zhang Man. Manifestations of gender discrimination in corporate human resource development-an interview study based on content analysis[J]. Management World,no.11,pp.110-118,2008.

Tian Zhilong, Chen Liling, Gu Jialin. The connotation and role mechanism of China's government innovation policy:a content analysis based on policy texts[J]. China Soft Science,no.02,pp.11-22,2019.

Xiao Guangling. Driving innovative development with disruptive technologies and "neck" technologies[J]. People's Forum-Academic Frontier,no.13,pp.55-61,2019.

Chu, Ruigang. Deconstructing and reconstructing environmental innovation tax policy: from a single tool to a combination of tools [J]. Science and Technology Progress and Countermeasures,vol.35,no.10,pp.107-114,2018.

He Pu, Yu Ge, Zhang Yanfeng, Bao Yubin. A prospective review of blockchain technology and applications[J]. Computer Science,vol.44,no.04,pp.1-7+15,2017.Li M. J., Wang D., Zeng S. S., Bai Q. L., and Sun Y. J. Blockchain-based food safety traceability system design[J]. Food Science,vol.40,no.03,pp.279-285,2019.

Yifu Lin, Qiang Gong. Development strategy and economic system choice [J]. Management World,no.03,pp.5-13+187,2010.

Website References

"The central government of the People's Republic of China Xi Jinping stressed during the 18th collective study of the Central Political Bureau to take blockchain as an important breakthrough in independent innovation of core technologies to accelerate the development of blockchain technology and industrial innovation," http://www.gov.cn/xinwen/2019-10/25/content_5444957.htm.(2019-10-25).

"Xinhua. Xi Jinping: Speech at the 20th Congress of the Chinese Academy of Sciences, the 15th Congress of the Chinese Academy of Engineering, and the 10th National Congress of the Chinese Association for Science and Technology," http://www.xinhuanet.com/politics/leaders/2021-05/28/c_1127505377.htm.(2021-05-28).

"National Bureau of Statistics of the People's Republic of China. Methodology for the division of eastern-western central and northeastern regions", http://www.stats.gov.cn/ztjc/zthd/sjtjr/dejtjkfr/tjkp/201106/t20110613_71947.htm.(2011-06-13).

Economic Daily. What value comes from the crypto asset trend [EB/OL]. (2021.4.20) [2021-05-16]. http://paper.ce.cn/jjrb/html/2021-04/20/content_442053.htm.