

# An Analysis of the Path of Intellectual Property Protection of Integrated Circuits in China from the Perspective of Sino-US Trade War in the Post-epidemic Era

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## Abstract

In the post-epidemic era, the evolution of the international landscape is accelerating, with unilateralism and trade protectionism gradually gaining the upper hand. The intensified competition between China and the United States makes the intellectual property disputes related to the trade war between China and the United States become more and more intense. As the core subject of intellectual property disputes, integrated circuit is also a direct embodiment of the hard power of science and technology of each country, and its protection path has high research value attribute. This paper aims to sino-us trade friction under the perspective of China's integrated circuit of intellectual property rights (IPR) protection path to explore, through fact analysis combined with the technique of comparative analysis, comparing with the integrated circuit industry and protection path, respectively from different aspects such as the theory and practice, macro and micro analysis, the use of big data for them, the rule of law suggestions and thoughts on the intellectual property protection path of integrated circuits under TRIPS-PLUS standard in the post-epidemic period were put forward.

**Keywords:** post-epidemic era, the trade war between China and the United States, integrated circuit, intellectual property rights

## 1. The Raising of the Problem

In early 2020, the outbreak of COVID-19 led to the acceleration of the reconstruction of the world economic pattern and the “introversion” of industrial chains between countries. Further contraction of the global industrial chain, the global market downturn.<sup>1</sup>

In fact, in recent more than ten years, with 5G, AI, VR and other many new generations of information technology breakthrough and the continuous emergence of new business types and new model industry chain, the rapid popularization of digital technology, followed by the digital economy has become a new engine to enhance the international competitiveness of our industrial chain and promote the rapid development of our overall economy.

The integrated circuit industry has not only become the core weight of political and economic disputes between the two countries, but also become the industry with the fiercest international competition and the most thorough global resource flow and replacement. If a country or region can successfully occupy the relative commanding heights in the integrated circuit industry chain, then it can naturally obtain windfall profits from the world market, and then stand boldly in the waves of world economic development.<sup>2</sup> The integrated circuit industry is one of the important components of the digital industrial chain, and the chip as the end product of the integrated circuit industry is the material carrier of almost all the new generation of information technology, so its smooth and orderly operation is of great significance to the development of the digital economy in China and the world.<sup>3</sup> Considering the fundamental position of chips in the field of information and communication technology, the

crisis in the IC industry will directly restrict the benign development of the global digital economy, and even delay the progress of a new round of scientific and technological revolution and industrial upgrading.<sup>4</sup>

## **2. The Historical Roots and Presentation of the IC Trade War Between China and the United States in the Post-Pandemic Era**

One of the core of the development of China's intellectual property system is the IP of integrated circuits, and the trade conflict between China and the United States will have a negative impact on China's intellectual property system itself, especially in the field of integrated circuits. Then, naturally, it will gradually become enacted the external environmental factors that the national strategy of intellectual property rights and the establishment and perfection of integrated circuit intellectual property rights laws and regulations cannot separate from.<sup>5</sup>

The trade friction between China and the US in the field of IC IPR mainly refers to a series of policy measures taken by the US unilaterally against China's IC trade, such as suppression, restriction and blockade. It is also the inevitable result of the unilateralism advocated by the US under the comprehensive drive of economic, political, legal and other factors.<sup>6</sup>

In the post-epidemic era, the competition and confrontation between China and the United States have intensified to varying degrees, and the integrated circuit trade war between China and the United States has gradually escalated. In this context, the intellectual property trade barriers faced by Chinese integrated circuit enterprises in the process of going out will become increasingly prominent.<sup>7</sup>

### *2.1 The Historical Roots of the IC Trade War Between China and the United States in the Post-Pandemic Era*

#### **2.1.1 Political Aspects**

Although there is a huge gap in IC strength between China and the US, from the perspective of the US government, the speed of China's IC development has touched the nerve of the American society. It is believed that the rise of China's IC will pose a serious threat to the "national security" of the US, and damage the global influence and core national interests of the US. In the 2018 National Defense Strategy report of the United States, China was identified as a long-term strategic competitor, which shows where the United States' intentions are.

#### **2.1.2 Economic Aspects**

In the post-pandemic period, the trade imbalance between China and the United States became more and more serious due to the impact of the COVID-19 pandemic. Therefore, the United States took IC as the most advantageous chip to solve the trade deficit. The US government aims to continuously guide the US-funded enterprises in China through laws and policies, and use the core technologies in the IC industry chain to exchange for a larger market share, so as to force China to surrender its current economic benefits. With the increase of the purchase share of IC derivative products, the trade deficit will naturally decrease.

### *2.2 The Presentation of the IC Trade War Between China and the United States in the Post-Pandemic Era*

The focus of the trade war between China and the United States has never been trade itself, but intellectual property, the core area that drives economic development. Therefore, the trade war between China and the United States is also known as the "IP war between China and the United States". As the fire of the trade war between China and the United States continues to expand, the geopolitical tug of war between the two countries has also been significantly intensified.

In the post-pandemic period, from the perspective of the China-US trade war, IC trade frictions are mainly manifested by the "choking" sanctions on the upstream industrial chain and the "entity list" export control.

#### **2.2.1 Upstream Industry Chain "Choke" Sanctions**

Since May 2020, the US government has again upgraded its sanctions on Huawei. The "choke point" behavior of directly banning OEM suppliers from supplying Huawei actually reflects the escalation of US sanctions on China's high-tech industry, and is more of an indirect disregard for the TRIPS agreement and even the intellectual property protection provisions related to integrated circuits in the FTA.

#### **2.2.2 "Entity List" Export Control**

At the beginning of the outbreak of the epidemic, the United States revised relevant regulations and bills many times to achieve a complete blockade of China's integrated circuit technology in various fields.<sup>8</sup> In May 2020, the US Department of Commerce added 33 Chinese companies and academic institutions to its "entity list", citing the country's "national security".<sup>9</sup> This practice of the United States just firmly grasped the core weakness of China's local manufacturing industry and indirectly built a high wall for the sound operation of the domestic IC market and the international protection of its IC intellectual property rights through trade sanctions.

## **3. The Comparison of Intellectual Property Protection Paths of Integrated Circuits in China and the**

## United States in the Post-Epidemic Era

Will be caused by the coronavirus pneumonia outbreak pattern, technical power and spread to the world order of structural impact, in Mr Reid diamond, the guns, pathogenic bacteria, and steel: the fate of the human society, has been predicted, as the “black swans” pneumonia outbreak will be increasing world economic pattern change again another opportunity. However, when the whole earth is facing “the greatest changes in a century”, the world pattern will further produce the reverse trend of “anti-globalization”.<sup>10</sup>

Intellectual property has become an “important field” and “core link” of world trade, and also has the status of “the main battlefield of global interest competition and game”.<sup>11</sup> Therefore, as the world’s top two economies, China and the United States have made a qualitative leap in protection in this respect compared with the previous, and the intellectual property protection path that focuses on both internal and external aspects and takes the integrated circuit field as the key perspective has also become one of the source forces that can not be underestimated in the construction of social rule of law and the coordinated industrial development of the two countries.

In the following, we will mainly use factual argument and horizontal comparative argument to conduct multi-dimensional analysis on the intellectual property protection path of IC in China and the United States in the post-epidemic era.

### *3.1 Review of IP Protection Path of Integrated Circuits in China in the Post-Epidemic Era*

Now, the position and location of China’s international intellectual property protection system are not clear enough. With the influence of TRIPS (Agreement on Trade-related Aspects of Intellectual Property Rights) decreasing day by day, the diversified rules in bilateral, multilateral, small multilateral and neighboring countries are promoting the construction of higher standard international intellectual property rules, and these rules have also become the new field of development and change of international intellectual property rules. From the earliest of the Paris convention, the Berne convention, the TRIPS agreement to the currently popular global free trade agreement (Free Trade Agreement, FTA for short below) and bilateral investment treaties (Bilateral Investment Treaty, BIT), international intellectual property protection has experienced a process from regionalization to globalization, and from globalization to regionalization again.<sup>12</sup> China has participated in TRIPS agreement, bilateral trade and regional free trade treaties, relatively little use of soft law.

#### 3.1.1 Protected by TRIPS

Since its accession to the World Trade Organization in 2001, China has adhered to the standards of intellectual property protection provisions of integrated circuits in the TRIPS Agreement for a long time, and has taken this as a firm position when participating in bilateral or regional arrangements. Then, our integrated circuit protection regulation is established by referring to the main terms of TRIPS agreement. However, with the rapid development of integrated circuit industry in various countries, developed countries are gradually dissatisfied with the minimum standards of intellectual property protection formulated by TRIPS agreement, and bypass TRIPS agreement through bilateral agreements or multilateral agreements, which leads to the effectiveness of TRIPS agreement in the world is gradually reduced. In developed countries in the world of exert a subtle influence on the trend of strengthening IPR protection of integrated circuit is more and more clear, both resisted and support, all countries are being adaptation, is embodied the integrated circuit protection situation of the intellectual property rights is high, which lead to the failure of standard of the lowest TRIPS agreement of intellectual property rights.

#### 3.1.2 Protected by BIT

BIT is a kind of agreement to agree the rights and obligations of both parties in order to promote the flow of capital factors and protect transnational investment. It is also a major tool to construct a new international intellectual property rule system. By the end of 2018, the global number of bilateral investment treaties has reached 2933, of which the investors pay more and more attention to the host country intellectual property rights protection standards, and patent, trade secret, integrated circuit, chip in countries such as the importance of business relationships, BIT involved in the terms of the protection of intellectual property rights are more and more. By 2020, China had signed bilateral investment treaties with 130 countries or regions, but according to China’s Ministry of Commerce, only 30 bilateral investment treaties were signed after 2000, and some of these agreements are due to domestic the legal review process is in an unfinished state, which makes its agreement substantially ineffective. And bilateral investment treaty negotiations often due to the complexity of the economic interests and political relations, especially in the United States to China’s disfavor attitude, as well as in the past two years COVID-19 outbreak many bilateral investment agreements under the influence of the process is infinite, so that the bilateral investment agreement for both sides investment to establish a stable, transparent, foreseeable and the role of safety protection of the law framework was cut.

#### 3.1.3 Protected by FTA

As a major form of regional economic cooperation, FTA aims to promote economic integration, eliminate trade barriers and strengthen the flow of capital factors among countries. FTA is also a specific form of the “TRIPS-plus” standard. According to the data released by the WTO, there have been 578 free trade agreements by 2022. In the early stage, developed countries often sign agreements with developing countries that apply higher intellectual property protection standards and dominate the content of the agreements, so as to require later accession countries to abide by the agreement rules. Now, in order to avoid putting their own countries in a disadvantageous position, many developing countries are also trying to establish beneficial free trade agreements with developing countries, and preliminary results have been achieved. For example, the regional comprehensive economic partnership agreement (Regional Comprehensive Economic Partnership, hereinafter referred to as the RCEP), which pays attention to balance the intellectual property rights protection standards of flexibility and high standard limit, it provides an excellent development space and business environment for small and medium-sized enterprises in developing countries, and also gives transitional treatment to market opening.

#### 3.1.4 Protected by Soft Laws and Regulations

In the case that some rules do not become binding laws, the countries that try to introduce such rules normally do not want the rules to have the effect of domestic law immediately, but instead want the rules to be verified by overlap, which is actually how “soft law” is born from the beginning. Soft law rather than a binding international treaty will be more flexible, and gradually in the core areas of intellectual property rights, such as integrated circuit suitable for soft law, finally, to a certain extent is the effect of the rules, not to confirm the effect of the rules themselves, thereby indirectly long-term strategic goal of create extensive international standard.<sup>13</sup> The Statute of the International Court of Justice does not incorporate soft law into the source system of international law. It may be because these rules themselves do not have any substantive legal binding, but in judicial practice, these rules may have a great influence on the judgment of the “legitimacy” of certain customary laws, treaties and the corresponding rules in the international law system.<sup>14</sup>

At present, FTA is about to join, ratify and implement some existing and future intellectual property conventions or soft law norms of WIPO, which are linked to each other. In general, FTA has become an indispensable link in promoting the change and upgrade of international intellectual property protection rules. Some of the regional trade agreements led by the United States and the European Union have included requirements for parties to comply with bilateral or multilateral memoranda. In addition, developing countries have also formed a variety of soft laws in the form of declarations, guidelines, recommendations and other non-regulatory forms in related fields such as traditional knowledge and genetic resources. Part of the soft laws between China and the United States involve the field of integrated circuits.<sup>15</sup> Non-governmental organizations are also actively exploring ways to integrate the new soft law within the WTO and WIPO legal systems, so that they can focus their efforts on the public goods themselves, other than innovation, and lead developing countries to achieve more outcomes than they could achieve in other areas of negotiation.<sup>16</sup>

#### 3.1.5 Protected by WTO

One of the main mechanisms for resolving international disputes is the World Trade Organization (WTO), which has been responsible for handling trade-related intellectual property rights (trips) disputes, but it has been shut down since December 11, 2019 due to a veto by the United States. The United States did not cooperate with the new multi-party interim arbitration mechanism. This means that neither China nor any other country can file an appeal without a judge. The United States uses the WTO’s rigid veto rules and three-person trial system to obtain “trade freedom privileges”, maintain its hegemony in world trade, and arbitrarily impose tariffs and “Section 337 investigations” and “Section 301 investigations” on other countries. It is obvious that the United States will continue to block the resumption of the WTO Appellate body in the future, and due to the high degree of freedom of national sovereignty, other countries cannot take strong sanctions against the United States for this kind of rascal and rogue practices. At the same time, the long-term suspension of the appellate body will undoubtedly be a serious blow to the existence and operation of the WTO for more than 20 years, and shake the system of intellectual property protection rules based on TRIPS.

### 3.2 Review of Intellectual Property Protection Path of Integrated Circuits in the Post-Epidemic Era in the United States

#### 3.2.1 Protected by the Judicial

Since the outbreak, the us has already held two chips of the White House meeting, especially the recent annual meeting, the United States government asked the world well-known semiconductor chip manufacturers to provide all of the core data information, the more obvious purpose is to stress the head enterprises to build factories in the United States, at the same time can set up a sound system of IC supply chain in the United States. It’s all about guaranteeing the security of America’s own chips. This is obviously selfish and undermines its status as the world’s leading power. According to the old Chinese saying, “everyone sweeps the snow in front of

his own door, not the frost on other people's tiles.”<sup>17</sup>

In 2020, US lawmakers from both parties introduced the Chip Production Incentives Act and the US Chip OEM Act of 2020 to encourage chip companies to set up factories in the US. It is not hard to see that America's intentions remain obvious. In 2021, the U.S. even introduced the Infrastructure Plan, the American Innovation and Competition Act, and the American Chip Act, after the Defense Advanced Research Projects Agency (DARPA) launched the Electronic Renaissance Program, which can be seen in its pertinence. The bill is the most significant intervention in U.S. government policy in the integrated circuit industry in decades, and it all takes aim at China. The bill provides huge subsidies to the local chip industry in the United States, which is a typical support policy for differentiated industries. Some provisions restrict the normal economic, trade and investment activities of relevant companies in China, which will distort the global semiconductor supply chain and disrupt international trade.

### 3.2.2 Protected by Indo-Pacific Economic Framework

Trade sanctions are one of the powerful tools commonly used by the United States to demand greater protection of intellectual property rights in other countries. It is also a tool that the United States has used with great ease. Since the former President of the United States Trump to exit the trans-Pacific partnership (Trans-Pacific Partnership Agreement, hereinafter referred to as TTP), after the United States has been looking for ways to back control of the Asia-Pacific economy, while India's economic framework is the latest plan. The plan seeks to establish strong new trade rules for the digital economy and emerging technologies, and to continue the U.S. strategy of controlling exports of new and sensitive technologies, particularly chips. For example, the exception clause in Chapter 32 of the US-Mexico-Canada Trilateral Agreement stipulates that “when either party enters into a free trade agreement with a non-market economy country, it shall allow the other party to terminate the agreement after giving six months ‘notice and replace it with an agreement between them (i.e., a bilateral agreement).”<sup>18</sup> The regulation is one of the “non-market economies” is refers to the Chinese, this rule not only has strong exclusivity, but also in the United States hegemonism thought, and greatly limits the free trade of other countries, it is not only against free trade and fair competition principle, WTO regulations and injure other countries' national sovereignty free. If the plan is carried out, the United States, India, Japan and Australia will form a four-way strategic alliance to destroy the harmonious and friendly relations in China's neighborhood and isolate China.

### 3.2.3 Comparison of Intellectual Property Protection Paths of Integrated Circuits in China and the United States in the Post-Epidemic Era

Historically, the intellectual property protection path of the United States has always been ahead of that of China, and the intellectual property protection path of China's integrated circuits mentioned above was basically established by the United States. Therefore, from the perspective of external concepts, comparing the IP protection paths of integrated circuits in China and the United States is to some extent like comparing the IP protection paths of integrated circuits in the new era and the United States in the old era. That is, the IP protection paths of integrated circuits in China and the United States have a high degree of similarity and overlap.

However, from the perspective of the historical development of the two IC IP protection paths, they are very different. The path of IC IP protection in the United States is from home to abroad. Due to the historical origin, the United States is also leading the world in semiconductor technology, and the United States has the most disputes about semiconductors. The United States is also a country with case law. This means that the legal consciousness of semiconductors in the United States has been pushed forward by the rapid development of the semiconductor industry, that is, the protection of semiconductors in the United States is an innovator and creator. In the United States, the legislation for IP protection of integrated circuits is generally introduced in the country first, and then promoted to the world by establishing and revising rules of international organizations or international treaties after being authorized. In the early days of the founding of China, many laws were established by transforming international conventions or learning from other countries' laws. For example, the content of the Regulations on Integrated Circuit Layout-Design, which was issued by China in 2001 to join the WTO, borrowed a lot from the provisions of TRIPS agreement. To the early China in the legal aspects of China is often a follower of the image, that is, China's integrated circuit intellectual property protection path is from abroad to home.

Although China's legislation started late, the intellectual property protection paths of integrated circuits in China and the United States have different spiritual connotations in essence. In recent years, the United States has taken various measures against the “threatening countries” that are considered to shake the status of the United States as the No. 1 major power. It can be seen that the United States has been adhering to the neoliberal “deprivation accumulation”, that is, the neoliberalism concentrates power and wealth through the plunder of public and individual land and property.<sup>19</sup> In the academic context of American intellectual property rights, this kind of

deprivation accumulation is called the “second enclosure movement”, that is, the enclosure and plunder of the information field.<sup>20</sup>

In short, the United States expects to be the dominant player in the intellectual property discourse of the future. China, on the other hand, is different. Guided by the spirit of “harmony without uniformity” and “world for the common good”, China is willing to promote its own development and promote the development of other countries to achieve win-win cooperation. China is also willing to tolerate and coexist with other countries on its way to becoming a strong intellectual property power.

#### 4. Suggestions and Thoughts on the Path of Intellectual Property Protection of Integrated Circuits in China in the Post-Epidemic Era

At present, China has basically abandoned the pure mode of “copying the cat and copying the tiger” of other countries’ intellectual property protection system. Based on the judicial experience in other areas of intellectual property accumulated during the normalization of the epidemic, China has gradually embarked on a new type of intellectual property protection with unique features and quite Chinese characteristics. With the increasing popularity of “TRIPS-Plus” standard in the post-epidemic era, international disputes involving IC intellectual property rights have become increasingly prominent. The deeper meaning behind the disputes is the occupation of world economic status and the grabbing of international discourse rights by various countries. This means that our country should focus more attention on the multi-dimension perfection of the intellectual property rights system of integrated circuit.

As a great power of a developing country, our country should show our great power style and extensively participate in the negotiations and formulation of international trade agreements. In addition to considering the interests needs of our country, we should also make our own efforts to guide other developing countries to protect their legitimate interests. Under the theme of peaceful development, we should respect differences among countries, and achieve win-win cooperation in the “re-globalization” of the world economy through the integrated circuit IP diplomacy strategy that combines efforts and benefits.

In summary, it is necessary to promote the targeted domestic integrated circuit strategy and establish a sound judicial system with soft law as the core; At the same time, the United States has taken the initiative to show cooperation intention to more countries with inclusive intellectual property diplomacy strategy, showing the great power style of compatibility and economy, which is also a strong proof that the United States has surpassed both the superficiality and limitation of unilateral IPR maximization behavior.

<sup>1</sup> Wenjia Zhang, (2021). Suggestions for the development of China’s Industrial Chain in the post-pandemic Era, *Northern Economy*, (6), pp. 47-50.

<sup>2</sup> Li Chuanzhi, (2020). China’s Integrated Circuit Industry Chain: International Competitiveness, Constraints and Development Path, *Journal of Shanxi University of Finance and Economics*, 42(4), pp. 61-79, April.

<sup>3</sup> Yuezhou CAI et al., (2020). The Impact of COVID-19 on Integrated Circuit Industry and Challenges Facing China, *Academic Research*, (6), pp. 86-93+178.

<sup>4</sup> Zhang Wen-Jia Wen, pp. 47-50.

<sup>5</sup> Yi Jiming, (2019). China-US Interaction and Evolution of China’s Intellectual Property System in the Past 40 Years of Reform and Opening-up, *Jiangxi Social Sciences*, 6, pp. 158-169.

<sup>6</sup> Yang Biqin, Lai Yanting, (2021). The Impact of Sino-US Trade Friction on China’s Integrated Circuit Import and Export and Development Countermeasures, *Journal of Inner Mongolia University of Finance and Economics*, 19(6), pp. 99-105.

<sup>7</sup> Wei Yali, (2022). The Response Strategy of US 337 Investigation from Huawei’s Victory in 337 Case, *Jiangsu Business Journal*, (5), pp. 3739.

<sup>8</sup> Pengfei Ji et al., (2022). The Development Trend and Countermeasures of Integrated Circuits in the United States, *China Integrated Circuits*, 31(S01), pp. 32-38+64.

<sup>9</sup> Earthy finance and economics, the upgrade: the embargo, domestic alternative to accelerate, <https://xw.qq.com/cmsid/20200429A0Q43600>, last access date: August 31, 2022; See Global Times commentary: The American then 33 Chinese entities listed in the “entity list” reason is still without shame, <https://baijialiao.baidu.com/s?id=1667462188035103549&wfi=spider&for=pc>, last access date: On August 31, 2022.

<sup>10</sup> Previous news: How Can Intellectual Property Agencies Help amid the Global pandemic, <https://sghexport.shobserver.com/html/baijiahao/2020/08/25/249921.html>, last access date of August 30, 2022.

<sup>11</sup> Simeng Shao, (2021). China’s International Intellectual Property Protection Path in the Post-TRIPS Era, *Academic Frontiers*, (4), pp. 104-107.

<sup>12</sup> Same as above.

<sup>13</sup> Gabriel, H. D., (2009). The Advantages of Soft Law in International Commercial Law: The Role of UNIDROIT, UNCITRAL, and The

- 
- Hague Conference, *Brooklyn Journal of International Law*, pp. 655-672.
- <sup>14</sup> SIMMA, B, (1971). Modern Introduction to International law AKEHURST, M, *American Journal of international law*, pp. 643-644.
- <sup>15</sup> Zhang Yanmei, (2015). The Limitation and Breakthrough of Global Governance of Intellectual Property Rights from the Perspective of Balance of Interests, *Journal of Northeast Normal University: Philosophy and Social Sciences Edition*, 4, pp. 94-99.
- <sup>16</sup> Helfer, L.R., (2004). Regime Shifting: The TRIPS Agreement and New Dynamics of International Intellectual Property Lawmaking, *Yale Journal of International Law*, pp. 58.
- <sup>17</sup> Electronic engineering world: the china-us relations under the changing global IC industry “, <https://www.eetchina.com/mp/a101289.html>, last access time: on August 29, 2022.
- <sup>18</sup> Ustr: Chapter 32 Exception to the Agreement between the United States of America, the Mexican United States, and Canada.
- <sup>19</sup> Christine B. Harrington & Z. Umut Tiire, (2006). Accounting for Account ability in Neo liberal Regulatory Re gimes, Michael W. Dowdle (ed.), *Public Account ability Designs, Dilemmas and Experiences*, pp. 204.
- <sup>20</sup> Yochai Benkler, (1999). Free as the Air to Common Use, First Amendment Constraints on Enclosure of the Public Domain, 74 *New York University Law Review*, pp. 354, James Boyle, (2003). The Second Enclosure Movement and the Construction of the Public Domain, 66 *Law & Contemporary Problems*, pp. 33.

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