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## China's Sustainable Industrialization and Its Significance

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China's reform and opening-up over the past 40 years is in nature of an industrialization process. China's industrial development conforms to the development goals, principles and spirit of inclusive and sustainable industrialization established in the United Nations' *Transforming our World: The 2030 Agenda for Sustainable Development*. This paper reviewed the main achievements obtained during China's industrial development since the reform and opening up, and set forth the methods the Chinese Government had used to promote sustainable industrialization from five aspects, i.e. taking measures to promote infrastructure construction, paying high attention to scientific and technological innovations, boosting the integration of IT application with industrialization, advancing industrial energy conservation and emission reduction and developing small and medium enterprises. At the end, this paper pointed out that China's industrial development and sustainable industrialization are not only important to the country itself, but also to the world's economic development and sustainable development.

*Keywords:* 40 Years' reform and opening-up; industrial development; sustainable industrialization; worldwide significance.

### **1. Achievements of China's Industrial Development During the 40 Years' Reform and Opening-Up**

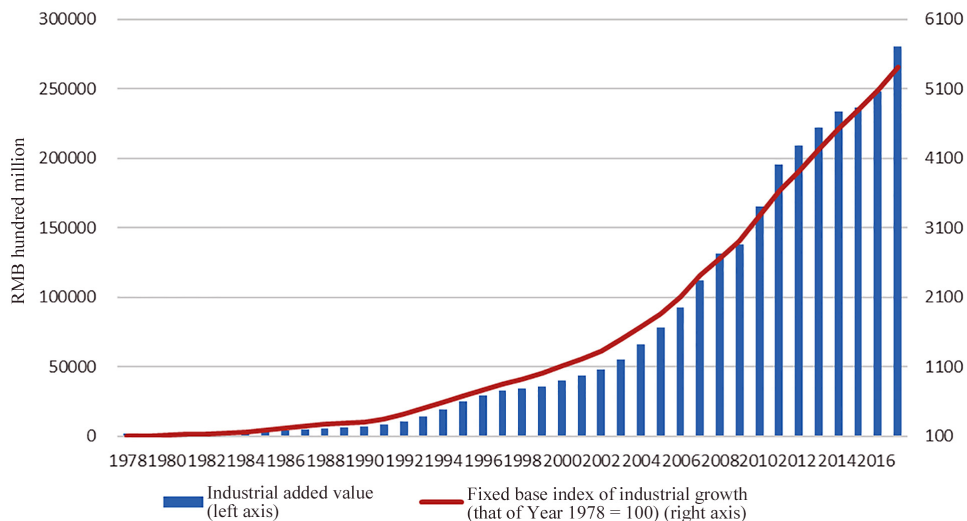
#### **1.1. China's total industrial output experienced a rapid growth and the output of major industrial products ranked among the top countries of the world**

During the 40 years' reform and opening-up, China had achieved a continuous economic growth and industrial development at a high speed, which is rarely seen in the world, and the level of industrialization has improved greatly. During the period of 1978–2017, China's GDP increased from RMB 367.87 billion to RMB 82.7122 trillion, registering

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Source: Prepared according to *China Statistical Yearbook 2018*.

Fig. 1. China's industrial growth since the reform and opening-up.

an average annual growth of 14.9% in nominal terms; the GDP's fixed base index of 2017 was 3,452.5 (that of year 1978 = 100), and if calculated at constant price, the GDP's actual growth per year on average was 9.5%. As seen in Fig. 1, the industrial added value to GDP increased from RMB 162.15 billion in 1978 to RMB 27.9997 trillion in 2017, registering an average annual growth of 14.1% in nominal terms; the industrial added value's fixed base index of 2017 was 5,405.1 (that of year 1978 = 100), and if calculated at constant price, the industrial added value's actual growth rate per year on average was 10.8% (higher than the actual growth rate of GDP during the same period). Judging from the contribution rate of industry to China's economic growth, during the 40-year period from 1978 to 2017, 17 years' contribution rates of industry to GDP growth exceeded 50%; of the 17 years, three years' contribution rates exceeded 60%; only nine years' contribution rates were less than 30%, and another 14 years' contribution rates to GDP growth ranged between 40% and 50%.

Since the adoption of reform and opening-up policy, the outputs of major industrial products have substantially increased, part of which has grown out of nothing, from less to more, or even to such extent that every person or family owns one industrial product. Table 1 reflects the growth of some representative industrial products since the reform and opening up. Compared with the situation at the beginning of reform and opening up, the outputs of some products such as household refrigerator, integrated circuit and others have grown more than thousandfold, and those of some other products such as air conditioner, washing machine, color TV, computer and mobile phone have grown by over 10,000 times. Even for some products whose outputs have only grown by over 20 times, such as steel products, cement and others, their average annual growth rates also reached 8% or more.

Table 1. Growing outputs of representative industrial products since the reform and opening up.

Multiples of output growth from 1978 to 2017				
	$\geq 10,000$ times	$\geq 1,000$ times	$\geq 100$ times	$\geq 20$ times
Representative products	Air conditioner, domestic washing machine, color TV, micro-computer and mobile phone	Household refrigerator, integrated circuit	Automobile, magnesium metal, electrolytic aluminum, chemical fiber, plastic in primary form and beer	Pig iron, steel products, sheet glass, cement, machine-made paper and paperboard, crude steel, generating capacity, generator set, ethylene, caustic soda, cigarette, copper, lead, zinc, nickel and titanium

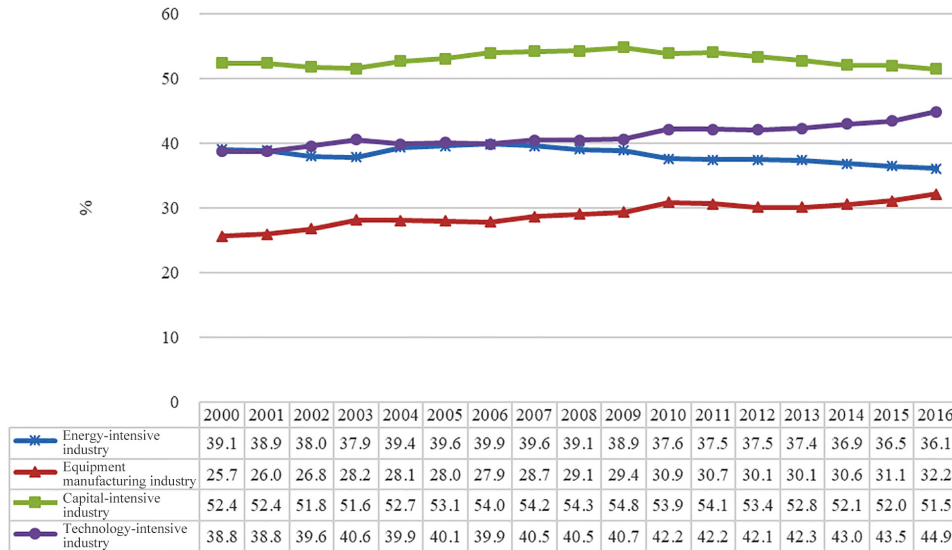
Source: Prepared according to *China Statistical Yearbooks* from previous years.

China's industrial production has an important position in the world. According to International Standard Industrial Classification, China's industrial production ranks top in seven of the 22 major categories, and the outputs of more than 220 industrial products including steel, cement, automobile and others occupy the first place in the world (Ma, 2014). It is calculated that the outputs of China's following industrial products rank first in the world, of which the proportions to the world's total are: pig iron, 59%; coal, over 50%; crude steel, over 45%, exceeding the total output of the countries ranking 2–20 in the list; shipbuilding, 41%; cement, over 60%; electrolytic aluminum, over 65%; chemical fertilizer, 35%; chemical fiber, 70%; sheet glass, over 50%; automobile, 25%; mobile phone, 70% (here calculated as per shipments); and integrated circuit, 90% (here calculated as per shipments) (Huang *et al.*, 2017). Statistics also show that the products of some emerging industries such as smartphone, new energy automobile and industrial robot also enjoy a higher market share around the world. In 2016, China's smartphone sales had an over 20% market share across the globe; 510,000 new energy automobiles were sold, ranking first in the world (National Bureau of Statistics, 2017a).

### **1.2. The industrial structure has kept improving and industrial transformation and upgrading sped forward**

Since the reform and opening-up, the internal structure of China's industry has kept improving, a process that has accelerated since the 21st century dawned. Figure 2 shows that from the year 2000, the proportions of equipment manufacturing industry and technology-intensive industry had been on a steady rise; the capital-intensive industry's proportion tended to drop after a rise; the energy-intensive industry's proportion had been falling steadily after 2016. Equipment manufacturing industry refers to the manufacturing industry of production machines, which is a country's "general armament department" and possesses an important position in the industry. In 2000, the proportion of equipment

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Source: Prepared according to the data provided in *China Statistical Yearbooks* (from the previous years).

Fig. 2. Changes in China's industrial structure (by proportion of assets).

manufacturing industry in China's industry increased sharply, and in 2016 it jumped by 6.5%, indicating that China's industrial level and strength in industrial technology had been further enhanced. Before 2006, the proportion of energy-intensive industry in the industry kept fluctuating or even rising, but after 2006, with a whole set of national policies on energy conservation, and emissions and overcapacity reduction, the energy-intensive industry's proportion plummeted, laying a solid foundation for China's green industrial development and high-quality development. Although capital-intensive industry overlaps technology-intensive industry in many areas, after 2009 it saw a gradual decline in capital-intensive industry's proportion and a steady rise in technology-intensive industry's proportion. This shows that China's industrial restructuring is in a period of transition from the stage led by capital-intensive industry to that led by technology-intensive industry.

In recent years, the industrial transformation and upgrading in traditional sectors have kept advancing, while strategic emerging industries have undergone accelerated development. From the view of industrial growth rate, among conventional industries, the subdivided industries in line with the direction of transformation and upgrading have developed quickly, e.g. a two-digit growth occurred in most subdivided industries such as synthetic material manufacturing, specialty chemicals manufacturing, rare-earth metal smelting as well as the medical and consumable industries that are closely related to residents' living and consumption. From the perspective of regulating productive capacity, along with the deepening supply-side structural reform, cutting overcapacity in conventional industries such as steel, coal, petrochemical and building materials has seen constant progress. With the market's supply-demand relations being improved and in a better production and operation environment, enterprises developed stronger profitability. In

parallel with the development of strategic emerging industries at an expedited pace, new products adapting to structural upgrading and consumer demand have constantly sprung up. From the year 2013 to the year 2016, the outputs of following products had increased at such average annual rates: photoelectronic devices, 27.1%; optical cables, 19.1%; base station equipment of mobile communication, 33.1%; electrical instruments, 17.8%; solar battery, 22.1%; sports utility vehicles (SUV), 45.7%; and special equipment for prevention and control of environmental pollution, 12.7%. Over the last two years, along with the rapid development of intelligent, green and high-end industries, industrial robots, new energy automobiles, photoelectronic devices and other emerging products all registered a high-speed growth by several tens of percentage per year. In terms of international division of labor, conventional industries driven by innovation have enabled China's status in division of labor to move up in the international industrial chain, and its heavy dependence on importing critical equipment and core components to be gradually lessened. Special steels featuring advanced technology have re-energized the transformation and upgrading of iron and steel industry (National Bureau of Statistics, 2017b).

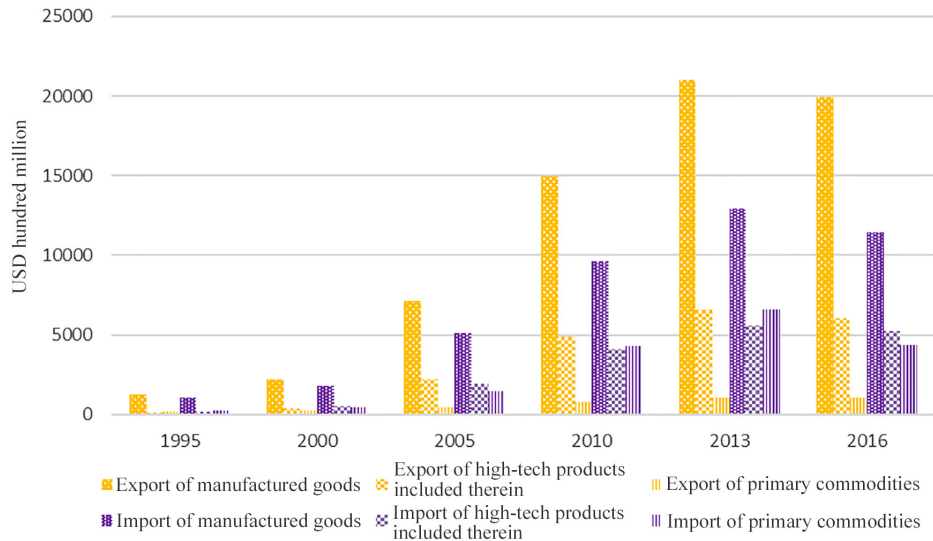
### ***1.3. Both the quality and quantity of industrial products in foreign trade have improved and their international competitiveness has become much stronger***

Since 1978, China's import and export trade experienced a sustainable growth and its structure has kept improving, in which manufactured goods and high-tech products performed exceptionally well. Figure 3 reflects the growth and structural changes of China's foreign trade from the year 1995 to the year 2016. Compared with the year 1995, the total import–sexport trade volumes of commodity, manufactured goods and primary commodity in 2016, respectively, increased by 12.1 times, 12.4 times and 10.9 times, in which the import–export trade volume of high-tech products increased by 34.3 times. The proportion of manufactured goods to the total volume of import and export trade rose by 1.6%, and that of primary commodity dropped by 1.6% accordingly, in which the proportion of high-tech products jumped by 19.2%.<sup>1</sup> In the aspect of exports, the total export trade volumes of commodity, manufactured goods and primary commodities in 2016, respectively, increased by 13.1 times, 14.7 times and 3.9 times from those in 1995, in which the import–export trade volume of high-tech products increased by 58.9 times. The proportion of manufactured goods to the total volume of export trade rose by 9.4%, and that of primary commodities dropped by 9.4% accordingly, in which the proportion of high-tech products jumped by 22.0%. Judging from the trade competition (TC) index, the overall trade competition index of goods had kept rising from 0.06 in 1995 to 0.14 in 2016; that of manufactured goods during the same period rose from 0.08 to 0.27, in which the figure of

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<sup>1</sup>Note: Considering the necessity to quote the latest data, the text written here is to compare the data of 2016 with that of 1995. In fact, China's foreign trade in 2013 performed even better than 2016. Due to the global financial crisis and the reviving of trade protectionism, since the year 2012, the global trade growth rate has been lower than the global economic growth rate of the same period, a trend that is totally different from those in previous years. Due to the influence of global economy and trade situation, China's foreign trade experienced a medium- to low-speed growth from 2012 to 2014, and a negative growth after 2015.

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Source: *China Statistical Yearbooks* from the previous years.

Fig. 3. Growth and structural changes of foreign trade.

high-tech products increased from  $-0.37$  to  $0.07$ , gradually revealing China's competitive advantages in the international market.<sup>2</sup>

It is worth mentioning that in 2013 China's total goods import–export volume was RMB 25.8 trillion, with a year-on-year increase of 5.7%, overtaking the US for the first time and leaping to the first place in the world. China is also the first country whose total commodity trade volume exceeded USD 4 trillion, a miracle in the development history of world trade. In addition, during the period of 2013–2016, the proportion of general import and export trade kept growing year by year, which respectively stood at 52.8%, 53.8%, 54.0% and 55.1%, and that of 2016 reached the highest point in history. During the same period, the import and export trade of processed products respectively amounted to RMB 8.4 trillion, RMB 8.7 trillion, RMB 7.7 trillion and RMB 7.3 trillion, and accounted for 32.6%, 32.7%, 31.5% and 30.2%, showing a downtrend and further optimized ways of trade (National Bureau of Statistics, 2017c).

The World Economic Forum's *The Global Competitiveness Report 2015–2016* shows that in 2015 China's international competitiveness ranked 28th among 140 countries or regions, up by one spot from that in 2012 and topping the list of developing countries (National Bureau of Statistics, 2017d). China's international competitiveness in the industrial sphere particularly stood out. According to the latest results of Competitive Industrial Performance Index by the United Nations Industrial Development Organization (UNIDO), China, Germany, Japan, Republic of Korea and the United States are the five

<sup>2</sup>The design formula for TC index:  $TC\ index = (export\ volume - import\ volume) / (export\ volume + import\ volume)$ . This index ranges between  $-1$  and  $1$ , indicating weaker competitiveness when it approaches  $-1$  and stronger competitiveness when it approaches  $1$ .

countries with strongest industrial competitiveness across the world. According to the research results of Global Manufacturing Competitiveness Index by Deloitte Touche Tohmatsu Limited and US Council on Competitiveness, in 2016 China, the United States and Germany are the top three countries with strongest manufacturing competitiveness in the world (National Bureau of Statistics, 2017b).

According to a study by the World Bank, in the five major manufacturing sectors (high-skilled innovation industry, middle-skilled innovation industry, capital-intensive processing industry, product processing trade and low-skilled labor-intensive trade), the top 10 exporting countries (whose total exports are calculated as per domestic value added) are mostly high-income countries, except China. In 1995, China already ranked second in terms of labor-intensive manufactured exports, only next to Italy, and became the top exporter in 2002, 2007 and 2011. During the period of 1995–2011 China had rose to become the world's manufacturing plant, and its high-skilled and middle-skilled innovation industries had taken an increasingly greater share of exports. For example, back in 1995, China was not in the list of top 10 exporters in high-skilled innovation industry, but in 2002 China rose to the 8th place and soon became the top one in 2007. Similarly, in middle-skilled innovation industry, China was not in the list of top 10 exporters in 2002 but became the fourth largest exporter in 2007 (Hallward-Driemeier and Nayyar, 2018).

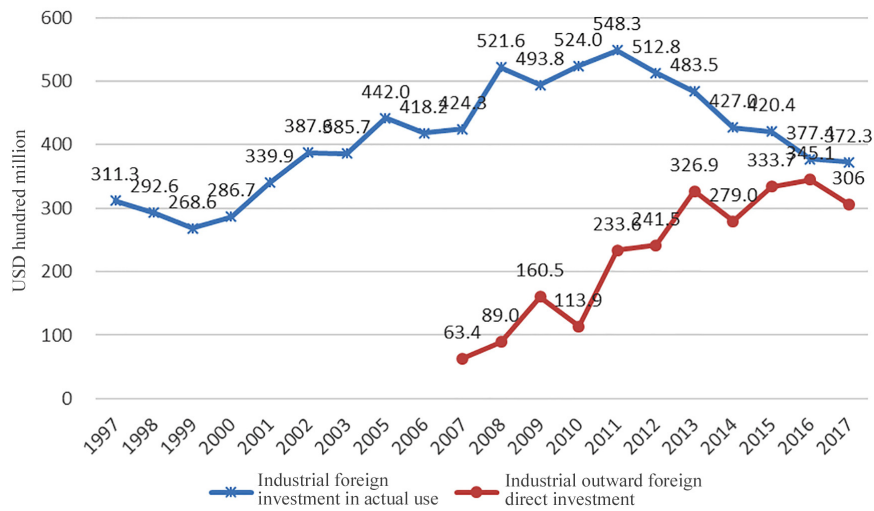
#### ***1.4. Coordinated progress has been made in “bringing in” and “going out,” and a new round of high-level opening-up is entering a new phase***

Guided by the basic policy of opening-up, China has soon focused its efforts in terms of foreign trade on attracting and utilizing foreign investment, and utilizing foreign investment and introducing advanced technology are regarded as having great strategic significance to accelerating the socialist modernization drive. Based on this understanding, China has attracted foreign investment with the most preferential policies involving taxation, land use and fee collection. In addition, with vast workforce, low wage and relatively low environment control standards, China by undertaking the international industrial transfer and implementing the “bringing in” policy has introduced overseas capital, technology, management experience, supply chains, brands and marketing channels, making itself quickly integrated with the global production networks and serving as a “world factory”. China has over the years topped the list of developing countries in respect of using foreign investment, and the utilization of foreign investment for industrial purpose has taken the lion's share. Before 2009, over 50% of total foreign direct investment had been used for industrial purpose and before 2005 this figure was generally over 70%. But in recent years, the proportion dropped slightly and most of the foreign investment was used for service industry.

Furthermore, along with China's ever-increasing overall national strength, the Chinese Government has constantly improved the policy system of investments abroad, made continued advances in bilateral and multilateral cooperations in practical terms, kept stepping up the “going out” pace and taken a great leap forward in outward foreign direct investment. Since the fall of 2013 when China proposed the Belt and Road Initiative, Chinese enterprises have significantly increased their “going out” speed, and quickly



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Source: Prepared according to *China Statistical Yearbooks* (from the previous years) and the data provided in *Statistical Communiqué of the People's Republic of China on the 2017 National Economic and Social Development*.

Fig. 4. China's industrial foreign investment in actual use and outward foreign direct investment.

carried out the international capacity cooperation projects with the countries along the Belt and Road, moving faster to usher in a new phase for a new round of high-level opening-up. According to the statistics, by the end of 2016, Chinese enterprises had established 56 cooperation zones that began to take shape in the countries along the Belt and Road, with a total investment of USD 18.55 billion. The enterprises in those zones numbered 1,082, generated a total output of USD 50.69 billion, paid to the host countries USD 1.07 billion for taxation and created 177,000 jobs for local people.

Figure 4 shows China's industrial foreign investment in actual use and outward foreign direct investment. Before 2011, China's industrial foreign investment in actual use had increased in size year by year and reached its peak at USD 54.83 billion in 2011. From then on, the industrial foreign investment in actual use has shifted to a negative growth, and the service industry has taken the place of industry to be the main foreign investment direction. In another aspect, China's industrial outward foreign direct investment had grown rapidly from 2007 to 2013, at an average annual growth rate of 31.4%. By 2013, China's industrial investment abroad already exceeded USD 30 billion and then entered a new plateau. As China's outward foreign direct investment already surpassed its foreign investment in actual use, it is predicted that in the near future the industrial outward foreign direct investment will also surpass the industrial foreign investment in actual use, and the industry will be one of the net capital exporting fields.

## 2. Major Measures for Promoting China's Sustainable Industrialization

China's industrial development has greatly pushed forward its industrialization process. Currently, China has entered the late stage of industrialization (Huang and Li, 2017). Over



the years, China has put into practice the new development philosophy of innovation, coordination, green development, openness and sharing, and focused on promoting sustainable industrialization by the following measures.

### ***2.1. Vigorously promoting infrastructure construction and improving the industrial development environment***

Infrastructure is the foundation of developing various economic undertakings in a country and the precondition and material basis of industrial development. On one hand, a good infrastructure can optimize the industrial development environment, reduce industrial development costs and improve regional industrial layout; on the other hand, a heavy investment on infrastructure construction can stimulate economic growth and expand the application space for industrial products. Since the reform and opening up, China's infrastructure such as transportation, postal service, hydraulic engineering, telecommunications, Internet and public environment facilities have been constructed and developed in full swing. In the early 1980s when the slogan "Building roads before getting rich" was once brought up, transportation infrastructure had kept improving. Compared with the situation at the beginning of reform and opening up in 1978, the operating mileages of highway, railway, civil aviation and pipeline transport in 2017 respectively increased by 4.36 times, 1.47 times, 49.25 times and 13.37 times. The operating mileages of highway, railway, civil aviation and pipeline transport had respectively grown from the year 1978 to the year 2017 by 4.40%, 2.33%, 10.57% and 7.07% per year on average. Meanwhile, electric power and other energy infrastructures had also developed quickly. During the period of 1978–2017, China's installed power-generating capacity had increased from 57.12 million kW to 1.78 billion kW in 2017, ranking first in the world; the average annual growth rate of installed capacity (9.2%) exceeded the total electricity consumption (8.6%) of the same period by 0.6%. Entering the 21st century, the constantly-improved modern telecommunication infrastructure has provided a good condition for the integration of China's industrialization and IT application, and further for China's industrial transformation and upgrading, and the development of new economy and knowledge economy. Since the year 2000, the length of optical cable line, quantity of Internet access ports and capacity of mobile telephone exchange have kept growing by 22.43%, 30.83% and 18.26% per year on average. By the end of 2017, they respectively reached 37.8 million km, 776 million pieces and 2.422 billion users (see Fig. 5).

### ***2.2. Paying high attention to scientific and technological innovations, and taking solid steps to promote industrial technology***

Since the adoption of reform and opening-up policy, China has paid high attention to the revolutionary role of science and technology. Comrade Deng Xiaoping once drew a well-known conclusion, i.e. "science and technology are the primary productive forces". In 1995, the Chinese Government formally released the strategy of revitalizing China through science and education. In terms of actual practices, scientific research institutions,

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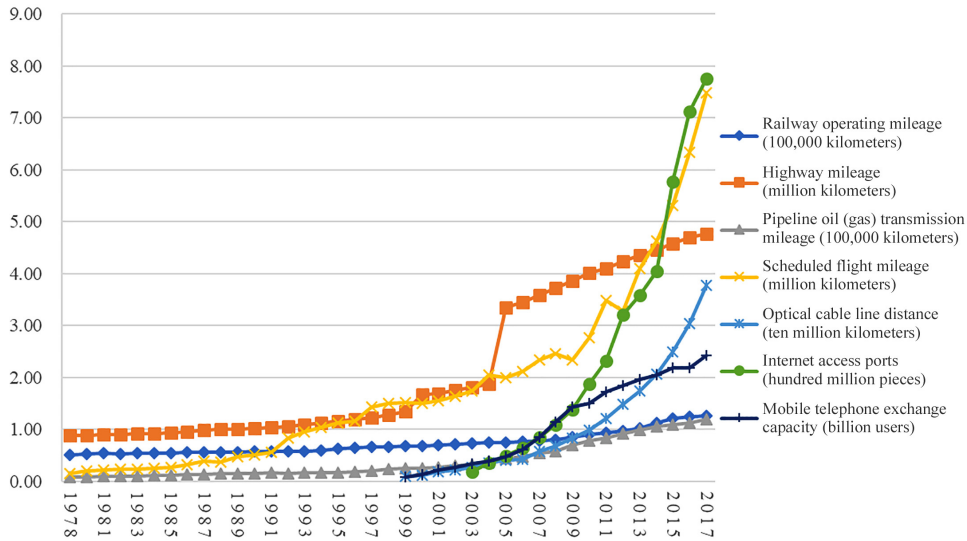


Fig. 5. Development situation of China's main infrastructures.

universities and enterprises have all increased their input of scientific and technological resources. Along with economic development, technological advancements and intensified market competition, the organizational form of scientific research in China has also undergone a major adjustment, i.e. a gradual transition from the scientific and technological supply system of the Planned Economy Period focusing on scientific research institutions to the one that is adaptive to the socialist market economy system, oriented to market, based on enterprises and featured by collaborative innovation integrating the government, industry, university, research and user.

Since 1978, China has attached great importance to the scientific and technological innovations of industrial enterprises, including original innovation, integrated innovation and the practice of introduction, digestion, absorption and re-innovation, and raised the level of industrial technology to a new high.<sup>3</sup> From the view of investments on science and technology, in 2016, China's industrial enterprises above designated size carrying out R&D activities already reached 86,891, the number of personnel working for enterprises' R&D institutions reached 2.924 million and enterprises' expenditure on R&D activities reached RMB 1.09447 trillion. The three figures respectively increased by 4.1 times, 3.5 times and 8.9 times during the period of 2004–2016, with average annual growth rates of 14.5%, 13.4% and 21.1%. The personnel and fund invested by industrial enterprises on research and development were much higher than the total social investments of the same period. From the perspective of outputs from scientific and technological innovations, in 2016, the number of patent applications, number of inventive patent applications and number of valid inventive patent applications of industrial enterprises above designated size respectively

<sup>3</sup> Due to the limitation of comparable data analysis, only the scientific and technological innovations of industrial enterprises above designated size since 2004 are counted here.

reached 715,000, 287,000 and 770,000 pieces, which were 11.1 times, 14.0 times and 25.4 times those of 2004, with average annual growth rates of 22.2%, 24.6% and 30.9%. In 2016, the sales revenue of new products by industrial enterprises above designated size already reached RMB 17.5 trillion, accounting for 15% of the enterprises' main business income; compared with 2004, the sales revenue increased by 6.7 times, with an average annual growth rate of 18.5% and its proportion to the enterprises' main business income up by 3.5%. The continuous advancements in science and technology made by industrial enterprises have become an important driving force for China's innovative development. The Global Innovation Index (GII) published by World Intellectual Property Organization (WIPO) shows that China's comprehensive ranking in innovation ability rose from the 34th place in 2012 to the 22nd place in 2017, topping the list of middle-income economies (National Bureau of Statistics, 2017a).

In recent years, China's industrial technology has kept moving forward and generated fruitful results, such as high-speed railway, manned space flight, lunar exploration program, quantum communication, giant aircraft, human occupied vehicle (HOV), radio telescope, super computer and other ground-breaking scientific and technological achievements.

### ***2.3. Boosting the integration of IT application with industrialization, and embarking on the road of new-type industrialization***

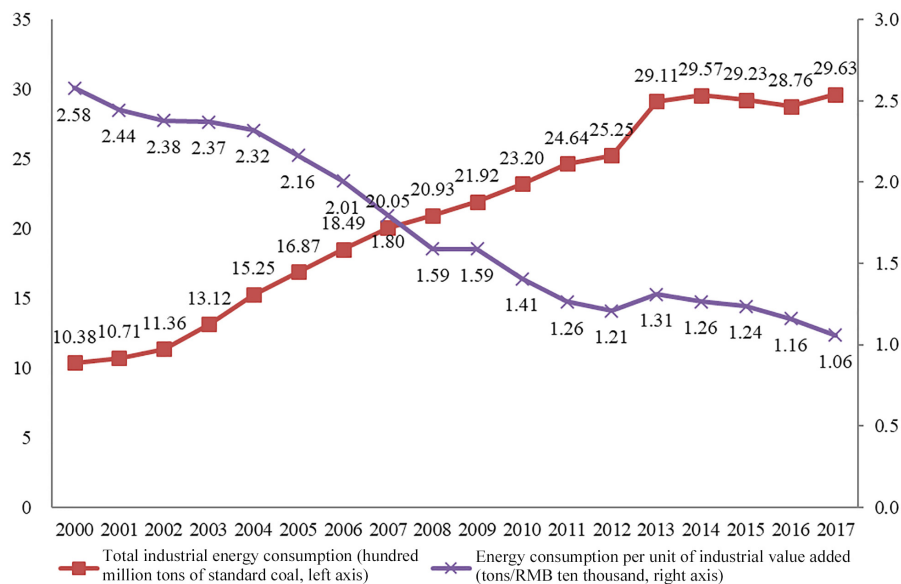
As the largest developing country in the world, China has faced the challenges and opportunities brought by IT application before completing its industrialization, making it necessary to follow the road of new-type industrialization, i.e. integration of IT application with industrialization by using IT application to power industrialization and in turn spurring IT application with industrialization. In recent years, guided by a series of favorable policies such as "Made in China 2025" initiative, "Guiding Opinions of the State Council on Deepening the Integrated Development of the Manufacturing Industry and the Internet", "Integrated Development Plan of IT Application and Industrialization (2016–2020)" and "Intelligent Manufacturing Development Plan (2016–2020)", the integration of IT application with industrialization in China has picked up speed and kept going deeper. According to the statistics, in 2015, due to the penetration of information technology into various parts of an enterprise, the penetration rate of digital R&D tools reached 61.1%, and the numerical control rate of critical processes reached 45.5% (Ministry of Industry and Information Technology, 2016). According to the research and evaluation of China Center for Information Industry Development, the integrated development index of IT application and industrialization has increased from 52.73 in 2011 to 72.68 in 2015 (China Center for Information Industry Development, 2018). New progress has been made in intelligent manufacturing development: faster intelligence-based reconstruction of production equipment and rapid development of intelligent products manufacturing; new models such as Internet-based custom-made products, service-oriented manufacturing and others, and new forms of industry including industrial cloud and industrial big data emerging one after another; the stronger support and service capabilities of information technology, and deeper infiltration of big data, cloud computing, Internet of Things (IoT) and other

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new-generation information technology into manufacturing industry. Due to the tendency of manufacturing industry to be digital, networked and intelligent and along with the ever-growing intelligent manufacturing, there in China have sprung up not only a batch of intelligent manufacturing projects with demonstration significance, but also some industrial Internet platform projects with international competitiveness such as COSMOPlat (of Haier Group), iRootech (of Sany Heavy Industry) and CASICloud (of China Aerospace Science and Industry Corporation Limited).

#### 2.4. Pushing forward industrial energy conservation and emission reduction, and markedly improving green industrial development level

Since the adoption of reform and opening-up policy, in particular after entering the 21st century, China's green industrial development has faced increased pressure and impetus. During the Tenth Five-Year Plan period (2000–2005), China proposed the target, i.e. the total discharge of major pollutants in 2005 was 10% less than that in 2000. During the Eleventh Five-Year Plan period (2006–2010), China proposed the target, i.e. reducing the energy consumption per unit of GDP by 20% or so and the total discharge of major pollutants by 10%. During the Twelfth Five-Year Plan period (2011–2015), China proposed another target, i.e. reducing the discharge of carbon dioxide per unit of GDP by 17% and energy consumption per unit of GDP by 16%; increasing the proportion of non-petrochemical energy to primary energy consumption by 3.1%, i.e. from 8.3% to 11.4%; lessening the total discharge of major pollutants by 8–10%. With Made in China 2025



Source: Prepared according to the data available on the website of National Bureau of Statistics (<http://data.stats.gov.cn/>).

Fig. 6. Industrial energy consumption.

initiative, such main targets for future green industrial development were laid out: By 2020, the energy consumption per unit of industrial value added (above designated size), discharge of carbon dioxide and water consumption shall be, respectively, 18%, 22% and 23% less than those in 2015; by 2025, the three figures shall be, respectively, 34%, 40% and 41% less than those in 2015; the multipurpose utilization rate of industrial solid wastes shall increase from 65% in 2015 to 73% by 2020 and further to 79% by 2025.

In response to people's demand for green development and as driven by a range of plans, schemes and policies, China has vigorously pressed ahead with industrial energy conservation and emission reduction and produced remarkable effects. Since the year 2000, the energy consumption per unit of industrial value added has decreased sharply. Total industrial energy consumption had drastically increased from 1.038 billion tons of standard coal in 2000 to 2.963 billion tons of standard coal in 2017, with an average annual increase of 6.37%, which is mainly attributed to the growing total industrial scale. However, the energy consumption per unit of industrial value added had been on a decline from 2.58 tons of standard coal per RMB 10,000 in 2000 to 1.06 tons of standard coal per RMB 10,000 in 2014, with an average annual decrease of 5.10%. The statistics also show that in 2016 China's energy consumption per unit of industrial value added (above designated size) was totally 24% less than that in 2012, and 6.1% higher than the reduction of energy consumption per unit of GDP, registering an average annual decrease of 6.6% (see Fig. 6). According to the calculation by energy consumption per unit of industrial value added (above designated size), the total energy-saving amount of industrial enterprises above designated size was about 790 million tons of standard coal, accounting for the majority of the country's total energy-saving amount (over 90%). The reductions in China's energy consumption per unit of GDP were mainly contributed by industrial enterprises (National Bureau of Statistics, 2017e).

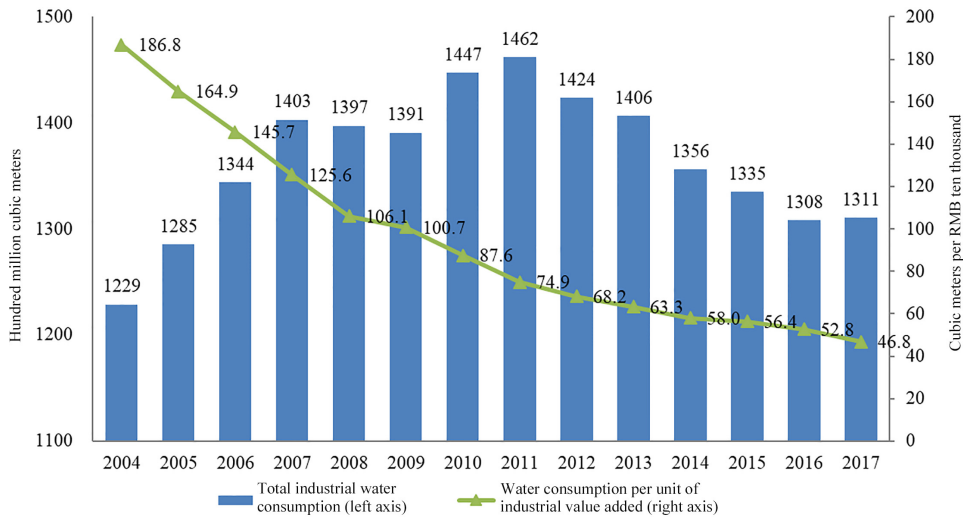
Judging from the industrial water consumption, before 2011, the total industrial water consumption had been on the rise, but after 2011 on an absolute decline (see Fig. 7). The water consumption per unit of industrial value added had been on a steady decline from 186.8 m<sup>3</sup> per RMB 10,000 in 2004 to 46.8 m<sup>3</sup> per RMB 10,000 in 2017, with an average annual decrease of 10.1%.

Judging from the discharge of major pollutants, the discharge of industrial pollutants in China has kept decreasing since the year 2000. Table 2 shows that the total discharges of industrial sulfur dioxide and industrial wastewater experienced a process of dropping after a rise: the discharge of industrial sulfur dioxide reached its peak at 19.805 million tons in 2005 and then kept declining, and in 2015 became 2.489 million tons less than that in 2005, down by 12.6%; the total discharge of industrial wastewater also reached its peak at 24.31 billion tons in 2005 and dropped to 22.99 billion tons in 2015, down by 5.4%. The industrial chemical oxygen demand had kept decreasing from 7.045 million tons in 2000 to 3.526 million tons in 2015, down by 50%.

### ***2.5. Developing small and medium enterprises and improving inclusive development level***

According to the classification standard of small and medium enterprises and the calculation based on the Third China Economic Census data, the total number of micro-, small- and

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Source: Prepared according to the data available on the website of National Bureau of Statistics (<http://data.stats.gov.cn/>).

Fig. 7. Variations in China's industrial water consumption and water-consuming intensity.

Table 2. Discharges of China's industrial pollutants.

Indices	Year 2000	Year 2005	Year 2010	Year 2015
Discharge of industrial sulfur dioxide (10,000 tons)	1612.5	1980.5	1864.4	1731.6
Discharge of industrial chemical oxygen demand (10,000 tons)	704.5	554.7	434.8	352.6
Total discharge of industrial wastewater (100 million tons)	194.2	243.1	237.5	229.9

Source: The website of National Bureau of Statistics (<http://data.stats.gov.cn/>).

medium-sized enterprises may account for 99.7% of all the enterprises (Dong, 2018). Over the 40 years since the reform and opening-up, the proportion of GDP created by small and medium enterprises has quickly grown from 1% at the beginning up to 60%, and they contributed about 60% of the GDP growth. Small and medium enterprises have become the main source of tax revenue and contributed to over 50% of the country's tax revenue. Small and medium enterprises have become important job creators, providing 80% of employment opportunities in urban areas, absorbing over 70% of rural migrant workers and adding 90% of new jobs. As a positive force in technological innovation, small and medium enterprises have made 70% of inventive patents, over 75% of technical innovations and over 80% of new products (Dong, 2018).

China's small and medium enterprises are mostly private enterprises. Private enterprises are naturally matched with a market economy and their development has facilitated the vigorous development of China's socialist market economy. China has established the

basic economic system of public ownership playing a dominant role and multiple ownership economies developing together, and it unwaveringly consolidates and develops the public economy, and unwaveringly encourages, supports and guides the development of the non-public sector. To sum up, China's private economy boasts such features: contributing over 50% of tax revenue, over 60% of GDP, over 70% of technological innovation achievements, over 80% of urban employment opportunities and over 90% of enterprise quantity.<sup>4</sup>

In recent years, by encouraging people to start business and make innovations, and driven by new economic patterns, new technologies and new forms of industry, a mass of small and medium enterprises have sprung up. The best of these enterprises have quickly become the hidden champions or unicorn companies of the subdivided industries in a very short term.

### **3. Significance of China's Sustainable Industrialization**

As a late-developing country, China has adopted the reform and opening-up policy for over 40 years, and has caught up with or surpassed the pioneering countries in industrialization. China's industrial development and sustainable industrialization are not only important to the country itself, but also to the world's economic development and sustainable development.

#### **3.1. *China's industrialization is a large country's industrialization exerting a worldwide influence***

China's industrialization since the reform and opening-up has taken place in a large country with a population of 1.3 billion people, which is an unprecedented modernization process in human history. From the perspective of the world's industrialization history, in two or three centuries' development, only about 1 billion people have benefited from industrialization across the globe. So China's industrialization exerts significant effects on the industrialization process of the entire human race and rewrites human history.

#### **3.2. *China's industry is an important engine driving the world's industrial growth***

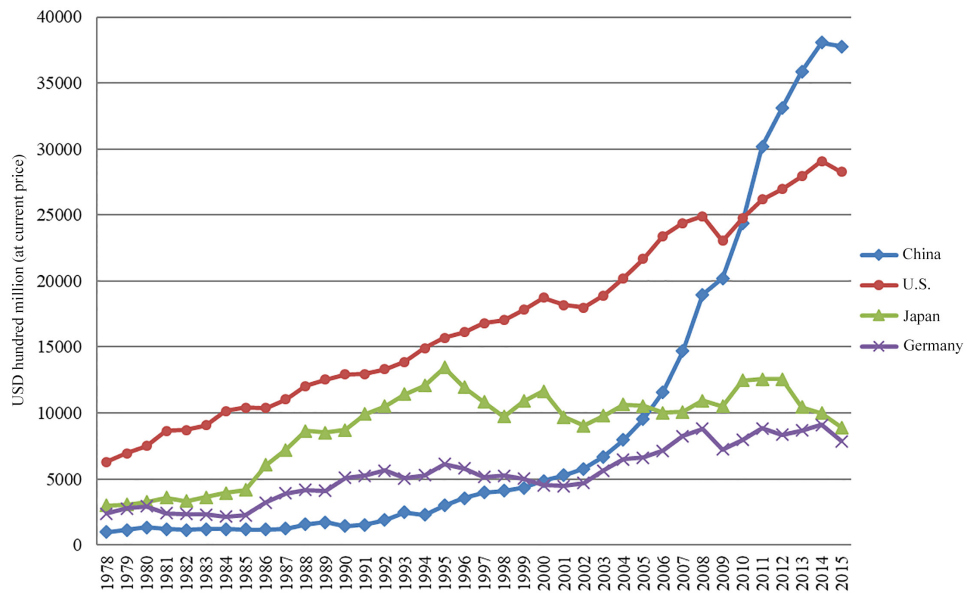
According to the data provided by UNIDO, the annual growth rates of the world's industry in recent years have ranged from 2% to 4%; those of major advanced economies from 0% to 2%, and those of developing countries and emerging economies mostly from 4% to 6%. But China's industrial economy has increased by 6.7% per year on average, topping the list of major economies in the world and serving as an important force to sustain the world's industrial growth (National Bureau of Statistics, 2017b).

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<sup>4</sup>Xi, Jintan. 2018. "A Speech on Private Enterprises Symposium." People's Daily. November 2. <http://politics.people.com.cn/n1/2018/1102/c1024-30377201.html> (accessed November 2, 2018).



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Source: The United Nations' database (<http://data.un.org/>).

Fig. 8. International comparison of gross industrial production.

In 1978, China's manufacturing value added was converted into only USD 96.3 billion (at the current price), with its gross scale less than one-sixth of the United States', one-third of Japan's and one-half of Germany's. Since then, China's development has made great headway: In 2000, China's manufacturing value added reached USD 486.3 billion (at the current price), with its gross scale surpassing Germany's and ranking the third place in the world; in 2006, this figure reached USD 1.1568 trillion (at the current price), with its gross scale exceeding Japan's and ranking the second place in the world; and further in 2011, the figure reached USD 3.0201 trillion (at the current price), with its gross scale exceeding the United States' and making China the No. 1 manufacturing power in the world. In 2015, the gross scale of China's manufacturing industry was 1.3 times the United States', 4.2 times Japan's and 4.8 times Germany's. Along with the increasing scale, China's manufacturing value added had occupied even a larger proportion of the world's manufacturing industry, up from 18% in 2010 to 25% in 2015, with an average annual increase of 1.4% (see Fig. 8).

### 3.3. China's industrialization is part of Chinese solutions and it offers Chinese wisdom

As an important part of Chinese solutions and a reflection of Chinese wisdom, China's industrialization can provide practices and experience as a reference for other late-developing countries in promoting industrialization, which is a spillover effect generated by China's development and also a contribution to the world's economic development. China's main experience in sustainable industrialization is as below.

### 3.3.1. *Deepening reform and emancipating industrial productive forces*

At the beginning of reform and opening up, China had to make important decisions on the orientation and strategies of reforms. Thanks to the perseverance in pursuing market-oriented reforms and proper reform methods such as “taking the easiest first” and “incremental reform comes before stock reform”, China has completed the process of changing from a planned economy to a socialist market economy system, through which the productive forces have been released and developed. In the field of industrial economy, the main methods are as follows. At the beginning, China pushed forward the reform of state-owned enterprises through pilot projects and also enhanced the economic vitality by actively attracting foreign investments, developing and growing private enterprises and other non-public sectors of the economy to force the state-owned economic reform. Afterwards, efforts were made to keep improving the basic socialist economic system, unwaveringly consolidate and develop the public economy and unwaveringly encourage, support and guide the development of the non-public sectors so as to facilitate their coordinated development. During this process, an industrial management system had been established to adapt to the socialist market economy system, achieving its transformation from micro-level to macro-level, from direct mode to indirect mode and from individual sectors to an entire industry.

### 3.3.2. *Persisting in opening up and integrating into the global industrial system*

Since the World War II, a new round of revolution in science and technology and industrial upgrading starting from the United States has triggered a transmissible wave of international industrial transfer. By the 1980s, the United States, Japan and other developed countries have shifted their industrial focus to the high-tech, IT-based and service-oriented fields, and further transferred their labor- and capital-intensive industries and partial low value-added technology-intensive industries to the overseas. The “Four Asian Tigers” (South Korea, Taiwan, Singapore and Hong Kong) and other emerging industrialized countries and regions who had received massive investments from developed countries and undertaken the heavy chemical industries, micro-electronics and other high-tech industries from the United States and Japan, then needed to move out their own labor-intensive industries and partial capital- and technology-intensive industries. At this very moment, China who just opened to the outside world and possessed a huge labor market grabbed this precious historic opportunity, and not only became the main country undertaking industries transferred from other countries or regions, but also thereby integrated itself into the global industrial division system, bringing great changes to its own economic destiny and the world's economic landscape. The process of integrating China's industry into the global system can be roughly divided into three progressive development stages: (i) “Bringing in” stage: Attracting foreign investments with the most preferential policies and undertaking industries transferred from other countries or regions; (ii) “Going out” stage: Making the best of the advantages in low factor prices to participate in the competition in the international market; (iii) the expansion of the previous two stages in parallel, in which China's openness to the outside world has kept improving, in particular after 2013 when

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China vigorously promoted the Belt and Road Initiative and the global cooperation in production capacity, and at the same time, China has taken an active part in the global economic governance to push forward its deep integration with the world economy.

### *3.3.3. Adhering to the road of new-type industrialization featuring Five-Pronged Coordination*

China's industrialization quite differs from the developed countries' which is of a tandem type, i.e. sequential development of industrialization, urbanization, agricultural modernization, IT application and environmental friendliness. The emerging Fourth Industrial Revolution has not only brought great opportunities but also posed serious challenges to China's industrial development. In a new historical context, China will no longer follow the conventional industrialization path but pursue its new-type industrialization road. It is impossible for China to merely pursue industrial development, but to coordinately promote the new industrialization with IT application, new urbanization, agricultural modernization and environmental friendliness (Five-Pronged Coordination). Since the adoption of reform and opening-up policy, China's industrial development has been heading towards the Five-Pronged Coordination and achieved phased objectives.

### *3.3.4. Properly handling the relationship between markets and the government to create effective markets and government*

After the World War II, only very few countries or regions have realized the leapfrog development from a low-income level to a mid-income level and then to a high-income level. The key factor shared by the economies that succeeded in such transformation is to achieve a good combination of effective markets and government (Lin, 2014). The relationship between markets and the government has been properly handled during China's industrial development. Since the reform and opening up, China's industrial development has always adhered to the market-oriented reform, enabling the market to play a basic or even a decisive role in allocating resources along with the economic development. Meanwhile, to better play its role, the government by following the general rules of industrial development has formulated a whole set of industrial strategies, plans, schemes, policies and standards, to avoid detours when catching up with or even surpassing advanced economies as a late-developing industrial country, and finally realized leapfrog development. The government's important role in China's industrial development is not only determined by the basic economic system with public ownership playing a dominant role and multiple ownership economies developing together, but also by China's development stage of transformation and catching up with or surpassing advanced economies.

### *3.3.5. Respecting the masses' initiative and exploring appropriate paths of regional industrialization*

China's reform and opening-up witnesses that the initiative of the masses and local governments at all levels is mobilized. Some economic development models with distinctive

regional and temporary features have taken shape in China, such as the Pearl River Delta model for developing export-oriented economy, the Sunan model for developing collective economy in towns or townships, the Wenzhou model for developing private economy and the Jinjiang experience for developing the model that focuses on market economy, export-oriented economy and stock cooperative system, and allows diverse sectors of the economy to develop side by side. China has a vast territory, and has highly diversified resource endowments, economic conditions and cultural habits across regions, thus it is important to respect the masses' initiative and encourage various regions to explore regional industrialization models and routes that fit the region, which is a successful experience in China's industrialization.

#### 4. Conclusions

In the United Nations' *Transforming our World: The 2030 Agenda for Sustainable Development*, Goal 9 points out, "Build resilient infrastructure, promote inclusive and sustainable industrialization and foster innovation", including such main tasks: developing infrastructure, raising industry's share of a national economy, supporting the development of small and medium enterprises, promoting industrial and infrastructure upgrading, enhancing resource utilization efficiency, increasing research and development expenditure, pressing ahead with technological innovations, strengthening international capacity cooperation and giving aid to the industrial development of developing countries (The United Nations, 2016). China's industrial development during the 40 years of reform and opening up conforms to the development goals, principles and spirit of inclusive and sustainable industrialization established in *The 2030 Agenda*.

China's practice of sustainable industrialization and the achievements obtained therefrom are not only conducive to the development of the country itself, but also important to the development of the world. As an important component of Chinese solution and Chinese wisdom, China's industrialization provides practices and experience as a reference for other late-developing countries in promoting industrialization, and therefore promotes the world's economic development and sustainable development.

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