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Textual Quantitative Analysis and Suggestions on China's Integrated Circuit Industry Policies

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Abstract

The integrated circuit industry, as the core and foundation of the information technology industry, plays an irreplaceable strategic role in promoting economic and social development and safeguarding national security. China attaches great importance to the development of this industry and has formulated and continuously improved a large number of relevant industry policies. This paper employs quantitative analysis methods such as text mining to systematically analyze China's integrated circuit industry policies from multiple dimensions including policy time distribution, issuing authorities, types of issuance, theme recognition, and policy tools.The research findings are as follows: China's integrated circuit industry policies have gone through three stages: exploration, acceleration, and rapid development. The types of policies are increasingly diverse but dominated by "notices" as the main form of issuance. Policy formulation shows a trend of inter-departmental cooperation, with the Ministry of Finance, the National Development and Reform Commission, and other departments playing a leading role. Policy themes mainly focus on enterprise support, technological innovation, production incentives, research management, talent development, and intellectual property protection. Policy tools are predominantly supply-side oriented, with fewer demand-side tools being utilized, and different stages emphasize adjustments in tool combinations.Based on this, the paper proposes suggestions such as strengthening inter-departmental coordination mechanisms, dynamically optimizing the combination of policy tools, consolidating talent and intellectual property foundations, closely monitoring cutting-edge dynamics and timely adjusting policies, enhancing the systematic, targeted, and execution-oriented nature of policies, aiming to provide beneficial reference for further optimizing and improving China's integrated circuit industry policies.

Keywords

Integrated circuit policies, policy tools, policy themes, quantitative evaluation.

1. Introduction

Integrated circuits, as a strategic foundation of contemporary information technology industry, have become an important indicator of a country's scientific and technological strength and overall national power[1]. The level of development of the integrated circuit industry directly determines the prospects of the information technology industry and plays an irreplaceable strategic role in promoting a new round of technological revolution and industrial transformation, and achieving high-quality economic development[2]. In recent years, with the continuous breakthroughs in emerging technologies such as artificial intelligence, 5G communication, and big data, the integrated circuit industry has shown a rapidly evolving

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development trend, becoming a new high ground for countries to actively deploy and compete[3]. As a major player in the integrated circuit industry, the Chinese government attaches great importance to its development. Since the 1980s, the country has continuously introduced relevant policies to promote the development of the integrated circuit industry, creating a favorable environment for its sustained and healthy development[4]. Entering a new era, China further establishes the integrated circuit industry as a leading and foundational strategic industry, proposing to accelerate the promotion of independent innovation in integrated circuits and achieve breakthrough development[5].

Systematically sorting out and deeply analyzing national-level integrated circuit industry policies is of great theoretical and practical significance for comprehensively grasping the development trajectory of policies, clarifying the root causes of existing problems, and proposing targeted policy recommendations. In view of this, this paper intends to use quantitative analysis methods such as text mining to systematically sort out and analyze China's integrated circuit industry policies from multiple dimensions including policy time distribution, issuing authorities, types of issuance, theme recognition, and policy tools, aiming to provide beneficial references for further optimizing and improving China's integrated circuit industry policies.

2. Literature Reviewt

Previous studies on integrated circuit industry policies have mainly relied on econometric modeling and content analysis. In terms of econometric modeling, J.F.Sun et al. [6] employed entropy weighting to determine the weights of various indicators based on cross-sectional data of integrated circuit enterprises. They then utilized dynamic panel models to analyze the impact of tax incentives on these indicators, providing policy recommendations based on their results. B.H.Guo et al.[7] measured the development level of key core technologies using patent data, and further decomposed policies based on these core technologies. They subsequently employed regression models to analyze the impact of policy measures and coordination on the development level of key core technologies. Additionally, some scholars have used correlation analysis to examine the relationship between industrial policies and industrial competitiveness[8].In terms of content analysis, research can be divided into qualitative and quantitative studies. J.Zhu et al.[9] conducted a comparative analysis of industrial policies and financial support policies among various provinces to provide recommendations for policy formulation in Beijing. X.K.Yu et al.[10] compared domestic and foreign policies to draw on advanced foreign experiences, providing targeted suggestions for optimizing China's policy system. Some studies have focused on tax policies, analyzing the entire process of adjusting and improving tax incentives and financing policies, as well as the problems encountered in implementation. They have also drawn on advanced foreign experiences to provide insights for improving tax policies[11][12]. In terms of quantitative research, D.H.Qiu et al.[13]conducted a statistical study on national-level integrated circuit innovation policies from the perspective of policy tools, proposing improvements to industrial innovation policies by strengthening market management and enhancing independent innovation. Y.H.Tao et al.[14]analyzed the characteristics of key technology innovation policies in eastern, central, and western China from the perspective of policy tools, and provided optimization suggestions for breakthroughs in key core technology innovation. W.C.Zhang et al.[15] extracted information on industrial policies from the dimensions of policy tools, research and development, application, and policy objectives, providing reference for enterprises, efficiency, and research institutions. Q.Luo et al[16] utilized co-occurrence word networks to categorize policy quantities, issuance themes, and policy focuses by stage, and proposed a series of suggestions for improving the policy system.

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Although existing research has made many valuable explorations into integrated circuit industry policy research, it mainly focuses on a single policy type or a certain aspect of analysis. Currently, there is a lack of research that simultaneously considers the temporal context of policy development, characteristics of issuing bodies and types, thematic connotations, and tool applications, and comprehensively grasps industrial policies. In particular, there is scarce research that traces the evolution trajectory of policy themes over time from the perspective of policy text. This study aims to employ quantitative analysis methods such as text mining to systematically analyze China's integrated circuit industry policies from multiple dimensions such as policy time distribution, issuing bodies, issuing types, theme identification, and policy tools. It aims to comprehensively review the policy development process, deeply analyze the content framework of policies, and provide reference basis for understanding the characteristics of China's integrated circuit industry policies and future optimization and improvement.

3. Research Design

3.1. Research Approach

This study focuses on national-level integrated circuit industry policies and utilizes various quantitative analysis methods. Firstly, the temporal context of policy issuance, distribution of issuing departments, and characteristics of document types are analyzed through descriptive statistics. Secondly, the BERTopic topic modeling technique is employed to conduct topic mining on policy texts, identifying thematic areas and analyzing the evolving trends of each topic's strength. Finally, a multidimensional analysis of policy tool usage is conducted to clarify the application characteristics of different types of tools in terms of total quantity and stage, revealing the government's orientation in industrial policy formulation.

3.2. Data Collection

In this study, policy texts were collected from central government department websites (excluding local government websites) using keywords such as "integrated circuit," "chip," "IC," and "semiconductor" for policy retrieval. Additional policy documents were supplemented from databases such as CNKI (China National Knowledge Infrastructure), PKU Law China, and PKU Law Vision. For policies that were already repealed or unavailable on official websites and databases, supplementary searches were conducted using related clauses obtained from existing policy texts to obtain policy names and document numbers, followed by searches on Baidu. To avoid duplicate or irrelevant collection of policy texts and improve the relevance of the research, only documents classified as laws, regulations, plans, outlines, opinions, notices, announcements, methods, and regulations were retained. After manually deleting duplicates, irrelevant, and non-official decision-making documents, documents whose titles did not contain keywords such as "integrated circuit," "chip," "IC," or "semiconductor" but whose content included integrated circuit industry policy content were retained, and 106 valid policy documents related to integrated circuits were ultimately selected as research objects. The distribution of integrated circuit industry policies over time is shown in Fig.1.

From the perspective of the quantity of policy issuance over time, China's overall policy issuance shows a fluctuating growth trend, with stage peaks in policy issuance reached in 2001, 2012, 2016, and 2021, roughly coinciding with the start of China's five-year plans. Based on the changes in policy issuance quantity and the actual development of the industry, China's integrated circuit industry policies can be roughly divided into three stages:

Preliminary exploration stage (1980s to late 20th century): China began to pay attention to the integrated circuit industry from a policy perspective as early as 1987. However, due to the

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overall low level of the national economy at that time and the weak foundation of the integrated circuit industry, relevant policy issuance was not active.

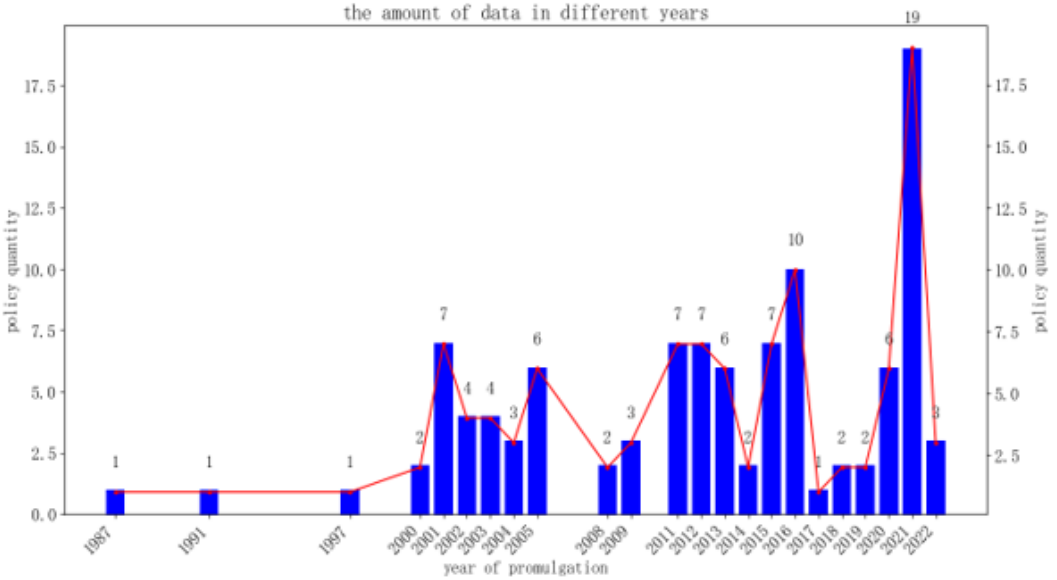

Fig.1 Annual Statistics of integrated circuit Industrial policy，1997-2022

Accelerated development stage (early 21st century to 2010): Starting from the year 2000, with the improvement of industrial technological capabilities and the introduction of relevant policies by the State Council, the government's attention to the integrated circuit industry significantly increased, leading to a substantial increase in the number of policy issuances. During the period from 2000 to 2010, China's integrated circuit production achieved a slight increase.

High-speed development stage (2011 to present): Entering the period of industrial transformation and upgrading, the demand for the development of the integrated circuit industry accelerated, and related industry policies also entered a period of significant growth. Especially since 2018, faced with pressure from foreign technology blockades, China's integrated circuit policy issuance has reached a new high, aiming to accelerate the promotion of independent innovation and high-quality development in this field.

4. Multidimensional Exploration of Policies

4.1. Analysis of Policy Issuing Authorities

Policy issuing authorities refer to government departments responsible for formulating and issuing policy documents. Through in-depth analysis of these authorities and their collaboration patterns, we can effectively reveal the distribution of departments involved in the formulation of integrated circuit industry policies, the relative positions of each department within the system, and the dynamics of cooperation among them[17]. The statistics of independently issued and jointly issued policy documents are shown in Table 1 below.

Table 1 Statistical analysis table of the number of policies issued independently and jointly.

Department	Quantity	Join	Department	Quantity	Join
Ministry of Finance	44	39	Tariff Department	2	0
State Administration of Taxation	38	22	National Natural Science Foundation of China	2	0
Ministry of Industry and Information Technology	38	25	National Health and Family Planning Commission	1	0
National Development and	30	28	State Administration for	1	0

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Reform Commission			Market Regulation		
State Council	16	2	Ministry of Personnel	1	0
General Administration of Customs	12	11	Standardization Administration of China	1	1
Ministry of Science and Technology	9	8	Ministry of Housing and Urban-Rural Development	1	0
State Intellectual Property Office	9	9	Academic Degrees Committee of the State Council	1	1
Ministry of Human Resources and Social Security	7	4	National Health Commission	1	0
Ministry of Education	5	5	Department of Occupational Skill Testing	1	0
Ministry of Commerce	4	4	China Banking and Insurance Regulatory Commission	1	1
Inspection and Quarantine	2	2	National Development and Reform Commission	1	1
National Gold Card Project Coordination Group	3	2	Central Cyberspace Affairs Commission	1	0
National Bureau of Foreign Experts Affairs	2	2	China Personal Names Database	1	1
Ministry of Ecology and Environment	2	1			

From the perspective of the number of issuing authorities, central government departments are widely involved in the formulation and issuance of policies related to the integrated circuit industry. Twenty-nine central issuing authorities have played significant roles, with the Ministry of Finance issuing the most policy documents, accounting for approximately one-fifth of the total. The State Taxation Administration, the National Development and Reform Commission, and the Ministry of Industry and Information Technology also rank high in terms of the number of issued documents, playing critical roles. Twenty departments participated in joint issuance of documents, reflecting the necessity of interdepartmental collaboration in the formulation of integrated circuit industry policies. The participation of some smaller or specialized departments, such as the General Administration of Customs and the National Natural Science Foundation of China, although limited in the number of issued documents, reveals their broad coverage in industrial policy, involving finance, taxation, industry, technology, education, commerce, and many other aspects.

4.2. Analysis of Policy Issuance Types

Policy types refer to the forms of legally binding documents issued by the government or relevant public authorities. In this study, the types of policies were categorized based on the titles and content of 106 policy samples collected over the years[18],The results are shown in Table 2.

Table 2 Statistical Table of Types of IC Industry Policies in China (Unit: Articles)"

Type	Quantity	Percentage	Type	Quantity	Percentage
Notification	48	45.28%	Regulation	3	2.83%
Measure	13	12.26%	Standard	3	2.83%
Plan	9	8.49%	Rules	2	1.89%
Announcement	9	8.49%	Provisions	2	1.89%
Guideline	6	5.66%	Outline	2	1.89%

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Opinion	4	3.77%	Regulations	1	0.94%
Program	4	3.77%			

From the results of policy types, China's integrated circuit industry policies mainly include 13 types of documents such as "notice," "measures," "plans," "announcements," "guidelines," "opinions," and "schemes," covering a wide range of document types. At the national level, policies have been issued not only strategic plans and guidelines but also a series of schemes and notices based on the actual development of the industry, considering the practical operability. Overall, the policies issued focus on both macro-level goals and development plans as well as micro-level specific operations and implementation details, adopting a combination of "soft" and "hard" measures. In terms of policy effectiveness, "notices" account for the largest proportion at 45.28%, indicating that China's integrated circuit industry policies are mainly issued in this form, which is more specific, formal, and has stronger enforcement power. In addition to "notices," although there are also policies issued in the form of "regulations," "standards," and "provisions," their proportion is relatively small. This indicates that over the past 30 years, there have been relatively few inefficient policy documents, and efficient, guiding policy documents are more common.

From Fig.2, it can be observed that during the initial development stage of the integrated circuit industry, China's policy types were limited to the single form of "notices." However, entering the 21st century, with the gradual growth of the industry, China's integrated circuit industry policies have shown a trend towards diversification. During the acceleration phase, the forms of policy texts gradually expanded, encompassing not only the initial "notices" but also including various forms such as "measures," "announcements," "regulations," and "provisions," as shown in Figure 5. As we transitioned into the high-speed development phase, the forms of policies further expanded to include "opinions," "guidelines," "schemes," and "standards," among others. Although "notices" still dominate as the main form overall, the number of other policy types has also significantly increased. This indicates that China's integrated circuit industry policies are gradually becoming more diverse and systematic, with continuous improvements in the policy system, making policy formulation more comprehensive.

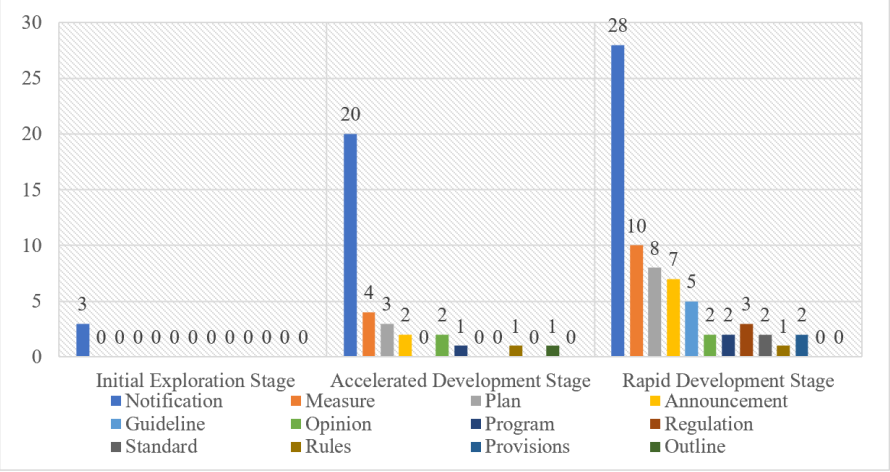

Fig.2 Distribution of policy types at different stages

4.3. Theme Analysis

4.3.1. Theme Identification

Policy theme mining aims to analyze and process policy texts to clarify the main themes and relevant information of policies, understand the focus and direction of policies, and identify existing problems and contradictions in policies, thereby formulating more effective policies. In this study, the BERTopic model was used to mine the themes of policy texts, and the

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BERTopic library in the Python language was employed for this purpose. In the data preprocessing stage, the policy texts were tokenized and stop words were removed using the Jieba tokenizer in Python. Multiple stop word lists were merged and duplicates were removed to form a custom stop word list for this project, which also included a custom word list. In the training stage, the processed data was input into the pre-trained bert-base-chinese language model for text embedding, resulting in 768-dimensional word vectors. To facilitate better clustering by the HDBSCAN algorithm, the UMAP algorithm was used to reduce the dimensionality of word vectors to 15 dimensions. After testing, the min_cluster_size parameter of the HDBSCAN algorithm was set to 5, resulting in the identification of 6 themes. Finally, the c-TF-IDF algorithm was used to calculate the c-TF-IDF values of the vocabulary under each theme, in order to obtain keywords for summarizing the themes. Through the BERTopic theme model, 6 themes were generated for the policy texts related to integrated circuits. Figure 6 displays the results of theme extraction and the top 10 characteristic words for each theme in the form of a bar chart.

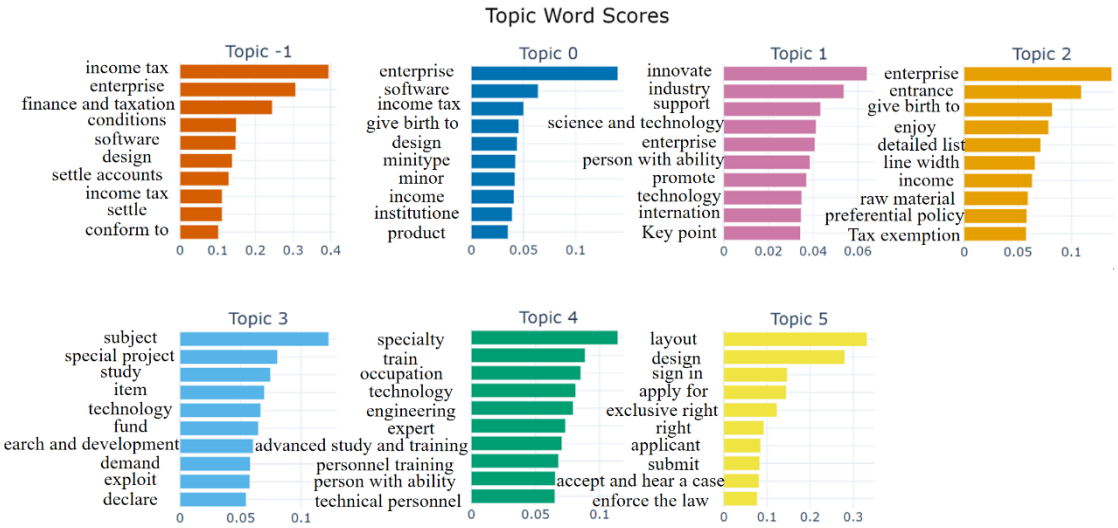

Fig.3 Integrated circuit industrial policy topic extraction results

Based on the results shown in

Fig.3, the keywords of Topic0, such as "enterprise," "institution," "micro," and "small and medium-sized," represent companies engaged in the field of integrated circuits. Keywords like "production" and "design" indicate crucial areas in the integrated circuit industry. Terms like "income" and "income tax" reflect policies aimed at reducing the cost burden on companies through comprehensive support, which can be summarized as "support for enterprise development."Topic1 covers keywords related to technology, innovation, industry, support, science and technology, and emphasis. Terms like "innovation," "technology," and "science and technology" highlight the theme's focus on promoting technological innovation in integrated circuits. "Industry," "emphasis," and "talents" indicate support for industry development, emphasizing not only the promotion of technological innovation but also the cultivation of high-quality talent teams. Additionally, the keyword "international" expresses an internationalization strategy as a core aspect of the policy, which can be summarized as "technology innovation and introduction."Topic2's keywords cover various aspects such as enterprises, imports, production, enjoyment, list, linewidth, income, raw materials, preferential policies, and tax exemptions. Terms like "imports," "production," "raw materials," and "list" mainly focus on the need for imported raw materials in the production process of the integrated circuit industry. Keywords such as "enterprise," "enjoyment," "income," "preferential policies," and "tax exemption" express tax incentives and tax exemption policies for integrated circuit enterprises, which can be summarized as "import and production incentives."Topic3's

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keywords cover multiple aspects of project design and application in the integrated circuit industry. This theme focuses on the entire lifecycle of projects in the integrated circuit industry, covering aspects from design application to research and development, and then to funding, which can be summarized as "research project management." The keywords of Topic4 include talents, engineering, specialties, training, technology, talent cultivation, training, science and technology, advanced, and technical personnel. This theme focuses on promoting industry development through technological innovation and talent cultivation in the integrated circuit industry, which can be summarized as "talent team construction."Topic5's keywords express the timely application and registration of integrated circuit layout designs to protect intellectual property rights. Keywords like "acceptance" and "law enforcement" express the crac.

4.3.2. Theme Intensity

The sum of probabilities of all policy documents-topics obtained from the BERTopic model for the integrated circuit industry is used as the theme intensity, and a trend chart of theme intensity evolution is plotted (as shown in Fig.4). Overall, the intensity of each theme fluctuates significantly at different time points but exhibits certain stage-specific characteristics.

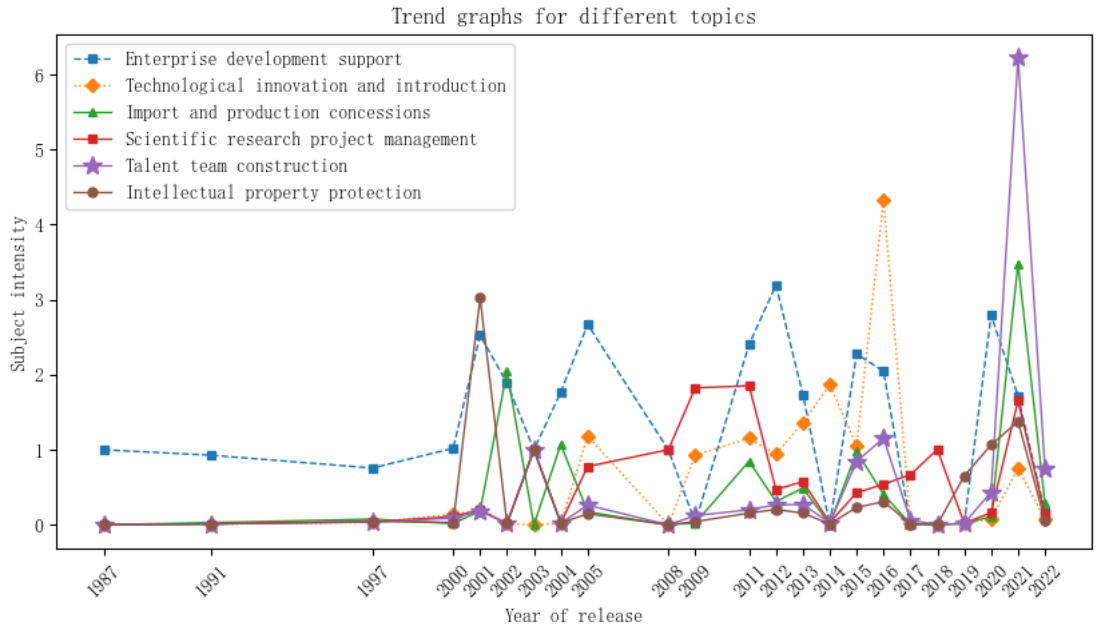

Fig.4 Trend of change in the intensity of IC industry policy themes

During the initial exploration stage, due to the weak foundation of the integrated circuit industry, the overall intensity of policy themes remains relatively low, mainly focusing on infrastructure construction and initial technical support, preparing for industry initiation. In the acceleration development stage, as the integrated circuit industry gradually grows, the government places high importance on two major themes: "support for enterprise development" and "technology introduction and innovation." Through measures such as tax incentives and financial investment, direct support for enterprise development is vigorously promoted. At the same time, active introduction of advanced foreign technology is encouraged to promote independent innovation and enhance industry technological capabilities. In the high-speed development stage, as the industry enters a period of transformation and upgrading, policy themes further diversify. The intensities of themes such as "construction of talent teams" and "protection of intellectual property rights" show significant increases in this stage,

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reflecting the government's recognition of the importance of high-quality talent teams and intellectual property protection for sustainable industry development. The intensity of the theme "management of research projects" also increases, reflecting the policy orientation of increasing investment in scientific research.

In terms of the content of each theme, "support for enterprise development" focuses on promoting enterprise growth and strength through measures such as tax incentives and financial support. "Technology introduction and innovation" aims to promote independent control of key core technologies through technological innovation, talent introduction, and international cooperation. "Import and production incentives" provide policy support for the production process of enterprises. "Management of research projects" comprehensively standardizes the entire process of research projects. "Construction of talent teams" emphasizes the cultivation and introduction of high-end talents. "Protection of intellectual property rights" focuses on the protection and enforcement of intellectual property rights.

4.4. Policy Tool Analysis

This study adopts the policy tool classification standards proposed by Rothwell et al. [18] and refers to integrated circuit-related research[19][20][21][22], categorizing policy tools for the integrated circuit industry into three types: supply-side, environment-side, and demand-side. Supply-side policy tools directly support industry development from the supply side and can rapidly advance industry objectives. These tools directly affect various factors needed by the industry. Environment-side policy tools indirectly influence industry development by creating a favorable development environment conducive to industry revitalization. Demand-side policy tools provide markets for industry products and technologies from the demand side, focusing on actual needs and enhancing industry vitality. Combining with national-level integrated circuit industry texts, this study further classifies its industrial policy tools into secondary categories. The specific classification is shown in Table 3. Utilizing Nvivo12 software, 106 policy documents were coded, resulting in 636 coding nodes. The policy text content was standardized and encoded according to "policy number-chapter number-article number."

Table 3 IC Industrial Policy tools and descriptions

Primary Tools	Secondary Tools	Description
Supply-driven	Infrastructure	By constructing research and development centers, key laboratories, national engineering laboratories, and international talent training bases, etc.
	Technology support	Through importing technological equipment, process research and development, key core technology research and development, and the construction of major scientific and technological projects, etc.
	Talent cultivation	By building talent training mechanisms, introducing overseas talent, and improving talent incentive systems, etc.
	Capital investment	The government promotes the development of the integrated circuit industry through direct special funds and development funds.
	Intellectual property services	Through establishing patent and trademark applications, intellectual property transactions, and legal affairs, etc.
Environment-driven	Industry-university-research collaboration mechanism	Through government guidance, a cooperation mechanism among enterprises, research institutions, and scientific research institutions is established to promote the coordinated development of the integrated circuit industry chain.
	Financial support	Integrated circuit enterprises are encouraged to issue bonds and allowed to obtain loans. Financial institutions improve financial services, intellectual property pledges, etc.

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Demand-driven	Tax incentives	Corporate income tax and business tax are reduced or exempted for integrated circuit enterprises, and import taxes on equipment and materials are exempted, etc.
	Industry regulation	By setting industry goals, overall planning, as well as enterprise certification and mergers and reorganizations, etc.
	Service outsourcing	Vigorously developing and undertaking service outsourcing to promote the export of integrated circuits.
	International cooperation	Through specialized cooperation agreements, assisting enterprises in establishing overseas branch institutions, advocating for talent to go abroad for exchanges and learning, etc.
	Trade control	Through exempting import and export tariffs, bonded policies, and introducing customs clearance facilitation measures, etc.
	Promotion and application	Increasing efforts to promote innovative integrated circuit products, and promoting the demonstration and application of key products to drive continuous upgrades of technology and industry.

4.4.1. Overall Analysis Based on Policy Tools

The statistical results of policy tools based on standardized coding of policy content are shown in Table 4. Overall, China's integrated circuit industry policies exhibit a predominance of supply-side policy tools, followed by environment-side policy tools.

Table 4 Overall Distribution of Policy Tools

Primary Tools	Secondary Tools	Number of Policies	Number of Reference Points	Type Percentage
Supply-driven	Infrastructure	22	54	8.49%
	Technology support	46	110	17.30%
	Talent cultivation	34	58	9.12%
	Capital investment	32	46	7.23%
	subtotal	57	268	42.14%
Environment-driven	Intellectual property services	25	35	5.50%
	Industry-university-research collaboration mechanism	17	20	3.14%
	Financial support	21	48	7.55%
	Tax incentives	52	75	11.79%
	Industry regulation	43	86	13.52%
	subtotal	81	264	41.51%
Demand-driven	Service outsourcing	4	5	0.79%
	International cooperation	13	22	3.46%
	Trade control	24	29	4.56%
	Promotion and application	27	48	7.55%
	subtotal	50	104	16.35%
	total	106	636	100.00%

Environmental policy tools account for 41.51% of the overall policy tools, and are widely applied, creating a favorable external environment for industrial development. Especially in areas such as tax incentives and industry management, the government plays a crucial role. On one hand, it alleviates the burden on enterprises, stimulating innovation vitality; on the other

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hand, it exercises control and guidance over the direction of industrial development, promoting orderly and healthy growth. Supply-side policy tools exhibit significant internal differences, which is closely related to the characteristics of the integrated circuit industry as a strategic emerging industry for the country. Due to the long development cycle, high risks, and large capital investment involved in integrated circuit technology, it is difficult to rely solely on market forces for support. Therefore, the government provides direct impetus to industry development through supply-side tools such as capital investment, technological support, and talent cultivation. Among supply-side tools, technological support is most frequently used, as China's integrated circuit industry started relatively late and faces challenges with core technology constraints, urgently requiring technological support to drive independent innovation and achieve breakthroughs in key technologies. Demand-side policy tools receive insufficient attention, accounting for only 16.35% of the total, far lower than supply-side and environmental policy tools. This is related to China's long-standing industrial orientation towards supply-led development, with lagging demand. This is primarily reflected in the extensive use of policy tools for promoting application, emphasizing the practical application and dissemination of technological products, and highlighting commercial utilization. However, the application of demand-stimulating tools such as service outsourcing is insufficient, which may affect the traction between the government and the market. As an important demand-side tool, service outsourcing can provide technological and industrial supplements, introduce external resources, and accelerate industrial development processes.

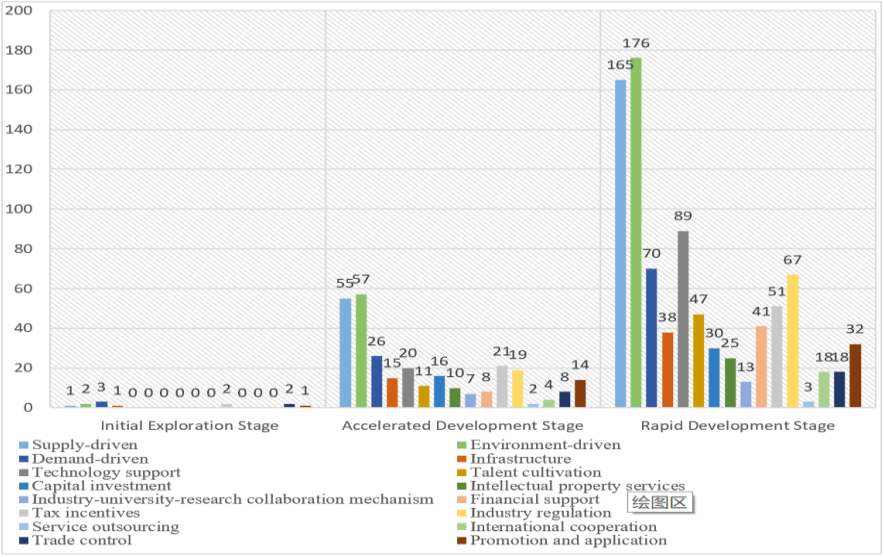

Fig.5 Distribution of Policy Tools at Different Stages

4.4.2. Stage-based Policy Tool Analysis

From Fig.5, it can be observed that during the initial exploration stage, the focus was on infrastructure development and initial technological support, which aligned with the actual needs of the industry's initial phase, laying the groundwork for subsequent development. During the accelerated development stage, there was a significant increase in the use of supply-side and environmental policy tools, reflecting the government's intensified efforts to support the industry. Supply-side tools focused on capital investment, talent cultivation, etc., aiming to enhance independent innovation capabilities; environmental policy tools emphasized tax incentives, etc., to optimize the development environment. This aligns with the urgent situation at that time where China's integrated circuit industry was catching up with developed countries. In the high-speed development stage, on top of the existing tools, there was a noticeable increase in the frequency of talent cultivation and industry management usage. This is because with the expansion of the industry scale, the demand for talent is increasing, and naturally, the application of talent tools is expanding; at the same time, for orderly and healthy development,

the role of industry management is becoming increasingly prominent. It can be seen that the government's tool selection closely matches the real needs of different stages. Overall, the choice of policy tools for China's integrated circuit industry is generally reasonable, but there is still room for optimization in terms of supply-demand balance, tool combinations, etc., requiring continuous improvement based on changing circumstances.

5. Conclusion

This study conducted a quantitative analysis of China's integrated circuit (IC) industry policies from multiple perspectives and angles, comprehensively reviewed the timeline of policy development, the collaborative pattern among policy-making entities, the focal points of thematic content, and the policy orientation in tool selection. It provided data support and analytical basis for grasping the characteristics of China's IC industry policies and directions for future improvement. The following conclusions are drawn:

(1) China's IC industry policies have gone through preliminary exploration, accelerated development, and high-speed development stages, with a fluctuating growth trend in the number of policies. Policy types have become increasingly diverse, mainly concentrated in notifications, plans, and methods.(2) Policy formulation exhibits a pattern of cross-departmental coordination, with the Ministry of Finance, the National Development and Reform Commission (NDRC), and other departments playing leading roles. However, there is still room for improvement in the level of cooperation among some departments.(3) IC industry policies generally focus on six main themes: support for enterprise development, technology innovation and introduction, import and production incentives, research project management, talent team construction, and intellectual property protection.(4) Policy tools are primarily supply-side, followed by environmental, with technology support being the most utilized within supply-side tools. Demand-side policy tools receive inadequate attention, necessitating increased efforts.(5) Different stages of development witness adjustments in the focus of policy tools, shifting from infrastructure construction to technology support, talent cultivation, and industry management.

Based on these conclusions, the following recommendations are proposed for China's future formulation and implementation of IC industry policies:

(1) Strengthen cross-departmental coordination mechanisms. Establish a regular inter-departmental joint meeting mechanism to discuss IC industry policies, coordinate planning, clarify division of labor, and avoid policy overlaps. The Ministry of Finance should play a leading role in fiscal and taxation policies, further improving preferential policies such as corporate income tax and import duties to inject more momentum into enterprise innovation and development. The NDRC should increase support for breakthroughs in key technologies, formulate medium and long-term plans for scientific and technological innovation, and support IC enterprises in implementing strategies for independent and controllable development. Leading departments should extensively solicit opinions from other relevant departments and industries before major policy issuance to enhance the foresight and scientificity of decision-making.(2) Dynamically optimize and adjust the policy tool combination. Based on the characteristics of different stages of industrial development, dynamically evaluate the applicability of existing policy tools, timely optimize and adjust the policy tool combination. In the initial stages of industry establishment and technological catching up, focus on supply-side policy support. Once entering a mature stage, increase the deployment of environmental and demand-side policy tools. Vigorously promote demand-driven policy tools such as service outsourcing to create conditions for the commercialization of IC technology and the market promotion of products. Innovatively utilize a combination of multiple policy tools in accordance with actual needs, leveraging the synergistic effects between policy tools.(3) Strengthen the

foundation of talent and intellectual property rights. Increase efforts in the construction of relevant disciplines in the IC field, reform talent cultivation models, and cultivate versatile, internationalized talents. Encourage deep integration of industry, academia, and research, providing more high-quality innovative talents for the IC field. Improve the IC intellectual property rights protection system, perfect patent examination and rights protection mechanisms, strictly punish infringement activities. Develop IC intellectual property rights transactions, explore new financial service models such as intellectual property rights pledge financing, and enhance international cooperation in IC intellectual property rights to enhance China's voice in global governance.(4) Keep abreast of cutting-edge dynamics and adjust policies in a timely manner. Closely monitor the latest technological developments in the IC field, benchmark against international advanced levels, and supplement relevant policy themes in a timely manner. Focus on emerging technologies such as quantum computing, 3D integrated circuits, and formulate strategic policies to support them. Dynamically adjust the focus of support to key support objects according to the evolution of technology routes, avoiding the dissipation of limited resources. Encourage enterprises and research institutions to proactively apply for innovative needs, and ensure that policy themes are mutually verified with practice.(5) Enhance the systematic, targeted, and executable nature of policies. Adhere to the "problem-oriented" principle, formulate precise and effective policy measures according to the actual needs of different industry entities and development stages. Simplify and optimize the policy approval process, improve the accessibility of policy acquisition, and enhance policy operability. Strengthen the supervision and management of policy implementation, establish a mechanism for evaluating and providing feedback on policy effectiveness, and continuously revise and improve policies. Emphasize the seriousness and authority of policies, strictly enforce laws against violations, and enhance the binding and execution of policies.

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