The Role of High-end Manufacturing in Sino US Trade Friction

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Abstract. Since the end of 2017, the US China policy has undergone major changes, and trade friction and technological competition have gradually become the focus of bilateral relations. China strives to strengthen its independent innovation capability, master key core technologies, and become an innovative country. The United States suppressed China on the grounds that "China forces us enterprises to transfer technology and steals US intellectual property rights.". Advanced technology has become the main stage of competition and contest between China and the United States. And high-end manufacturing enterprises play an extremely important role. From the perspective of the economic development of China and the United States, this paper looks for the causes of Sino US trade frictions and the underlying internal logic. Finally, from the perspective of high-end manufacturing development, the paper analyzes the advantages and possible problems of the development of China and the United States.

Keywords: Sino-US trade friction; Trade deficit; Balance of trade surplus; High end manufacturing.

1. Introduction

The most obvious difference between the high-end manufacturing industry and the middle and low-end manufacturing industry is reflected in the technical level. Cutting edge scientific and technological achievements are the source of industry progress. Overcoming these technologies often requires a strong willed and creative talent team, high R & D funds, equipment and materials. When the technological content and added value of an enterprise increase, it can not only radiate to the whole industry, but also benefit enterprises in the upstream and downstream of the industrial chain.

In fact, although China is still facing the phenomenon of "choking" of some core technologies, and the middle and low-end manufacturing industries occupy most of the market share, which is a certain gap compared with developed countries, the attention and activity of high-end manufacturing industries represented by industrial robots, photovoltaic cells and semiconductor materials have significantly increased in recent years, and the industrial structure has been constantly optimized. At the same time, thanks to the years of hard work of domestic enterprises and the accumulation of technology with independent intellectual property rights, an industrial cluster with certain international competitiveness has been formed. In addition to favorable policy advantages, it can be said that China's high-end manufacturing industry has begun to take shape and has significant growth potential. It is expected to further realize domestic substitution in key parts and products.

Mastering science and technology means mastering the initiative of development. Enterprises that started from manufacturing have a deep understanding of this. However, science and technology is a general and broad concept. In the context of the development of enterprises, it is not only the leading technical ability, but also the comprehensive ability of enterprise operation and management. Technical ability is an important branch of it, and other abilities are equally important. Only by coordinating the overall vision and strategy, can we deliver continuous power to the technologies that need to be updated and iterated, so as to ensure the long-term competitiveness of enterprises.

It is not the combination of information technology and manufacturing that can be called high-end manufacturing. Embracing new technologies and changes is a topic for all enterprises and industries in this era. Deeply participate in it and promote comprehensive innovation with scientific and technological innovation as the core. The profound changes in R & D, production, sales and other links, as well as the supply and market system brought about in this process, are the key direction for the manufacturing industry to move from the low-end to the high-end.

In other words, on the one hand, high-end manufacturing means the overall improvement of the scientific and technological level of the whole industry; on the other hand, it means that individual enterprises grasp the wind and hit the water in the middle stream. While developing and polishing high-end products and processes, they integrate and apply emerging information technologies, so that they can not only promote the improvement of production efficiency and efficiency and the breakthrough of related professional technologies, but also open up the internal and external environment for enterprises, from single point to multiple points, Both lateral penetration and longitudinal extension.

Taking this as an opportunity, some enterprises closely follow the development trend of the industry and refine the market demand, constantly deepen technical research, increase the transformation of scientific and technological achievements, accelerate the updating and optimization of products, strengthen the training of professional talents, and build an independent and controllable intelligent and digital manufacturing ecosystem. Relying on relatively perfect strategic layout and relatively complete technical support, it serves enterprises to build ecological barriers to seize market opportunities and provide sufficient momentum for the upgrading of high-end manufacturing industries.

Generally speaking, the development of enterprises can indeed promote the progress of the industry, and the wind direction of the industry will have a certain impact on the actions of enterprises. However, we should also realize that every step taken by an enterprise is related to the work and life of several people. In many cases, an enterprise does not have the right to choose or the room to retreat. The transformation of individuals is still so difficult, not to mention the collective composed of tens of thousands of individuals. The manufacturing industry has experienced nearly a hundred years from scratch. From the middle and low end to the high end, we should be fully prepared for the long run. In recent years, with the global expansion of the value chain, new trade modes have been born.

Under the background of Sino US trade relations in the new era, how can the two high-end manufacturing industries seize the development opportunities to face difficulties. It is a difficult problem for two high-end manufacturing companies to give full play to their own technological, talent or policy advantages. Similarly, the development of high-end manufacturing in the two countries is also constantly affecting the status and development prospects of the two countries in international trade. Therefore, how to develop high-end manufacturing industry is not only for enterprises to think and solve, but also for the government to consider.

2. Sino US Trade Friction

In the past 40 years, the global trend has been free trade, which is based on David Ricardo's comparative advantage theory. The theory of comparative advantage sounds complicated, but the truth is simple. Assuming that the United States is more efficient than China in producing aircraft and cars, it has advantages over China. This is called absolute advantage. Does the absolute advantage mean that the United States produces both aircraft and cars, and does not need to do any trade with China? The theory of comparative advantage tells us that we should not look at absolute advantage, but comparative advantage. If the technological advantage of the United States in aircraft production is greater than that in automobile production, the United States should concentrate on aircraft production. Although China's absolute advantage is not high, we have a comparative advantage. China should produce cars, and the two countries will have international trade [1].

The theory of comparative advantage is a static analysis. In the above example, whether China should always only produce cars, if China's technological progress makes it possible for China to produce aircraft, what is the dynamic process of this adjustment, and whether trade protection can help the development of some industries? This is a controversial issue. Free trade and trade protectionism have advocated free trade in different countries at different stages of history, but have also adopted some trade protection policies, reflecting the problems, challenges and advantages faced by each country at different stages of development.

Fig. 1 Proportion of Sino US trade volume in GDP

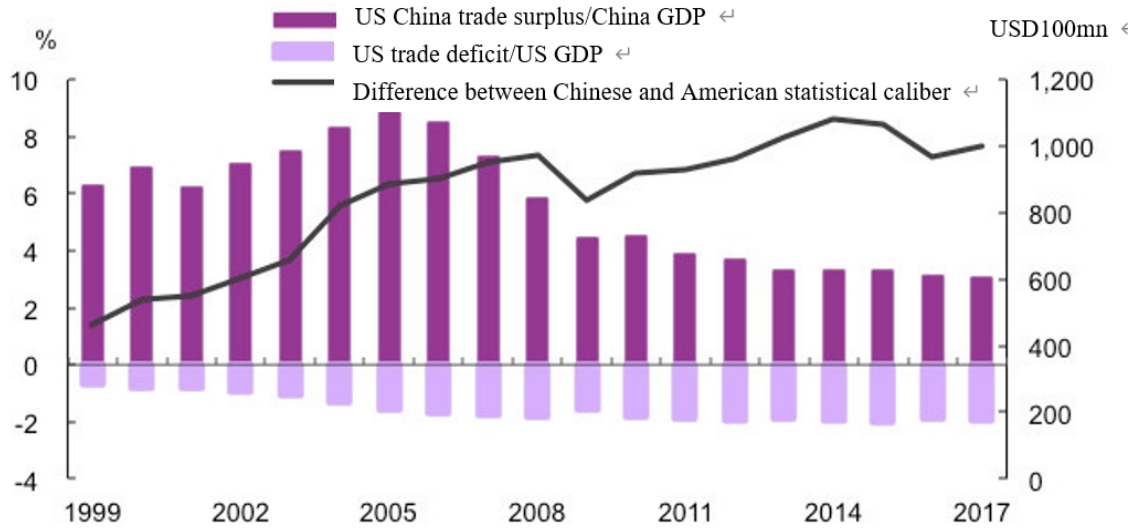

Fig. 2 Changes in China US trade surplus

The US trade deficit has shrunk from 5% before the financial crisis to about 3%, mainly due to the reduced domestic demand after the crisis. In contrast, there are many reasons for the decline of China's trade surplus. First, the development of real estate and finance in the past decade has actually guided more and more resources to meet the needs of internal nontrade goods, rather than export trade; Secondly, it is the change of demographic dividend and the rise of labor cost.

Therefore, relative to the economic scale, the global trade imbalance has been corrected since the financial crisis. But why does the US government now think that trade imbalance has become a new problem? First of all, compare the bilateral trade deficit and surplus between China and the United States. The trade surplus between China and the United States, or the U.S. trade deficit with China, has decreased significantly compared with China's GDP, indicating that the imbalance has been corrected obviously, but there has been little change compared with the U.S. GDP. At present, there are some differences in the trade caliber between China and the United States. Even according to the statistical caliber of the United States, for China, the bilateral trade imbalance has decreased. In the past, we worried that China's trade surplus reflected the imbalance of the domestic economic structure. This is not the pressure from the Americans, but we need to correct it ourselves.

Fig. 3 Proportion of China US GDP in Global GDP

3. High End Manufacturing

Multinational companies represented by apple of the United States use the global value chain strategy to outsource the manufacturing and assembly of products to contract processors, while they focus on product design, promotion and sales. This mode of trade is different from traditional trade, and current trade statistics cannot track this new trade activity [2].

For example, according to the United Nations commodity trade statistics, China imported only $4 million in notebook computers and mobile phones from the United States in 2018. In fact, apple alone has sold $52 billion worth of similar products in China.

Why is there such a contradiction? Xing Yuqing [3] an economics professor at the Japan University of policy studies and overseas Dean of the Global Value Chain Research Institute of the University of international business and economics, believes that such errors are related to outdated statistical methods. The World Bank's definition of value chain trade now focuses too much on the proportion of imported intermediate products used in export products, which misses some trade activities along the value chain.

According to the World Bank's definition of value chain trade as "intermediate products that cross national borders twice", China's participation in the global value chain decreased from 35.1% to 33.9% from 2010 to 2020. This is not consistent with the actual situation.

The reason is that with the continuous improvement of China's production capacity, many raw materials that were originally imported can be produced in China, which is also the way China participates in the global value chain - OEM for famous brands, intangible assets (creativity, design, etc.) for brands, and China is responsible for assembly and production. With the continuous expansion of the domestic consumer market, OEM products are sold domestically in China, and there is no physical import and export.

In her view, such transactions should not be included in the statistics of the global value chain, and the amount of such trade is huge. If we use the new calculation method - "factor income trade" concept to calculate, we will find that from 2005 to 2016, the trade deficit between the United States and China decreased by 32% on average compared with the traditional calculation method and 17% compared with the current popular algorithm of value-added trade.

So, what new changes have taken place in the global value chain? Why can GVCs promote China's exports? How far does China participate in global value chains?

In recent years, China's overall technological strength has gradually increased, becoming an influential science and technology power. However, China still has a long way to go from a big country in science and technology to a powerful country in science and technology. Whether viewed from the horizontal scope or the vertical gap, the technological strength of the United States is still

the world's leading. Some key basic indicators reflect the basic situation of China US technical strength comparison:

(1) Knowledge creation is the basic index to measure scientific and technological strength, which is directly reflected in the number of scientific and technological papers issued and cited. Many authoritative statistical data, including natural index, show that in recent years, in terms of the number of conference papers and peer-reviewed journal articles, China has continued to grow rapidly, and the gap with the United States has been narrowing, and even surpassed the United States in some rankings. However, China still lags far behind the United States in the number and originality of highly cited papers [4].

(2) Financial input is the basis of technological innovation. In terms of total R & D expenditure, the United States has long been the world's largest. Since 2008, China's R & D expenditure has increased rapidly, with an average annual growth rate much higher than that of other countries, and it is likely to match or even exceed that of the United States. China's R & D intensity has increased rapidly, but there is still a certain gap compared with the United States. The amount and proportion of investment in basic research in China is still far lower than that in the United States [5].

(3) The core of technological competition lies in talents. The quality of higher education and scientific research environment is the key to test whether a country can attract and retain talents. At present, China has taken the lead in the number of R & D personnel and potential R & D personnel. It is estimated that by 2025, the number of stem doctoral graduates in China will be nearly twice that in the United States. However, on the premise of guaranteeing a certain quantity, the United States has a considerable degree of quality advantage. In various rankings, American higher education has an overwhelming advantage. Affected by the US government's ban and the COVID-19 epidemic, the number of international students studying in the United States has declined in the past two years, but the United States is still the preferred destination for international students. Its relatively loose and innovative research environment is also favored by scientific and technological talents. A considerable number of overseas students choose to study in the United States after obtaining a doctorate in stem in American universities [6].

(4) Patent application and transformation reflect the scale of national technological output to a certain extent. China has surpassed the United States in the annual patent application volume (including the "patent application volume of the applicant's national nationality" and the "PCT patent application volume" reflecting the patent quality), and the gap with the United States in the effective amount of patents is gradually narrowing. However, the patent technology field in the United States is relatively comprehensive and of high quality, while the patent structure in China is relatively single and of low quality. In terms of patent conversion rate and conversion efficiency, there is still a significant gap between China and the United States, but the trend of gradual narrowing is gradually obvious [7,8].

(5) The degree of participating in and leading the formulation of international standards reflects the level of national technological innovation and industrial comprehensive competitiveness. The United States has led the formulation of international technical standards in recent decades, and has formed a systematic advantage in the market, with a great voice. With the progress of domestic technology and industrial development, China has accelerated its participation in the formulation of international standards and achieved "point breakthroughs" in some industrial fields. In general, China has made revolutionary breakthroughs in some key indicators, and the overall gap between China and the United States has been narrowing, but the United States still maintains its overall and key advantages.

It should be emphasized that these key indicators can only reflect the general situation of China and the United States in the field of basic research and application to a certain extent, and cannot fully and accurately show the current situation and future of the comparison of technological power between China and the United States. Because the increase or decrease of technological power is directly related to innovation ability, and innovation has nonlinear characteristics, any index may be biased in the process of innovation. Therefore, even if all indicators are compared and analyzed, we

cannot simply regard them as the true embodiment of technical power. National innovation is a dynamic system engineering, involving the development of "government, industry [9], university, research and application" at all levels. In the modern complex industrial system, innovation is often neither a single subject nor a single time. In addition to the above indicators, the interaction between producers and users and strategic decisions has a profound impact on innovation ability and technical strength. Information technology, artificial intelligence and aerospace are the three representative fields of China US technological competition. These three areas are not only important in science and technology and economy and trade, but also directly related to the interaction between China and the United States at the national security and strategic levels [10].

Integrated circuits and special equipment, information and communication equipment, operating systems and industrial software are the key bases for the development of the new generation of information technology industry, and also the focus of competition between China and the United States in the field of information technology. Among them, integrated circuits provide the hardware foundation for most information technologies; Communication equipment is the core medium of information technology and one of the most important application fields of integrated circuits [8]; operating systems and industrial software are important software guarantees for building various information technologies and their industrial ecology. The three fields are closely connected and influence each other. The integrated circuit industry has the characteristics of high division of labor and interdependence in the world. Although the United States relies on foreign enterprises in wafer manufacturing and other links, it still has overall technological advantages; The US government is also trying to maintain its leading position by increasing investment in the integrated circuit industry [11].

In contrast, China's integrated circuit industry is in a period of high-speed development, and has basically achieved full coverage of the product field. However, there are also problems such as many but not strong enterprises, homogeneous development in the industrial field, serious low-level redundant construction, and high dependence on the import of core equipment and parts. In the field of information and communication, the gap between China and the United States in technological strength is relatively small. Among them, China has certain patent advantages in the fifth-generation mobile communication technology (5g) and has begun to lay out and explore the next generation technology; However, in recent years, the United States has also begun to catch up by increasing government investment and cooperating with allies [13].

At the same time, although Chinese enterprises have reached the top level in the industry in the design of various communication modules, they are still constrained by American and Japanese enterprises in some key parts such as RF front-end chips, and their independent controllability needs to be further improved. In all kinds of operating systems, the United States has obvious advantages and has mastered core technologies such as kernel. In contrast, although China's domestic independent operating systems occupy a certain market share, they lack core competitiveness as a whole. American enterprises also maintain a leading position in most industrial software categories. Chinese enterprises occupy a certain domestic market share in data sensitive software such as economic management, but it is always difficult to break through in the global high-end market; However, there is still a big gap between China and the United States in terms of R & D design and general tool software (such as EDA software) that are more critical to the development of information technology.

In recent years, there have been more and more frictions between China and the United States due to network and data security, which has also made the issue of information technology increasingly secure. In the face of cyber-attacks, both China and the United States have suffered many losses in recent years; [14] However, considering the potential technology blockade and the maturity of the security industry, China needs to make greater efforts in the network and data security of most civilian fields. In addition, the United States has suppressed Huawei and other Chinese enterprises and played up the threat of China on the grounds of network and data security around the world, making relevant international cooperation more difficult, and the trend of politicization and camp has emerged. In

view of the trend of bilateral relations and the domestic political environment of the two countries, China and the United States will not be able to improve their concerns about network and data security and lack of mutual trust in the short term, and the political color in technology competition may be further intensified with the increase of investment by both sides [15].

In terms of personnel training in the fields of integrated circuits, operating systems, industrial software and so on, there is a shortage of high-end talents and a lack of compound talents in China. Although many universities in China have recently established relevant colleges or majors, and governments at all levels have actively promoted the integration of industry and education, there is still a big gap between China and the United States in industry university research cooperation, scientific research, entrepreneurship ecology and other aspects in relevant fields. In terms of basic research of information technology, Chinese universities have made great progress in recent years, and the relevant rankings have reached new highs. However, American universities still have certain advantages in talent training in some cutting-edge technology fields.

Standards and norms in the field of competitive information technology mainly refer to guiding standards and norms negotiated and formulated by relevant international industry associations or mechanisms. In recent years, although Chinese enterprises have made concentrated breakthroughs in relatively important and wide-ranging fields such as 5g communication technology standards, they still have limited international voice in technology and product standards in many subdivided fields such as memory and vehicle gauge chips. In addition, because it does not have the first mover advantage, China also lags behind the United States in the "soft standard" composed of core technology advantage, market penetration, user acceptance and other factors summary.

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4. Discussion

The "technology decoupling" between China and the United States has a tremendous impact on China's information technology industry. At present, as more and more Chinese entities are sanctioned by the United States and Chinese enterprises such as Huawei are frequently suppressed by the United States in the international market, the global information infrastructure and even technology development have a "dual track" trend. The daily R & D and operation of sanctioned Chinese enterprises and institutions have been restricted, and some sanctioned college students have difficulty in studying in the United States [16]. In this context, the normal business activities and cooperation exchanges between some Chinese entities that are not sanctioned and the United States and other countries have also been hindered. In contrast, the direct impact of "technology decoupling" on the US information technology industry is not obvious at this stage.

In the field of artificial intelligence, the scientific and technological strength of China and the United States is far ahead of other countries and regions in the world. The United States holds the advantages in computing power and algorithm, and China benefits from the huge and diverse domestic big data. At present, the strength of artificial intelligence in China and the United States can be measured in three aspects. In terms of basic research, the number of published and cited AI research papers in China and the United States are equal, but the United States has obvious advantages in original and pioneering research. In terms of industrial technology, the United States is the originator of core technologies such as artificial intelligence chips, algorithms and machine learning, and it still leads China with rapid progress [17]. Thanks to the open knowledge sharing of the scientific community, the gap between China and the United States in software, models and algorithms is limited. In terms of applied technology, China and the United States have their own strengths. Based on the advantages of massive data accumulation and user experience, China leads the United States in technology fields (such as face recognition, voice recognition, computer vision and image diagnosis technology) where products drive R & D. The United States has made major breakthroughs in introducing machine learning technology in biosynthesis and drug research and

development. The United States also takes the lead in promoting the military application of artificial intelligence technology.

Against the background of intensified strategic competition among major countries, the security problems in the field of artificial intelligence have become increasingly prominent, and there is even a trend of over security and politicization. At the national level, the military application of artificial intelligence is directly related to the national defense security and military strength, while its commercial application is related to economic prosperity and social development [18]. Both the trump administration and the Biden administration have elevated artificial intelligence to the strategic level of national security and development, and regarded China as an imminent threat to the long-term technological advantage of the United States. At the domestic political level, because some institutions and figures claimed that the 2016 US election was interfered by false information and intelligence activities of foreign forces, artificial intelligence was linked to domestic political security of the United States for the first time, causing alarm in the American society. The maturity and popularity of artificial intelligence monitoring technology has also triggered criticism from the United States on China's human rights situation, privacy security and "digital authoritarianism". These factors have intensified the ideological color of the competition between China and the United States in artificial intelligence technology, and also increased the political sensitivity of topics such as network security, data security and cross-border transmission, information dissemination and public opinion supervision.

The United States is the preferred place for global AI professionals to receive higher education and choose employment. In terms of talent education and training, American universities established a full set of artificial intelligence professional talent system and laboratories earlier. China has only begun to catch up with China in the past three years, but there is still a long way to go. The total number of artificial intelligence practitioners in China has grown rapidly, but the number of high-end R & D talents is far less than that in the United States [18]. China is the main source of university reserve talents in the field of artificial intelligence, but it is not a popular place for employment. Among China's top AI talents, 34% are employed in China, and about 56% are employed in the United States. Among the Chinese who went to the United States to study artificial intelligence, 88% worked in the United States after graduation, and only 10% returned to work [19]. Although the overall exchange of scientific and technological talents between China and the United States has weakened due to the "politicization" of the trump administration, in the field of artificial intelligence, the academic community is still willing to open up and share scientific achievements. In the field of artificial intelligence, it seems that there is no obvious tide of Chinese scientists returning home due to the deterioration of Sino US relations.

Artificial intelligence has brought common governance challenges to all countries, but the international discussion around the technical standards and governance norms of artificial intelligence highlights the power game and political concept differences among major countries. Although it is difficult to promote relevant regulatory legislation in the United States, the United States actively participates in international discussions on Technology Governance and standards and strongly opposes any proposal by China. The United States is also seeking to build an ideological "democratic technology alliance" and cooperate with so-called "like-minded" countries in the formulation of regulatory regulations and standards to limit the application of China's artificial intelligence technology and its international promotion [15]. China is increasingly active in science and technology diplomacy and participating in international dialogues on artificial intelligence ethics, governance and technical standards. However, due to the lack of coordination among relevant central ministries and commissions, the voice and participation of Chinese representatives on different international platforms are inconsistent [21].

The Biden administration still regards artificial intelligence as one of the core technology fields of strategic competition with China, basically continuing the "decoupling" measures of the trump era. However, in addition to the restrictive measures of the US government on technology export control and investment review, the cooperation and exchange between Chinese and American enterprises and

scientists in the field of artificial intelligence have never been interrupted. In March 2021, the National Security Council of artificial intelligence of the United States released its final report, recommending that "targeted isolation" measures be taken to protect the national security, open source technology ecology and intellectual property rights of the United States [20]. The optional measures include more targeted export control and investment review, reducing technology dependence on China, and promoting international technical standards and norms that conform to American values. This may represent the mainstream thinking of the current US government.

At present, the international aerospace pattern is characterized by "one superpower and many strong powers". In the field of space transportation, manned space flight, satellite navigation and communication, deep space exploration, etc., the United States is absolutely in the lead, while China has an independent technology and equipment system, and is the second echelon with Europe and Russia [17]. In the key links such as aero engines, avionics and aviation materials in the aviation field, the United States has maintained a leading position on the whole, while China has developed rapidly, and is the second echelon with Russia, Britain and France. The interdependence between China and the United States in the aerospace field is relatively weak, and the competition in technology and security is gradually heating up, but the industrial competition relationship is highly asymmetric.[20]

Space security is a complex of territorial air security and space security. Both China and the United States have issued a "space strategy" that regards them as a unified whole. Space security competition focuses on two aspects:

First, military aviation, focusing on aero engines, avionics, missiles and missile defense, and hypersonic weapons; the second is space security, which is based on space transportation and situational awareness, and focuses on anti-satellite capabilities.

5. Conclusion

At present, the United States is far ahead in these two aspects. China has developed rapidly in the field of military aviation, and is the second echelon with Russia, Britain and France; In the field of space security, China can form a "quasi three pole pattern" with the United States and Russia. Space security and nuclear security are closely linked and highly complex and sensitive. The United States has long pursued the theory of "space control" under the condition that it has obvious superiority in space military strength, which makes China feel threatened. The United States has also accelerated the militarization of outer space. The trump Administration officially established a space force and launched a new version of the defense space strategy, clearly viewing China as a hypothetical enemy in the field of space security. China has actively promoted the building of defense capability of "space integration", strengthened space security cooperation with Russia, jointly proposed a code of conduct against the militarization of outer space, and frequently clashed with the United States at the United Nations Disarmament Conference.

In the long run, talents and R & D system are the basic factors that determine the competitiveness of China and the United States in the aerospace field. Judging from the strength of talent training institutions, American universities occupy the forefront of astronomy, space science, geophysics, atmospheric science and other disciplines in the world, while China's top universities only reach the level of the second and third echelons. In engineering disciplines, Chinese universities have certain advantages. However, in terms of capital investment and the number of professional and technical personnel, the United States is far higher than China. As for the main R & D body, China takes the "national team" as the main force, and the capital and technical resources are concentrated. In the United States, the government and private entities work together to achieve coordination between government and enterprises through project procurement, and at the same time, competition among enterprises provides innovation power. In recent years, emerging companies such as SpaceX have become leaders. In the R & D process, China has learned from the western scientific research management system since the 1980s and gradually explored a relatively mature "pre research trial

production mass production" mechanism, which is no essential difference from its American counterparts.

Competition for technical standards and norms issue 123 7 China and the United States are both participants in the global commercial aerospace and civil aviation industry, but their market share and competitiveness are far from each other. In terms of commercial aerospace, the U.S. commercial rocket launch capability is the only one in the world, and GPS accounts for more than 60% of the global satellite navigation market, so it has the largest voice in these two industries. In terms of civil aviation industry standards, the United States has the largest number of aviation technology patents in the world. Although China has rapidly narrowed the gap with the United States, its core patents are limited, its market conversion rate is not high, and it still relies on imports in key fields such as civil aircraft engines. The United States also has great influence over the international civil aviation organization, which formulates global civil aviation standards. However, in recent years, China's Beidou navigation system and civil UAVs have made great progress, and the international market share has increased rapidly. The Chinese enterprise Dajiang has even become the world's largest civil UAV manufacturer and is expected to become a global industry rule setter.

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