China's Industrial Modernization: Development Rationale, Current Status, and Policy Directions

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Abstract: *Economies that have effectively escaped the "middle-income trap" demonstrate common traits in their industrial restructuring as they progressed to high-income status. These include a relatively stable share of an economy's manufacturing sector, a reasonable economic structure, enhanced industrial capabilities, and growth driven by innovation. However, late-moving countries face a number of hurdles as they strive to cross this threshold. China's development advantages include, among other things, a complete industrial system, a more balanced industrial structure, growing indigenous innovation capabilities, continual expansion and upgrading of domestic demand, and a greater degree of openness. These capabilities have provided continuous momentum for industrial growth, allowing China to capitalize on the next wave of technological and industrial revolutions while also promoting long-term, steady industrial development. During its modernization efforts, China has seen substantial changes in the external environment surrounding its industrial development. We must not only recognize the increasing complexity, intensity, and uncertainty of these changes, but also take proactive steps to solve diverse issues and capitalize on opportunities arising from global digital and green transitions. Equal focus should be placed on strengthening reforms and promoting high-level openness, improving policy coordination and consistency, and pursuing an innovation-driven strategy. This will speed the development of a modern industrial system and encourage the formation of new, high-quality productive forces.*

Keywords: *Industrial development, industrial structure, middle-income trap, high-income countries*

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It is a common aspiration for all countries to achieve industrialization and continuously raise their level of economic development. Yet, only a few have successfully reached high-income status and joined the ranks of developed nations, while many others have stagnated at the middle-income level. The reasons behind this divergence warrant careful exploration. As China enters a critical phase in its development toward becoming a high-income country, it can benefit from examining how other developed nations have transitioned, particularly in terms of industrial restructuring. At the same time, it is important to consider the profound global changes currently underway, including rapid advancements in scientific and technological innovation, as well as shifting economic and trade relations disrupted by self-interested countries. This paper aims to analyze China's current economic development, identifying

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both the favorable and unfavorable factors that will affect its transition to high-income status. Adopting a global perspective and analyzing China's situation within the context of these changes, this paper compares the industrial structures and development trajectories of developed countries with those of China, examines the global economic environment and its trends, and offers policy recommendations for maintaining competitiveness and ensuring long-term growth in China's manufacturing sector.

1. Economic Characteristics of Countries toward the High-Income Status

Since the Industrial Revolution in the 1760s, innovations in science and technology have unleashed significant productivity growth, greatly propelling the global economy forward. However, only a few economies have risen to the ranks of high-income or developed countries. According to a World Bank report, out of 101 middle-income economies in 1960, only 13 had attained high-income status by 2008, including Equatorial Guinea, Greece, Hong Kong SAR of China, Ireland, Israel, Japan, Mauritius, Portugal, Puerto Rico, South Korea, Singapore, Spain, and Taiwan Province of China (World Bank, 2013). Using data from 1960 to 2014, Lee (2020) identified 14 economies that successfully transitioned to high-income status and nine that achieved sustained economic growth, while classifying 52 middle-income economies as having failed to converge. As of 2023, the United Nations recognized only 36 advanced economies worldwide, primarily concentrated in Europe, North America, and the Asia-Pacific region (United Nations, 2023). Most countries in Latin America and the Middle East had reached the middle-income status in the 1960s or 1970s, but remained at this level ever since (World Bank, 2013). During their rapid economic growth in the 1990s, the "Four Asian Tigers" of Thailand, Malaysia, Indonesia and the Philippines had a per capita GDP level far above China's, but are now overtaken by China. This widespread inability of most countries to move beyond low- or middle-income status is known as the "poverty trap" or the "middle-income trap" (Arias and Wen, 2015).

For both developed countries that have achieved high-income status and various developing countries, their economic upsurge mostly began with rapid industrial growth, which is why the process of economic growth or joining the ranks of developed countries is referred to as "industrialization". Prior theoretical analyses examined the economic phenomenon where countries, upon reaching high-income status, exhibit a decreasing share of manufacturing and an increasing share of services. This trend creates an illusion of declining industrial significance, which contradicts the underlying reality. Since the 1960s, the world has experienced three major industrial relocations. In retrospect, despite the environmental improvement and efficiency gains, the relocation of manufacturing activity has led to economic hollowing, fewer jobs, and less innovation, presenting major challenges to sustained economic development. Germany's Industry 4.0 and the United States' re-industrialization indicate that those developed countries have once again come to recognize the irreplaceability of manufacturing in economic development. In this paper, we focus on the characteristics of economies in terms of industrial structure, market demand and industrial capabilities after successfully crossing the middle-income threshold, revealing the role of industry, especially manufacturing, in economic development after escaping the "middle-income trap".

1.1 Relatively Stable Share of Industry and Improving Economic Structure

After economic development reaches the high-income level, there will be a rapid rise in the demand for service activities, causing the share of services to increase and that of industrial sectors to decline. Based on analysis of high-income countries, we found that although their industrial and manufacturing sectors represented smaller shares than during their economic takeoff stage, those countries continued to maintain relative global advantage and superior scale in certain sectors. Even with GDP per capita topping 20,000 US dollars or more, the vast majority of developed countries continue to maintain a significant portion of manufacturing and have attempted to raise the share of manufacturing in recent

years. For instance, the National Industry Strategy 2030 released by Germany in 2019 adopted the strategic objectives of increasing the share of its industrial value-added to 25% and that of the European Union to above 20% by 2030, respectively.

1.1.1 Stabilizing the share of manufacturing through structural improvement

High-income countries have maintained a stable share of the manufacturing industry primarily through constant internal structural upgrades. Although the level of economic development may push up factor price, it may also promote capital and technology accumulation and create conditions for a country's industrial structural upgrade. All countries having avoided the middle-income trap have successfully shifted from a labor-intensive industrial structure into a capital and technology-intensive one (such as steel, petrochemical, shipbuilding, automotive and computer sectors), completing an upgrade from labor-intensive processes such as global value chain (GVC) processing and assembly to more sophisticated activities such as R&D, manufacturing of intermediate products, and even value chains with higher technological content and greater value addition. Yılmaz (2016) found that significant differences exist in the growth rates of labor productivity between middle-income-trap countries and non-middle-income-trap countries. The former recorded an average labor productivity growth rate of about 1.93% between 1950 and 2005, while the latter's labor productivity growth averaged 4.3% over the same period. Their difference primarily stems from widening intra-sectoral productivity growth difference, and the manufacturing sector contributed the most to the widening intra-sectoral productivity gaps. By 1990, Japan and South Korea's medium and high-tech manufacturing value-added accounted for over 40% of their total manufacturing output. This ratio was only 28.6% for Argentina and 30.7% for Brazil even by 2021. The value-added of Japan, South Korea and Spain's "chemical engineering + machinery and transportation equipment industries" accounted for over 30% of their total manufacturing value-added around the time when they crossed the threshold of high-income countries, while these figures were 26.5% and 28.0% for Argentina and Brazil in 2021, respectively. In terms of trade structure, intermediate and capital goods made up close to 50% of Spain's exports and over 70% of those of Japan and South Korea after they crossed the threshold for high-income countries. In comparison, intermediate and capital goods represented a relatively small share of export commodities for countries stuck in the middle-income stage. After 2021, intermediate and capital products made up only 33.2% and 29.8% of Brazil and Argentina's total exports (see Table 1). Countries that have joined the ranks of developed economies have not only upgraded their industrial structures from labor-intensive to capital- and technology-intensive sectors, but also established themselves in emerging industries based on frontier and disruptive technologies.

Table 1: Manufacturing Structure and Export Structure of Representative Countries in Their Transition towards the High-Income Level, %

	Value added of medium and high-tech manufacturing sectors as a share of total manufacturing output	"Chemical engineering + machinery and transportation equipment industries" as a share of total manufacturing output	Intermediate and capital goods as a share of total exports
Japan	50.87	31.27	70.34
Spain	35.87	29.32	47.28
South Korea	47.84	45.73	71.03
Brazil	30.68	28.02	33.16
Argentina	28.59	26.52	29.77

Notes: Due to limited data, the share of value-added from medium and high-tech manufacturing sectors is based on 1990 data of Japan and Spain, and 1996 data of South Korea; the share of "chemical engineering + machinery and transportation equipment industries" is based on data of 1975 for Japan, 1987 for Spain, and 1996 for South Korea; the share of exports in intermediate uncovered of products is based on data of 1988 for Japan, 1989 for Spain, and 1996 for South Korea. 2021 data are adopted for Brazil and Argentina.

Source: The World Development Indicators database (https://databank.worldbank.org/) and the WITS database (https://wits.worldbank.org/).

1.1.2 Maintaining domestic and international equilibrium of trade and investment

In terms of trade and investment structure, countries that have successfully crossed the high-income threshold will shift away from their previous export-oriented trade pattern and toward more reliance on domestic markets. Japan, South Korea, and Spain all have relatively large ratios of imports and exports to GDP. Meanwhile, they have maintained a basic balance of import and export volumes before and after crossing the high-income level. Countries possess advantages in different industries, and considerable disparities exist between the products and technologies of companies from various countries within the same industry. As a result, even developed nations continue to actively seek foreign capital to shore up the vulnerabilities in their domestic industrial chains and satisfy differentiated domestic demand. Outbound foreign direct investment (OFDI) is meant to develop resources critical to industrial development, use high-end factors from other nations such as knowledge and technology, better serve the host country's market, and maximize global resource allocation. Given the declining domestic economic growth rates as they enter the high-income development stage, high-income countries can harness the growth dividends of other developing countries through OFDI. They use overseas resources to increase wealth and drive GDP growth in their home soil, all while gaining more control over global industrial development.

1.2 Steadily Increasing Industrial Competitiveness and Innovation-Driven Growth

1.2.1 Greater importance to fostering industrial development capabilities

The "middle-income trap" is manifested by both slowing economic growth and an unreasonable industrial structure, but many studies have highlighted industrial capabilities and technological innovations as more fundamental factors. Structural transition, particularly the improvement of industrial capabilities, is a critical factor for middle-income economies to successfully navigate the risks and challenges associated with the "middle-income trap" (Vivareli, 2016), which is essentially a trap of industrial capabilities or one caused by a failure of technological innovation. Huang (2016) stated that the real challenge posed by the middle-income trap is an economy's ability to consistently promote new competitive industries and enterprises once it has reached the middle-income level. Countries that fail to develop these qualities will fall into the middle-income trap. They are unable to compete with more sophisticated economies due to their low efficiency or with less advanced economies due to their higher costs. According to Paus (2017), the primary cause for countries falling into the middle-income trap is insufficient development of innovation capabilities, which hinders them from upgrading to higher value-added activities within or across industries. According to Justin Yifu Lin (2018), "the middle-income trap is a result of middle-income countries being unable to outpace high-income countries in terms of labor productivity growth via technological innovations and industrial upgrade". A key reason for countries' premature deindustrialization is that their industrial capabilities did not evolve in tandem with their factor endowment. Labor-intensive industries lose international competitiveness and shrink when wages rise, preventing more innovation-dependent industries or industrial processes from developing, resulting in a reduction in manufacturing's share of the economy. On the contrary, countries that have overcome the middle-income trap have consistently improved their industrial capabilities.

1.2.2 Maintaining economic leadership through indigenous innovation

Almost all research on industrialization have found that technological advancement has accelerated industrial development, and technological revolution can raise economic efficiency to new heights, resulting in new disparities in industrial development between countries (Perez, 2007). Late-moving countries have long trailed industrialized countries in terms of innovation and industrial technology. Importing technology and imitating industrialized countries' technological paths is the least expensive strategy and the source of the "late-moving advantage". However, the "imitation-catch-up" mode is ineffective for acquiring vital technology. Market competition becomes more intense as new late-moving

countries enter the picture. Profit margins are low due to excessive competition and price wars. To sustain medium-high growth rates and approach the high-income level, middle-income countries must transform their economic growth patterns, shift from quantitative expansion to qualitative improvement, transition from a factor input-driven approach to an innovation-driven approach to development, increase product value-added, and reduce resource and energy consumption per unit of output.

Innovation-driven development includes learning and imitating advanced technology from developed countries to raise a home country's technological level, as well as initiatives to improve original innovation capabilities, increase the share of original technology and design, and pursue higher-quality development. The higher the wealth level, the greater the demand for creative invention. Countries that have escaped the middle-income trap have fairly high intensities of R&D investment and basic research. Japan and South Korea spent over 2% of their GDP on R&D in 1981 and 1994, respectively, whilst Argentina spent only 0.52% in 2021. Japan and South Korea had a proportion of basic research investment to GDP that exceeded 0.3% in 1983 and 1997, respectively, whereas Argentina's was only 0.12% in 2021; Japan and South Korea's commercial R&D spending as a share of GDP exceeded 1% after reaching the high-income level, while Argentina's was 0.11% in 2021 (see Table 2). Spain's R&D spending as a share of GDP, basic research input as a share of GDP, and commercial R&D spending as a share of GDP were relatively low when the country reached the high-income threshold, but they increased to 1.43%, 0.32%, and 0.72%, respectively, by 2021.

Table 2: Percentages of R&D Spending and Basic Research Spending Relative to GDP for Representative Countries Transitioning Towards High-Income Status, %

	R&D spending as a share of GDP	Basic research spending as a share of GDP	Commercial R&D spending as a share of GDP
Japan	2.00	0.26	1.36
Spain	0.59	0.08	0.27
South Korea	2.11	0.29	1.66
Brazil	1.15	-	-
Argentina	0.52	0.12	0.11

Notes: Based on data of 1981 for Japan, 1987 for Spain, 1996 for South Korea, 2021 for Argentina, and 2020 for Brazil.
Source: Data for Japan, Spain, South Korea and Argentina are from the OECD.Stat database (https://stats.oecd.org/), and Brazil's data are from the World Development Indicators database (https://databank.worldbank.org/).

To support industrial upgrade, a new factor endowment structure must be developed through continuous investment. Capital, technology, knowledge, and management are instances of new production factors, as is data. These production factors are embodied in modernized ports, docks, airports, highways, railways, computer centers, and other types of infrastructure, as well as manufacturing facilities like factories. They are also reflected in highly capable entrepreneurs, scientists, engineers, technicians, and other forms of human capital, as well as an intricate network of businesses, people, and infrastructure.

It is worth noting that countries that have successfully overcome the middle-income trap did so by capitalizing on the strategic opportunities presented by technological revolution and industrial change. Since the Industrial Revolution, human society has gone through several rounds of Kondratiev longwave cycles. Throughout each longwave cycle, a number of frontier and disruptive technologies emerged. These new technologies have evolved into new products and industries with enormous market potential, which may stimulate the rapid growth of other industrial sectors, thereby providing a significant boost to economic growth (Freeman and Lusan 2007). The emergence of disruptive new technologies during each technological revolution and industrial change represented a shift in national power. Many

new technologies have had a powerful disruptive effect on the existing industrial landscape, severely weakening or even dismantling existing technological strengths. This has significantly reduced the cost for late-moving countries to enter relatively mature markets. As can be seen from historical records, industrialization in European countries led by the United Kingdom has benefited from advances in science, revolution, and industrial change. Many late-moving countries have taken full advantage of technological revolutions and industrial change. From the 18th to the 19th centuries, the United Kingdom achieved and commercialized technological innovations, making it the world's most advanced country. During the Second Industrial Revolution, the United States and Germany emerged as dominant nations by capitalizing on new technologies and industries, transforming the global industrial landscape. Japan and South Korea leveraged the opportunities created by the IT revolution to boost global competitiveness in the IT manufacturing sector.

1.3 Late-Moving Countries Face More Challenges in Overcoming the Middle-Income Trap

The fact that most countries in the world have remained stuck at the middle-income level demonstrates how difficult it is to break free from the middle-income trap and enter the high-income stage of development. Middle-income countries face more and greater barriers to reaching medium and high levels of technology than countries that were the first to industrialize (Andreoni and Tregenna, 2020).

1.3.1 Developing countries have a late-mover disadvantage in overcoming the middle-income trap

Developing countries can reduce the cost of industrialization by learning and imitating developed countries' technology. However, there is no guarantee that their economies will grow steadily and catch up with the income levels of developed nations. On the contrary, they face greater development challenges than early industrialized countries. Foreign aggression, colonialism, and exploitation enabled early industrialized nations to complete their industrialization. In contrast, late-moving industrialized nations may rely solely on their own accumulation. Early industrialized countries are at the forefront of technological and industrial development, and they may reap significant benefits from technological and industrial advancements. Although late-moving countries may gain a "late-moving advantage" through technological imitation, they face competition with powerful market incumbents, intellectual property barriers, and an international order shaped by developed nations. These challenges never existed in early industrialized countries. As a result, the return on technological and industrial upgrades is extremely low for late-moving economies.

1.3.2 Late-moving countries face suppression and containment from developed countries

When late-moving countries' GDP per capita approaches that of high-income countries, developed countries face a challenge in terms of economic aggregate, technological sophistication, and global industrial chain position. To maintain their technological and industrial advantage, as well as influence and control over industrial chains, developed countries use a variety of nonmarket means to suppress and contain late-moving major countries in their technological innovation and development of high-tech industries, making it more difficult for late-moving countries to pursue further industrial upgrading.

1.3.3 Policy inertia developed by late-moving countries in their catch-up process

Middle-income countries are significantly behind developed countries in terms of technological sophistication. Hence, in most mature industries, the most cost-effective development path is to learn from and emulate developed countries' technological paths. Consequently, both the government and businesses are accustomed to imitating and following others. Enterprises lack unique innovation capabilities. The government is unable to create policies that effectively promote original innovation. Technology innovation and industrial development systems, as well as the social environment, are

incompatible with the requirements for original innovation, making it difficult for late-moving countries to capitalize on the opportunities of the new technology revolution and industrial change.

1.3.4 Challenging nature of balancing various factors and objectives in economic development

Aside from technological and economic factors, industrial capabilities and structures evolve in response to changes in factor endowment. Furthermore, a stable and secure financial system, an effective market, a capable government, and a fair income distribution system are all required for a country to successfully overcome the middle-income trap (Zhang, 2021).

2. Industrial Foundation for China to Enter the High-Income Stage

When People's Republic of China was founded in 1949, the Second Plenum of the Seventh CPC Central Committee adopted the principle of "building an advanced industrialized nation" and began implementing a series of plans and measures aimed at concentrating resources across the country to create a complete industrial system. China's manufacturing sector has grown rapidly since reform and opening up, making it the largest manufacturing nation in the world by 2010. By 2023, China's manufacturing value-added accounted for 35% of the global total, with the country leading the world in more than 220 product types out of over 500. While increasing industrial capacity, China has also established a comprehensive industrial system with a reasonable industrial structure to meet the demands of economic development and the improvement of people's living standards. When compared to the industrial development and economic structures of high-income countries, it is clear that industry has laid the groundwork for China to enter the high-income development stage.

2.1 Industrial Fundamentals and Market Conditions for Escaping the Middle-Income Trap

Comparing the economic performance of different countries during their ascension to the high-income stage reveals that countries succumbing to the "middle-income trap" were always accompanied by prematurity of industrial structure and industrial hollowing. More fundamental causes of a country or region's middle-income stagnation are stalling technological progress, slow market growth, and a low level of opening up. When reviewing China's industrialization based on historical conclusions, it is reasonable to assume that China's industrialization and modernization processes will continue and deepen. This will be demonstrated not only by China's ownership of the world's largest industrial capacity and most complete industrial system, but also by its unwavering domestic demand and high-quality opening up.

2.1.1 Manufacturing industry: Reasonable share and improving internal structure

Rekha and Suresh (2022) put forth the following thresholds for premature de-industrialization: GDP per capita is less than 11,750 US dollars, the share of manufacturing employment is less than or equal to 18.0%, and the proportion of manufacturing value-added is at least 18.0%. According to World Bank data, China's GDP per capita was 12,720 US dollars in 2022, with manufacturing value-added accounting for 27.7%, a level that has remained around 27% since 2018. Zheng et al. (2023) discovered that the proportion of China's manufacturing industry is within a reasonable range, taking into account the heterogeneity between the mid and high-end manufacturing and low-end manufacturing sectors. Over the past decade, China's industrial structure has shown a significant trend of upgrading from final products to intermediate and capital goods in global value chains (GVCs), with raw materials accounting for less than 2% of total exports of goods, while intermediate and capital goods have increased to nearly 20% and 50%, respectively. Furthermore, some strategic emerging industries have thrived and rapidly gained international competitiveness. The "new three" (new energy vehicles, solar cells, and lithium-ion power cells for automobiles) have ranked first in the world in terms of manufacturing output and export,

emerging as new highlights of China's industry. China's industry has enormous capacity and covers a wide range of sectors. These advantages, combined with continuous industrial structure upgrades, have enabled China's industry to demonstrate exceptional resilience and unleash growth dynamism in the face of external shocks.

2.1.2 Domestic demand potential is unleashing, and the export of industrial goods remains stable

Industrial demand is driven by exports, investment, and domestic consumption, also known as the "three drivers". At various stages of development, the "three drivers" took on different roles: Prior to the reform and opening up policy of 1978, China's industrial demand was primarily driven by investment in the defense and heavy industries. Between the start of reform and opening up and the onset of the global financial crisis in 2008, exports were the most powerful driving force behind China's manufacturing growth. After the global financial crisis erupted in 2008, international market growth stalled, prompting China to launch a new round of infrastructure construction, focusing on transportation and information technology. Domestic demand began to accelerate as one of the "three economic drivers" after the 18th Central Committee of the Communist Party of China (CPC) adopted the new development concept, partially compensating for the negative impact of slowing international market growth. China's industrialization and development are still primarily driven by exports, investment, and domestic demand. However, the roles and relationships of the "three economic drivers" have shifted. Since 1995, China's industry and manufacturing share of global exports has never decreased. Following the global financial crisis, China's goods exports increased by nearly seven percentage points to approximately 15% of the global total. In terms of investment, China has made massive investments in infrastructure construction. However, significant infrastructure gaps persist between regions and between urban and rural areas. Many weaknesses and disparities remain in infrastructures such as transportation, energy, water conservancy, communications, and disaster prevention. China called for the development of "new infrastructure" in 2021, which increased investment demand in digitalization, new energy, and R&D. Both compensating for shortfalls in traditional infrastructure and getting a head start on developing new infrastructure will generate significant investment demand. On the consumer demand side, China's GDP per capita has crossed the middle-income threshold, but there are still some disparities in its per capita consumption levels when compared to developed and even developing countries. For example, China's per capita car ownership is one-fourth that of the United States and one-third that of Japan, and it is dwarfed by Thailand and Malaysia. Overall, China's long-term industrial development is secure on the demand side, with the continuous release of domestic demand capable of generating unrelenting development dynamism on the demand side.

2.1.3 Improving quality of "bringing in" and "going global"

China's stock of foreign capital utilization remains the second highest in the world, despite the fact that it has experienced a decline in recent years as a result of the evolving international environment. Foreign investment in high-tech sectors increased to 37.4% of China's total foreign capital inflows in 2023, indicating that foreign capital is being utilized more effectively. Faced with challenges to international industrial chain restructuring in the new development stage, China will commit to creating a more equitable market environment and relaxing foreign capital access requirements to allow foreign capital to be integrated into the Chinese economy across a wider range of sectors. China will continue to be one of the most attractive investment destinations in the world. Meanwhile, China's foreign investment has steadily increased across a broader range of industries, making it the world's second-largest source of overseas foreign direct investment (OFDI). By 2022, China had established 47,000 overseas enterprises in 190 countries and regions, spanning 18 industries. China is also dedicated to creating a fair and efficient international economic and trade environment to accelerate the globalization process. In 2013, China announced the Belt and Road Initiative (BRI), which aims to promote

international industrial capacity cooperation. The BRI is the first international economic cooperation platform launched by a developing country with widespread international participation. In recent years, China has also signed the Regional Comprehensive Economic Partnership (RCEP) to officially apply for membership in the Digital Economy Partnership Agreement (DEPA). By 2023, China signed 22 free-trade agreements with 29 countries and regions, accounting for roughly one-third of China's total foreign trade volume. Overall, high-quality opening up is critical for China to avoid being locked into a "subordinate" and "low-end" position in the global division of labor, allowing it to independently and securely leverage domestic and international resources at a high level to ensure the continuous progress of industrialization.

2.2 Great Improvements in Capabilities to Innovate and Seize Strategic Opportunities

2.2.1 Rising growth of knowledge and technology output

Following the global financial crisis in 2008, Chinese enterprises with R&D activities accounted for a significantly increasing share, and industrial enterprises' technological spending began to shift toward indigenous innovation. In 2011, China's spending on indigenous innovation outpaced its investment in importation and imitation, rapidly widening the gap with the latter. According to World Bank data, China's R&D spending as a percentage of GDP was 2.43% in 2021. Although this level remained lower than the averages of high-income and OECD countries, as well as the United States, Japan, Germany, the United Kingdom, and South Korea, it exceeded the averages of the European Union, upper-middle-income countries, and developed countries such as France, Italy, and Canada (see Figure 1). China already has the world's second-largest R&D spending, the most patent applications, and the most basic science papers published. The World Intellectual Property Organization (WIPO) published the Global Innovation Index 2023, which ranked China 11th in the world and first in the upper-middle-income group. It is the only middle-income country among the top 30 economies in the world, ranking sixth on the knowledge and technology output index (WIPO, 2023). Even when measured by the number of household patent applications per unit of R&D spending, China remains the highest-ranking middle-income country (Huang, 2016). China has a much higher level of education than other developing countries. It has produced the world's most highly skilled industrial workers and engineers. The talent system, research institutions, and infrastructures have laid the groundwork for China to catch up with and outperform other countries in technological innovation.

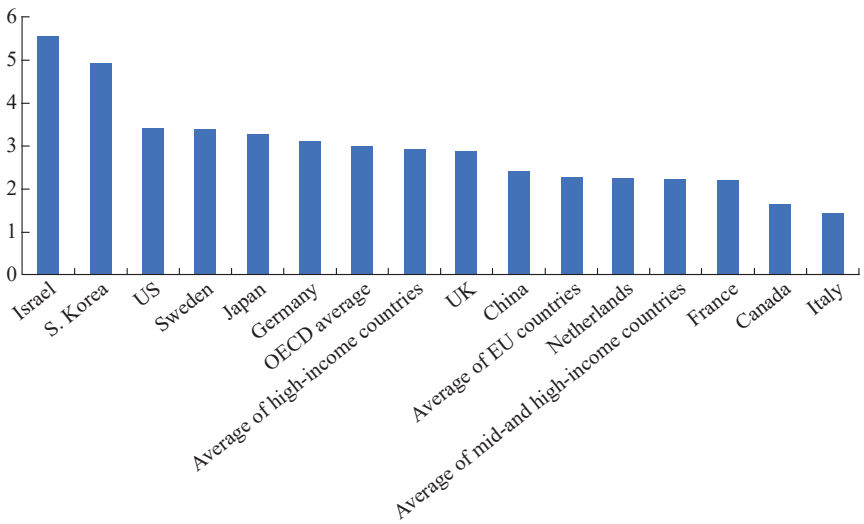

Figure 1: Proportion of R&D Expenditure to GDP in Major Countries in 2021

Source: The World Development Indicators Database (https://databank.worldbank.org/).

2.2.2 Increasing basic capabilities for seizing the historic opportunities for technological revolution and industrial change

Following previous rounds of industrial revolution, China came to a historical intersection of global technological revolution and domestic modernization drive. Despite significant transition pressures and external uncertainties, the majority of China's strengths and capabilities are endogenous, which contrasts sharply with the previous development stage, when China was more reliant on foreign markets, capital, and technology for its own development. China has developed the capabilities and conditions to deal with external challenges and overcome internal constraints during the new technology revolution and industrial change, to cultivate new-quality productive forces that will lead the world, and to incorporate them into the realization of the strategic centennial goals of new industrialization and modernization.

China has established research and development capabilities that are comparable to those of developed nations. Each technological revolution will open a new technological window. However, this does not imply that late-moving countries will necessarily take advantage of this window period to close the gap with technological leaders, if not overtake them. In fact, countries that can emerge as great powers from a new technological revolution are few and far between. More late-moving countries will only fall further behind in the new technological revolution. China currently leads the world in technological R&D spending and output. With a complete R&D system, China has built major technological infrastructures that lead or are unique in the world. It can compete and collaborate with developed countries in the areas of fundamental, frontier, and strategic technology R&D. Unlike previous rounds of technological revolution, the new technology revolution is primarily a replacement of human brainwork with artificial intelligence (AI). On some brand-new tracks, China is on the same starting line as developed countries, with a smaller late-moving disadvantage in technology R&D. For example, China has world-leading R&D capabilities in disruptive technological domains such as AI, mobile communications, quantum technology, and space development.

China has the capability to rapidly commercialize new technologies. China's large population and economic aggregate provide a wide range of application scenarios as well as a significant market demand for the commercialization of new technologies and business models. China's complete industrial sectors and auxiliary industrial systems enable the rapid commercialization of technological innovation results, as well as the continuous improvement of production processes, product quality, and production costs. For instance, China produces more than 60% of the world's new energy vehicles through large-scale development of power batteries and automotive manufacturing. China accounts for more than 40% of total installed photovoltaic and wind power generation capacity, as well as more than two-thirds of photovoltaic and wind equipment manufacturing globally. Based on extensive application scenario innovations, the global AI industry has established a paradigm in which China and the United States are at the forefront. In 2023, the "new three" exports experienced rapid growth. This demonstrates China's ability to accelerate development in emerging industries during a new round of technological revolution and industrial change, resulting in global leadership advantages.

China possesses high-quality factor supply capabilities. Except for a slowing increase in labor supply, China's supply of traditional production factors such as capital, land, and energy has not decreased. Despite institutional reform and improvement, there is still plenty of room for improvement in traditional factor allocation (Cai, 2021). More importantly, emerging factor resources such as top-tier talent, technology, data, and algorithms have expanded dramatically. China has the world's largest engineering and industrial workforce, employing over 200 million skilled workers and 60 million highly qualified professionals. China also has the world's most abundant data factor resources, with newly created data making up one-quarter of the total. China has the world's most advanced wireless communications network and industrial Internet, accounting for roughly 27% of global computing power, laying the groundwork for the industrial digital transition.

China's domestic market promotes technological progress and emerging industries. China has

the world's largest middle-income group, and driven by sustained economic growth, it is on track to overtake the United States as the world's largest consumer country by 2030. In terms of new industries and business models emerging from the new technological revolution and industrial change, China has a world-class consumer infrastructure. China accounts for some 70% of the world's 5G base stations, which comprise a cost-effective mobile communications network with broad coverage and fast Internet speeds. China is home to over 80% of public fast charging piles and more than 50% of public slow charging piles, making it the most important new energy vehicle infrastructure. Chinese consumers have a strong desire to purchase new tech products and services. They have a strong preference for new business models like e-commerce and the sharing economy, and they can adapt to the shift to digital consumption. Rising income levels have coincided with a rapid increase in the demand for healthcare services. China's per capita healthcare spending increased by 17.1% in the first half of 2023, and its share of total consumption spending increased from 3.2% in 2010 to 9.6%. It is fair to say that China's massive domestic market, with its high demand and diverse application scenarios, will provide strong support for application scenarios and consumer demand for digital technologies, new energy, new energy vehicles, telemedicine, and other emerging industries.

2.3 Shortcomings and Constraints Challenge High-Quality Industrial Development

Overall, China has the basic conditions and capabilities to sustain stable and rapid industrial growth, capitalize on the opportunities of the new industrial revolution and industrial change to foster emerging industries, and break free from the middle-income trap and advance to high-income country status. However, industrial and economic development is not without its challenges. It is critical to recognize the flaws and constraints that impede sustainable and long-term industrial development.

2.3.1 Resurfacing of excess capacity in certain sectors and persistent "chokepoint" risks

Extensive, large-scale, and persistent excess capacity poses a daunting challenge to China's high-quality industrial development (Zhu and Zhang, 2023). While the market and policy factors that contribute to excess capacity have yet to be fully addressed, the recent problem of excess capacity has impacted traditional capital-intensive industries such as steel and building materials, which are susceptible to disruptions in downstream sectors and frequent excess capacity. Furthermore, the problem of excess capacity has spread to emerging industries with strong growth potential and significant competitive advantages, such as power cells, new energy, and new energy vehicles. Between 2021 and 2023, China's lithium-ion phosphate batteries, ternary lithium batteries, and total battery production capacity increased by twelve, five, and eightfold, respectively. Misguided investment fueled mid- and low-end competition and oversupply. Meanwhile, the large and integrated industrial system cannot conceal gaps in critical processes. China relies on foreign suppliers for high-end equipment, critical processes, core materials, and basic software. Certain processes of China's industrial chain are subject to "chokepoints" in the context of growing uncertainties in the major-power relationship, impeding the development of an entire industry through transmission to other links of the industrial chain. For instance, the United States imposed restrictions against China's chip weaknesses, stifling the growth of the chip industry and downstream high-tech emerging sectors.

2.3.2 Wide technological disparities in frontier fields, along with insufficient high-tech investment and a lack of entrepreneurial vitality

China is a major source of technology R&D spending and output. However, China's original innovation is insufficient, and its basic technology R&D, R&D spending on frontier technologies as a share of total R&D spending, and proportion of relevant high-value patents pale in comparison to those of the United States, Japan, and Germany. China produced few original and underlying technologies, limiting its ability to pioneer emerging industries. Basic R&D and innovation activities focused on the

technological frontier are uncertain and risky. As China's technological innovations move into more "uncharted territories," the experiences gained during the "importation, absorption, and re-innovation" stages may no longer be applicable, necessitating significant changes to the institutional mechanisms and policy systems for technological innovation and industrial development. In recent years, Chinese enterprises have demonstrated a willingness to invest despite external constraints on the supply of sensors, chips, and other core technologies, key components, and basic software. If China is unable to foster independent technology innovation capabilities in the new technology revolution, even if it achieves a technological breakthrough or leadership in certain segments, it is very likely to lose speed and deviate from its trajectory in technological competition, resulting in a lack of momentum for its innovation and entrepreneurial activities.

3. Changing External Environment and New Opportunities

China's modernization efforts have resulted in significant shifts in the external environment surrounding its industrial development, with increasing complexity, severity, and uncertainty. From the escalating climate crisis to the "scar effect" of the COVID-19 pandemic, from frequent geographical conflicts to divergent growth trends across economies, the global economy has experienced its slowest growth rates in 30 years over the last five years. Debt and inflation continue to have a global impact. Although major economies have shown greater resilience than expected, there is a vulnerability to this resilience. In terms of China's industry, a significant portion of external risk factors are attributed to China-US competition and the closely related trend of global industrial and supply chain restructuring. From a mid- to long-term perspective, the new round of technological revolution and global carbon neutrality present both challenges and opportunities. It is critical to take the initiative to respond to and seize significant opportunities for exploring new business segments and establishing new advantages.

3.1 Objective View of External Uncertainties and Challenges

3.1.1 Intensifying global technological and industrial competition

Global technology innovations have entered a stage of vibrant development as a new round of deepening technological revolution and industrial change unfolds. Technologies and business models are constantly evolving, leading to the emergence of new industrial fields. Competition for those new fields has been a focus of major-power competition, with corporate champions shaping the industrial ecosystem. Based on this strategic starting point, emerging fields that are focused on future industries lack a clear cost orientation in their early-stage development. The "technology backlash" effect may persist in the sense that enterprises have been and will continue to localize R&D and manufacturing capabilities under the internalization motive to monopolize innovation returns and "niche markets". This will weaken the case for R&D cooperation and division of labor (Qyu and Yang, 2022). Interruptions to international cooperation in R&D and innovation, whether initiated by a country or imposed on it, have adverse consequences. Given the uncertainty of new fields, the risk of failure in cooperation mechanism stems from misjudgments on an industry's technological path and development due to ineffective information communication, which may cause firms at an equal position or even leading firms to fall behind. This situation became clearer after the large language model (LLM) became the dominant approach to artificial intelligence (AI). The introduction of ChatGPT has boosted investment and innovation in the field of AI. In 2023, American tech firms made the world's top five AI investments. In contrast, China's domestic AI financing volume has decreased by 4.5% year on year. In this situation, the market capitalization of Chinese Internet giants has fallen further behind that of US tech champions. The implication is that late-moving countries, even if they achieve technological breakthroughs or leadership in specific fields, may lose speed and deviate from their trajectory in the technology competition. Today's global technological and industrial competition has evolved into a "race to be the

first" to explore and dominate new fields, rather than a focus on efficiency. "Technology nationalism" and "resource nationalism" coexist with trade protectionism and unilateralism, causing industrial chain fractures to varying degrees. This "knockout race" places greater emphasis on diversity and autonomy of technology sources. It is no longer sustainable for Chinese enterprises to rely on the old path of acquiring advanced technology by serving as a destination for international technology transfer. While maintaining the independence and security of industrial and innovation chains, interactions with global frontier technology innovation concepts, factors, and modes must continue. Not only should more diverse mechanistic explorations be conducted at the national level, but corporate action should be galvanized.

3.1.2 Escalating major-power competition has intensified geopolitical conflicts, generalizing global security issues

Without a doubt, the China-US relationship is the most significant uncertainty and risk factor in the external environment for China's industrial development today and for the foreseeable future. Since 2018, the US government has adjusted its China policy for various rounds, ranging from the trade war with China to comprehensive industrial and technological "decoupling" and so-called supply chain "de-risking". The US government has used various expressions to describe the global supply chain landscape in the context of major-power competition, but its strategic intent against China, its most serious threat and rival, has not changed substantially (Cai et al., 2024). In terms of strategic arrangements, the United States has enacted the Infrastructure Investment and Employment Act, the Chips and Science Act, and the Inflation Reduction Act ("Three Acts") as a combination of offensive and defensive industrial policies to thwart and suppress China's technological innovation activities and advantageous industries (Yang, 2023). Some industrial policies are selective and confrontational, challenging the principles of the current multilateral system and leading to fragmentation in the era of globalization (Blanga-Gubbay and Rubínová, 2023). Alarmingly, persistent pressures imposed by the US government have had a great impact on the decisions of its domestic investors. There are signs that US investors are exiting China's capital markets at a rapid pace. In 2023, the transaction volume of US capital in China's primary market fell significantly year on year, with participation in transaction events dropping by up to 50%. US investors are more concerned with financial returns than with government intent and national interest. In addition to factors such as interest rate spread and exchange rate, changes in their investment behaviors are largely driven by the US government's vigorous interventions and frequent pressures via legislation in the face of China-US technological and industrial competition. The US Department of Commerce emphasized in its 2023 Export Control Law Enforcement Report that "in order to prevent the most critical technologies from falling into the hands of adversaries, export control has never been more important than today" (BIS, 2024), and the European Union and the United Kingdom also launched the "European Economic Security Package" and "Critical Input and Supply Chain Security Strategy" in early 2024 to enhance supervision and review over foreign capital. The sobering prospect of the China-US relationship has slowed the inflow of various types of foreign capital. Western countries, led by the United States, have enacted security-focused policies and regulations that have created institutional barriers to Chinese enterprises engaging in technological cooperation, technology imports, and cross-border mergers and acquisitions, restricting their access to overseas capital and creating tension in the security situations for critical industrial chains.

3.1.3 Deepening impact of global industrial chain structuring

In the face of tightening global security, international investment and trade growth has been slow, with serious consequences for the global production system, trade order, and investment landscape. According to the World Bank, global actual fixed capital formation volume increased by about 1.9% in 2023, significantly lower than the 3.3% level in 2022 and well below the global average growth rate of 4.0% between 2011 and 2019. Global industrial production and trade have been trending downward.

In 2023, international trade growth was sluggish at 0.6%, a significant decrease from 5.7% in 2022. Many studies have also discovered that an increasing number of trade activities have begun to deviate from their role as a conduit for the realization of returns on division of labor and as a driving force in economic growth. Global industrial chains are being restructured due to rampant protectionism, resulting in closer production layouts, deeper economic and trade relations with "partners" who share similar values, and acquisition of supply chain links from more resilient sources (Blanga-Gubbay and Rubínová, 2023). Over the past few years, governments, the corporate community, academia, and international institutions have focused on restructuring global industrial and supply chains. However, some significant shifts in trend are not fully supported by international trade and capital flow data. Tensions in international political, economic, and trade relations caused by China-US competition have persisted for years, and direct evidence of a link between China-US relations and "anti-globalization" appeared to be lacking. However, the situation is changing. Following the enactment of the Three Acts, the United States has expanded its tools for suppressing and blocking China into a series of progressive domestic laws. Restricted multinational corporations either proactively or passively make the "China plus 1 or N" adjustment to their global supply chains, which has an increasingly clear impact on decoupling. According to WTO data, China fell to second place on the list of import source countries for the United States in 2023, with the proportion of US imports of intermediate inputs and components from China increasing from 11.4% in 2019 to 12.8% in 2022 before falling to 10.5% in the first half of 2023. According to Lábaj and Majzlíková's (2023), "re-industrialization" and manufacturing re-shoring led to a significant decrease in offshore outsourcing from the European Union and the United States between 2010-20. Specifically, the European Union's outsourcing business with China fell by 3.7%, while the US and EU's share of near-shoring increased from 83.1% and 66.8% to 89.6% and 73.0%, respectively. In 2023, Japan's largest export destination shifted from China to the United States. Not only has China's industrial correlation with developed countries weakened, but Chinese enterprises risk being replaced by countries and regions with lower manufacturing costs in GVCs with high levels of globalization (Freund et al., 2023). Global manufacturing distribution is defined as the coexistence of "diversification of low-end supply chains and re-shoring of high-end supply chains". This trend in spatial distribution has created a "two-way squeeze" on Chinese enterprises. Furthermore, China's traditional comparative advantage has eroded, posing new challenges to its ascent into higher-value global value chains.

3.1.4 Industrial green transition has a long way to go under the global carbon neutrality goal

Major countries have all accelerated their energy transitions, particularly in the energy sector, where carbon neutrality is the most onerous task. Global energy investment grew faster than total investment in 2023, and clean energy investment remained stable for three years in a row. However, current clean energy investment and growth levels fall short of the global net-zero emissions target. Under the current supply-demand situation, the "impossibility triangle" of energy security, price stability, and low-carbon transition cannot be overcome. As a result, countries must seek long-term dynamic equilibrium in the three target dimensions of security, environment, and economics. As a developing country with a large population and industrial base, China has vowed to pursue high-quality industrial development by ensuring energy security, maintaining energy price stability, and achieving carbon neutrality and carbon peak goals, all of which require significant socioeconomic costs. In terms of technical emissions reduction, the use of digital technologies is generally beneficial in precisely identifying the potentials and pain points of industrial enterprises for energy conservation and emissions reduction, as well as improving the efficiency of green innovations. Meanwhile, digital infrastructures such as supercomputers, artificial intelligence, and smart devices account for a rapidly growing share of energy consumption. Carbon reduction technologies such as carbon capture, utilization, and storage (CCUS) continue to fall short of industrial application requirements in terms of technical economics and market readiness. The dilemma of green and low-carbon technologies failing to achieve comprehensive and

systematic breakthroughs has severely limited the space and overall progress of emissions reduction in carbon-intensive industrial sectors. In terms of institutional emissions reduction, major-power competition is intensifying, even in the low-carbon sector, where competition and cooperation are most likely to coexist. Countries not only increased their support for the development of low-carbon industries in their own countries and expanded the domestic green product market, but they also invested heavily in policy instruments to compete for dominance in clean energy, green technology, and product standards. Institutional arrangements led by the European Union's carbon border adjustment mechanism (CBAM) have disrupted China's traditional export advantages in steel and nonferrous metals. Another source of uncertainty, including investment and the low-carbon transition, exists at the microscopic level. In recent years, the business community in developed countries has shown subtle shifts in their attitude toward ESG, in contrast to Chinese enterprises' commitment and enthusiasm for the ESG concept. Currently, ESG remains a binding force on corporate management performance, but levels of attention and investment are decreasing. In the first three quarters of 2023, various types of investors in the United States withdrew more than 14 billion US dollars from ESG funds. In 2024, many countries, including the United Kingdom and France, will tighten their ESG investment criteria. Such a shift can be interpreted as a reaction from the business community to the abuse of ESG in certain countries, and, worse, the use of ESG as a political slogan that forces businesses to change course. The root cause is that many investment projects are marketed as "green and low-carbon" without producing the anticipated output level. The dire climate situation and the uphill battle to achieve global carbon neutrality have added uncertainty to green technology innovation for Chinese businesses. Meanwhile, they present higher requirements for creating a science-based and independent green industrial development system capable of achieving the carbon peak and carbon neutrality goals while remaining highly compatible with the modern industrial system.

3.2 Seizing the Opportunities from the Changing Situation

The unpredictable external environment, as well as its complex consequences, should be viewed objectively and dialectically. On the one hand, escalating great-power competition and deepening decoupling have exacerbated China's "chokepoints" in core technologies, critical components, basic algorithms, advanced materials, software systems, standardization, and rulemaking, exposing its weaknesses in technological originality, industrial chain dominance, and influence over international rules. On the other hand, the increasingly difficult industrial chain security situation has resulted in a reverse transmission effect. On both "top-down" and "bottom-up" pathways, the government and businesses have reached an agreement and taken coordinated actions to accelerate R&D spending and the commercialization of critical technologies and components. Major breakthroughs have been made in critical areas such as large cruise liners and gas turbines. In the midst of industrial change toward digitalization, green development, and integration, China has strengthened its foundation for the transition to the high-income stage and the construction of a modernized industrial system to enhance its new advantages for high-quality development.

3.2.1 Seizing opportunities in industrial digitalization and digital industrialization to transform china into a digital economy powerhouse

The development of the digital economy and the digital transition are the most iconic events and trends in global economic development and human progress in the 21st century. After more than a decade of development, China has developed strengths in digital assets, new infrastructure, core digital economy industries, digital technology and smart manufacturing applications, and business model innovations. According to the Digital China Development Report (2022), China's digital economy has grown to 50.2 trillion yuan, 4.6 times its size in 2012, accounting for 41.5% of China's GDP. It generated 8.1 ZB of data, accounting for 14.5% of the global total. China is the world's second largest digital economy and data generator, and it has built the world's largest and most technologically advanced network

infrastructure to become a true digital economy powerhouse. Meanwhile, Chinese enterprises have used their previous experience in the platform economy and cross-border e-commerce to deepen business model innovation, proactively develop overseas markets, and expand the international influence of leading digital economy enterprises. In response to the global digitalization trend, Chinese enterprises should invest more in advanced smart hardware R&D and manufacturing, as well as the development of high-end professionals, resulting in the deployment of voice recognition, classic AI, computer networks, multimedia, visualization, and other frontier technologies, as well as future strategic industrial initiatives and technological capabilities in both domestic and international markets. In this way, Chinese enterprises will provide industrial Internet and smart manufacturing solutions for the transition and upgrade of traditional industries, promote discussions on international topics such as trade, security, public governance, and regional cooperation related to the digital economy, and propel China's digital economy to a new stage of both quantitative and qualitative development.

3.2.2 Strengthening industrial advantages and leading the global energy transition and innovations

In recent years, the accelerating global energy transition has created major opportunities for China's new energy and new energy vehicle industries, resulting in explosive growth in exports of electric vehicles, lithium batteries, and photovoltaic products, collectively known as the "new three". According to customs statistics, China's "new three" exports surpassed 1 trillion yuan for the first time, reaching 1.06 trillion yuan, up 29.9%, establishing a new engine of foreign trade growth. The "new three" exports have resulted from the accumulation and release of China's technological innovations and industrial capabilities, reflecting the vibrancy and resiliency of China's industry. They are a highlight of industrial upgrading and a milestone in the development of international new competitive advantages. It should be noted that the following uncertainties continue to challenge China's current advantages: First, on the supply side, excess capacity in power batteries and other products has emerged. Given their industrial organization characteristics, the "new three" export-oriented industries have a low entry barrier. The market forces of incumbent enterprises are insufficient to prevent the emergence of new technology paths, and disruptive innovations are likely to emerge in the technology paths of relevant sectors. Second, the market boom cycle's sustainability is determined not only by infrastructure renewal, product performance iteration, and consumption policy orientation, but also by product lifecycle constraints. Such cyclical changes in product performance will become a critical factor in determining the international market reputation of China's "new three" exports, as well as a true test of Chinese enterprises' capabilities for sustained innovation and industry development. Third, the market dominance of China's "new three" exports, which are rapidly capturing overseas markets, is at risk due to the "heavy-handed and revealed" industrial policy led by the US Inflation Reduction Act, which is aimed at excluding competitive rivals. This policy features the theme of "mandatory domestic manufacturing" and the provision of substantial subsidies (He, 2023).

According to the historical trend, each industrial revolution was followed by an energy revolution. Xi Jinping, General Secretary of the CPC Central Committee and President of China, stated, "China has abundant wind, photovoltaic, and other resources with enormous potential for new energy development. Following relentless R&D efforts, China now leads the world in many new energy technologies and equipment manufacturing capabilities. China has built the world's largest clean electric power supply system and fostered strong international competitiveness in new energy vehicles, lithium batteries, and photovoltaic products, laying the groundwork for future energy development. China has emerged as a strong supporter of the global energy transition and climate change response".[1] Despite new changes and adjustments to the policy orientation and business priority of electric vehicles and other products in

[1] See Xi Jinping Calls for Vigorous Promotion of China's New-Energy Development and Greater Contributions to Building a Clean and Beautiful World at the 12th Collective Study Session of the CPC Central Politburo, *People's Daily*, March 2, 2024, page 1.

Europe and North America, the international community has agreed to proactively develop clean energy and accelerate socioeconomic green and low-carbon transitions in addressing climate change. In strategic emerging industries such as new energy and new energy vehicles, China has created unique development conditions that combine early-moving and late-moving advantages, with leading enterprises beginning to dominate the rate of industry technology iteration. Going forward, it is recommended to closely monitor changes in global clean energy technology paths, the direction of green and low-carbon transition, and the evolving trends of the policy system. Domestic R&D institutions and enterprises should be guided to strengthen their competitive products and improve their industrial chain status while proactively investing in hydrogen energy, new energy storage, next-generation battery technology, and other new areas of the energy revolution to contribute Chinese solutions to promoting high-quality and sustainable new energy development and building a clean and beautiful world.

3.2.3 Enhancing strategic capabilities and restructuring critical mining industrial chains

Critical minerals are finding increasingly extensive applications in new-generation information technology, new materials, high-end equipment, and defense as a new round of technological revolution and industrial change unfolds. In recent years, there has been an increase in demand for critical minerals as part of the global clean energy transition, and critical minerals have become a focus of great-power competition (Cheng et al., 2021). Over a long period of time, the composition of strategic resource-based industrial chains has been primarily influenced by resource endowment under the traditional international division of labor, resulting in a global industrial landscape in which China's advantages are concentrated in the mid- and upstream industrial chains, while developed countries control downstream high-value materials. Because of their high demand elasticity, critical minerals have an unstable supply and demand relationship, resulting in frequent price volatility, and industrial chain competition is primarily manifested as a fight for pricing power. Escalating great-power competition has exacerbated uncertainties in global supply and demand for key minerals, prompting Western powers, led by the United States, to renew their critical minerals list. To strengthen strategic cooperation in the field of critical minerals and reshape the supply chain system, the United States established the "Minerals Security Partnership (MSP)," a new international mineral coordination mechanism also known as the "Metallic NATO", in 2022. The strategic arrangements made by Western countries led by the United States exhibit two distinct themes: technological "de-resourcing" and supply chain "de-risking". Both themes aim to reduce external reliance on China for critical mineral resources. On the one hand, this "de-Sinicization" trend for critical minerals has posed challenges to the high-quality and sustainable development of relevant industries, but it will also force China to promote in-depth industrial chain extension and balanced development. On the other hand, China has relatively complete critical mineral products with abundant reserves, giving it significant capacity and cost advantages in resource extraction, smelting separation, and raw material purchasing and manufacturing. It is a true powerhouse in terms of reserve, production, consumption, and export of critical mineral resources. Based on this endowment condition, critical minerals are an important area for countermeasures in great-power competition. China's resource advantages in rare earths and other critical minerals failed to translate into industrial advantage. This is primarily due to international patent protection and the demand and application of domestic raw materials subject to technological and industrial structure. China's ambitions to become a high-income country and complete modernization have raised the bar for its overall industrial performance, providing intrinsic dynamism to boost R&D and investment in high-end applications, as well as bring about overall improvements in industrial raw material process technology, application structure, and value addition. Meanwhile, the restructuring of relevant industrial chains opens up new opportunities for China to participate in global governance of critical mineral resources and establish dominance over strategic resource and industrial sectors. Leveraging these opportunities will provide critical raw material security assurance for energy transition and industrial upgrading, accelerating China's transformation from a major resource country of critical minerals to an advanced materials powerhouse.

3.2.4 Exploring emerging markets and sharing China's industrialization achievements globally

Over the past three centuries, industrialization has generated unprecedented material wealth for human society. However, many countries and regions around the world have yet to complete their industrialization processes, and some of the least developed countries have even failed to enter the industrialization phase. With the rise of emerging markets, the new industrial revolution, fueled by rapid advances in new transportation and information technology, has demonstrated a new paradigm of spatial response, characterized by multi-origin trends and global leapfrogging. Accelerating industrial development in an increasing number of countries and regions will naturally result in a large market for industrial and consumer goods. Emerging markets, with their rapid population growth and significant structural transition potential, will provide significant opportunities for China's industry to expand trade and investment, strengthen industrial capacity cooperation, integrate strategic resources, and dominate industrial chain distribution. These opportunities can be used to highlight China's industrial advantages, which include a complete industrial system, diverse entities, applicable technologies, large industrial capacity, and product cost-effectiveness. In recent years, China has made significant progress in emerging markets such as ASEAN, Latin America, and Africa. According to customs data, China's trade with ASEAN increased by 8.8% per year on average between 2013 and 2023, outpacing the country's overall annual trade growth by 3.8 percentage points. China and ASEAN are not only each other's largest trading partners, but they have also fostered extensive industrial and supply chain interconnection based on their comparative advantages. In 2023, China's intermediates trade with ASEAN was worth 4.13 trillion yuan, and ASEAN has been China's largest trading partner for intermediate inputs for many years. Over the past two years of implementation, the Regional Comprehensive Economic Partnership (RCEP) has significantly reduced regional trade costs and benefited its member countries. In 2023, China's total imports and exports with RCEP member countries outside ASEAN totaled 12.6 trillion yuan, up 5.3% from the level before the RCEP went into effect. China's trade index with BRI countries has increased from 100 in 2013 to 165.4 in 2022, reflecting the BRI's deepening implementation. In 2023, China's total imports and exports to BRI countries were 19.47 trillion yuan, accounting for 46.6% of China's total foreign trade volume. Both the volume and proportion of trade with BRI countries have reached their peak since the BRI's inception. Many risks and barriers to trade are expected to persist. In traditional labor-intensive industries, emerging economies have already competed with China. In general, the rapid development of emerging markets will offer Chinese enterprises opportunities to leverage their industrial system advantages. They can invest in infrastructure construction, develop and utilize mineral resources, build a clean energy system, export large whole-set equipment and finished industrial products, and expand cross-border e-commerce platforms. This will provide more opportunities for mutually beneficial cooperation and win-win results, contributing to the creation of a community with a shared future for mankind through the global benefits of China's industrialization achievements.

It should be noted that the government must play a role in facilitating information communication and multilateral cooperation, shaping geopolitical relations, advocating international rules, and avoiding systemic risks. It must fully trust outstanding entrepreneurs who grew up in the midst of fierce international competition, inspire entrepreneurial initiative and creativity, and turn them into participants in developing new fields, explorers of new markets, and mainstay of industrial modernization.

4. Policy Orientation for High-Quality Industrial Development in the Process of Modernization

As mentioned before, China has a solid foundation and comprehensive strengths to develop into a middle-income country and industrial powerhouse based on historical trends, development rationale, and current conditions. China has made significant progress toward the development of a modern industrial system. However, it should be noted that China's high-quality industrial development faces challenges and obstacles such as reliance on foreign supplies of critical technologies, insufficient

effective demand, excess capacity in certain sectors, and a lack of confidence in corporate development. In addition to the development stage and changing external environment, these risks and challenges can be attributed to policy deviations and unfavorable implementation effects, indicating deep-seated structural contradictions in China's industrial development. For late-moving countries, the problem of structural imbalance appears to be present throughout their industrialization process, manifesting itself in both traditional and high-tech sectors. Based on historical experiences and international comparisons, structural adjustment can only be accomplished through relentless innovation. Based on this understanding, China's high-quality industrial development will be a long-term and difficult task. There is a lack of coordination and imbalances between factors, sectors, wages, market entities, investment and consumption, and policy instruments, stressing the importance and urgency of "coordinating economic and other policies," as emphasized by the Central Economic Working Conference in 2023.

Based on the strategic goal of developing a modernized industrial system, industry authorities and governments at various levels have implemented a variety of policy measures to address issues faced by different industries. They have taken proactive steps toward adopting innovative industrial policies, supporting new industrialization, accelerating high-quality industrial development, and ensuring industrial independence and security. However, it should be noted that the implementation of some policies has failed to produce desired results for a variety of reasons. They include insufficient knowledge renewal, a lack of investigation and research and comprehensive information, poor policy design as a result of inaccurate problem capture, an unreasonable choice of policy instruments, and bad timing, inefficiency, and coordination of policy implementation. In emerging and future industries, new technologies and business models emerge at a rapid pace, and traditional regulatory models are unable to keep up with the demands of technological renewal and use case development. In some industries and sectors, the problems of early and late policy initiatives coexist. To begin with, new businesses and profit models are not subject to market regulation, commercial laws, or the tax system, resulting in legal and regulatory gaps. Another reason is that it takes time to determine the governance rationale for the gaming and content industries, as well as the ownership rights of data assets, data factor pricing, data security, and privacy protection, which have yet to be fully revealed. As a result, industrial policy and the regulatory system have become disorientated. Some policies that lack solid demonstration and coordination were enacted in haste, deviating from their original intent and resulting in a slew of unexpected collateral consequences. There is room for improvement in policy alignment with the global competition landscape, national strategies, industry development trends, and market expectations.

In terms of the international environment, the generalization of global security issues emphasizes the need and importance of proactive arrangements and policy responses. Major economies have adopted industrial policy as a key policy tool for accelerating technological innovation, promoting structural change, increasing economic resilience, reducing security risks, and even suppressing competitors. Government intervention and alliances have expanded to include frontier technologies, advanced materials, core components, critical minerals, and highly strategic sectors related to the clean energy transition and defense industry, with the goal of accelerating infrastructure renewal and future industrial development through increased subsidies. It should be noted that major-power competition and geopolitical conflicts have resulted in a shift in international relations and reshaped the global industrial landscape. The superimposition of risks that set the stage for crises has become the "new normal" for many countries. Given the numerous challenges posed by the evolving landscape, it is more important than ever to strike a balance between development and security. Major countries, in particular, should set aside a portfolio of more coordinated and effective policy instruments. However, China's policy toolkit for dealing with external risks is insufficient, necessitating an upgrade to a forward-looking top-down design that draws on past experience. At the technical level, a combination of short and long-term strategies should be used to implement an array of initiatives.

In the modernization process, we should combine technological innovation with institutional

innovation as the primary focus for improving the policy support system. We must have the courage to reform and innovate, make progress to maintain stability, and establish new goals and systems before dismantling old ones. Overarching strategic arrangements, science-based and systematic policy design, and efficient and orderly implementation should be combined to overcome major contradictions, problems, and risks, as well as promote China's long-term high-quality industrial development.

First, we must prioritize technological innovation in order to lead the development of a modern industrial system and foster new, high-quality productive forces. In response to a new round of opportunities and challenges from a new cycle of technological revolution and industrial change, the Central Economic Working Conference has called for "spearheading the development of a modern industrial system through technological innovation". This statement not only captures the primary contradiction in China's high-quality industrial development, but it also represents a realistic option and long-term task for late-moving countries to develop endogenous capabilities for technological progress. It is critical to foster strategic national strengths in science and technology, invest more in fundamental R&D, and promote technological independence and strength through "0 to 1" original innovation. It is suggested that the List of Critical and Emerging Technologies be released and updated, that new technology innovation platforms be developed to foster frontier technologies and future industries, that enterprises and research institutions be guided to focus on technology innovation, that synergy between basic research and applied innovations be increased, and that high-quality industrial development be steered toward total factor productivity (TFP) improvement. Conditions should be created to break down barriers and maintain linkages and communications with the global frontiers of technological innovation, with a focus on addressing the constraints of core technologies, critical components, and advanced raw materials to China's high-quality industrial development, as well as achieving independence and self-reliance for major technologies and equipment. New industrialization should be relied on to generate dynamism for fostering new domains, entities, clusters, and pillars for high-end, intelligent, green, and integrated development with a view to strengthening the digital economy, accelerating low-carbon transition and green development, elevating strategic emerging industries, planning for future industries, and expediting the transition and upgrade of traditional industries driven by intelligent, digital, and green technologies.

Second, we should work on both the supply and demand sides to develop market capacity and a consumption system that is compatible with China's industrial capacity. The Central Economic Working Conference emphasized the need to address the issue of declining social expectations. Uncertain expectations and lack of confidence manifest not only in a weakening desire of private enterprises to invest, but also in complex causes of slow private consumption. It is necessary to issue more intense, vigorous, innovative, and coordinated policy signals, to launch initiatives to stabilize expectations, growth, and employment, to improve a sense of security for business entities and a sense of gain for the masses, to accelerate the stabilization of social expectations, to boost market confidence, and to create a market environment that meets high-quality development requirements. On the supply side, efforts should be directed toward furthering supply-side structural reforms. A new round of equipment renewal investment should be launched to improve compatibility between traditional and new factors, as well as phase out obsolete capacity in traditional industries. Capacity analysis and early warning for emerging industries should be conducted. Leading businesses in relevant industries should be guided to achieve the dual benefits of mutually reinforcing economies of scale and technological capabilities. The Opinions on Promoting the Private Sector of the Economy should be implemented to improve legal assurance for the development of the private sector of the economy while also inspiring the dynamism of innovation and entrepreneurship. On the demand side, emphasis should be placed on increasing effective demand, removing barriers to a unified national market, lowering transaction costs, breaking down market segmentation, and leveraging the advantages of an ultra-large domestic market into driving forces of market and consumption growth. Efforts should be made on multiple fronts to improve workforce competency, promote innovative forms of employment, broaden employment channels, improve the

distribution system and income expectations, and support the development of an industrial powerhouse by transforming the country into a consumption powerhouse.

Third, we should promote synergy between deeper reforms and increased high-level openness. As a late-moving populous country, China's main source of insecurity is a lack of development. Reform and opening up are an ongoing initiative during China's modernization drive for the country to escape the middle-income trap and develop into a high-income economy. In the new development stage, it is critical to find solutions based on China's past successes in reform and opening up, as well as to develop a theoretical system based on the mission and epochal characteristics of Chinese modernization to guide efforts to achieve breakthroughs in critical areas. It is suggested to fully capitalize on the initiative of the masses, mobilize the enthusiasm of governments at all levels, encourage businesses to transition, dismantle implicit institutional hurdles, and remove institutional barriers to the development of new-quality productive forces. In the face of declining dynamism and a lack of consensus, it is critical to ensure that China's opening up endeavor does not deviate from its trajectory by ensuring unwavering determination, greater commitment, and stronger initiatives for opening up, building a market-oriented, standardized, and world-class business environment under the rule of law, promoting steady growth of foreign trade and capital, and smoothing domestic and international circulations with broader openness. It is suggested to coordinate the modernization of national governance with global governance, advocate for new multilateral agenda such as digital trade, clean energy, climate governance, and emergency management, resolve disputes and confrontations through constructive international coordination, enhance China's international influence, appeal, and leadership, and create a conducive situation of benign interactions between high-quality development and high-level security.

Fourth, we should create new international industrial and supply chain systems, focusing on critical industrial chains as breakthrough points. It is suggested to insightfully identify the evolving patterns of global industrial chains and key industries, explore opportunities from a new round of technological revolution and in-depth adjustment in the international production system, and implement high-quality development initiatives for key industrial chains. Focusing on critical minerals, power batteries, new energy, new energy vehicles and integrated circuit, efforts should be made to elevate basic industrial capabilities, deepen cooperation under the Belt and Road Initiative (BRI), broaden the space for factor, technology and industrial capacity cooperation, and guide Chinese enterprises to move atop industrial and supply chains based on the dual circulations landscape. Meanwhile, the government is advised to establish complete supply chain security evaluation and risk prevention mechanisms, adopt innovative work methodologies, enrich the policy toolbox to respond to geopolitical risks, technological blockades, and major emergency incidents, and increase supply chain stability. It should promote industrial and supply chain coordination with new-quality productive forces, rely on independent, controllable, secure, effective, intelligent and green innovation and industrial chains, attract market entities including multinational companies, and create an independent, resilient and dynamic industrial ecosystem integrating all stakeholders, both domestic and international, for mutual benefit and win-win results.

Fifth, we should prioritize policy coordination and consistency. It is vital to balance the relationship between stability and progress, increase the consistency and compatibility of economic policy with other policies, and coordinate multidimensional dynamic relationships between technology and production factors, development space and strategic depth, capacity release and sustainable development, manufacturing and services, and domestic industrial chains and global supply chains. Industrial policy should be systematically coordinated with fiscal, financial, investment, trade and competition policies, green development, regional distribution strategies, and market standardization, with a focus on key areas. Short-term strategies should be combined with mid- and long-term ones to create synergy and ensure timely regulation. It should be noted that achieving coordination and consistency requires more rigorous policy research, formulation, and evaluation. As a result, policymakers should promote decision-making mechanism reform and innovation, proactively identify emerging areas and future

industrial development patterns, broaden their knowledge system, understand new policymaking requirements and characteristics, and improve policy instrument innovation in order to provide high-level decision-making support to new industrialization.

5. Concluding Remarks

Reviewing the historical trends of industrial development in typical countries, it is evident that countries and regions that have escaped the middle-income trap have generally followed the laws of industrial evolution on structural change, despite their diversity and differences in factor endowment, development model, and institutional choice. Certain common traits can be found in their development logic. An inspiring experience is that technological innovation as a decisive factor of productivity growth has always been the primary impetus for accelerating industrial upgrading, increasing national strength, and raising people's living standards. To surmount the middle-income trap, China must make coordinated progress in terms of its industrial system, technical capabilities, and factor conditions. As a late-moving, populous industrial nation, China faces even greater challenges in achieving its mission of building a modernized country in all respects. China's great achievements in industrial development over the past century, particularly since the reform and opening up program, have paved the way for high-quality development and created conditions for the country to become high-income. This represents a fundamental requirement for China's industry to advance to the next stage of development, as well as confidence in the ability to build an industrial powerhouse.

Around the world, there may be a small number of success stories, but they all point to how difficult it is for a country to achieve high income status. On its path to modernization, China's industry is inevitably confronted with a variety of problems and barriers. Among them, certain problems and difficulties stem from the combined effects of China's changing development stage and institutional mechanisms. Our world is changing, as are our times and histories. At this juncture, the onset of external uncertainties has exacerbated the challenges to China's high-quality industrial development, magnifying the difficulties and pressures to avoid risks and resolve contradictions. We must understand the global development megatrends based on the laws of historical progress in order to navigate the complex international environment. It is essential to cultivate a thorough understanding of the important guidelines made by Xi Jinping, General Secretary of the CPC Central Committee and President of China, regarding the progress of new industrialization: "We should actively adjust to and spearhead a new wave of technological revolution and industrial change, apply the principles of high-quality development throughout new industrialization, and develop our country into a manufacturing powerhouse through the digital economy and industrial informatization, so as to build robust material and technological foundations for realizing Chinese modernization".[2]

Looking ahead, China's rise to the status of a high-income country must be accompanied by innovative new industrialization practices and the development of a modernized industrial system. As a result, we must approach problems with a development mindset, find proactive solutions, and innovate with a broad horizon (Dong, 2024). It is critical to fully, accurately, and comprehensively implement the new development concept, broaden and reengineer China's industrial system based on new technologies, business models, and business segments, and achieve overall improvements in industrial performance. The goal is to surmount the hardships and obstacles at the historical intersection of major risks, safeguard China's sustainable industrial development, underpin the foundation for Chinese modernization with growing new-quality productive forces, and contribute groundbreaking, pacesetting, inclusive, and sustainable Chinese paradigms for the global industrialization process and the evolution

[2] See "Implementing the Principles of High-Quality Development throughout the Process of New Industrialization and Creating a Powerful Material and Technological Foundation for Chinese Modernization", *People's Daily*, September 24, 2023, Page 4.

of human industrial civilization based on China's more complete, resilient and robust industrial system, more vibrant innovation ecosystem, and unique institutional advantages. CE

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