

A Macro-Study on the Development of China's Strategic Emerging Industries in the New Era

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Abstract: The status of strategic emerging industries in China's modern industrial system and their contribution to high-quality economic development are becoming more and more significant. In face of complex domestic and international environments and the situation that China is about to enter the 14th Five-Year Plan period, it is urgently necessary to make macro thinking and strategic positioning on China's strategic emerging industries. The paper carefully analyzes the development situation of emerging industries in developed countries; examines the achievements, challenges, and problems of emerging industries in China; demonstrates the urgent needs and importance of speeding up the development of relevant industries in China; and outlines a general idea about the development in China. China should regard the cultivation and development of strategic emerging industries as an important pillar in the national modern industrial system; ensure the identification, classification and strategic deployment of the neck clamping technologies in the industries; and plan scientifically the regional layout of strategic emerging industries and healthy cultivation of industrial clusters at the national level. Conclusively the paper suggests that China should include strategic emerging industries in the national 14th Five-Year Plan; issue a special plan for the development of strategic emerging industries in the 14th Five-Year Plan; and explore the mechanism of national integrated system and talent cultivation and sharing.

Keywords: strategic emerging industries; macro research; industrial system; industrial clusters

1 Introduction

Today, a new round of technological and industrial revolutions is sweeping across the world, taking on many new features and bringing profound changes to industrial form, core industrial factors, and the competition paradigm. Global scientific and technological innovation has entered a new stage characterized by multi-point breakthrough, group outbursts, and continuous advent of disruptive technologies. This has given birth to new technologies, business patterns, and models, making an unprecedented profound impact on the traditional mode of production and lifestyles. As usual, the world's major economies adopt the development of emerging industries as their national strategies. Hence, they increase scientific and technological input, and actively encourage scientific and technological innovation. The US *National Strategic Overview for Quantum Information Science* believes that quantum information technology will lead the next technological revolution and bring significant changes to national security, economic development, and basic scientific research. In addition, the US has formulated a national strategy of developing 5th generation mobile communication technology (5G) and rural networking, advanced manufacturing,

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artificial intelligence (AI), advanced transportation, network security, and the digital economy. Japan regards the Internet of Things (IoT), AI, and robotics as the core of the Fourth Industrial Revolution. In addition, Japan has established a complete R&D promotion mechanism at a national level and rendered more support for aeronautic and astronautic and hydrogen fuel industries. The UK has identified four significant challenges that will enable it to lead the global technological revolution and occupy the forefront of emerging industries, namely, AI and the data economy, clean growth, future transport, and an aging society. Germany is seeking to ensure or regain its economic and technological strength, competitiveness, and industrial leadership of relevant fields domestically, in Europe, and even globally.

Since its reform and opening up, China has achieved rapid economic growth and built an all-round industrial system. However, China's huge industrial system is still at the middle and low ends of the global value chain, and the lack of core and key technologies poses a severe threat to China's industrial security. Strategic emerging industries, which represent the trend of a new round of technological and industrial revolutions, have gained significant momentum in recent years. In China, developing strategic emerging industries is of vital importance to achieving the two centenary goals (i.e., the goal at the centenary of the People's Republic of China and goal at the centenary of the Communist Party of China, CPC) and occupying the commanding heights of international technology and industry. Scholars have conducted several studies on strategic emerging industries. Roughly, the studies concentrate on three aspects: 1) specific emerging industries such as AI, new energy, and digital creativity [1–3]. 2) Development of strategic emerging industries in the Yangtze River Delta, Pearl River Delta, and Beijing–Tianjin–Hebei region [4,5]. 3) Policy support and orientation for strategic emerging industries [6,7]. The aforementioned studies have presented many innovative paths, arguments, and specific measures. In the new situation, however, to the best of our knowledge, there have been no macro studies on the overall development of strategic emerging industries from the perspective of national strategy. Based on extensive survey and project research findings, this study provides an in-depth analysis of the development of strategic emerging industries in China from a strategic, macro, and proactive perspective.

2 Progress and main problems of China's strategic emerging industries

China attaches great importance to the development of strategic emerging industries and has carried out a number of supportive policies. Owing to national and local policy support coupled with the cooperation of enterprises and capital markets, the development of strategic emerging industries in China has presented striking characteristics, such as growing scale, strong growth in key areas, efficient agglomeration of factors, continuous improvement in innovation ability, and continuous perfection of the policy environment. Hence, strategic emerging industries are playing an important role in driving high-quality development of the national economy. By the end of the 12th five-year period, the value-added of strategic emerging industries accounted for 8% of China's GDP, successfully reaching the specified goal. In addition, a number of new technologies, products, models, and business patterns have emerged, providing strong support for stable economic growth, economic reform and restructuring, and people's livelihoods. From 2015 to 2018, the average annual growth rate of value-added of industrial enterprises above the designated size in China's strategic emerging industries reached 10.1%, 3.8 percent points higher than that of China's industrial enterprises above the designated size in the same period, overall. The average annual growth rate of operating revenue of service enterprises above the designated size in China's strategic emerging industries was 15.7%, 3.7 percent points higher than that of China's service enterprises above the designated size in the same period, overall [8]. China has made significant breakthroughs in key technologies such as digital economy, industrial Internet, and AI, and enjoys a world-leading status in next-generation mobile communications, photovoltaics, and nuclear power. In addition, new models and business patterns are emerging successively, and the trend of cross-industry operation is increasingly obvious. Some industrial clusters with distinctive advantages have been formed. In addition, the supporting industrial promotion policy system has been preliminarily established.

Notwithstanding these achievements, the development of strategic emerging industries also encounters various problems. The scale of China's strategic emerging industries still falls short of the goal specified in the 13th Five-year Plan.

2.1 Severe industry homogenization and overcapacity due to inadequate overall planning in national and local policies

China has defined five strategic emerging industries, including next-generation information technology (IT), high-end equipment manufacturing, biotechnology, green and low-carbon technology, and digital creativity;

basically, provincial regions of China concentrate on the development of the five emerging industries. Due to inadequate overall planning in national and local policies, local governments often conduct industrial layout planning only from their own standpoint. This results in severe homogenization and overcapacity in some strategic emerging industries, but lack of key technologies in other strategic emerging industries. Some local governments do not understand the development priority of each strategic emerging industry, merely incorporating various projects into the planning of strategic emerging industries. Some local governments show great enthusiasm for the development of strategic emerging industries. Due to their stereotyped mindset, they still follow the concept of development for traditional industries. Hence, a large amount of capital is invested in the manufacturing at the back end of industrial chains, and they even directly purchase foreign production lines. Meanwhile, many high-end products have to be imported from foreign countries.

2.2 Complete industrial system, which is large but not strong

Since the Sino–US trade conflict, China has gained a more in-depth understanding of the short slab of various industrial chains in China. Core and key technologies are apparently controlled by foreign countries. First, a large number of technological bottlenecks call for a breakthrough; key products (e.g., high-performance aero-engines and high-end chips) need to be imported for a long time, but cannot be produced independently in China. Second, the industrial basic ability is weak in core basic parts, advanced basic technology, and key basic materials, and the industrial upgrading and development ability is far from the independent development ability. Third, the independent innovation ability is yet to be further improved, and there are various deficiencies in the investment in basic scientific research, construction of scientific infrastructure, and efficient transformation of research achievements. There is still a large gap in terms of the formation of an industrial development pattern dominated by independent innovation [8].

2.3 Abundant but scattered scientific and technological resources

China's total R&D expenditure was nearly 2 trillion yuan in 2018 and has maintained a double-digit growth rate for several years, ranking second in the world. China's scientific and technological resources (e.g., stock of large-scale instruments and scientific research data) rank at the top globally, but are nevertheless scattered, failing to form a resultant force. On one hand, the administrative power over science and technology in China is scattered in different departments, which have set up various scientific research platforms. This results in a scattered layout of scientific research platforms and scattered financial support for scientific research, failing to form a resultant force. On the other hand, facing the new domestic and international situation, China's provincial regions have adopted policy measures to promote technological progress and development of strategic emerging industries. To some extent, this has produced a good effect, but has also resulted in further scattering of scientific and technological resources, failing to form a cohesive force.

2.4 Talent incentive mechanism

Talents, especially high-end talents, are the primary resources for the development of strategic emerging industries. Today, the development of strategic emerging industries has a more urgent demand for talents. Since implementing the strategy strengthening the nation through human resource development, China has not only made many remarkable achievements, but also encountered some problems that urgently need to be solved. Among all existing problems, the most important is to explore a talent incentive mechanism and sharing mechanism suited to the whole-nation system for science and technology in the new era. Moreover, it is a thought-provoking phenomenon that the increasingly severe talent competition results in policy homogenization, policy rivalry, and vicious competition in many regions. To a varying degree, the problems will bring about disorderly movement of talents and inefficiency of human resource allocation and use.

3 Urgency of accelerating the development of strategic emerging industries

To meet the fierce international competition and satisfy China's development needs, it is a matter of particular urgency to accelerate the fostering and development of strategic emerging industries in the new era.

First, it is necessary to gain a deep understanding of the arduousness and long-term existence of the Sino–US game. The US is the only hegemonic power in the world, and the core goal of its global strategy is to maintain an unshakable global hegemony. With rapid economic development and rise, China's comprehensive national strength

ranks second globally. It is an inevitable historical trend and necessity that the US refocuses its global strategy on the Sino–US strategic competition. In the historical period to come, the Sino–US strategic competition will become the core of the global strategic game. The Samuelson trap reveals the following: 1) if China makes technological progress in industries in which it has comparative advantages, the US will benefit from this and 2) if China makes technological progress in industries in which the US has comparative advantages, the US will sustain losses. Evidently, in the process of overtaking and surpassing the US, if China gains a technological advantage in high-end industries that the US is good at, this is against the interest of the US. As China has established technological advantages in fields such as 5G and AI, China is endeavoring to establish a hi-tech industry system with a competitive advantage; in this situation, the Sino–US relationship has fallen into the “Samuelson trap.”[9] Hence, China must be fully prepared psychologically to meet the long-term and arduous Sino–US game.

Second, it is imperative for China to accelerate the development of strategic emerging industries. After years of rapid development, China has not only made great achievements, but is also confronted with problems such as resource shortage and severe air, water, and soil pollution. Therefore, high-quality development is a matter of urgency. The key to promoting high-quality development is to promote industrial transformation and upgrading, and make the real economy well-grounded, stronger, and better. Emerging industries are those that have a great development potential but are still at a budding or initial stage of development. Compared with traditional industries, emerging industries are characterized by low energy consumption, pollution, and input but high return. Such industries provide a new impetus to the economic development of a country and an important road to improve competitiveness. In addition to having the characteristics of emerging industries, strategic emerging industries are future-oriented, thus enabling a country not only to meet the needs of current and recent industrial and economic development, but also conduct better industrial planning and lay a foundation for long-term development. Considering the characteristics and orientation of strategic emerging industries, it is a matter of urgency to give first priority to the development of strategic emerging industries in the new era, thus providing a new impetus to economic development.

Third, accelerating the development of strategic emerging industries provides an important guarantee to prevent the “middle-income trap.” Since the Second World War, most middle-income countries have fallen into this trap in the effort to become higher-income countries, and only a few have turned themselves into high-income countries through leapfrog development. The “middle-income trap” is a challenge to be faced by developing countries after they enter the middle-income stage. According to the World Bank's income grouping criteria (2018), countries worldwide are grouped as follows: 1) low-income countries with per capita gross national income (GNI) of less than US\$1 025. 2) Below-average-income countries with per capita GNI of US\$1 026 to 3 995. 3) Above-average-income countries with per capita GNI of US\$3 996 to 12 375. 4) High-income countries with per capita GNI of more than US\$12 376. According to the National Bureau of Statistics, China's per capita GNI reached US\$9 732 in 2018, approximate to the upper limit of that of above-average-income countries. China is the largest developing country in the world. Since its reform and opening up, China has maintained rapid economic development, creating a world miracle. However, this pattern of development, which is dominated by extensive economy and labor-intensive industries, is difficult to sustain. At this critical stage, overcoming the “middle-income trap” is a challenge that China must address. Based on a case study on how Japan and South Korea successfully overcame the trap whereas Latin American countries fell into the trap, combined with the analysis of China's actual condition, upgrading traditional industries and fostering strategic emerging industries are found to provide a strong guarantee for overcoming the middle-income trap[10].

4 Roadmap of development of strategic emerging industries in the new era

China has completed the top-level design for the fostering and development of strategic emerging industries. At the new stage of development, it is necessary to continuously place strategic emerging industries in a more prominent position in socioeconomic development, and promote their coordination and integration with traditional industries, thus building a modern industrial system. In such a system, it is necessary to identify the key technological short slabs, and overcome these using two methods, namely, international cooperation and independent development. In addition, it is necessary to further plan domestic resources as a whole, accelerate regional layout of strategic emerging industries, and promote the development of industrial clusters.

First, it is necessary to take the fostering and development of strategic emerging industries as an important pillar of the national modern industrial system. Hence, China needs to further define and optimize the scope of strategic emerging industries. In China, such industries to be fostered and developed mainly include next-generation IT

industry, bioindustry, high-end equipment and new materials, green and low-carbon industries, and digital creativity industries. Over the years, some industries have grown strong. In 2018, China's output and sales volume of new energy vehicles reached 1.256 million, accounting for more than half of the global market share. This type of industry should gradually be excluded from strategic emerging industries, whereas those with strategic importance and future orientation (e.g., quantum information science, strategic computing, and producer services) should gradually be categorized as strategic emerging industries. The intent is to further boost the status of strategic emerging industries in the national modern industrial system and expand their scale. There has been no generally accepted definition or connotation for a modern industrial system. As far as China is concerned, a national modern industrial system roughly comprises traditional industries and strategic emerging industries. While actively developing strategic emerging industries, China should encourage the application of emerging technologies and industries to traditional industries. The aim is to promote the integration of emerging technologies and traditional industries, further boost the level of the industrial chain, boost China's industries to the middle and high ends of the global value chain, and build a modern industrial system with international competitiveness.

Second, it is necessary to identify, classify, and strategically plan the key technological short slabs in strategic emerging industries. China possesses numerous industrial sectors. Nevertheless, it has many industrial short slabs and lacks many core and key technologies, and it is therefore impossible to solve all industrial problems at once. Primarily, it is necessary to identify the short slabs and core and key technologies in the industrial chains of strategic emerging industries. Under the resource constraint, superior resources should be concentrated on core and key technological short slabs that are urgently needed and can be solved. For such short slabs that are intractable over a long period of time, it is necessary to set strategic objectives and accomplish them stage by stage, but not in one stroke. Furthermore, it is necessary to identify short slabs in industrial chains of strategic emerging industries and long slabs in such short slabs and increase the difficulty in international industrial or technological decoupling. The intent is to develop a pattern characterized by both mutual dependence and restriction. No countries are able to master all core and key technologies. With the deepening of globalization, global value chains and supply chains have formed, and interdependence is increasing in global industrial chains. According to statistics, two thirds of global trade volumes are associated with middleware. The proportion of this continues to increase, implying an increasing degree of internationalization in industrial chain composition and operation. In other words, global interdependence is intensified; objectively, this significantly increases the difficulty and cost of technological decoupling.

Third, it is necessary to plan the regional layout of strategic emerging industries scientifically at a national level and foster industrial clusters. Today, city clusters or metropolitan regions, which are represented by the Beijing–Tianjin–Hebei region, Yangtze River Delta, and Guangdong–Hong Kong–Macau Greater Bay Area, have become the most important fronts that agglomerate production factors and drive regional economic growth. In the context of deepening regional integration, it is increasingly possible to integrate regional superior resources, plan the layout of strategic emerging industries across different provinces, and eliminate existing barriers (e.g., homogeneous and disorderly competition). To properly address the homogeneous and disorderly competition across different provincial regions, cities, and even counties, various industrial clusters planned by provincial regions of China can be arranged in two ways: 1) Based on regional advantages, arrange innovative and resource-based industry clusters in a lateral manner. 2) Arrange inter-provincial (or inter-regional), provincial-level, and distinctive industrial clusters in a vertical manner. Inter-provincial (inter-regional) industrial clusters should be planned and arranged on a national scale and from the perspective of regional development strategy; hence, an inter-provincial coordination mechanism should be established. Provincial-level industrial clusters should be arranged based on national top-level design and overall regional layout, thus preventing a waste of resources and overcapacity arising from disorderly competition. Distinctive industrial clusters should be planned and arranged according to actual provincial conditions.

5 Measures and suggestions

Policy support plays an irreplaceable role in the vigorous development of strategic emerging industries in China. To promote healthy development of such industries, China has mainly made efforts in three aspects (i.e., adjust the supply structure, improve the development environment, and expand the market demand) over the past decade. Hence, a number of specific measures have been taken, such as talent training, capital support, technical support, public services, target planning, financial support, laws and regulations, property rights protection, tax preferences, government procurement, trade policies, user subsidies, application demonstration, and price guide [8]. On this basis, the following key measures should be taken in the new era.

5.1 It is necessary to strengthen the top-level design, incorporate strategic emerging industries into the 14th Five-year Plan, and issue a specialized plan for the development of such industries in this period.

As China's economy has entered the stage of new normal and high-quality development, economic growth has become innovation-driven rather than factor-driven. In this context, it is necessary to further strengthen the fostering and development of strategic emerging industries, highlight such industries in the 14th Five-year Plan, and issue special plans to facilitate industrial restructuring (i.e., from the middle- and low-end industries to the middle- and high-end industries). In addition, the layout and development of strategic emerging industries are facilitated by a series of national strategies (e.g., innovation-driven development, coordinated development of the Beijing–Tianjin–Hebei region, development of the Yangtze River Economic Zone, ecological protection and high-quality development of the Yellow River Basin, development of the Guangdong–Hong Kong–Macao Greater Bay Area, and integrated development of the Yangtze River Delta). In the 14th Five-year Plan and national development program for strategic emerging industries, it is necessary to fully consider organic integration of such industries with national strategies, and further define the orientation, objectives, and tasks of these industries in the period. Moreover, the national development program for strategic emerging industries should keep a close watch on latest developments and trends of international industries. Based on the development achievements in the 12th and 13th five-year periods, strategic emerging industries should be optimized, reselected, and redeployed according to the latest strategic requirements of national economic and social development and directions of scientific and technological breakthrough.

5.2 It is necessary to explore a whole-nation system in the new era and develop an inter-provincial and inter-departmental coordination mechanism to tackle key problems jointly.

For basic research and vulnerabilities (especially certain key technological and industrial short slabs), it is necessary to inherit and carry forward the new whole-nation system characterized by “pooling resources to perform great deeds.” In other words, China should establish an inter-departmental and inter-provincial coordination mechanism and concentrate its superior resources to tackle key problems jointly. Practice shows that, as a new exploration of whole-nation system for science and technology in the new era, national laboratories serve to effectively integrate scientific and technological resources, and pool scientific and technological innovation, elite forces, and high-level research platforms to a national research platform. However, existing national laboratories are mainly established by integrating the distributed platforms approved by ministries and commissions under the State Council. Hence, it is still necessary to further explore how to integrate inter-provincial superior resources and stimulate the enthusiasm of different provincial regions. To promote basic research and improve key technological and industrial short slabs, it is necessary to establish perfect incentive, appraisal, and mobilization mechanisms, fully stimulate all provincial regions to participate in the construction of national laboratories, and ensure that all participant provincial regions can enjoy the benefits created by national laboratories in a timely manner. To promote the development of industrial clusters, the participant provincial regions should properly arrange and adjust their strategic emerging industries according to their own and regional advantages and output of national laboratories.

5.3 It is necessary to explore a talent incentive and sharing mechanism in the new era.

In response to the great changes in domestic and international environments, it is a matter of urgency to establish an appropriate talent incentive mechanism. Primarily, China should provide a powerful material guarantee for talents' work, specifically, satisfying their basic education, housing, and medical needs, and ridding them of various worries. In addition, China should stimulate talents spiritually, progress with a human-oriented spirit, respect innovation, improve their social status, and increase their sense of identity. Moreover, China should guide public opinions correctly, and create a favorable environment of respect for science and talents in society as a whole (particularly among young people). Finally, China should create a nationwide talent database, perfect the part-time job system for talents, and develop a flexible talent sharing mechanism.

References

- [1] Du C Z, Hu J, Chen W X. The development model and countermeasures of China's New Generation Artificial Intelligence Industry [J]. *Economic Review Journal*, 2018 (4): 41–47. Chinese.
- [2] Lin B Q. Strategic consideration of new energy development in China [J]. *Journal of China University of Geosciences (Social Sciences Edition)*, 2018, 18(2): 76–83. Chinese.

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- [3] Chen G, Song Y Y. Research on the development of digital creative industry [J]. *Guizhou Social Sciences*, 2019 (2): 82–88. Chinese.
- [4] Ren B Q, Ren Y S. Research on the evolution trend and growth quality of strategic emerging industries in the Yangtze River Delta [J]. *Modern Economic Research*, 2016 (9): 77–81. Chinese.
- [5] Zhang G Q, Tang X J. Comparison of the competitiveness of regional strategic emerging industries: Taking the Yangtze River Delta, Pearl River Delta and Beijing–Tianjin–Hebei as examples [J]. *Inquiry into Economic Issues*, 2012 (8): 42–47. Chinese.
- [6] Zhu R B. Chinese strategic emerging industries’ cultivating and policy tropism [J]. *Reform*, 2010 (3): 19–28. Chinese.
- [7] Xue L, Zhao J. Toward agile governance: The pattern of emerging industry development and regulation [J]. *Chinese Public Administration*, 2019 (8): 28–34. Chinese.
- [8] Chinese Institute of Engineering Development Strategies. Report on the development of strategic emerging industries in China in 2020 [M]. Beijing: China Science Publishing & Media Ltd., 2019. Chinese.
- [9] Su Q Y. The theory of “decoupling” between China and the United States and the “Samuelson Trap” [J]. *World Affairs*, 2019 (15): 52–53. Chinese.
- [10] Yao S J, Han C. How China across the “middle-income trap” from the perspective of technical innovation [J]. *Journal of Xi’an Jiaotong University (Social Sciences)*, 2015, 35(5): 1–6. Chinese.