Based on Index Comprehensive Evaluation Method—Impact of "De-risk" Measures in the US Automotive Sector on China's Industrial Safety and Relative Suggestions

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Abstract*:* In recent years, the United States has successively introduced multiple bills and policies to accelerate the implementation of trade restrictions and technology suppression against China. Since 2023, with the goal of "de-risk", the global automotive industry chain supply chain has accelerated its adjustment. Faced with the increasingly severe and complex international environment, China needs to actively respond to new risks and challenges while promoting the transformation and upgrading of the automotive industry, maintaining industrial safety, and being alert to the signs of "de-sinicization" of the global industrial chain and supply chain, so as to help accelerate the recovery of the global automotive market in open cooperation. The paper first introduces new "de-risk" measures in automotive industry of the US, and then based on the Analytic Hierarchy Process (AHP) and Comprehensive Index Method, quantitatively evaluates the impact on the safety of China's automotive industry, while also qualitatively analyzing the impact of relevant measures, and finally proposes countermeasures and suggestions.

Keywords: chip, battery, export control, automobile, product trade, industrial security

1 Introduction

In recent years, the dispute between China and the United States has evolved from trade suppression to technology suppression. The containment of China's technological rise is one of the biggest commonalities between the Trump and Biden administrations, and has become the core of US policy towards China[1]. The automotive industry is an important pillar industry of major global economic powers and one of the industries with the highest degree of globalization. The United States has successively introduced multiple bills and policies to implement trade wars, technology wars, and other measures against China, and continues to upgrade and strengthen them, promoting the accelerated adjustment of the global automotive industry chain supply chain, with the intention of building a new pattern of "de-sinicization". Since 2021, China's automobile exports have achieved rapid growth, and by 2023, it has become the world's largest vehicle exporter. However, the drastic changes in the external environment will have a certain impact on China's automotive product trade and industrial security. In order to support China's accelerated construction of a modern automotive industry

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system, achieve high-quality development of automotive product trade and industry, relevant research is conducted and countermeasures and suggestions are proposed.

In terms of the automotive industry, especially the promulgation of *the Chip and Science Act* and *the Inflation Reduction Act*, it marks the completion of the systematic capacity building of the United States to curb technology in China. Chips and batteries have become two major levers for the US to suppress the development of China's automotive industry.

1.1 Content related to the automotive industry under the Chip and Science Act

On August 9, 2022, the US government passed the $280 billion *the Chip and Science Act*. The Biden administration stated that the bill will revitalize the US manufacturing and supply chain, create good job opportunities, and compete with China in the field of advanced technology. In addition to chips, the bill also plans to provide support for advanced scientific fields, such as quantum computing, artificial intelligence, and advanced biotechnology.

1) Relevant provisions of the automotive industry

Provide special funding subsidies and tax subsidies to the US chip industry. According to the bill, the US government will invest over $52 billion in funds over the next five years to provide special support for the US chip industry and enhance domestic production capacity. A maximum of 2% of the funds can be allocated per fiscal year for salaries, expenses, administration, and supervision, of which $5 million is allocated annually for supervision. The incentive plan includes allocating $39 billion over five years to implement the National Defense Authorization Act (NDAA) authorization program (which subsidizes chip companies to build factories in the United States). The highest allocation amount in 2022 is $19 billion. From 2023 to 2026, maintain an annual allocation of $5 billion. Priority will be given to providing chip incentives for key manufacturing industries such as the automotive industry. At the same time, a 25% Investment Tax Credit (ITC) is provided for investment in advanced process chip manufacturing production lines (with an estimated total amount of $24 billion). The calculation basis for the relevant tax credit is the cost of tangible assets (eligible assets) that are specifically used for chip production (excluding office buildings with non production functions) and can be depreciated and amortized for the construction of advanced process chip production lines, such as related factories and production equipment. The relevant tax credits apply to projects that are put into use after December 31, 2022, and begin construction before January 1, 2027. Some of the subsidies can be used to help companies building factories in the US produce military chips.

Restrict the expansion and establishment of advanced process chip production capacity by 'beneficiary enterprises' in China and other regions. Corresponded to the large-scale provision of financial support and tax credits, the bill establishes a special "guardrails provision" that explicitly stipulates that entities receiving the aforementioned funding, including any affiliated companies of the entity identified under *the Internal Revenue Act of 1986*, should sign an agreement with the US Department of Commerce, specifying a period of 10 years from the funding date, It shall not engage in any "significant transactions" related to the substantial expansion of chip manufacturing capabilities in "foreign entity of concern", including but not limited to adding or expanding production capacity in relevant countries. Prohibit "beneficiary companies" from expanding or building manufacturing capabilities for certain advanced chips in "foreign entity of concern" that pose a national security threat to the

US. To ensure that these restrictions and the current state of chip technology are consistent with US export control regulations, the Department of Commerce will coordinate with the Department of Defense and the Central Intelligence Agency, utilize industrial inputs, and regularly review which technologies are subject to this ban. It can be said that the overall goal of the 'guardrails provision' is to ensure that investments in the chip industry are made within the US and its allies[2].

***The Proposed National Security Guardrails for CHIPS for America Incentives Program* further restrict chip subsidy beneficiaries' investment in expanding production and joint research activities in China.** Through *the Chip and Science Act* alone, it is difficult for American companies to determine whether their foreign expansion and "significant transactions" in the chip industry are restricted by *the Chip and Science Act*[3] . After nearly a year of deliberation, on September 22, 2023, the US Department of Commerce released the final details of guardrails provisions of *the Chip and Science Act*. As a policy continuation of *the Chip and Science Act*, the require beneficiary manufacturers to strictly control investment and research and development in China within ten years of receiving US chip subsidies, otherwise the Ministry of Commerce can recover all federal financial aid funds after evaluation. Compared to *the Chip and Science Act*, the guardrails provisions still expand the scope of restricted entities for beneficiary manufacturers to conduct joint research or technology licensing with China. Chip companies, research institutions, individuals, and other types of entities are all subject to the regulatory restrictions on research cooperation under the barrier regulations. It should be noted that although *the Chip and Science Act* allows companies to expand the production of traditional chips in "foreign entity of concern" under limited circumstances, the *Proposed National Security Guardrails for CHIPS* excludes the inclusion of contemporary and mature node chips used for quantum computing, radiation intensive, and other specialized military capabilities within the scope of traditional chips.

1.2 Automotive Industry Related Content of the Inflation Reduction Act, and the Critical Minerals Agreement(CMA)

On August 16, 2022, the Biden administration signed *the Inflation Reduction Act*, which covers areas such as climate change, healthcare, and tax reform.

1.2.1.the Inflation Reduction Act and its implementation details

In terms of the automotive industry, the bill divides the tax credit for new electric vehicles into two parts, setting requirements for key mineral sources and localization of battery components. Electric vehicles that meet the relevant requirements will be given a tax credit of $3750 each, while proposing that "foreign entity of concern" cannot obtain tax credits. The maximum price limit for subsidized vehicles is usually $55000 for passenger cars, and $80000 for vans, SUVs, and pickup trucks, and the sales limit for individual car companies receiving subsidies has been lifted.

Excluding China from the supply chain of electric vehicle batteries in the US based on the Free Trade Agreement (FTA). To meet key mineral requirements and qualify for a $3750 tax credit, the applicable proportion of the value of key minerals contained in power batteries must be extracted or processed in the US or countries that have signed an FTA with the US, or recycled in North America in accordance with the provisions of *the Inflation Reduction Act.* The applicable proportions of key mineral values will reach 40% (2023), 50%

(2024), 60% (2025), 70% (2026), and over 80% (2027 and later), respectively. Vehicles that meet this condition can receive a tax credit of $3750.

The origin of battery components has been further reduced to only being manufactured or assembled in North America. In order to meet the requirements for battery components and qualify for an additional $3750 tax credit, the applicable proportion of battery component value must be manufactured or assembled in North America in accordance with the provisions of *the Inflation Reduction Act*. Battery components include but are not limited to battery cathodes, battery anodes, solid metal electrodes, separators, liquid electrolytes, solid electrolytes, cells and modules, etc. Products that do not contain any key mineral components such as solvents, conductive agents, additives, etc. are not subject to the restrictions of this Act. The applicable ratios for the value of battery components will reach 50% (2023), 60% (2024, 2025), 70% (2026), 80% (2027), 90% (2028), and 100% (2029), respectively. Electric vehicles that meet this condition can receive an additional $3750 tax credit.

The bill imposes stricter requirements on 'foreign entity of concern' and will not be eligible for tax credits from 2024 to 2025 onwards. The bill stipulates that starting from 2024, eligible vehicles cannot be manufactured or assembled with battery components by "foreign entity of concern" (referring to China); Starting from 2025, the power batteries of qualified vehicles must not contain key minerals extracted, processed, or recycled by "foreign entity of concern".

Establish tax credit requirements for new cars, used cars, commercial vehicles, and alternative fuel refueling stations. The amount of tax credit received by new and used car consumers is mainly directly related to consumer income, and the restrictions on eligible used cars that can enjoy subsidies have been relatively relaxed. The personal income tax credit for used cars does not set key raw material source locations or North American localization requirements. The bill also provides tax credits for businesses purchasing clean vehicles, with a maximum limit of $40000. To promote the popularization of clean vehicles in underdeveloped and rural areas, the bill provides tax credits for alternative fuel refueling stations built in these areas. In addition, the US Department of Energy provides $3 billion and $2 billion in loans and subsidies for advanced technology vehicle manufacturing loan programs and domestic manufacturing conversions.

1.2.2the Critical Minerals Agreement(CMA)

In March 2023, the United States and Japan signed *the Critical Minerals Agreement (CMA).* The agreement mainly focuses on mineral trade between the US and Japan, providing provisions for key mineral export tariffs, foreign entity investment, international standard setting and multilateral cooperation, labor protection, and prohibition of forced labor. According to the agreement, the two countries will be prohibited from implementing bilateral export restrictions on critical minerals such as lithium, nickel, cobalt, graphite, and manganese in electric vehicle batteries, and will make Japanese produced electric vehicles eligible for tax credits under the US *Inflation Reduction Act*. The agreement aims to combat "non-market policies and practices" of other countries in the industry by seeking cooperation, as well as to conduct investment reviews on foreign investment in their key mineral supply chains, in order to reduce the "dependence" of the US and Japan on China in such materials, and the intention to limit the development of China's automotive industry is very clear.

1.2.3.Related to export controls and investment bans

Since 2018, in order to maintain a leading advantage in technology against China, the United States has continuously tightened its export controls on China, especially on chip related products, citing "security" as a reason. Due to the fact that the US only controls EDA software for electronic design automation in the advanced chip supply chain, other parts still require the cooperation of allies such as Japan and the Netherlands. In stark contrast to the Trump administration's approach, the Biden administration's restrictive policies are more systematic and comprehensive, which will stop exporting technology to a series of Chinese technology companies and cut off China's independent manufacturing capacity for producing advanced chips[4].

The essence of chip export controls is to eradicate the entire advanced technology ecosystem in China. In November 2021, the United States blocked the export of extreme EUV lithography machines to China. In July 2022, the US put pressure on the Netherlands and Japan to demand lithography machine manufacturers ASML and Nikon to stop selling more mature deep ultraviolet DUV lithography machines to China. In August of the same year, the US Department of Commerce's Bureau of Industry and Security (BIS) began implementing export controls on four technologies, including EDA software. Mainly aimed at chip EDA tools for 3nm and below processes, containing high-end chips in China from the design side. Two chip materials, diamond and gallium oxide, were also added to the commercial control list. The US Department of Commerce requires restrictions on the export of NVIDIA GPU chips A100/H100 and AMD GPU graphics cards MI250 to China. In January 2023, the US reached an agreement with Japan and the Netherlands to implement export controls on chips and chip equipment. The above-mentioned export control restrictions will restrict the design and manufacturing capabilities of China's chip industry from multiple dimensions such as front-end design and 4chip manufacturing.

On October 17, 2023, BIS released three rules updating the controls released on October 7, 2022, *"Export Controls on Semiconductor Manufacturing Items Interim Final Rule"*. On the basis of the temporary rules introduced in October 2022, further tighten export restrictions on artificial intelligence related chips and chip manufacturing equipment to China, and add multiple Chinese entities to the export control "entity list".

The United States has further tightened its review of high-tech investment in China. In August 2023, US President Biden officially signed the Executive Order on Dealing with US Investment in Certain National Security Technologies and Products in "Countries of Concern", authorizing the US Treasury to restrict US companies and individuals from investing in national security technology related industries in specific countries of concern to protect technologies crucial for next-generation military innovation[5]. This executive order identifies three categories of national security technologies and products covered by the plan, namely chips and microelectronics, quantum information technology as well as artificial intelligence. The reason for choosing these three categories is because they play a crucial role in accelerating the development of advanced military, intelligence, surveillance, and network capabilities. This executive order indicates that the US will further prohibit or restrict specific outward investments by US entities, hindering China's high-tech industry from benefiting from US investment and its accompanying funds, management, talent, market share, and other aspects.

2 Method

2.1 Construction of evaluation index system

The core issue of China's automotive product trade and industrial safety evaluation is to establish an indicator system, which directly affects the scientific, reasonable, and correct evaluation results. Therefore, scientifically and reasonably constructing an evaluation index system is a prerequisite for evaluation.

1)Basic ideas for constructing an indicator system

The method of constructing an evaluation index system for China's automotive product trade and industrial safety in this paper is to construct a multi-level evaluation index system based on relevant theories of industrial safety, combined with the characteristics of the "de-risk" measures in the US automotive industry, and drawing on existing evaluation indicators for industrial safety.

2)Construction methods and principles of indicator system

The establishment of an evaluation index system mainly involves selecting indicators and determining the correlation between them. For the safety of the automotive industry, the establishment of an indicator system should follow a combination of quantitative and qualitative analysis.

a)Principle of comprehensiveness

The evaluation index system should be able to reflect the safety of the automotive industry from all aspects and angles. It should include both quantitative indicators (hard indicators) such as battery export amount and chip import amount, as well as qualitative indicators (soft indicators) such as the impact of the Chip and Science Act, the Inflation Reduction Act, etc. Qualitative indicators need to be quantified through expert surveys.

b)Principle of brevity

The evaluation indicators should be relatively independent, clear in hierarchy, and concise. Especially when selecting the third tier indicators, it is important to minimize the number of indicators that reflect the connotation of the second tier indicators.

c) Principle of operability

The industrial safety evaluation index system follows the principle of operability. The selection of data should mainly rely on official statistical indicators and be easy to collect, abandoning data indicators that are difficult to collect.

3)Selection of evaluation indicators

Based on the methods and principles of constructing the indicator system, this article constructs a safety evaluation indicator system for the automotive industry. The indicator system includes three layers and 13 indicators, as shown in figure 1.

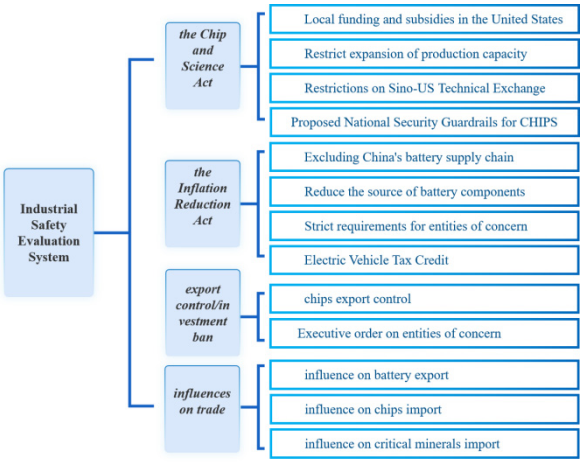

Figure 1 Evaluation Index Structure Chart

B Comprehensive Evaluation of Safety in China's Automotive Industry

Introduction to Index Comprehensive Evaluation Method

This article uses the index comprehensive evaluation method to comprehensively evaluate the trade and industrial safety of China's automotive products. The process of comprehensive evaluation using the index comprehensive evaluation method is:

a)Dimensionless evaluation indicators

Calculate the score of a single evaluation index, that is, compare the value of a single indicator with the overall average of the evaluation indicators.

b) Calculate comprehensive evaluation index from individual evaluation index

The weighted arithmetic mean of the individual evaluation index is used to obtain the comprehensive evaluation index. The closer the value of the comprehensive evaluation index is to 100, the greater the impact. The comprehensive evaluation index method can fully reflect the gap between various evaluation subjects.

1)Using Analytic Hierarchy Process (AHP) to Determine Index Weights

A fundamental and crucial aspect of the comprehensive evaluation of China's automotive product trade and industrial safety is to determine the weight of the evaluation index system. This article uses Analytic Hierarchy Process (AHP) to determine the weights of the indicator system.

Analytic Hierarchy Process (AHP) is a renowned operational research expert in the United States, Professor T L. Saaty was proposed in the 1970s and is widely used in the analysis and decision-making of complex systems. It is particularly suitable for quantifying qualitative evaluation indicators into quantitative evaluation indicators. The main implementation steps and principles are as follows:

a)Establish a hierarchical structure

Divide the evaluation indicators into different levels, such as target layer (first layer), criterion layer (second layer), scheme layer (third layer), etc., to represent the hierarchical structure of the levels and the subordinate relationship between each indicator factor;

b)Construct factor judgment matrix

The values of the judgment matrix elements reflect people's understanding of the relative importance of each factor, and generally use a scaling method of 1-5 and its reciprocal. And the Construction of Factor Judgment Matrix is shown in figure 2.

A	A_1	A_2	⋯	A_j	⋯	A_n
A_1	a_{11}	a_{12}	⋯	a_{1j}	⋯	a_{1n}
A_2	a_{21}	a_{22}	⋯	a_{2j}	⋯	a_{2n}
⋯	⋯					
A_i	a_{i1}	a_{i2}	⋯	a_{ij}	⋯	a_{in}
⋯	⋯					
A_n	a_{n1}	a_{n2}	⋯	a_{nj}	⋯	a_{nn}

Figure 2 Construction of Factor Judgment Matrix

Among them:

1- indicates that two factors have equal importance compared to each other;

2- indicates that one factor is slightly more important than the other compared to two factors;

3- indicates that compared to two factors, one factor is significantly more important than the other;

4- indicates that compared to two factors, one factor is more important than the other;

5- indicates that compared to two factors, one factor is extremely important compared to the other

- Hierarchy single sorting and consistency testing

To judge the Characteristic of Matrix A, AW= λ maxW, after normalization, is the ranking weight of the relative importance of the corresponding factors at the same level to a certain factor at the upper level. This process is called hierarchical single ranking. To perform consistency testing for hierarchical single sorting (or judgment matrix), it is necessary to calculate consistency indicators CI=$\frac{\lambda_{\max}-n}{n-1}$.

When Random consistency ratio CR=$\frac{CI}{R_i}$ <0.10, (Ri is the average random consistency indicator, which can be obtained by looking up the table), It is believed that the results of

hierarchical single sorting have satisfactory consistency, otherwise it is necessary to adjust the element values of the judgment matrix.

- Overall ranking of hierarchy

Calculating the ranking weights of all factors at the same level for their relative importance to the highest level (overall goal) is called hierarchical total ranking. This process is carried out layer by layer from the highest level to the lowest level. If the upper level A contains m factors A1, A2,..., Am, and its total ranking weights are a1, a2,..., am, respectively, and the lower level B contains n factors B1, B2,..., Bn, their single ranking weights for factor Aj are b1j, b2j,..., bnj (when Bk is not related to Aj, bkj=0), then the total ranking weights for level B are $\sum_{j=1}^{m} a_j b_{ij}$ $(i=1，2，\ldots，n)$.

- Consistency check of hierarchical total ranking

This step is also carried out layer by layer from high to low. If the consistency index of certain factors in the B level for Aj single ranking is CI, and the corresponding average random consistency index is CRj, then the random consistency ratio of the total ranking in the B level is:

$$RI = \frac{\sum_{j=1}^{m} a_j CI_j}{\sum_{j=1}^{m} a_j RI_j} \quad (1)$$

Similarly, when Ri<0.10, it is considered that the hierarchical total ranking results have satisfactory consistency, otherwise it is necessary to readjust the element values of the judgment matrix.

2)Determination of the weight of the evaluation index system

A total of 18 questionnaires were distributed and 14 were collected from the expert survey on the indicator system; The weights of evaluation indicators are calculated using the AHP method, as shown in Figures 3 and 4. In the secondary indicator system, the highest weight is "import and export impact", accounting for 30%, while the lowest weight is "export control and investment ban", accounting for 20%. In the three-level indicator system, the highest weight is "the impact of battery exports and chip imports", accounting for 12%, while the lowest weight is "China US technology exchange restrictions", accounting for 5%.

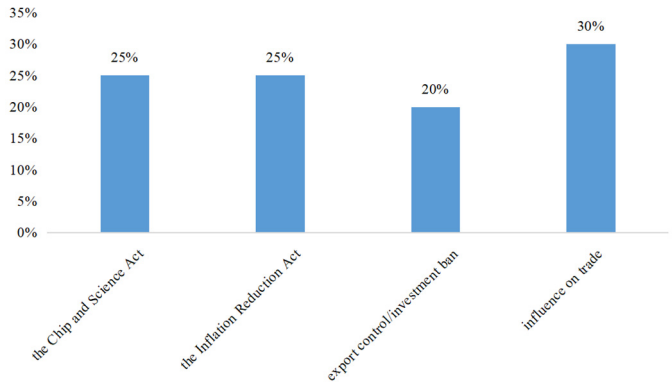

Figure 3 Calculation Results of Secondary Indicator Weights

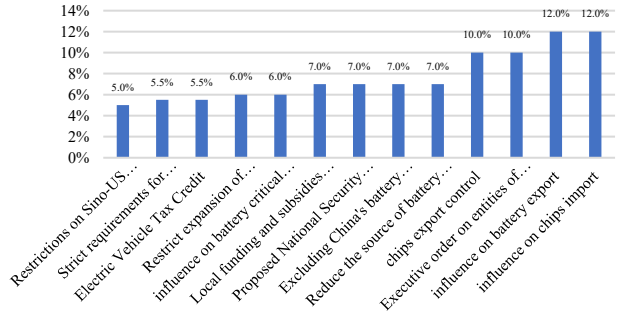

Figure 4 Calculation Results of Third Level Indicator Weights

3 Experimental Results

3.1 Comprehensive Safety Evaluation Results of China's Automotive Industry

Table 1 Safety Evaluation Standards for China's Automotive Industry

Scoring criteria	more influence	Significant impact	Small impact	Minor impact	No influence
Score	80-100	60-80	40-60	20-40	0-20

The comprehensive safety evaluation index of China's automotive industry adopts the 100 point system principle, which uses any value from 0 to 100 as the standard. Based on the criteria, the degree to which each indicator affects the safety of China's automotive industry will be scored, as shown in the table. Based on the comprehensive weighted average results of

14 experts in the industry on all 13 indicators, the scoring results show that the comprehensive safety evaluation result of China's automotive industry is 60.6, which is on the edge of "significant impact".

3.2 Evaluation of safety sub indicators for China's automotive industry

Since 2021, the global automotive industry chain supply chain represented by chips and power batteries has accelerated its restructuring. The strengthening of the North American automotive industry chain, represented by the United States and Mexico, will not only affect the foreign trade of China's key automotive products, but also have an impact on the safety of China's automotive industry.

The global automotive industry chain and supply chain are further fragmented, and the chip industry has become the focus of the technology war. Chips and batteries have become high-risk technological geopolitical issues, with an increasing impact on the global automotive industry. The global chip and battery industry chain supply chain operates based on the principle of comparative advantage, and the international division of labor system collaboration and huge potential market demand are essential elements for the rapid progress of chip technology[6]. Through fair competition and international division of labor, chip manufacturers have established a reasonable resource allocation mechanism. Excessive government regulation, technological monopoly, and trade protection can hinder fair and balanced competition, affect market operation, and bring huge losses to the government, enterprises, and consumers. The forced industrial transfer or decoupling by the US will inevitably lead to chaos in global division of labor and exacerbate the shortage of chip supply. At the same time, it will also increase the costs and risks of production and operation for chip companies, hindering the healthy development of the global chip industry. The proposed guardrail regulations introduced by the United States in March 2023 are a supplement to *the Chip and Science Act*, with the fundamental purpose of governing global leading chip companies with a long arm. By controlling their production capacity construction level in China, they create obstacles for Chinese companies' technological innovation and development, and achieve the goal of maintaining the US technological hegemony. On October 9, 2023, the Office of the President of South Korea announced that the US has agreed to provide equipment to its factories in China by Samsung Electronics and SK Hynix without the need for other licenses. Bringing huge pressure to the Yangtze River Storage and Changxin Storage enterprises, which are in a climbing stage and have a low yield rate. In addition, for areas of direct competition between China and the US, such as AI chips, extreme pressure measures are still adopted to restrict them.

The electric vehicle industry chain in the US continues to strengthen, making it possible for the United States to become once again strong. The successive introduction of the two major bills and related implementation rules in the US can be described as "siphoning" the entire industrial chain of electric vehicles in the EU, Japan, South Korea, and Taiwan regions, covering the fields of vehicle manufacturing, power batteries, raw materials, chips, and continuously strengthening cutting-edge technology and high-end manufacturing systems. Since 2022, numerous chip and battery companies have successively announced the establishment of factories in the US. According to the Chip Industry Association of America, *the Chip and Science Act* has stimulated approximately $200 billion in private investment and added more than 50 new chip ecosystem projects and 44000 jobs. Through continuous

cooperation and investment, Canada, the US, and Mexico are prepared to strongly support the chip industry in the Americas. However, it should be noted that if chip companies investing in factories in the US cannot overcome the high labor cost factors in the US, or cannot continue to receive subsidies from the US government, companies will lose the motivation to invest and produce in the United States for the long term. At the same time, more and more battery companies are starting to invest in building factories in the US, and there is also a situation where vehicle companies and battery companies jointly produce batteries.

Mexico has become the biggest beneficiary of reshaping the global automotive industry landscape and will become a strong competitor to China's automotive industry. Mexico's automotive industry has a strong foundation, with lithium ore reserves ranking tenth in the world, making it highly attractive to both vehicle manufacturers and lithium battery manufacturers. Under the USMCA framework, while enjoying the zero tariff policy of the three North American countries, Mexican produced electric vehicles are eligible for a full tax credit of $7500 in the US. In addition, factors such as its proximity to the US have elevated Mexico's position in the global automotive industry chain. In addition, in recent years, in order to alleviate cost pressures and reshape the post pandemic supply chain pattern, many European and American car companies have adopted a "nearshore outsourcing" supply chain strategy, transferring factories to Mexico. Under the combined influence of these factors, research has shown that more and more companies are starting to migrate to countries that have signed FTAs with the US, with Mexico becoming the top choice among them. Automobile companies from powerful automobile countries such as Japan, South Korea, and Germany have announced and implemented investment plans in Mexico. In terms of complete vehicles, Chinese car companies such as BAIC, MG, JAC, Chery, Jiangling, and Chang'an have also established production and sales in the local area; In terms of components, products such as Tuopu Group, Xinquan Group, Xusheng Group, IKD, Rongtai Group, Bertelli, Sanhua Intelligent Control, Daimei Group, Yinlun Group, and Shangsheng Electronics have been mass-produced in Mexico. In the first half of 2023, Chinese brand cars accounted for nearly 10% of the country's market share. The National Association of Motor Transport in Mexico predicts that due to the booming development of "offshore outsourcing" business, the investment growth of the Mexican automotive industry will reach 20% in the next four years. The country is expected to become the best destination for the Americas and even the world to undertake offshore or industrial backflow, and become a strong competitor to China.

Profound impact on China's automotive parts trade, especially the export of power batteries and chip imports, and inability to obtain subsidies for Chinese produced electric vehicles exported to the US. In terms of finished vehicles, since the trade friction between China and the United States, the United States has imposed a 25% discriminatory tariff on China's finished vehicle products on the basis of the original rate of 2.5% (Most-Favoured-Nation, MFN), which has not yet been exempted. Therefore, entering the US market faces a higher tariff of 27.5%. Taking an imported car made in China with a CIF value of 30000 US dollars as an example, it is required to pay a tariff of 30000 US dollars × 27.5%=$8250. Except for some models of SAIC General Motors returning to the US, Chinese brand companies currently do not export much of their entire vehicles to the US. However, a 25% discriminatory tariff and the requirements of *the Inflation Reduction Act* for the origin of electric vehicle batteries and battery components will seriously affect the expectations of Chinese companies in the US. In terms of components, the US is currently an important

market for China's export of power batteries. According to customs data, China's export value of power batteries to the US in 2022 was 10.394 billion US dollars, accounting for nearly 20% (19.1%), making it the largest single market for power batteries in China. According to *the Inflation Reduction Act*, starting from 2023, in order for electric vehicles to receive full tax credits, the batteries equipped with the vehicle must be composed of a certain proportion of components manufactured or assembled in North America. The localization ratio requirement will result in electric vehicles equipped with Chinese made power batteries not being able to enjoy full subsidies, which to some extent affects the export of power batteries produced in China.

China has the risk of being excluded from the supply chain of the US electric vehicle industry. In terms of batteries, *the Inflation Reduction Act'*s requirements for the localization ratio and source of batteries will result in electric vehicles equipped with Chinese made power batteries not being able to enjoy full subsidies, and will also affect the export of power batteries produced in China to the US[5]. In terms of chips, *the Chip and Science Act* prohibits subsidized companies from significantly increasing the production of advanced process chips in China. It will seriously affect companies that currently have chip factories in both China and the US, such as TSMC (Nanjing), Samsung (Xi'an), and Hynix (Dalian). If these companies receive subsidies from the US, they will be restricted from building or expanding advanced process wafer factories in China. At the same time, vehicle companies from various countries will inevitably increase their requirements for supplier review and strive to reduce the proportion of Chinese component matching, which will deeply affect the integration of Chinese automotive component companies into the global industrial chain. Tesla, General Motors, and other companies are re enjoying individual income tax credit subsidies, while electric vehicles exported by China cannot enjoy them. This trade-off will seriously affect the cost competitiveness of China's products exported to the US market. The bill's requirement for battery localization ratio for vehicles will result in the inability of electric vehicle products equipped with power batteries produced in China to enjoy full subsidies, affecting China's export of power batteries to the US. The localization requirements for raw material processing in the bill will weaken China's advantage in manufacturing power battery raw materials, forcing China to divert its power battery mineral resource processing capacity to the US or countries that have signed FTAs with the United States. Due to this impact, some Chinese complete vehicle companies' export plans have stagnated. BYD has clearly stated that it will not consider the US market. New power companies such as NIO, Ideal, and Xiaopeng have reported that they cannot export to North America before 2025, and battery companies such as Ningde Times have postponed their plans to build factories in North America.

The upward development of China's automobile industry has encountered setbacks and is facing industrial security threats. The high-end upward development of China's automotive industry has encountered obstacles. The introduction of the two major bills and their implementation rules in the US has strengthened the US's leverage in building a global supply chain for chips and power batteries, and comprehensively curbed the high-end upward development of China's automotive industry through measures such as group building, market compression, capital suppression, technology blockade, and export controls[7] . Especially for the chip industry in China, which has a relatively weak level of industrial capacity, if large-scale domestic substitution and key core technology breakthroughs cannot be achieved as soon as possible, the development of China's chip industry will face extreme constraints from the

US. For the power battery field with obvious industrial advantages in China, if it leaves the high-end market of Western countries for a long time, it will not only face a shrinking global share, but also lose the opportunity for technological innovation. The Science Law section of *the Chip and Science Act* explicitly prohibits Chinese companies from participating in the US manufacturing program, which creates obstacles for Chinese companies to participate in the development and application of specific US application technologies. The Chinese automotive industry faces many "bottlenecks" and technological shortcomings, such as autonomous driving chips, intelligent cockpit chips, turbochargers, underlying software, etc., which are the security foundation of the automotive industry and supply chain. However, measures such as export controls, technological exchange restrictions, and industry chain exclusion in the US will hinder the iterative upgrading of China's automotive industry, causing it to encounter "low-end lock-in" in the global value chain[8].

In 2022, the export of components to major automotive countries decreased, while the export of power batteries increased but the growth rate slowed down. As the third largest exporter of global automotive parts, China has deeply integrated into the global automotive industry chain supply chain, and its export volume has maintained rapid growth. In 2022, the export volume of components increased slightly, but exports to Europe, America, Japan, and South Korea decreased. Export growth comes from emerging markets such as Saudi Arabia, Malaysia, and Mexico. In the first nine months of this year, exports as a whole still achieved growth (+8.34%), but the growth rate showed a slowing trend, which was lower than the growth rate in the first six months of this year (+12.7%). Especially, the decline in exports to the United States and Canada increased, with -11.2% and -15.9%, respectively. Power batteries have become one of the "new three types" of China's foreign trade exports. In recent years, the export scale has continued to rise, but the growth rate has slowed down since 2023. In 2022, China's export of power batteries increased by 72.5% to reach 54.4 billion US dollars. Europe is China's largest export region for power batteries (accounting for nearly 40%), followed by the United States (nearly 20%) and South Korea (10%). In the first nine months of this year, the export volume increased by 34.0% to reach 50.4 billion US dollars (with a growth rate of 72.6% in 2022 and 51.9% in the first six months of 2023). China's export of power batteries in recent years is shown in figure 5.

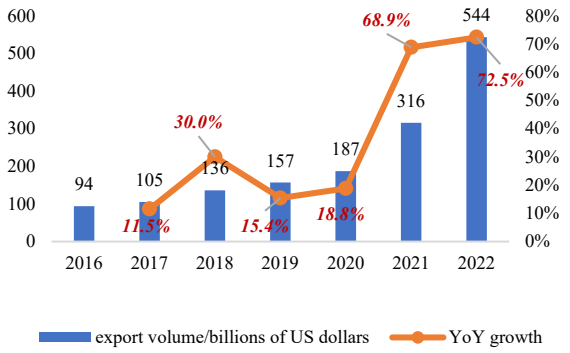

Figure 5 China's Export of Power Batteries from 2016 to 2022
Source: General Administration of Customs of China

The scale of component imports has decreased and is intensifying, and China's chip imports have entered a downward channel. Overall, the import volume of automotive parts in China has remained stable, but with the drastic changes in the global automotive industry environment, the supply capacity of domestic parts has increased, and the external dependence of electric vehicle parts has decreased[9] . Starting from 2022, the import volume has shown a significant decline. In 2022, China's import of components decreased by 17.3% to $34.9 billion, the lowest level since 2016. The import of components from Europe, America, Japan, and South Korea all experienced double-digit declines, with declines of 14.5%, 26.2%, 23.6%, and 17.5%, respectively. In the first nine months of this year, the decline in the import volume of parts increased (-16.6%), especially from Japan, the United States, and South Korea, with the largest decline of 39.0%, 18.2%, and 15.8%, respectively. Affected by factors such as domestic substitution of some products and poor overseas supply of high-end chips, China's chip import volume decreased by 4.0% to $417 billion in 2022. Taiwan, China is the largest chip importing region (accounting for nearly 40%), followed by South Korea (20%) and Malaysia (nearly 10%). In the first nine months of this year, the decline in chip import volume expanded to 19.8%, far exceeding the level of decline in 2022. China's import of chip in recent years is shown in figure 6.

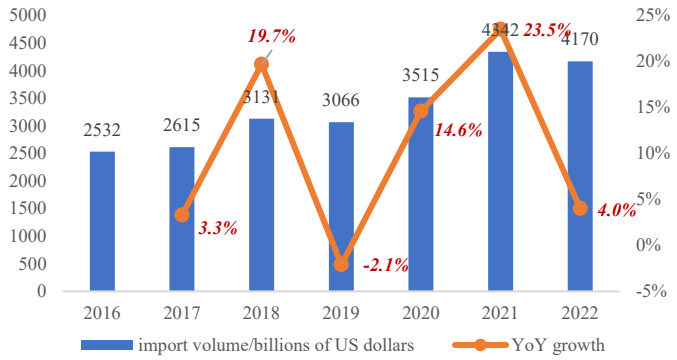

Figure 6 China's Import of chip amount from 2016 to 2022
Source: General Administration of Customs of China

Although the import volume of key minerals for power batteries fluctuates, the situation of high external dependence is difficult to change in the short term. Key minerals and raw materials for batteries have become the focus of international industry chain supply chain competition, and the United States, Japan, Canada, and others are strengthening control. Due to the insufficient and severe shortage of related raw material reserves in China, as the production of power batteries further increases, the shortage of raw material supply will continue to exist.

Since 2020, due to the explosive growth in the production and sales of electric vehicles and the demand for power batteries in China, the import volume of lithium has maintained a significant growth for three years. From $26.7 billion in 2020 to $42.1 billion in 2022, a significant increase; In terms of nickel, due to the fluctuation of international nickel prices and the decrease in nickel ore shipments caused by adverse weather conditions in major nickel

exporting countries such as the Philippines and Indonesia, although China's nickel import volume decreased by 8.2% year-on-year to 402.2 billion US dollars in 2022, due to the extreme shortage of nickel resources in China, it is expected to continue to maintain a large number of imports and high dependence on foreign trade in the future. In terms of cobalt, China's cobalt ore reserves are relatively small and the mining cost is high. The production is relatively small, and it heavily relies on imports. In 2022, China's cobalt import volume increased by 15.1% year-on-year to 3.873 billion US dollars.

4 Conclusion

4.1 Accelerate the implementation of core technology breakthroughs

One is to attract foreign enterprises to build factories in China through unconventional means. For high-end control chips and other chips with high technical difficulties, major specialized and concentrated research can be carried out. Key issues can be addressed through the Industrial Transformation and Upgrading Fund of the Ministry of Industry and Information Technology, the Industrial Remanufacturing and High Quality Development Special Project, and the Strategic Emerging Industry Development Special Project. We can refer to the case of introducing Tesla and break the current policy restrictions. From the aspects of planning, land, finance, services, subsidies, taxation, etc., we will implement a comprehensive innovation support policy of "one enterprise, one policy", especially to attract leading foreign automotive grade chip enterprises to invest in the construction of crystal wafer manufacturing plants. The second is to innovate the financial and tax classification support system for automotive chips. Implement inclusive financial and tax policies for the automotive chip industry to reduce operational pressure on chip companies, such as deduction of R&D expenses, immediate refund of value-added tax, and reduction of corporate income tax. Reduce the cost burden of new and expanded automobile chip production lines for chip production enterprises through multiple channels and paths, and expand domestic automobile chip production capacity.

4.2 Accelerate the construction of free trade zones

One is to actively promote the strategy of upgrading free trade zones. Accelerate the construction of a free trade area network covering the "the Belt and Road", actively promote negotiations on trade agreements such as the Comprehensive and Progressive Trans Pacific Partnership Agreement (CPTPP), the China ASEAN Free Trade Area 3.0, and the China-GCC, and include advantageous products such as electric vehicles and power batteries in the list of key tax reductions to eliminate trade barriers in overseas markets. The second is to conduct upgrade negotiations based on the tariff concessions level of FTAs signed between key markets and other countries. Based on the overseas development demands of key enterprises, we will focus on negotiating key core components of the FTA with higher tariffs, longer tax reduction cycles, and significantly higher agreement tariffs than other related liberalization agreements in the other country, striving to achieve effective tax reduction in the second phase of China South Korea and China ASEAN Free Trade Area 3.0 version of free trade agreements.

4.3 Improve the utilization of foreign investment

One is to increase the construction of an open environment to the outside world and promote the formulation of strategies for utilizing foreign investment in the new era. At present, China's independent brands have a certain level of strength, and the discourse power of the Chinese side in joint ventures has significantly increased. It is recommended to guide joint ventures to negotiate changes in stock ratios based on the wishes of both shareholders, while following the laws of market development and maintaining stable industrial development, in order to assist foreign and Chinese parties in forming common economic interests in China. The second is to release positive signals to foreign-funded enterprises, encouraging and supporting the long-term stable development of foreign investment in China. Jointly with the automotive industry regulatory authorities, foreign investment and foreign trade regulatory authorities, promote the establishment of a regular exchange mechanism for foreign-funded automotive enterprises, and jointly discuss and guide foreign-funded enterprises to adjust their development strategies in China. The third is to promote the adjustment of China's automotive foreign investment policies, and better attract and retain foreign investment. Combining measures such as tariffs, export tax refunds, and research and development support, with the aim of maintaining moderately fierce market competition and industrial innovation and development vitality, we will study and formulate reserve policies to support foreign car companies.

4.4 Timely introduction of countermeasures

One is to accelerate the research and development of China's countermeasures by referring to *the Chip and Science Act, the Inflation Reduction Act, and the European Net Zero Industry Act,* and if necessary, consider strengthening the effectiveness of countermeasures by issuing regulations or legislation. On the basis of implementing export controls on related items such as gallium, germanium, and graphite, we will consider studying the implementation of export controls on other key raw materials with high export volume and strong competitiveness in China. Secondly, the personal income tax law can be amended in a timely manner to implement a consumer income tax deduction policy for electric vehicle models that are equipped with domestically produced components and raw materials, and to hedge against the US individual income tax reduction measures. The third is to urge the US authorities to relax their requirements for power battery components and vehicle assembly. Utilizing China's global advantage in the largest single market, study imposing sanctions on the US, such as considering disqualifying non domestic American vehicles from enjoying domestic financial and tax incentives.

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