

# The Development Process of China's High-tech Industries

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## Authors' contributions

*This work was carried out in collaboration between authors LG and FX. Both authors contributed equally to this work. It means that they together designed the study, performed the statistical analysis, wrote the first draft of the manuscript and managed the literature searches. Both authors read and approved the final manuscript.*

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## ABSTRACT

Nowadays, high-tech industries are growing fast in different parts of the world. In order to strengthen its economy and increase employment, each country is trying to develop high-tech industries. In this development process of high-tech industries, though the competition is fierce, each country has its own effective way and advantages. Therefore, mutual cooperation and benefit are important. The article presented here mainly focuses on the development process of China's high-tech industries. Through the analysis of China's development process of high-tech industries, I hope we can learn something from other countries and vice versa.

*Keywords: High-tech; industries; development.*

## 1. INTRODUCTION

With the development of science and technology and the rapid economic globalization, the international competition in many areas is

becoming increasingly fierce. In the face of surging and sweeping waves of the high-tech revolution, the nations of the world are actively adjusting their strategies, coincidentally viewing the development of high-tech industries as the

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commanding height of participating in the international competition and of measuring the comprehensive national strength with others [1]. From this, we can see that new global industrial distribution system and division system are being formed. Overall, the developed countries are in a better position of knowledge supply [2] and high-end technology, while the developing countries often undertake the production of the products of labor-intensiveness, high resource and energy consumption, high pollution and low added values, called "three highs and one low", in the international division of labor. China is also one of the developing countries, whose overall technological level has a big gap indeed, compared with the developed countries. Our operating way, mainly in the extensive mode of economic growth, has not fundamentally changed. The product structure and industrial structure are not so rational, and some of the deep-seated issues in our economic development have to be resolved gradually [3]. So, observed from the international environment or from domestic real conditions, we'll find it necessary to adopt international comparison and learn from each other, so that we can have a clear direction to accelerate the development of China's high-tech industries, and strive to occupy an important place in the future world of the high-tech field, which is a very important and urgent strategic task. At present, China has proposed the development train of thought of "building an innovative country" and "strengthening the independent innovation and enhancing the international competitiveness of industries", requiring key breakthroughs in high-tech industries and accelerating development of high-techs, which fully shows the importance of developing high-tech industries by applying science and technology, so that we can improve labor productivity and economic efficiency, and promote industrial upgrading.

## **2. REALIZATION OF ECONOMIC REVITALIZATION NEEDS SCIENCE AND TECHNOLOGY**

"Science and technology are productive forces". This is the basic principle of Marxism. Marx pointed out: "Productivity also includes science," and he said, "The development of fixed capital indicates that the general social knowledge has become a direct productive force to a great degree." Marx also pointed out profoundly: "Social work productivity is first the power of science"; "That big-scale industries incorporate forces of nature and natural sciences into the

production process will surely improve labor productivity greatly."

As early as 1975, when Mr. Deng Xiaoping presided to rectify the fields and guided the drafting of "the report on the work outline of Chinese Academy of Sciences", he pointed out that science and technology are productive forces based on "Marx 'productivity includes science'", in view of the destruction of economy and technology during the "Cultural Revolution". After crushing "Gang of Four", Mr. Deng Xiaoping returned to his previous stage in 1977, and immediately proposed that science and technology are crucial for achieving modernizations. In 1978, at the National Science Conference, he reiterated that "Science and technology are productive forces," the Marxist argument, and elaborated, "Modern science and technology are undergoing a great revolution. In the last three decades, not only the individual scientific theory and individual production technology have improved in modern science and technology, not just having a general sense of progress and reform, but almost all scientific and technological fields have undergone profound changes and had a new leap forward, have produced and are continuing to produce a series of emerging science and technology. Modern science can pave the way for the progress of production technology and determine the direction of its development. "In September 1988, based on the development trends and status of modern science and technology, Mr. Deng Xiaoping proposed the assertion that "Science and technology are the first productive force". This thesis of Mr. Deng's reflects the theory of productivity and the scientific concept of Marxism. That "science and technology are primary productive forces" is both important features of modern science and technology in the development and the inevitable result of the development of science and technology. Social productivity is the ability of people to transform nature. As the natural science of human understanding and transforming nature, it must be included in social productivity. Once science and technology penetrate and act on the production process, it will become real and direct productivity. The characteristics and status quo of the development of modern science and technology tell us that science and technology, especially high technology, is growing at faster and faster speed to fully penetrate the various elements of productivity and integrate with them. Thereafter on different occasions, many of our leaders expressed their opinions about how to

make technology work go better in the new situation, stressing the necessity to support economic and social development by relying on science and technology, to revitalize economy and place science and technology on the prominent position as a strategic focus. We have to firmly promote technological progress in order to win in the fierce competition and take the initiative.

### **3. THE DEVELOPMENT COURSE OF CHINA'S HIGH-TECH INDUSTRIES**

The high-tech industry is a strategic leading industry of the national economy. The development of the high-tech industry is of great significance in strengthening the role of economic support of science and technology and in promoting industrial restructuring and transformation of economic development [4]. The development of China's high-tech began from military sophisticated technology in the 1950's of last century. The 60's and 70's witnessed great successes in some high-tech fields, and the high-tech began to grow faster in the 1990s. Because China is rich in human resources and has great talents, coupled with increased investments and remarkable achievements in science and technology, with the use of high-tech industries and traditional industries combined to form the new productivity, it obtained fast development and increasing scale. After the development of more than twenty years, although some companies were eliminated in the rapidly changing and highly competitive market, more high-tech enterprises have continued to grow. Many companies have grown from small to large and from weak to strong, showing a strong vitality and competitiveness, which becomes an important part of the national economy. In 2009, the National Development and Reform Commission issued a "Guidance on Accelerating the Development of the National High-tech Industrial Base," (No. 3211), giving a full direction about how to make the high-tech play a leading part in the optimization and upgrading of industrial structures; about how to accelerate the development of high-tech industrial bases with prominent innovation capability, perfect industrial chains and distinctive industrial characteristics so as to promote the construction of an innovative country. The national high-tech industrial base refers to high-tech industrial clusters with exemplary and leading functions of high-tech industrial development and regional economic

development in the field of information technology, biotechnology, aerospace, new materials, new energy, marine and some others. The national professional high-tech industrial base focuses on a particular high-tech industry in which the production and service of most enterprises are concentrated, with specialized features. The comprehensive national high-tech industrial base means that the base has leading domestic technology advantages and has formed industrial agglomeration in a number of fields of high-tech industries at the same time. Accelerating the development of a national high-tech industrial base is the urgent need for improving the international competitiveness of high-tech industries and for the industry to expand under the new historical conditions. This is an objective requirement of facing the future direction of the industry, influencing and promoting regional economic development, and is also an important measure of fostering strategic emerging industry.

#### **3.1 In 2011, the Output Values of High-tech Industries Broke 8 Trillion Yuan**

The output values of China's high-tech industries in 2011 exceeded 8 trillion yuan, but the growth rate of the output values in high-tech industries did not keep the rising trend since 2008. When it reached 16.3% in 2010, the highest in recent years [5], it fell to 9.6% in 2011 (calculated at comparable prices). In 2012, the gross annual values of national high-tech industries exceeded 10 trillion yuan. From January to August, 2013, China's high-tech products of import and export were \$ 367.57 billion and \$ 426.63 billion, an increase of 16.5% and 15.2% respectively. The growth rate was 9.2 percentage points higher than the total of the country's foreign trade goods. At present, China's development capabilities in industrial technology have greatly enhanced, and the originality has been made in some major fields. For example, China has the ability to use 3D printing technology to produce complex aircraft structures, which has higher performance, lower cost and shorter duration. 2013 was the first year when the spirit of the 18th CPC National Congress began to be implemented comprehensively. Under the guidance of innovation-driven development strategies and under the encouragement of a series of high-tech industrial policies, our high-tech industries maintained a steady growth momentum and the innovation capabilities continued to be improved.

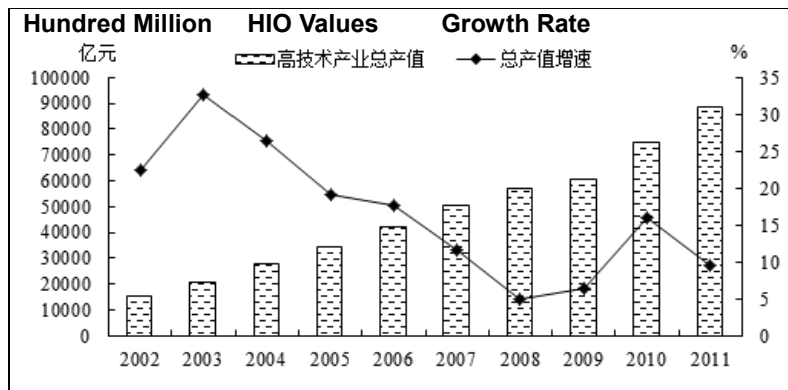


Fig. 1. High-tech industry output values and growth rate (2002-2011) [6]

### 3.2 Great Differences in the Scale of Industries, High Geographic Concentration of Industries

From the industry distribution of the high-tech output values, in 2011, the output values of electronic and communication equipment manufacturing ranked first, whose proportion was still close to half. The output values of computer and office equipment industries ranked second, almost accounting for 1/4. The aerospace manufacturing output is the smallest proportion, only 2%. From the regional industry distribution, high-tech industries have shown a high degree of geographic concentration. The eastern proportion of high-tech industrial output values reached 81.7%, almost five times that of the midwest, among which Guangdong and Jiangsu provinces reached half of the national output values.

### 3.3 The Proportion of Domestic Enterprises Increased, Foreign-funded Enterprises Decreased

With the enhancing capability of independent innovation of domestic enterprises, in the "12th five-year-plan" period, the growth share of high-tech industry output values of domestic enterprises further increased, amounting to 37.1% in 2011. And the long-term main force of China's high-tech industries, foreign-funded enterprises' proportion, fell from 72.0% in 2006 to 62.9%.

### 3.4 R & D Funding for High-tech Industries Continues to Grow

In 2011, the R & D expenditures for large or medium-sized high-tech industrial enterprises reached 123.78 billion yuan, accounting for

26.0% of R & D funding of large or medium-sized manufacturing enterprises. Meanwhile, the high-tech industry R & D intensity continued to rise compared with 2010, reaching 1.71%. Among them, the aerospace industry was of the highest R & D intensity, up to 7.94%; the lowest intensity went to computer and office equipment manufactures, 0.74 percent, 1.02% lower than R & D level of the overall industry. Geographically speaking, the high-tech industry R & D expenditures in the eastern part accounted for 84% of the country, much higher than that of the Midwest.

### 3.5 The Rapid Development of High-tech Industrial Development Zones

Chinese High-tech Industrial Development Zone is referred to as "National High-tech Zone" or "Nation-level High-tech Zone" for short [7]. Chinese Hi-Tech Industrial Development Zones are the concentrated built areas that regard intelligence-intensiveness and open environmental conditions as the basis, mainly rely on domestic technology and economic strength, fully absorb and borrow foreign advanced technology resources as well as funding and management means, and try to achieve local optimization of hardware and software environments to maximize the scientific and technological achievements into practical productive forces through the implementation of preferential policies and reform measures of high-tech industries.

From the beginning of the 1950s, our science and technology industrial parks have been playing a fundamental role in promoting the transformation of scientific and technological achievements, fostering innovative high-tech enterprises and entrepreneurs, new technological revolution and new industries and

promoting the development process of the new economy. They have become an effective way of economic growth and socially sustainable development and important means in promoting the realization of national and regional high-tech industries. In 1988, the State Council approved the establishment of the State High-tech Industrial Development Zone. The establishment of the State High-tech Industrial Development Zone is an important achievement of China's economic and technological reform and is an effective way of developing new technology industry in line with China's national conditions. Its purpose is to further rely on institutional and technological innovations, enhance functional construction, create a favorable environment for

innovation and entrepreneurship to attract outstanding scientific and technological personnel and managers, become an important base for technological innovation and industrial development, and play a leading radiation role in regional economic development. In May 1988, the State Council approved the establishment of the Experimental Zone of Beijing New Technology Industry Development, promised the Zone 18 preferential policies and began to carry out the Torch Program in August, which attracted the regions all over the country to actively found their own high-tech industrial development zones combined with their local characteristics and conditions. By November 2012, the State Council approved the establishment of 105 national

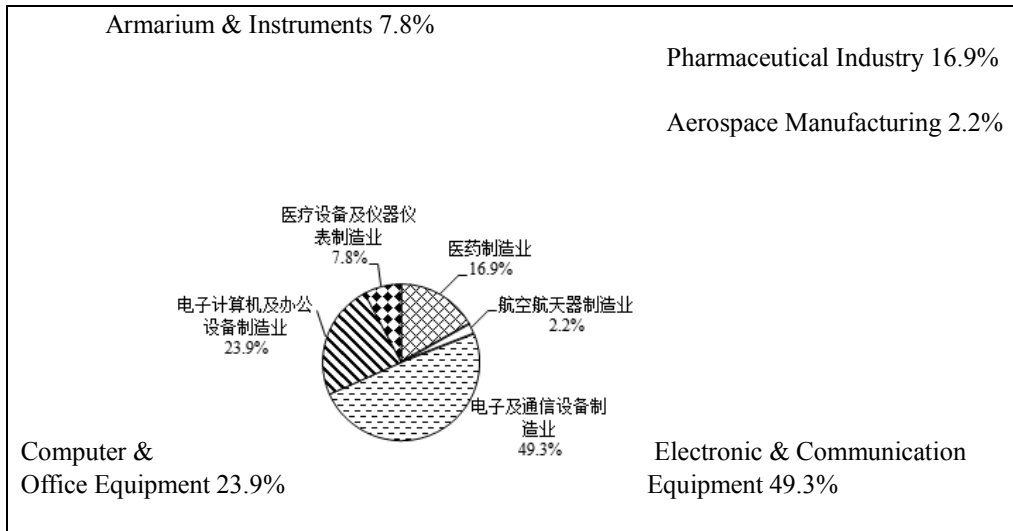


Fig. 2. High-tech output values by industry distribution (2011)

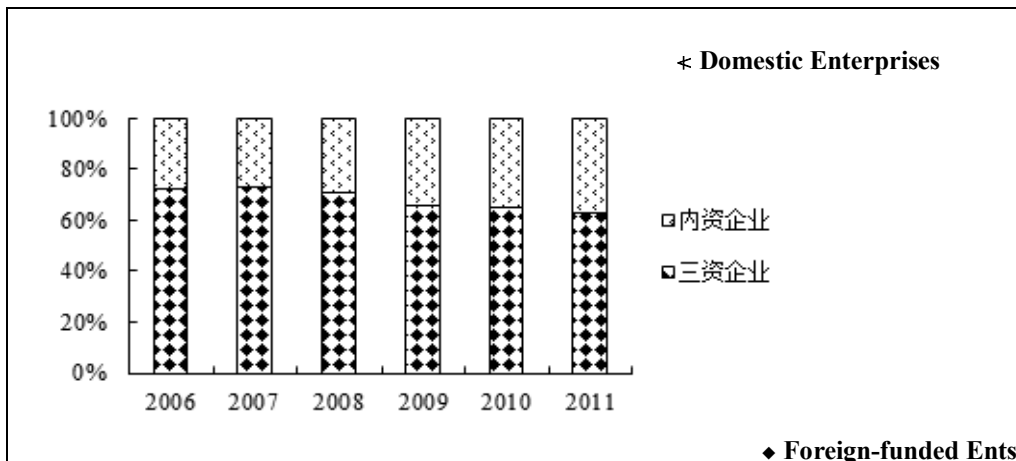


Fig. 3. The proportion of different types of registered enterprises (2006-2011) [6]

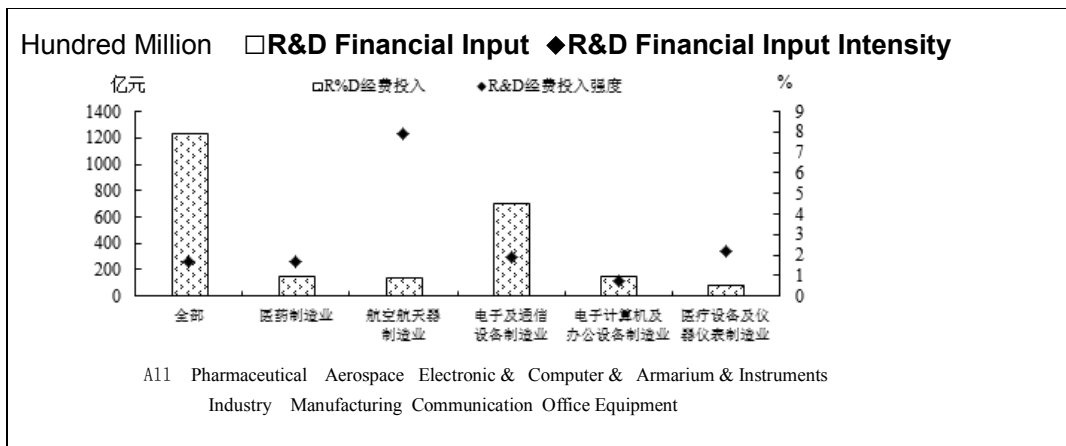


Fig. 4. High-tech investment intensity in R & D funding by industry distribution (2011) [6]

high-tech industrial development zones. Since their establishment, Chinese High-tech Industrial Development Zones have got unconventional development. They began to explore the road with Chinese characteristics in high-tech industry development and made remarkable achievements.

During the "Eleventh Five-Year Plan", China's high-tech industries made remarkable achievements. A number of major technological innovations sprang up in the fields of information, space, new materials, advanced manufacturing, energy, advanced transportation, etc, and they further enhanced the capability of independent innovation. The technologies for high-speed rails, wireless broadband communications, high-performance computers, new energy cars and some others entered the advanced ranks of the world. Several major high-tech outfits and their key components achieved self-designed manufacturing. Emerging new industries in modern services based on e-commerce and digital media of high-tech information network turned up one after another. Therefore, the economy in high-tech industry development zones continued their rapid growth, high-tech industrial output values kept going up and there was a more prominent position in the region. The industrial structure got optimized, new industries continued to emerge, innovative resources increased a lot and the capability of independent innovation significantly enhanced. The environment for innovation and entrepreneurship got significantly optimized. The system for the growth of fostering enterprises almost formed. The green development model and the urban functions improved constantly and effectively. Compared to the end of "Tenth Five-Year Plan",

the total revenue and industrial output values of the national high-tech zones in 2010 grew by 182.4 percent and 161.6 percent separately. During the "Eleventh Five-Year Plan", the total revenue and industrial output values of the national high-tech zones reached 23.1% and 21.2% annually. In 2012, the total revenue of the nation's 105 high-tech zones reached 16.1 trillion yuan, and industrial added values accounted for 13.6% of the nation. With the advantage of entrepreneurial elements, innovative environment, institutional mechanisms and some other aspects, the national high-tech zones continuously influenced and promoted the development of surrounding areas. The industrial added values in many high-tech zones accounted for more than 30% of the city's industrial added value, whose contribution to regional economic development turned out more prominently. Of course, though the national high-tech zones had made significant achievements, some problems still existed, which are mainly reflected in the weak ability of independent innovation, and especially, the achievements of the original innovation and integrated innovation in leading industrial development are not enough; strong and big business are less than normal; the competitiveness of some high-tech industries is weak and the industries in the real high-end and global dominance lack a lot; the financial system in promoting the development of innovation and entrepreneurship is still not perfect, industrial organization is not active and civic and social capital needs to be further guided; an interdepartmental, interregional policy coordination mechanism has not yet formed in the development of emerging industries, spreading influences and driving functions, etc.

National Hi-Tech industrial development zones			
Approval year	Approval numbers	Provinces having more than four zones	Numbers (Total: 114)
1988	1	Hebei Province	5
1991	26	Henan Province	5
1992	26	Hunan Province	5
1997	1	Liaoning Province	6
2007	1	Shaanxi Province	6
2009	2	Shandong Province	9
2010	26	Guangdong Province	9
2011	5	Jiangsu Province	12
2012	17	Fujian Province	5
2013	8	Hubei Province	5
2014	1	Other provinces	47



High – tech Industrialization Index, 2013	High – tech Industrialization Index, 2012
1. Tientsin	1. Shanghai
2. Shanghai	2. Jiangsu
3. Peking	3. Tientsin
4. Jiangsu	4. Guangdong
5. Chungking	5. Peking
6. Szechwan	6. Szechwan
7. Guangdong	7. Chungking
8. Hubei	8. Chekiang
9. Shandong	9. Hubei
10. Fujian	10. Fujian
11. Hainan	11. Shanxi
12. Henan	12. Shandong
13. Jiangxi	13. Henan
14. Guangxi	14. Jiangxi
15. Tibet	15. Hainan
16. Chekiang	16. Jilin
17. Shanxi	17. Hunan
18. Guizhou	18. Tibet
19. Yunnan	19. Anhwei

High – tech Industrialization Index, 2013	High – tech Industrialization Index, 2012
20. Jilin	20. Liaoning
21. Heilongjiang	21. Guangxi
22. Liaoning	22. Guizhou
23. Hunan	23. Heilongjiang
24. Anhwei	24. Inner Mongolia
25. Inner Mongolia	25. Hebei
26. Gansu	26. Yunnan
27. Hebei	27. Gansu
28. Shanxi	28. Qinghai
29. Ningxia	29. Ningxia
30. Qinghai	30. Sinkiang
31. Sinkiang	31. Shanxi

**Fig. 5. Industrial index sorting of high-techs of different provinces (2012-2013) [8]**

### 3.6 Industrial Index Sort of High-techs (2012-2013)

In the sort of high-tech industrial index, Tianjin, Shanghai, Beijing, Jiangsu, Chongqing, Sichuan, Guangdong, Hubei, Shandong and Fujian top the first ten [9], and they are also the regions whose indexes are higher than the national average (the average of national high-tech industrialization index is 50.00%). Comparing the result of 2013 monitoring with that of 2012, we can see that the high-tech industrial indexes in Chongqing, Beijing, Hubei, Sichuan, etc. are above the prior-year level. There are 24 regions whose industrial indexes are below the prior-year level, among which Ningxia, Hebei, Qinghai and Zhejiang fall by more than 10 percentage points. According to the 2012 high-tech industrial index sorting, the growing regions that rank fastest are Guangxi and Yunnan, which jump to the first 14 and the first 19 compared with the first 21 and the first 26 the year before; Hainan and Guizhou rise, respectively, to 11 and 18 compared with the first 15 and 22 of the previous year; Shandong, Tibet and Shanxi rank, respectively, at 9, 15 and 28, all increased by 3 in comparison with the prior year; Zhejiang decreases fastest, dropping from last year's first 8 to 16; Shaanxi drops from last year's first 11 to 17; Hunan drops from last year's first 17 to 23; Anhui decreases from the first 19 to 24; Jilin goes down from the first 16 to 20 and Guangdong from the first four to 7.

### 4. CONCLUSION

China today has become bigger and stronger, which owes much to some advanced technologies with our own independent intellectual property rights produced in our research and development. Science and

technology are primary productive forces, and science and technology innovation is the powerhouse of the country. The development process of our country for decades proves that [10]. The rise and fall of great nations in modern times tells us that the contest between countries is mainly embodied in the economy, military powers, and more in talents, technology and innovation. Whoever occupies the commanding heights of technological innovation will be able to seize the initiative in the development. For this purpose, we had to tighten our belts to come up with "two bombs and one satellite", i.e. atomic bomb, hydrogen bomb and artificial satellite. Now we are making greater efforts to explore next big breakthroughs in manned space-flight, manned deep diving, satellite navigation and other sophisticated areas just for the same objective. The lunar exploration in recent years is an important symbol of Chinese aerospace engineering, which will help us to understand the moon from a scientific point of view, and to develop aerospace engineering and technology, thus boosting the development and progress of information technology, new energy and new materials technology, MEMS technology and other high-techs. Today's world is on the eve of a new round of technological and industrial revolution. Whoever starts one step ahead in this transformation can obtain the initiative and advantage over their competitors in the future development of high-tech industries [11] and will be in an invincible position in global economic integration.

### COMPETING INTERESTS

Authors have declared that no competing interests exist.



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