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AMERICAN "DIGITAL CURTAIN" TO ISOLATE CHINA

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Abstract. The Biden administration openly declares Washington's intention to "play offense, act more aggressively" against China, which, in its opinion, is an "unfriendly" country and pursues a policy of "military-civilian fusion" aimed at undermining American production and national security. In accordance with the doctrine of "precision decoupling", the desire to "actively strangle large segments of the Chinese technology industry" becomes a priority instrument of pressure on China and is put above the commercial interests of American companies and concerns about the possible diplomatic or economic consequences of these steps. Subsidies, tax incentives, as well as regulations obliging American enterprises to use local raw materials, components and parts become the main instruments of competition designed to "put an end" to US dependence on imports of semiconductor products. The possibility of extending restrictions on the sale of almost any equipment containing at least a small proportion of American technologies is being studied. The actions of the Biden administration are based on the presumption of the existence of an insurmountable gap in the scientific and technical power of the United States and China. However, an objective analysis of the existing global economic relations in the semiconductor industry indicates a high degree of dependence of this industry in the United States on the state of cooperation with firms in China, Taiwan and South Korea. A radical restructuring of supply and logistics chains can lead to an increase in production costs and, ultimately, to disruptions in the US manufacturing sector. Despite the sanctions, China aims to increase its share in the semiconductor technology market and intends to concentrate resources on original and innovative scientific and technical research to pursue a course towards self-sufficiency.

Keywords: USA, China, technological leadership, economic nationalism, industrial policy, supply chains, import substitution, protectionism, trade policy.

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АМЕРИКАНСКИЙ "ЦИФРОВОЙ ЗАНАВЕС" ДЛЯ ИЗОЛЯЦИИ КИТАЯ

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Аннотация. В статье анализируется эффективность принимаемых Вашингтоном мер по стимулированию национального производства и переформатированию глобальных цепочек поставок в полупроводниковой промышленности. Оценивается результативность усилий Вашингтона, имеющих целью затруднить компаниям КНР доступ к инновационным технологиям, разрабатываемым не только в США, но и в союзных им странах. Сделан вывод, что стремление США к технологической гегемонии замедлит переход Китая к цифровой экономике, но благодаря принимаемым руководством этой страны защитным мерам не обнулит возможности для модернизации полупроводниковой промышленности.

Ключевые слова: США, Китай, технологическое лидерство, экономический национализм, промышленная политика, цепочки поставок, импортозамещение, протекционизм, торговая политика.

Focusing on the idea of American leadership, the Biden administration is inclined to perceive China's impressive achievements in innovative technologies as challenges to US national security. Responding to the calls of the anti-Chinese lobby in the US Congress, acting in tandem with American industrial corporations, President Biden promised to return America to the status of the "workshop of the world", to put a barrier to the "technodictatorship" of the PRC and Beijing's intention to position China as the "leading world scientific and technical superpower" [source 1]. One of the most important goals is to nullify China's efforts to modernize the semiconductor industry. It is argued that if China can displace American multinationals in microelectronics, this will give it the opportunity to make breakthroughs in other technological areas that are of decisive importance for the 21st-century economy.

"FIERCE" COMPETITION ON THE EDGE OF "TECHNOLOGICAL WAR"

Speculating on the thesis about the high probability of the approaching "twilight period" of American technological dominance, official Washington declared the production of semiconductors a "force multiplier" and even equated them to "new oil". The Biden administration has also stated its desire to end the country's dependence on imports from "unfriendly" states and to ensure that global value chains (GVCs) begin and terminate in America. The strategy of maintaining relative advantages, which set the United States the task of remaining a couple of generations ahead of its competitors in terms of innovative technologies used, is being replaced by a focus on global dominance in the field of innovation, unconditional and not limited by timeframes [source 2]. In this regard, experts speak of a "phase shift" in the White House strategy, threatening a transition from "fierce" competition to an uncompromising "technological war". It is also noted that, contrary to the tenets of a market economy, the initial competition between US and Chinese companies has grown into a technological confrontation at the state level.

Over the past decade, China has not only become one of the world leaders in the mass production of semiconductors, but also made a breakthrough in the manufacturing of computers and mobile phones. It has surpassed most of its competitors in quantum computing, navigation satellite systems, artificial intelligence, while advancing significantly along the path of digitalization of the industry [1]. At the same time, American multinationals, accustomed to being at the forefront of the development of key technologies, have relied on "fabless" semiconductor production and concentrated their efforts on the most profitable stages of the manufacturing ecosystem: designing advanced chips, making the most advanced semiconductor products and software for production automation. Mass production of chips, which are used in a huge range of products that rely on reliability and fail safety, has been outsourced to Asian foundries.

The disadvantage of such a strategy is clearly manifested in the fact that ¾ of the world's production capacity of silicon wafers, assembly, testing, and packaging of semiconductors was concentrated in the Asian region, and only minor quantity remained in the United States. After decades of inaction, the US share of semiconductor production has fallen from 37% in 1990 to just 10% today [source 3]. The dependence of the American market on imports from China, South Korea, and Taiwan of microcircuits, memory devices, optoelectronics, and sensors has increased. The shortage of semiconductors in the US domestic market during the COVID-19 pandemic as a result of reduced supplies from Asian countries forced American automobile concerns to sharply reduce product shipments.

Washington is particularly concerned about the achievements of Asian countries in a number of areas. The share of Taiwanese and South Korean firms in the global production of semiconductors using the most advanced technical processes (under 10 nm), used for national security needs, in aerospace and critical infrastructure, for systems with artificial intelligence, quantum computing, is now 92 and 8%, respectively [2]. Thirty-five years ago, the leader of the American semiconductor industry, *Intel*, produced about 65% of innovative chips in the world, but today its stake does not exceed 10%. At the same time, the world champion of the semiconductor industry, the Taiwanese corporation *TSMC*, is reaching 53% [3]. There has also emerged an even more dangerous

trend for American TNCs towards a decrease in their share of income associated with the design of microcircuits.

The Biden administration sees a solution in increasing government intervention in the investment process. The White House strategy is aimed at revitalizing the chip manufacturing across a wide range of technologies. Among the tasks for the rehabilitation of the industry are: the creation of greenhouse operating conditions for American companies; increased spending on research and development (R&D) and training of a qualified workforce; stimulating import substitution, including by returning jobs and technological facilities from developing countries back to the United States ("re-shoring") or allied countries ("friend-shoring"), as well as increasing the sustainability of GVCs. Critics of Biden's policy, however, note that the use of sectoral policy instruments in the interests of a single industry runs counter to the doctrine of free enterprise, according to which American authorities have for decades insisted on the need to strengthen international cooperation to counter "disruptive" industrial policies and "non-market" subsidies from China.

The Creating Helpful Incentives to Produce Semiconductors (CHIPS) and Science Act of 2022 calls for USD76 billion over the next five years to modernize the US semiconductor industry as a "down payment on future American leadership". Of the USD52.7 billion intended directly for investment in new construction and modernization of existing enterprises, approximately a third is allocated to expand the production of chips using outdated technical processes, but the bulk of the funds will go to boost the production of innovative microcircuits. Subsidies and a 25% investment tax credit were chosen as economic incentives for investment [source 4].

The White House expects that the modernization of the semiconductor industry will bring additional dividends to the American economy via increased employment, enhanced production of goods and services, and improved localization of GVCs. "By producing the world's most complex technologies, including semiconductors, on American soil and strengthening our relationships with allies and like-minded partners, we can ensure our strategic advantage over bad actors", the American president said [source 5]. The US share in global semiconductor production capacity is expected to expand to 13–14%, and the level of self-sufficiency in advanced microprocessors and computer memory devices will also inflate [4].

To date, plans have been announced to invest a total of USD180 billion in 46 new projects in the semiconductor industry by 2026. *Intel* announced the construction of eight new plants, including a large-scale project in Ohio with an investment of USD20 billion. *Micron*, which currently produces all of its hi-tech chips in Japan, Singapore, and Taiwan, announced its readiness to invest up to USD100 billion over the next 20 years in the production of computer memory devices. New factories of *Texas Instruments* and *IBM* are also planned, with investments of USD30 and USD20 billion, respectively [source 4].

Potential beneficiaries are dissatisfied with the fact that winning companies will be required to comply with the requirements of the "Buy American" Act. In addition, the allocation of budget funds for specific projects is contingent on their alignment with American democratic values, which has led local media to rename the new regulation the Act "On Industrial Social Policy."

Applicants for subsidies exceeding USD150 million are invited to share part of their excess profits with the state, as well as provide their employees with additional social benefits, including child care. The Act also provides for the revocation of issued subsidies in case of misuse of funds. This is explained by the fears of the federal authorities that investors may adopt the "smart capital" approach voiced by the management of *Intel*. According to this strategy, the preferred use of public funds is the construction of factory buildings, while outfitting them with expensive equipment is best postponed until the currently stagnant demand for semiconductors increases once again. Investor caution is understandable, especially in light of the temporary overproduction of chips in the post-COVID period, which led to a wave of bankruptcies and an increase in the number of abandoned projects.

American companies currently do not have the full range of technologies necessary to reconstruct the semiconductor industry. In terms of absolute R&D expenditures (more than USD50 billion per year) and their ratio to sales volume, the US semi-

conductor industry is inferior to the pharmaceutical and biotechnology industries. Its main vulnerability remains the presence of an insurmountable gap between the "laboratory and the factory". Taking this into account, the authors of the Act included some additional government appropriations for R&D in the amount of USD13 billion. Of this sum, USD2 billion is expected to be invested in a new foundation that will operate in the interests of the US Department of Defense. The remaining funds are intended for the development of national semiconductor technology centers and the federal program for expanded assembly, testing, and packaging of chips [5].

Recipients of subsidies can be not only American but also South Korean and Taiwanese companies, which, according to the authors of the Act, will help attract investment and qualified personnel from competing countries to the United States. Washington has already managed to win over *TSMC*, which has pledged to invest up to USD40 billion in the production of chips using advanced technological processes at its American factories. Another world leader, South Korean *Samsung*, announced plans to invest USD17 billion in a new plant in Texas, but due to the rise in construction expenses since the decision was made, the cost of the project has increased to USD25 billion [6].

Washington's plan was based on the fact that the main consumers of the new enterprises' products would be American multinationals, which had previously imported advanced chips from South Korea or Taiwan. However, as far as a Taiwanese company is concerned, there is reason to believe that investment decisions were made by its management not so much based on their economic feasibility, but as an insurance policy – to maintain established ties with American companies in case of aggravation of relations between Beijing and Taipei.

It also turned out that the spreading of preferences to Asian companies was not entirely consistent with the expectations of *Intel*, *Global Foundries*, and other American TNCs, which have spent USD141 million over the past three years lobbying for the CHIPS Act [7]. In their opinion, Washington is obliged to provide preferential treatment exclusively to national investors. After the adoption of the Act, pressure on the White House increased to provide additional benefits to American companies by softening the current environmental regulations. The US semiconductor lobby explains this by saying that administrative environmental restrictions are excessively stringent and can delay the construction and commissioning of industrial enterprises for years.

Calculations by American consulting companies and industrial associations show that the funds allocated under the Act are not adequate to surpass Asian countries in terms of mass production of semiconductors. And, in order to achieve self-sufficiency, it is necessary to invest in the modernization of the industry the amounts that may exceed the capabilities of the federal budget.

Creating new microchip production facilities in the United States will cost about 20% more than in South Korea and Taiwan, and 30% more than in China [8]. After completing the planned projects, Taiwanese and South Korean companies may still be one or two generations ahead of their American competitors in terms of the level of technology used. *TSMC* intends to produce 600 thousand silicon wafers per year at its American factories, while its total production capacity is designed for 13 million wafers per year. The company has already launched a new production facility in Taiwan with a capacity greater than that of two factories in Arizona, and with more advanced technologies, and is also building a new factory in Japan [9]. Another circumstance working against the United States is that more than 20 countries of the world, including a number of European Union countries, China, Japan, South Korea, Canada, Mexico, and India, have adopted their own investment programs in semiconductor production.

The Biden administration will also have to solve the difficult problem of establishing a sustainable supply of scarce raw materials to American enterprises. China maintains a strong position in its supplies. It accounts for 63% of the world's production and 85% of the processing of rare earth elements, 92% of the production of rare earth magnets, and 30% of neon gas used in the production of semiconductors [10]. It will also be necessary to reconsider the system of training engineering personnel for the industry. Traditionally, its needs were replenished mainly due to the influx of immigrants, which has been declining in

recent years due to the anti-Chinese campaign in the United States, the tightening of American immigration laws, as well as the semiconductor boom in China.

"TECHNOLOGICAL HEGEMONISM" IN ACTION

Having come to power under the slogan of fighting protectionism, the Biden administration not only maintained the entire arsenal of aggressive trade policies used by President Trump but also modernized it, focusing efforts on countering the technological development of "unfriendly" countries. The Biden administration is prioritizing efforts to curtail significant segments of the Chinese tech industry ignoring the USA's commercial interests or concerns about the possible geopolitical consequences of such actions.

The White House staff has formed an interdepartmental "strike force" (The Disruptive Technology Strike Force) to counter external threats in the field of technology [11]. Priority is given to measures aimed at weakening China's ability to acquire advanced technologies for which it lacks the prospects of achieving technological independence quickly enough on its own. The CHIPS Act contains a provision that prevents US firms seeking federal subsidies from expanding or upgrading their advanced semiconductor manufacturing facilities in China or any other foreign country of "concern" for ten years.

The White House intends to use any means necessary to achieve global technological isolation of China, up to and including its complete exclusion from the GVCs. A boycott of international initiatives with the participation of the PRC has been announced. American standards in microelectronics are imposed on US partners. In accordance with Biden's demands, Germany, the Netherlands, Japan, and Taiwan have decided to introduce selective restrictions on exports to China. The intention of some European TNCs to enter the American semiconductor market with investment projects is also announced, subject to the extension to them of all the benefits provided for by the CHIPS Act.

In October 2022, the Biden administration approved new export controls that set the toughest restrictions on technology flows into China since the Cold War [source 6]. Restrictions on dual-use goods extend to many commercial technologies. These primarily include integrated circuits for supercomputers, quantum computing systems, and artificial intelligence. The Foreign Direct Product Rule (FDPR) can now apply to the products of any chip manufacturing enterprise in the world if they were manufactured using American technology, equipment, or software. Requests for licenses to export a wide range of microcircuits to China will in most cases be considered on the basis of a presumption of refusal. Reasons could include suspicions of facilitating Beijing's efforts to modernize its military, links to the CCP, participation in the "oppression of the Uyghur population" or other attacks on human rights or American democratic values.

The main innovation of Biden's plan is to block Chinese companies' access to equipment for the production of advanced semiconductors, as well as to software and services. Washington managed to force the Dutch company *ASML*, as well as the Japanese *Tokyo Electron* and *Nikon*, to limit the range of supplies of lithographic equipment to China, although for them this could mean a loss of up to a fourth of their income. Problems may also arise with the German *Zeiss* and *Siemens*, which closely cooperate with *ASML* [12]. Washington plans to form an alliance of "friendly" countries to agree on an embargo on the export to China of chip-making machinery using less advanced technological processes.

The White House's greatest concern is the possibility that Beijing will gain control of Taiwan's semiconductor capacity. Treasury Secretary Yellen even declared the dependence of the US microelectronics industry on Taiwan as a risk to national security [source 7]. American diplomacy has set the goal of pushing Taipei to completely sever technological ties with Beijing, and at the same time blocking Chinese companies' access channels to technologies used by South Korean enterprises. Under pressure from Washington, *TSMC* was forced to refuse to supply ultra-pure silicon to Chinese partners, but this kind of partial concession does not suit Washington.

As for American companies, only a few of them, including *Dell*, took the White House's instructions as a guide to action and declared their

readiness to completely abandon cooperation with Chinese partners. Only 10–15% of leading American companies have begun to return some of their facilities from China. According to surveys, almost three-quarters of firms said that they were not considering the option of moving manufacturing outside of China at all. Most of them consider the "China plus one country" or "China plus three or four countries" strategies more acceptable.

A fairly significant part of American business has perceived the new features in terms of export controls as disadvantageous and is trying to persuade the authorities to take a more selective approach to relations with the PRC. According to many, partial decoupling reduces the ability of the United States to keep Chinese firms dependent on American supplies, so denying them access to key technologies is a preferable strategy ("a scalpel is almost always better than an axe"). "Selective protection is essential for the most advanced chip manufacturing technologies; broad bans on obsolete technologies could cause great harm to American semiconductor firms, but will not protect US national security" [13].

The negative effect of the introduction of export restrictions is already manifested in a reduction in the turnover of US-Chinese trade in semiconductors. Bans on supplies to China have a negative impact on the financial performance of the leading American manufacturer of semiconductor equipment, *Applied Materials*. The loss of the Chinese market will mean a reduction in sales by 25–30% [14].

Apple, for which China was the second largest market and the main assembly shop, is forced to urgently diversify its range of partners. According to forecasts, by 2025, ¼ of its products may be assembled outside of China (currently, 5%). *Apple* opened production lines in Vietnam and established cooperation with the Indian *Tata Group*. *Apple*'s Taiwanese partner, *Foxconn*, plans to invest USD700 million in a new plant in India [source 8]. There is reason to believe that in the future the White House views India, with which cooperation is being developed as part of a new bilateral initiative on critical and emerging technologies, as a suitable replacement for China.

Despite business opposition, Washington is exploring further tightening of export controls and increasing pressure on allies to join US sanctions. Due to the obvious exhaustion of this resource, the emphasis is increasingly shifting toward the rules governing the investment flows of American companies. The justification is the thesis that "unfriendly" countries are able to use American investments "to gain access to confidential data and technologies for purposes that are detrimental to US national security".

It is expected that the planned restrictions will primarily apply to investments in advanced semiconductors, quantum computing, and artificial intelligence. However, Washington is in no hurry to introduce them, for fear of not finding understanding from American investors who have already invested billions of dollars in Chinese companies in the field of microelectronics. It is also taken into account that China is now less dependent on the influx of foreign capital than before and is able to form its own programs to attract alternative investors.

"INTELLIGENT TRUMPISM"

The predictable result of the aggressive anti-Chinese campaign launched by the Biden administration in full accordance with Trump's slogan "China will pay" was a temporary weakening of the PRC's position as a manufacturer and exporter of microcircuits against the background of a decrease in the investment attractiveness of this sector of the Chinese economy. *Apple*, with the support of the US federal authorities, managed to weaken the position of its main competitor in smartphones and telecommunications equipment, *Huawei*, which American politicians called the "commercial subsidiary" of the CCP. Most of the other "national champions" of the PRC, which successfully competed with American multinationals in the fields of telecommunications, semiconductors, digital optics, cybersecurity, and drone production, also suffered as a result of the introduction of restrictions. Among them are the largest Chinese chip developer *Semiconductor Manufacturing International Corporation (SMIC)*, flash memory manufacturer *Yangtze Memory Technologies (YMTC)*, telecommunications equipment and mobile phone manufacturer *ZTE*, a number of other market leaders and even startups.

The main vulnerability of the PRC in the competition for the microelectronics market remains the orientation of supply chains to a narrow range of countries – allies of the United States. More than 90% of semiconductors used in China are imported or produced locally by foreign suppliers. As the largest consumer of semiconductors and semiconductor equipment in the world (32 and 29%, respectively), mainland China controls only 1% of chip design software developments [15]. In practice, this means that even if a Chinese company is involved in supply chains with companies in Taiwan or South Korea, there remains a high probability that American firms took part in the development of the architecture of chips produced in the PRC. Other negative factors hindering the modernization of the semiconductor industry in China are geopolitical instability, increased protectionism, rising labor costs, and a chronic shortage of qualified personnel.

Nevertheless, the task set by Beijing to redouble its efforts to form a national semiconductor ecosystem in order to break the technological blockade organized by Washington is being solved quite successfully. Over the past decade, 110 industrial facilities making semiconductor products have been built in China, and another 38 projects are under implementation. A package of government support for national companies is being developed, a total of USD143 billion worth, which significantly overlaps similar allocations in the United States under the Biden plan [source 9].

China is improving its legal system to more effectively protect its innovative developments. As a counterbalance to the anti-Chinese *Chip 4* alliance, which in addition to the United States includes South Korea, Japan, and Taiwan, an alternative Asian supply chain *Altasia* is being formed, which includes 14 countries, including China and India [source 10].

The fact that Washington is constantly tightening restrictions on semiconductor exports is proof that the borders already introduced are not able to affect China's desire to achieve technological sovereignty in the long term. Despite external pressure, the production of integrated circuits in China increased by 1/3 in 2022. The level of self-sufficiency in semiconductors improved from 5% in 2018 to 17% in 2022 and is projected to exceed 25% in 2023 [source 11].

At the same time, Beijing is increasing its R&D spending, concentrating resources on original and innovative research in order to increase its scientific and technological independence, reduce the gap with competitors, and in the future make the country one of the world leaders in semiconductor technologies. China has achieved a high degree of domestic substitution for 28- and 14-nanometer chips, is implementing the making of products using the 7-nanometer process technology, seriously reducing the gap with *Intel*, and intends to compete with *Samsung* and *TSMC* in 5-nanometer technology in the future [16]. By 2030, Beijing hopes to surpass Washington in chip design and establish mass production of original and advanced lithography machines. Until recently Chinese firms relied mainly on foreign technologies, now they are gradually beginning to switch to domestic ones.

Beijing is also increasing its arsenal of tools to counter the US dictatorship, increasingly publicly accusing Washington of hegemonism, politicization, and militarization of economic issues, and destabilization of the GVCs. The task is to strengthen the protection of intellectual property rights for original Chinese inventions. As a key supplier of electronic components to Vietnam and Mexico, China has the ability to influence supply chains that include these countries, which in turn remain major suppliers to American companies.

RESULTS AND CONCLUSIONS

Washington's strategy toward China is based on the presumption of the impossibility of overcoming in the foreseeable future the existing gap in the scientific and technical potential of both countries. In pursuit of the goal of slowing down China's technological growth and eliminating its main competitor from the global innovation ecosystem, the Biden administration is abusing subsidies and export restrictions imposed under the pretext of national security, which, however, does not guarantee decisive unilateral advantages for American companies. To achieve self-sufficiency in semiconductors, it will be necessary to significantly

increase allocations for subsidies and tax breaks, to attract the resources of motivated US states, increase spending on R&D and commercialization of their results, and diversify procurement channels for rare earth metals and materials.

The policy of bloc diplomacy ("reliance on friends") pursued by Washington is aimed at organizing an international blockade of the PRC's technology sector. Focusing on the formation of anti-Chinese, American-centric GVCs brings limited results, since Washington does not have the ability to offer its allies, who are losing benefits from the disruption of commercial ties with the PRC, an equivalent alternative.

Rhetoric about the advisability of further escalation – from partial technological disengagement toward a broader "draconian decoupling" – remains on the agendas of both parties and the US Congress. There are fears that new American technonationalism or the growing conflict over Taiwan could ultimately lead to the formation of a "digital Iron Curtain" and the division of the world into two separate technological ecosystems. True, so far statistical data on bilateral trade and investments indicate the continued interdependence of economies. The semiconductor industry of both countries remains tied to the GVCs, which gives grounds to speak about a new phase in the development of US-Chinese relations, in which conflict persists and even intensifies, but economic ties remain active.

The US desire for technological hegemony can slow down the pace of China's technological development and delay the country's transition to a digital economy. Limited innovative potential remains the Achilles heel of the PRC at the current stage of confrontation between the two powers. At the same time, the aggressive actions of the United States are pushing the Chinese leadership to speed up the transition of the industry to a greater focus on self-sufficiency. In its competition with Washington, Beijing relies on the presence of a developed production environment, which has been actively modernized in recent years with government support.

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