Composition and Development Strategies of an Industrial System for China's Modernization Drive

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Abstract: *The creation of a modern industrial system is a key priority for China's high-quality economic development. It is fraught with obstacles and challenges, and it necessitates great courage, wisdom, and a suitable approach and strategy. Today's world is defined by rapid technology innovation, shifting consumer demand, geopolitical restructuring, and an evolving global industrial division of labor. In this context, China's current industrial structure is characterized by an increasingly entrenched dual structure. While conventional sectors are afflicted by excess capacity and growth bottlenecks, emerging high-tech industries are hampered in their development. These difficulties can be linked to a variety of factors, including slow domestic consumer demand and insufficient innovation. The creation of a modern industrial system strives primarily to foster inclusive innovation of the existing industrial system in order to reallocate resources in accordance with a demand-driven approach. This paper suggests that the current division between conventional and high-tech sectors should be replaced with a new industrial system that in this study we refer to as "3+1" structure for sound and sustainable development. To that end, we recommend that the government: (i) Adopt a demand-oriented development approach; (ii) support industrial development through the application of digital technologies; (iii) make coordinated progress between technological and industrial innovations; and (iv) continue to reform and open up, as well as reshape global technology and industrial cooperation networks.*

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The purpose of this paper is to analyze that after China became a middle-income country in recent years, the industrial structure of the current industrial system has begun to be solidified. The causes of this phenomenon encompass both exogenous factors such as geopolitical changes, accelerated technological progress, and changes in the industrial ecological environment, as well as endogenous factors including rising labor costs, insufficient innovation capabilities, and the need for improvement in industrial spatial layout. The superposition of these factors has adversely affected China's further economic growth and may lead China to fall into the "middle-income trap". In light of the imperative for future growth, how to get out of such a dilemma is a topic worth studying. This paper argues that it is a key step for China to build a modern industrial system that is future-oriented and globally competitive. In addition, how to transform our China's current industrial system into a modern industrial system is the core issue of modern industrial system construction.

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1. Structure Entrenchment of Current Industrial System and Causes

In comparison to China's current industrial system, the term "industrial system for the modernization drive"[1] refers to a new industrial system with cutting-edge technology and a new comparative advantage to suit the needs of human society. To succeed, the industrial system for the modernization drive, which evolves from the existing industrial system, requires a firm base, clear direction, and adequate dynamism.

1.1 Dual Structure of China's Industrial System

Industrial sectors can be classified for statistical analysis and research purposes. One typical approach is to categorize industries as primary, secondary, or tertiary based on the relationship between production and natural resources. Such an industrial structure offers an important perspective for assessing the development status of the global industrial system. Also, the current industrial system can be divided into two categories based on the level of technological density. Labor- and capital-intensive sectors with low technological density, often known as conventional industries, include manufacturing, agriculture, and services. The other category includes technology- and knowledge-intensive industries based on emerging technologies, such as aviation and aerospace, robotics, smart equipment, chip manufacturing, as well as modern agricultural and high-end services. The industrial system, according to this classification, has a dual structure comprised of these two arrays of sectors.

After decades of reform and opening up, China has made significant progress in its industrial structure and complete manufacturing system. China leads the world in the manufacturing of numerous products and it has substantially enhanced product quality to win consumers globally. However, based on its dual industrial structure, conventional sectors continue to provide the most to China's industrial output, accounting for more than 80% of China's GDP. China's emerging high-tech industries, whose development in recent years has given rise to prominent tech giants such as Huawei as well as remarkable small and medium-sized enterprises (SMEs) known as "hidden champions", account for less than 20% of China's GDP. This lopsided proportion has resulted in a slew of issues, including excess capacity in conventional industries, structural imbalance, slow technological progress, and tepid growth in total factor productivity (TFP) in the context of a changing global division of labor, new consumer demand, the digital economy, and artificial intelligence (AI) (Liu, 2021). Due to a lack of innovation and the technology embargo, the digital shift has encountered challenges, as have emerging tech sectors.

According to the World Bank, dozens of nations entered the industrial era after World War II, but the majority of them remained in the middle-income stage and fell victim to the "middle-income trap". Only 13 of them have advanced to the high-income society. However, after two decades of robust expansion, those 13 economies saw their GDP per capita decrease abruptly by 40% to 50%, or in some cases, more than half, after reaching the mark of 11,000 international dollars (Maddison, 2003). At this point, the middle-income economies cannot compete in terms of labor costs with low-income countries nor in cutting-edge R&D with high-income countries. This limbo is known as the "middle-income trap" (Gill and Kharas, 2007). The causes of the middle-income trap have been explained from a variety of perspectives by economists. According to our analysis, one of the key reasons is the dual industrial system. Rising labor costs associated with rising household income and rising land prices due to industrial expansion will reduce the profitability and competitiveness of conventional industries in the middle-income stage, creating excess capacity and driving some industries to migrate. The end result is the decline of conventional industries and the hollowing out of the industrial sector. Despite rising demand for high-tech goods and services, emerging high-tech industries in those middle-income

[1] It refers to a new industrial system that drives China's future modernization development.

economies confront two challenges. First, a lack of continuing support for high-tech products and services; due to the capital-intensive and time-consuming nature of research and innovation, it is difficult for middle-income nations to advance technologically in a short period of time. Second, to maintain their advantage in cutting-edge technology, advanced economies will go to great lengths to prevent emerging middle-income countries from acquiring critical technologies (Rui, 2021). As a result, for those middle-income economies, the dual industrial structure becomes entrenched, inhibiting further structural sophistication.

To escape the middle-income trap and enter the ranks of advanced economies, developing countries must break away from the dual industrial structure. Specifically, developing countries should create an industrial structure dominated by new high-tech industries with advanced technology and high value-added while conventional industries transition and migrate. For instance, countries such as Japan and South Korea advanced from developing to developed status following the World War II, owing primarily to the successful transition of their dual industrial structure. However, not all countries have completed this shift. Despite early progress, some developing countries may face stagnation or discontinuity in the transition to a dual industrial system. Argentina, Brazil, South Africa, Thailand, and Malaysia were all examples of countries that fell into the middle-income trap. Breaking away from the constraints of the dual industrial structure is a difficult and time-consuming task that needs contributions from both the market and the government.

1.2 The Dual Structure in China's Modern Industrial System

Since 2016, China's dual structure of conventional and emerging high-tech sectors has begun to take hold. China's conventional industries became less competitive and productive due to overcapacity and stagnation. Nonetheless, conventional sectors continue to account for more than 80% of China's GDP. Emerging high-tech industries have seen substantial output growth. China has created some high-tech modern industries from scratch, such as high-speed railway rolling stock, smartphones, 5G communications, semiconductor chips, and smart equipment manufacturing. All of these industries have been fast developing, and some - such as 5G communications, new energy vehicles, and BeiDou navigation satellite - have become internationally competitive. Despite the fact that these products are essential components of China's existing industrial system, emerging high-tech sectors account for less than 20% of China's GDP and are insufficient to support the country's overall economic growth (Rui, 2020).

The existing dual structure of China's industrial system contrasts with those of high-income countries led by the United States. Tech industries account for a major portion of GDP in developed countries, while most of their labor-intensive conventional industries have relocated offshore. Behind the contrast between China's industrial dual structure and those of developed nations are disparities in industrial technology, organizational efficiency, and, more importantly, workforce competence and skills, as well as progress in science and technology. The generation of value-added differs greatly among industrial systems having a dual output structure. High-income countries' industrial systems are principally responsible for the production of high-value goods and services. High-income countries, such as the United States, have tightened restrictions on China's access to vital technology, talent, equipment, and parts and components in order to hinder China's development of high-tech emerging industries. The stated rationale of national security belies the real intent of retaining industrial leadership by obstructing China's shift away from the dual industrial structure and blocking China's ascension to high-income status.

1.3 Logic behind the Formation of Dual Structure in China's Current Industrial System

Figure 1 depicts the progression and entrenchment of China's dual industrial structure. China initially developed conventional labor-intensive industries through the importation of foreign capital and technology and participation in the global industrial division of labor system since the implementation of the reform and opening up policy in 1978. These industries specialized in the production of low-

value goods and processing trade and export. Subsequently, China embarked on initiatives to develop other sectors, ultimately establishing a complete industrial system. The rising household income, the global financial crisis of 2008, and the appreciation of the renminbi all contributed to a rise in the cost of resources, the cost of living, and the cost of labor in China, reducing the competitiveness of conventional industries that rely heavily on cheap labor at the low end of value chains. Consequently, the initial feedback cycle that was mutually reinforcing is unable to endure, leading to a loss in the competitiveness of conventional industries in China. Since 2016, China's economic development has been impeded by industrial growth decline and inadequate domestic consumption, creating an economic quandary comparable to that encountered by other middle-income nations.

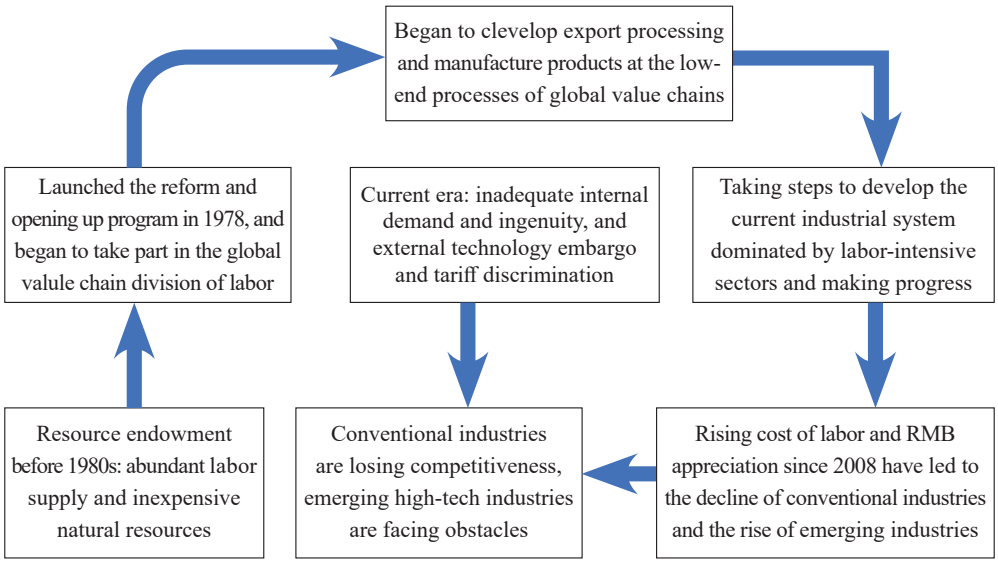

Figure 1: Formation and Entrenchment of China's Current Dual Industrial Structure

To keep the Chinese economy from falling into the middle-income trap, the State Council issued the *Made in China 2025* plan in May 2015[2], which lists nine key missions and priorities, as well as ten development focus areas. This 10-year action plan under the manufacturing revitalization strategy, advocates for China's transition from a large manufacturing nation into a resilient and competitive one; it upholds the incorporation of next-generation information technology into the manufacturing sector and the transformation of manufacturing mode, organizational methods, and industrial reforms to promote intelligent and service-based manufacturing. The implementation of *Made in China 2025* symbolizes the start of the transition and upgrade of China's current industrial system, which will be led by strategic emerging industries. This approach, however, sparked a pushback from developed countries determined to maintain their competitive position in high-value industries. Economic globalization and global value chains (GVCs) have been dominated by multinational corporations from high-income nations such as the United States (Gereffi, 2009). To lower costs and increase profits, these multinational corporations shifted low-value manufacturing activity to countries and regions with abundant labor resources. Furthermore, their technical patents, standards, distribution networks, and intellectual property right (IPR) arrangements have raised the bar to entering high-value processes such as design,

[2] The Central People's Government of the People's Republic of China: *Made in China 2025*, https://www.gov.cn/zhengce/content/2015-05/19/content_9784.htm.

R&D, and marketing, confining developing-country firms to low-end value chain segments. As a result, rich countries retain their high-income status, whereas emerging economies struggle to raise their income levels. In recent years, governments from developed countries began to intervene in the name of national security, hindering or suppressing free competition. Their restrictions on Chinese technology, industry, and talent have caused significant losses to the country's emerging high-tech industries. Tariff discrimination against China's conventional industries has weakened China's export competitiveness and exacerbated excess capacity and profit declines. The unfavorable external environment has contributed to the entrenchment of China's dual industrial structure, both at the high and low ends. Failure to address external challenges may result in the loss of China's comparative advantage, entangling the country in the middle-income trap and precipitating an economic crisis in the medium and long run.

2. "3+1" Composition of the Modern Industrial System

China has taken a forward-looking strategy in its continuous efforts to modernize its industrial system. This system should be globally competitive, sustainable, and based on the country's newfound comparative advantages, reflecting its social system and cultural customs, natural resource endowment, human resources, industrial asset stock, knowledge and technology resources, consumption tendencies, and ecological environment. Such an industrial system is distinguished by resource efficiency, green and low-carbon performance, intelligent information technology, optimized industrial value chains, reasonable spatial layout, indigenous innovations, openness and sophistication (Rui, 2018a). Emerging high-tech industries should be nurtured to become the backbone of the modern industrial system. Furthermore, innovation should breathe fresh life into conventional industries, making them important components of the modern industrial system. Furthermore, in the midst of scientific and technological progress, policymakers ought to devise strategies to anticipate the emergence of new industries, products, and enterprises. As rightly stated in China's *14th Five-Year Plan for Economic and Social Development and Long-Range Objectives through 2035*, the implementation of future industry incubation and acceleration programs is necessary to foster technology and industrial transformation, including deep-ocean and aerospace development, brain-inspired intelligence, quantum computing, genetic technology, future internet, hydrogen energy, and energy storage[3].

If the industrial system is still characterized by the level of technological density, it will be identical to the current dual structure. On the surface, the modern industrial system implies a significant growth in the GDP contribution of emerging high-tech industries. However, at a deeper level, it entails a considerable shift in industrial composition. Advancements in digital technology and artificial intelligence (AI) have transformed the industrial landscape, paving the way for more innovative high-tech industries of the future. China's modern industrial system consists of three arrays and one foundation, referred to as the "3+1" structure

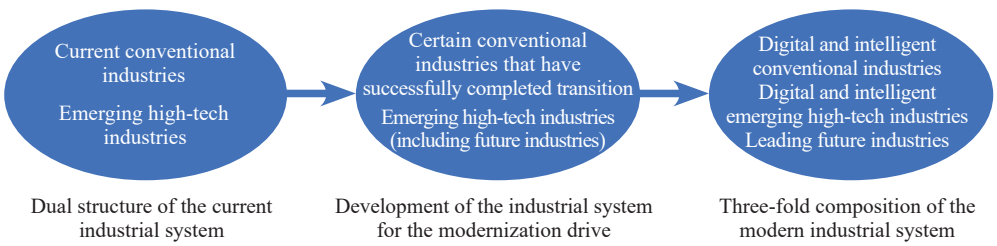

Figure 2: Evolving Structure of China's Industrial System for the Modernization Drive

[3] See *14th Five-Year Plan for Economic and Social Development and Long-range Objectives Through the Year 2035 of the People's Republic of China*, https://www.gov.cn/xinwen/2021-03/13/content_5592681.htm.

in this study. As shown in Figure 2, the three arrays consist of certain conventional industries that have been transformed by digital technologies, emerging strategic industries, and future industries that are presently being planned; the "one" foundation refers to the digital infrastructure industry.

2.1 First Array: Conventional Industries Transformed by Digitalization

The conventional industries that make up the 80% of China's industrial system need a comprehensive upgrading if the country is to achieve modernization. Certain sectors continue to hold significance in our modern industrial system due to their critical role in fulfilling people's daily necessities. They range from textiles and apparel to food processing, crop farming, building, retail, tra nsportation, energy, housing, and consumer services. However, in order to complete their transition via advances in technology, those conventional industries have to keep raising R&D spending. They must embrace digital and intelligent features in order to become an indispensable part of the modern industrial system. Not all conventional industries may accomplish this transformation; any significant shift in consumer demand or progress in science and technology may lead certain conventional industries to lose ground in the current industrial structure. On the other hand, conventional industries that are effectively adopting digital technologies will form the foundation of the first array of our modern industrial system.

2.2 Second Array: Emerging Strategic Industries

Emerging high-tech industries, which are distinguished by a high level of technology, value-added, reliance on innovation, and high-caliber talent, make up the second array of our modern industrial system. These industries are critical to our national security and technological advancement, as well as the competitive global industrial division of labor. Developed countries are dominant global players for certain emerging high-tech industries. China lags far behind advanced nations in those emerging industries in terms of technology, product, and innovation. In comparison to advanced economies in Europe and North America, China's emerging high-tech industries - such as semi-conductor chip production, software, AI applications, data analytics, medical equipment, aircraft engines, and new materials - are still in their infancy. However, these sectors form the bedrock of our industrial system. Given the rapid advancements in science and technology, it is imperative to acknowledge that the second array of industries is confronted with escalating global market competition and technology embargoes imposed by developed nations. China is reliant on unstable foreign supply of AI solutions, digital applications, new materials, and genetic technologies, as well as advanced manufacturing technology and process equipment. These supplies are regrettably susceptible to disruption as a result of external interventions. Without a doubt, the extent and quality of China's modern industrial system are dependent on the advancement of its second array of industries.

2.3 Third Array: Future Industries

Future industries are the third array of sectors in China's modern industrial system. Future industries are emerging industries that require a long time to develop, foreseeably 15 to 30 years. They have the potential to grow into strategic and forward-looking emerging industries powered by key technologies to meet people's aspirations for a better life. They represent the new directions of future technological and industrial development, as well as the driving force behind long-term social and economic development. As part of China's quest to establish a modern industrial system, it is recommended that the country support and lead the world in forward-looking industries backed by critical future technologies. Future industries, as a major component of the economy, constitute China's strategic emerging industrial cluster for mid- and long-term development, following the ongoing efforts to foster a diverse range of emerging high-tech industries. In a more precise sense, these industries are also included in the array of high-tech strategic industries as part of China's dual industrial structure. From a temporal standpoint, future industries currently under development should be strategic emerging high-tech industries to

supplant today's emerging high-tech industries in 15 to 20 years. It is expected that by then, China's future industries will be at the forefront of the country's economic and industrial development, offering premium goods and services that can compete on a global scale. Future industrial development is likely to be more uncertain than current emerging high-tech industries, necessitating new investment and development modes; as a result, future industries are identified as the third array in developing the industrial system for the modernization drive.[4]

2.4 New Digital Infrastructure Industry

Over an extended period of time, all the three arrays of China's modern industrial system should be built on the high-quality development of the new digital infrastructure industry. Data has become a new factor of production and will remain so in the foreseeable future[5]. As digital technology and AI advance at a rapid pace, they have become indispensable to the operations of modern industries and businesses. It is safe to say that the modern industrial system cannot flourish without the digital economy and new digital infrastructure. The term "new digital infrastructure industry" refers to a new type of infrastructure industry that promotes high-quality social and economic development, digital transition and upgrade of conventional industries, and the development of emerging high-tech, digital, and future industries to meet people's aspirations for a better life. The new digital infrastructure industries are also part of emerging high-tech sectors, although they are considered separately in this article due to their importance for other industries.

Physical infrastructure such as 5G base stations, sensors, and data centers are part of the new digital infrastructure industry, as are big data, AI, IT software and algorithms, and interconnection infrastructure such as industrial internet and intelligent IoT. The hardware, software, and connectivity infrastructures complement one another and form the foundation of the digital infrastructure industrial cluster, which will promote future development in the digital economy and digitalization of conventional industries.[6] The physical infrastructures, including 5G base stations and sensors, are the fundamental building blocks of digital technology and the conduits through which information is sent and stored. They generate and collect extensive interoperable and valuable data and information to enable data processing. Cloud computing, AI algorithms, and data analytics, as part of the soft infrastructure, enable data processing and mining based on software and algorithms to add value to data. In terms of connectivity infrastructure, industrial internet and intelligent IoT connect the virtual and physical worlds as a means of information transmission to boost productivity and upend conventional business models. Physical, soft, and connectivity infrastructures must be merged to establish a new sort of foundation for developing the three arrays of modern industries. The success of the three arrays depends on the new digital infrastructure industry taking the lead in innovation.

3. Strategies for the Development of the "3+1" Modern Industrial System

China has to establish a "3+1" modern industrial system led by growing high-tech sectors to avoid becoming stuck in a dual industrial structure dominated by conventional industries. That is the key for China to escape the middle-income trap and join the ranks of high-income countries through high-quality of social and economic development in the digital economy to swiftly improve people's welfare. Therefore, a scientifically-based strategy for the creation of a "3+1" modern industrial system is required

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[4] Rui Mingjie: "Forward-looking Science and Technology: Path for Identifying Future Industries," *Social Sciences Weekly*, January 12, 2023, Page 2.

[5] See the *Opinions of the CPC Central Committee and the State Council on the Development of More Complete Market-Based Factor Allocation Mechanisms*, https://www.gov.cn/zhengce/2020-04/09/content_5500622.htm.

[6] Rui Mingjie: "Three New Basic Industries for Accelerating the Digital Economy," *Liberation Daily*, March 3, 2020, page 13.

to facilitate the completion of the modern industrial system.

3.1 Adopting a Demand-Driven Development Strategy

The modern industrial system is primarily a supply-side system, and it corresponds to changing consumer preferences as well as the scale and structure of people's future needs for a better life. In addition to satisfying current consumer demand and following its trend, our industrial system must explore the possibility of creating new consumer demand, which is crucial for the development of the "3+1" modern industrial system and avoiding the entrenchment of the dual industrial structure. The size of the domestic market in China - a large country of 1.4 billion people - is determined by consumer choices and income levels. Domestic demand and industrial exports both contribute to the existing dual industrial structure that serves as the cornerstone of China's modern industrial system in the context of global economic integration.

China's per capita income was extremely low at the initial stages of the reform and opening-up policy in the early 1980s, implying poor consumer affordability. Domestic consumption historically represented only a minor share of economic growth. China's rapid economic growth was mostly driven by exports at the time. Subsequently, China's consumer market expanded further as per capita household incomes increased. In 2016 and 2019 China's aggregate retail sales of consumer goods exceeded 30 and 40 trillion yuan, respectively, before reaching a new high of 44 trillion yuan in 2021, which was 2.1 times the level in 2012. Despite COVID-19 lockdowns, China's retail sales of consumer goods totaled 43.97 trillion yuan in 2022, a 0.2% year-over-year decrease. This figure consisted of 38 trillion yuan in urban retail sales, which were down 0.3% from the previous year, and 5.9 trillion yuan in rural retail sales, which were equivalent to the previous year. China's final consumer spending contributed 66.4% to GDP growth in 2015[7]. Despite the COVID-19 pandemic, final consumer spending in China contributed 65.4% to economic growth in 2021. The current industrial system is supported by China's consumer market at 44 trillion yuan and the broader market for intermediate inputs. The question is, what does it take to construct an industrial system for the modernization drive?

Walt Whitman Rostow, a developmental economist, divided economic modernization into five stages of development in his economic takeoff model: (i) Conventional society: The society is based on agriculture and is characterized by poor productivity and extreme poverty; (ii) preconditions for take-off: The society prepares for industrialization through government investment in infrastructure; (iii) take-off: If the society embraces economic openness at this stage, it will attract foreign investment to fuel growth, enhance manufacturing sophistication, and accelerate industrialization; (iv) drive to maturity: In the mid and late stages of industrialization, the tertiary industry replaces the secondary industry as the dominant contributor to industrial output, and services develop rapidly; (v) mass consumption: In the final stage of the economic take-off model, domestic consumption has become the fundamental stimulus of economic growth, and domestic consumption, rather than an over-reliance on imports and exports, supports a high level of household welfare (Rostow, 2001). Currently, China's GDP per capita has reached $10,000 USD, joining the ranks of middle-income countries, and the tertiary industry accounts for more than half of China's GDP. By Rostow's standard, China's economic growth has entered the fourth stage of the economic take-off model, while some of China's prosperous cities, such as Shanghai, Beijing, Guangzhou, and Shenzhen, have entered the fifth. As a result, domestic consumption growth and demand structure adjustment have become the fundamental prerequisites for China to construct an industrial system for the modernization drive.

China's domestic market has been expanding over the last decade as the country transitions to a middle-income economy. However, low-end consumer goods continue to make for a sizable portion

[7] see *the Brief Update of China's Retail Sales of Consumer Goods in 2022*, https://www.ndrc.gov.cn/fgsj/tjsj/ssjj/202301/t20230130_1347724_ext.html.

of China's consumer demand. The present and future structure of consumer demand will be affected by household disposable income and consumer preferences, which in turn will have repercussions for industrial development. According to Shi et al. (2019), "Over the period from 1998 to 2017, China's urban and rural households continuously experienced Class I consumption upgrade (as manifested in the decreasing share of food and subsistence consumption) and Class II consumption upgrade (a rising share of symbolic and service consumption), but Class I consumption upgrade of rural households paled in comparison with that of urban households; since 2013, Class II consumption upgrade slowed amid downward pressures on China's macroeconomic performance, and housing spending created a significant crowd-out effect for other types of consumer spending. There is significant heterogeneity in consumer behaviors between urban and rural residents and between those whose Engel's coefficients are above and below 40%". Disparities in urban and rural household consumption and barriers to consumption upgrade can be attributed to the following problems in the income structure of China's 1.4 billion people: (i) Household disposable income per capita was generally low. Despite a 5% increase from 35,128 yuan in 2021, China's per capita household disposable income in 2022 was relatively low at 36,883 yuan. Monthly disposable income per capita was just 3,073 yuan, while monthly consumption spending per capita was 2,044 yuan. (ii) There were considerable regional income disparities among households. In 2022, for example, Beijing and Shanghai had per capita disposable incomes of 77,415 yuan and 79,610 yuan, respectively, whereas household disposable income in less affluent central and western provinces was only 30% that of Beijing and Shanghai. In particular, per capita disposable income in Gansu and Guizhou provinces was only 23,273 yuan and 25,508 yuan, respectively. (iii) Significant discrepancies in per capita income between urban and rural households persisted. In 2022, urban people in China had a per capita disposable income of 49,283 yuan, which was 40% higher than rural households' per capita disposable income of 20,133 yuan.

According to the data shown above, China's consumer market will continue to expand and support the modern industrial system if its household per capita income continues to rise, which is conducive to the development of a modern industrial system. In addition, household disposable income is low and uneven across regions. As a result, the coexistence of conventional low-cost consumer goods and certain high-value consumer goods is difficult to change in the short term. In this sense, China's development of an industrial system for the modernization drive is unique: The first and second industrial arrays must upgrade their products, but the new products must be affordable. The third array of future industries should not only pursue advancements in science and technology that are forward-thinking but should also consider the growth of China's household disposable incomes.

3.2 Digitalization

The scope of China's "3+1" modern industrial system is determined by two factors. The primary influence is current and future changes in household income levels, as well as shifting consumer demand, given that the modern industrial system is geared to produce and supply goods that match people's desires for a better life. Changes in demand will have an impact on the efficiency, product categories and quality, as well as the environmental sustainability of the current industrial system; it will also have an impact on scientific and technological progress (Rui, 2023). Without a question, big data and artificial intelligence (AI) are the most basic technologies for modern industries to respond to changing consumer demand. Data collection and analytics allow for an interpretation of consumer preferences. Intelligent manufacturing equipment, intelligent production lines, intelligent factories, and intelligent services are all part of AI solutions for meeting individualized consumer demand at scale. As a result, digital industrialization and industrial digitalization have become critical to China's industrialization and modernization efforts. This necessitates taking early initiatives to build digital new infrastructure.

Coordination among physical, software, and connectivity infrastructures, as well as advances in big data, AI, and other fields, have accelerated China's digital transformation, resulting in ongoing

iterations and upgrades of goods and services that redefine its global competitiveness. Technology and AI have turbocharged China's emerging high-tech industries, bolstering China's future industrial layout, growth, and leadership. The development of conventional industries is the first array in the modern industrial system, based on the support of new digital infrastructure, aims to apply digital technology for the transformation of existing technologies and manufacturing processes for the collection, analysis, research, and exchange of data factor during the manufacturing process in order to promote resource allocation efficiency, competitiveness and profitability, reduce production cost, optimize products, and accomplish the digital transition. Only when the digital transition is complete will the first array of industries, i.e. conventional industries, become a component of the modern industrial system. The second array of emerging tech industries, which lie at the heart of the modern industrial system and can be divided into three categories: First, data-generating and data-applying industries, including data analytics and 5G connectivity. Second, precise manufacturing, marketing, and services based on the data factor and digital technology, including mobile payment, e-commerce, and other services as part of digital economy industries. Third, high-tech industries that may not have used digital technology from the start and hence must also go through a digital transition. Among these are new energy vehicles, instruments and apparatus, and pharmaceutical manufacture. In the second array, all three industries must use data and digital technologies to improve manufacturing, business operations, and service modes. These industries are important components and driving forces of the digital economy. As shown in Figure 3, the growth of the third array of future sectors will inevitably be based on the foundation of data, digital technology, and AI.

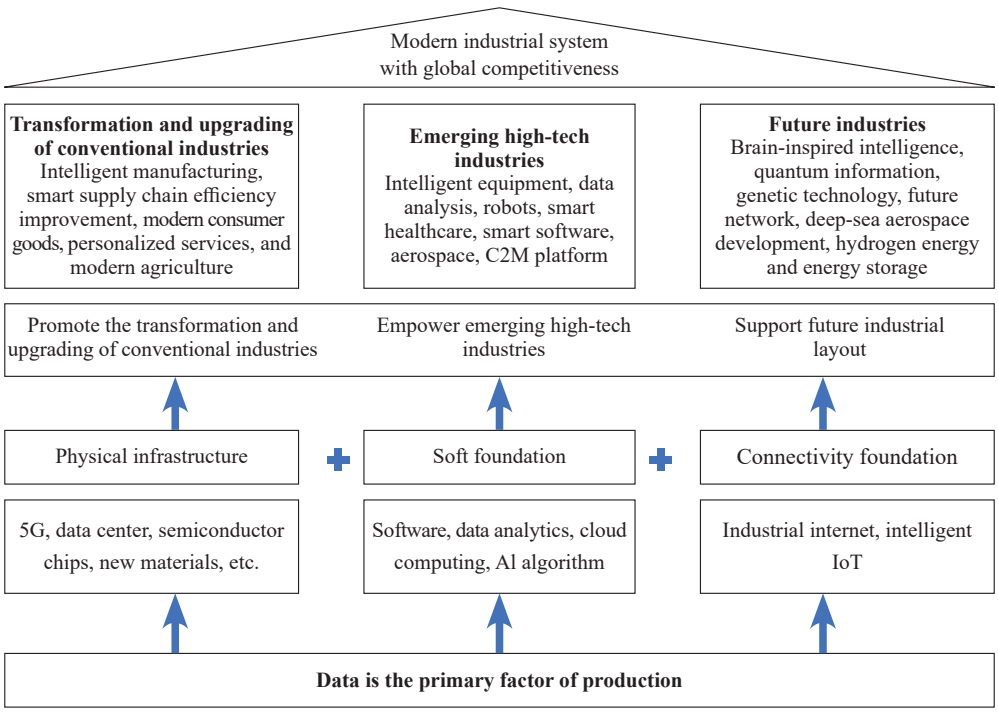

Figure 3: Digitalization Supports Modern Industrial System Development

3.3 Coordination of Technological and Industrial Innovations

The digital transformation of conventional industries, the rapid rise of emerging high-tech

industries, and the discovery of future industries all necessitate advances in science and technology, ingenuity, and the efficient output of innovation. Our existing industrial system is dependent on two sorts of innovation for ingenuity and innovation outcomes: Technological innovation and output and industrial innovation and output. Technology innovation is essential since it includes scientific discoveries as well as technological breakthroughs. Scientific discoveries are revelations of truth and patterns. Despite the lack of a direct relationship between scientific discoveries and industrial progress, the outcomes of scientific development are crucial to the invention and deployment of generic technologies. For example, electromagnetic theory led to the development of power-generation technologies, which revolutionized people's ways of life. Technology inventions stem from further innovations carried out on the basis of scientific discoveries, such as the widespread use of electricity as a result of the discovery of power-generation technology. Original applications of groundbreaking scientific discoveries are the outcomes of technological innovation and invention. However, as history has shown, not all discoveries made in the realm of science and technology will result in new products, and not all new products can be successfully commercialized and create new industries; rather, it takes successful industrial innovation to complete the transition from new products to emerging industries (Hall and Rosenberg, 2010).

The term "industrial innovation" refers to the entire process of developing new products and bringing them to market. Product innovation is the first phase in industrial innovation, followed by the creation of manufacturing equipment and processes based on product qualities and requirements. The third step is organizational innovation in the supply and value chains to support commercialization. The last step is market innovation, which advertises and delivers products to customers while creating value and contributing to GDP. To put it simply, industrial innovation is the mass commercialization of a groundbreaking invention. Industrial innovation promotes the emergence, commercialization, and rapid development of emerging high-tech industries and future industries. While universities and research institutes drive technological innovation, corporations drive industrial innovation. Technology and industrial innovations are not only the twin engines for the success of the modern industrial system; they must also work in tandem, with technology innovation, particularly basic research that supports scientific discoveries, taking the lead (Rui, 2018b).

The two-way relationship between technology and industrial innovations can also be understood through the *CHIPS and Science Act*, which the United States passed in 2022[8]. This act, ostensibly aimed at the chip industry, is focused on basic research, energy innovation, new materials, and scientific and technological growth in order to pursue leadership in technology innovation. The United States has taken a two-pronged approach. On the one hand, the US government is increasing fundamental research funding and subsidizing industrial innovation. On the other hand, it has implemented an embargo to prevent China from acquiring world-leading technology, so slowing China's advancement in science and technology and strengthening its own position.

Initially, US activities in applied research and development research attempted to promote market-based innovation. US politicians used to think that corporations and private research institutes should be responsible for applied research and development. Meanwhile, it is the government's responsibility to fund basic research. However, in recent years, the US government has begun to subsidize businesses that innovate in important fields. The US government's shift of strategy merits our consideration. Investment in science, technology, and basic research is required for the development of a modern industrial system. Great priority should be given to basic research and the acquisition of research outcomes. Since businesses are the driving force behind industrial innovation, it is crucial to harness entrepreneurial spirit to foster innovation, increase the number of successful innovations, and commercialize new products. That is the key for emerging high-tech industries and future industries to thrive.

[8] H.R.4346, *CHIPS and Science Act*, https://www.congress.gov/bill/117th-congress/house-bill/4346/text

3.4 Increase Reform and Openness to Rebuild International Systems of Cooperation in Technology and Industry

China's current industrial system has come a long way thanks to reform and opening up as the country's basic national strategy, as well as the creation of a socialist market economy that boosted private enterprise and led to the current industrial system. This is an extremely valuable experience. Significant changes have occurred in the international environment, technological progress, and international cooperation since the 1980s as China seeks to avoid the entrenchment of the dual industrial structure and begin to develop an industrial system for the modernization drive, which is an entirely different and much more difficult endeavor. Despite these changes, China remains dedicated to embracing a modern industrial system that is open and inclusive. The current industrial system is still built on the market mechanism, fair competition, as well as openness and inclusivity. In contrast to the export-oriented industrial system, the only difference is the goal of creating a modern industrial system with two-way circulation in which domestic demand is the primary engine and external demand plays a secondary role.

In the face of deepening economic globalization, China must embrace openness and cooperation, as well as market-based resource allocation, in order to avoid the entrenchment of the dual industrial structure and establish an industrial system to support its modernization drive. Aside from China's domestic resources, the development of a modern industrial system requires international collaboration with industries, corporations, and scientific research institutes to maximize global innovation resources and boost the innovative dynamism of industrial enterprises. The development of a modern industrial system must go beyond cooperation among industrial enterprises and include network-based cooperation among various entities and regions, as well as global technology and industrial cooperation networks, which are essential for the high-quality transition and upgrade of the "3+1" modern industrial system. Only by remaining open and cooperative in the new global industrial division of labor system will China be able to build partnerships that complement each other's strengths and weaknesses, overcome technological bottlenecks, shorten the cycle of innovation, transform conventional industries, and facilitate the growth of emerging high-tech industries to become the key driving forces of the modern industrial system. For China's future industries to lead the world in the next 15 to 30 years, groundbreaking innovations must be developed through collaboration and open innovation.

The transition from the current to the modern industrial system is fundamentally a reallocation of global resources in an open environment. The restructuring of global technology and industrial cooperation networks is required in order to optimize resource allocation. With broader openness, more efficient resource allocation can be achieved by altering existing assets, human resources, technological capabilities, manufacturing capabilities, and brand reputation, as well as incorporating current and future innovations, advanced technologies, human resources, and capital. This resource distribution process should continue to be based on market-based resource allocation under the condition of openness. It is difficult to fully implement market-based processes to achieve the survival of the fittest in conventional industries without the government issuing regulations to ensure fair competition. Emerging industries and start-ups should be encouraged to innovate and achieve breakthroughs in order to accelerate their development and integration into the modern industrial system. When planning for industrial development, policymakers should not only track technological progress trends, but also estimate the likelihood of commercialization success and forecast global market potentials. CE

References:

[1] Gereffi, Gary. 2009. "Development Models and Industrial Upgrading in China and Mexico." *European Sociological Review*, 25(1): 37-51.

[2] Gill, Indermit, and Homi Kharas. 2007. *An East Asian Renaissance: Ideas for Economic Growth*. World Bank.

[3] Hall, Bronwyn H., and Nathan Rosenberg. 2010. *Handbook of the Economics of Innovation*. Elsevier.

[4] Liu, Qiao. 2021. "Is China's Economy Poised to Make Another Miracle?" *Journal of Peking University* (Philosophy and Social Sciences), 57(02):99-104.

[5] Maddison, Angus. 2003. *The World Economy*. OECD publishing.

[6] Rui, Mingjie (ed.). 2020. *Annual Report on China's Industrial Development in 2019*. Shanghai: Shanghai University of Finance and Economics Press.

[7] Rui, Mingjie. 2018a. "Strategic Approach, Objectives and Pathways for Creating a Modern Industrial System." *China Industrial Economics*, (09):24-40.

[8] Rui, Mingjie. 2018b. *Industrial Innovation: Theory and Strategy*. Shanghai: Shanghai University of Finance and Economics Press.

[9] Rui, Mingjie. 2023. "Transition of SMEs and High-quality Development of the Modern Industrial System." *Frontiers*, (05):71-79.

[10] Shi, Mingming, Zhou Jiang, and Xiaoyan Zhou. 2019. "Consumption Upgrade or Downgrade." *China Industrial Economics*, (07):42-60.