Horyzonty Polityki
2024, Vol. 15, N° 51
OPEN ACCESS

Wanda Dugiel
http://orcid.org/0000-0003-1369-3523
SGH Warsaw School of Economics
wdugie@sgh.waw.pl
DOI: 10.35765/HP.2626

The Economic Role of Technology in International Trade: Theory and Practice in the Trade War

Abstract

RESEARCH OBJECTIVE: The aim of the paper is to analyze the economic effects of technological changes and restrictions on the freedom of technology transfer in the contemporary global economy on international trade turnover in the context of the trade conflict between the United States and China.

THE RESEARCH PROBLEM AND METHODS: A qualitative method was used to analyze the problem of restrictions on technology transfer in the modern world economy. The article also uses a quantitative method, including a review of the statistics of international trade turnover of high-tech goods to examine the effects of the US-China trade war.

THE PROCESS OF ARGUMENTATION: On the basis of the theoretical approach to the premises of trade exchange (Ricardian model, Heckscher-Ohlin theory) and subsequent theories, in particular the approach of Schumpeter, Krugman and Melitz, the relationship between the role of technological changes and the gains from international trade was examined. The article presents the motives behind the escalation of the technological trade war between the United States and China.

RESEARCH RESULTS: Scientific analysis confirmed that technological changes and the spread of technology as a result of the intensification of international trade turnover are associated with a specific impact on benefits and losses for the country with a technological advantage as a result of the “learning

Sugerowane cytowanie: Dugiel, W. (2024). The Economic Role of Technology in International Trade: Theory and Practice in the Trade War. *Horizons of Politics*, *15*(51), 203–223. DOI: 10.35765/HP.2626.

by doing" phenomenon. Theoretical analysis has led to conclusions that justify the use of massive public investments in US industrial policy.

CONCLUSIONS, INNOVATIONS, AND RECOMMENDATIONS: Further research should cover issues regarding the influence of states on supporting the development of advanced technologies. Appropriately shaped economic policy consisting in increased spending on research and development and the use of trade and industrial policy tools will significantly contribute to the increase in the competitiveness of the United States economy.

Keywords:

international trade, technological change, World Trade Organization, trade war, United States

INTRODUCTION

Nowadays, the United States has taken decisive actions in the field of economic policy to maintain technological power in the global economy. State participation in international trade and gains from international trade result from differences in the comparative advantages of economies, endowment with production factors and diversified technological resources of countries. The intensification of international trade as a result of ongoing multilateral liberalization under the aegis of GATT/WTO has contributed to technological development in the world and increased innovation incentives in economies.

The aim of the article is to analyze the impact of technological changes and restrictions on the freedom of technology transfer in the contemporary world economy on international trade in the context of the trade conflict between the United States and China.

Section 1 presents theoretical considerations regarding the interdependence of international trade and technological progress. Point 2 analyzes the issue of technology spread between the technologically advantaged country and other countries. The analysis also covers the actions of countries in terms of increasing spending on research and development and regulating patent protection, which can strengthen the technological position of economies. Section 3 presents the key drivers of growing protectionism in the trade of high-tech goods between the United States and China. Section 4 characterizes the most important economic effects of the US-China technological trade war on the global economy.

INTERNATIONAL TRADE AND TECHNOLOGICAL PROGRESS – THEORETICAL APPROACH

Comparative advantage and innovation in a given industry determine economic dominance in the world. The development of advanced technologies allows companies to specialize and achieve economic benefits from international trade, as well as to accelerate the country's economic growth rate. The essence of innovation, the development of advanced technologies, comes down to the variety of competitive products, includes the method of producing new goods, or new combinations of existing resources (Schumpeter, 1942; Metcalfe, 2012).

Classical theories of international trade identified the benefits of trade resulting from differences in comparative costs (the theory of D. Ricardo from 1817) and proportions of the endowment of production factors in countries around the world (the theory of E. Heckscher and B. Ohlin from 1919). Differences in how countries are equipped with global economic factors will determine the geographical structure of international trade and the countries' share in trade flows. Unlike D. Ricardo's model, the Heckscher-Ohlin theory takes into account more than one production factor and differences in technologies between countries.

Later additions to trade theories examined the benefits of trade across differences in the technological development of economies. Schumpeter (1934) concluded that innovation incentives created by differences in benefits for companies investing in research and development are among the most important factors determining the rate of economic growth. The occurrence of the phenomenon of creative destruction, the replacement of existing technological solutions by new technologies as a result of increased investments in innovations in the economy, brings economic gains in the form of increased prosperity (Aghion, Akcigit & Howitt, 2013).

According to Schumpeter, the effect of "creative destruction" is the temporary creation of a monopoly in the economy in the production of highly technologically advanced products, because innovations in production processes lead to new conditions of competition on the market. The amount of economic rents from creative destruction depends on many factors, including the protection of intellectual property rights (patent protection) in the economy, the development of the education system, the existence of a democratic state system, and the degree of openness of the economy.

The interrelationships between the development of innovation and the flow of international trade, the increase in export opportunities, were examined in the literature by Posner (1961), Arrow (1962), Vernon (1966), Krugman (1979), paying attention to the emergence of a technological gap in trade between countries.

Posner (1961), presenting the technology gap theory, examined the interdependence between international trade exchanges and the emergence of a technology gap between countries. International trade is the result of technological development, which, starting in one country, leads to differences in comparative costs in economies and the imitation of innovations by other countries. Technological development plays a key role in shaping the geographical structure of international trade. Posner, taking into account the assumptions of the Heckscher-Ohlin theory, concluded that the production of new goods in the global economy in the long run will occur at different rates in individual countries.

In economic theory, Arrow (1962) drew attention to the phenomenon of "learning by doing". The productivity of companies, the development of technological progress, and knowledge resources are the result of experience gained in the production process and are among the key sources of economic growth and maintaining the comparative advantage of countries (Bueara & Oberfield, 2020). Systematically repeated production activity, i.e. "learning by doing", resulting from investments in knowledge in the economy leads to increased production efficiency.

Some of the scientific research was based on Vernon's study, which concerned the problem of imitation in the product life cycle and the formation of asymmetry between the innovative North and developing countries in the South, imitating technologically advanced products manufactured in the North. The relationship between trade and technological development has been studied in product life cycle theory (Vernon, 1966). Innovations in product manufacturing reduce production costs, increase economies of scale and increase production efficiency due to the "learning by doing" phenomenon (Lukauskas, Stern, & Zanini, 2013).

The occurrence of economies of scale as a result of the use of advanced technologies leads to an increase in the positive effects of the "learning by doing" phenomenon and the spread of knowledge from developed countries to developing countries (Lukauskas, Stern, & Zanini, 2013). The result of the country's technological development and the greater demand for qualified labor will be the emergence of wage inequalities in the economy.

Krugman (1979) in his work entitled "A model of innovation, technology transfer, and the world distribution of income" from 1979, taking into account Vernon's product life cycle theory, concluded that innovations introduced in developed countries are among the key factors determining the geographical structure of international trade. Krugman made the following assumptions in the model: the existence of two countries in the world economy: the innovatively developed North and the technologically backward South, the existence of equal labor productivity, the existence of one labor production factor in each country, which means that there are no differences in the endowment of production factors between countries. The technological gap and delay in the adoption of new innovations by the South will lead to trade.

After some time, the South will adopt technological solutions to produce innovative products from the North, and the South will gain an export advantage. As a result of technological progress, relative wages in the North increase as a result of the production of more technologically advanced products, while negatively depending on the level of technology diffusion in the South.

In endogenous growth models (Romer, 1990; Grossman & Helpman, 1993; Young, 1991; Aghion & Howitt, 1998), the authors pointed to the role of competition on the world market in the technological development of countries. The increase in international competition led to the emergence of the "learning-by-exporting" effect in the economy, domestic companies gained access to technologically advanced products on the market, and a larger market size, which determines the benefits of companies from increasing investments in research and development as well as innovation and product differentiation.

The endogenous innovation model examined the impact of international trade on innovation incentives and economic growth rates due to the expansion of product diversity, based on Romer's (1990) closed economy model. Romer pointed out that the development of innovation is influenced by both imperfect competition, which allows for achieving economic benefits, as well as external effects. According to Romer, technologies have characteristic features that allow companies to obtain benefits; firstly, technologies do not belong to public goods, secondly they may be considered non-competitive. The existence of a technological gap between countries results from the fact that knowledge cannot be defined as a public good available to everyone. Knowledge, being endogenous in nature, cannot be evenly distributed in the economy between economic entities (Cartner, 2023). Non-competitive goods have the feature that their use as a production method by one company will not exclude the possibility of using this technology by other companies.

In subsequent research, Helpman (1993) indicated that the more technologically developed countries in the North should benefit from technology transfer. Helpman, drawing attention to the classic factors of economic growth in the form of capital accumulation, concluded that research and development and economies of scale also play an important role. According to Helpman, the neoclassical model of economic growth shows that even capital accumulation cannot lead to long-term economic growth, therefore faster technical progress and economies of scale are necessary in the economy, which will increase with the intensification of international trade.

International trade flows favoring the development of technology have increased the possibility of spreading the "learning by doing" phenomenon in the global economy (Grossman, 1994). Intensive international trade leads to positive effects in the country's economy, increasing its technological potential.

In the economic theory literature in the 21st century, it is emphasized that technological potential largely depends on the activities of companies that provide differentiated products, and in each country there are differences between companies in terms of efficiency and production quality. Company profitability is a determinant of market size (Geng & Kali, 2021). The larger size of the export market will lead to a recovery of the costs incurred in developing research.

When examining the importance of trade, especially exports, for companies to introduce innovations, attention was paid to the exogenous nature of company productivity (Melitz, 2003). Undertaking international trade as a result of specialization increases the possibilities of product differentiation, intra-industry trade intensifies, and simultaneous exports and imports of similar products from one industry (e.g. automotive) occur.

Melitz (2003) analyzed the benefits of trade achieved by the most productive firms that expand in export markets, while increasing competition causes the least productive firms to withdraw from the international market. The increase in prosperity in the economy occurs through increased productivity in the industrial sector (Melitz & Redding, 2022).

PREMISES AND COURSE OF THE UNITED STATES-CHINA TECHNOLOGICAL TRADE WAR

One of the main reasons for starting the technological trade war between the United States and China was the implementation of industrial policy aimed at enabling China to become the greatest technological power in the world economy. The main motives of the trade war also include the political concerns of the United States related to the use of semiconductors to strengthen China's military position. In response to China's adoption of the "Made in China 2025" strategy in 2015 developed countries have adopted a strategy to increase the technological competitiveness of their economies.

The implementation of the main goal of the "Made in China 2025" strategy – achieving by China a dominant role in the world in the production of advanced technologies, in the field of artificial intelligence, robotics, semiconductors and achieving self-sufficiency in the production of some high-tech final goods – was associated with the phenomenon of forced technology transfer. from developed countries. Access to the Chinese market in trade exchange has been made dependent on the creation of joint ventures with Chinese entities and securing technology transfer (Sykes, 2021).

The United States took the first steps limiting China's practices regarding the forced transfer of technology, innovation and intellectual property in 2017. In a memorandum of August 14, 2017, US President Donald Trump recognized China's practices regarding the transfer of technology and innovation as violating the economic interests of the United States, and depriving the owners of American technological ideas of benefits (Federal Register 2018, 16th August). On August 18, 2017, the United States initiated an investigation into technology transfer and intellectual property protection under Section 301 of the Trade Act of 1974. Following an investigation on March 28, 2018, the USTR report listed grounds for taking action to restrict exchange trade as a result of China's policy of forced technology transfer and activities in cyberspace leading to the illegal seizure of American intellectual property (Hart & Murill, 2022). In June 2018, a list of products containing technologies of key importance in the application to the industry and implementation of the assumptions of the "Made in China 2025" strategy was published. The United States imposed tariffs of 25% on imports from China of goods worth USD 50 billion (Federal Register, 2018, 20th June). Then, on August 16, 2018, the United States introduced tariffs of 25% on further products of strategic importance for the implementation of the "Made in China 2025" program (Federal Register, 2018, 16th August).

The United States, recognizing that China had adopted rules for forced technology transfer, applied the provisions of Section 301 of the Trade Act of 1974 to counteract unfair trade practices that could harm the development of innovation and technology in the United States. China has used administrative proceedings and joint venture requirements to pressure technology transfer from the United States (Office of the United States Trade Representative. Executive Office of the President, 2018).

In the conditions of the trade war with China, the issue of separating the US economy from the Chinese economy plays a key role. The US Congress recognized that China intends to gain technological dominance in the world as a result of the transfer of internally acquired and external technologies. China, through legal and illegal means to capture technology and develop secondary patents, has already achieved a total GDP comparable to that of the US. The United States found the results of GDP growth dynamics disturbing, which may be higher in China than in the USA in the coming years (118th Congress, 2023).

When considering the issue of forced technology transfer, the Congress invoked the argument of national security. Huawei was found to be intercepting American technologies, including 5G technologies of strategic importance to the national security of the United States.

In addition to the provisions of Section 301 of the Trade Act of 1974, restricting trade, the United States has adopted regulations controlling the flow of foreign direct investment, citing the argument of national security. The adoption of the Foreign Investment Risk Review Modernization Act (FIRRMA) in 2018 increased control over technology exports to China (Chorzempa, 2019).

In 2018, the United States introduced export controls on technology products and components, and in 2019, Huawei, a leading technology giant, was identified as an entity of national security concern. The National Security Bureau indicated that there were grounds to consider Huawei's actions as contrary to the national security of the United States (Federal Register, 2019, 21th May). On October 7, 2022, the United States introduced export controls on semiconductor and artificial intelligence production technologies, followed by the next stage of export controls on October 17, 2023, aimed at limiting the creation of China's technological power.

The United States has taken further actions to limit the transfer of technology to China. President J. Biden adopted on August 9, 2023, an outbound investment control program, based on the powers of the acts applicable in emergency situations: the International Emergency Economic Powers Act (50 USC 1701 et seq. (IEEPA), the Emergency Situations Act (50 USC1601 et seq. (NEA), and Section 301 of Title 3. Outward investment control covered states whose strategic goal is to acquire and use advanced technologies to achieve military dominance.

Countries of concern to the United States, rapidly developing the production of semiconductors, microelectronics, and quantum information technologies, may pose a threat to US national security (Swanson, 2023).

The House of Representatives Committee of the US Congress notified key technology companies about concerns about investments in China and investing capital in the assets of Chinese companies producing artificial intelligence and semiconductors. On February 28, 2024, the United States introduced an Executive Order on Preventing Countries of Concern from Accessing Bulk Sensitive Personal

Data of Americans and Data from the US Government (Brown, Chin-Rothmann & Brock, 2024).

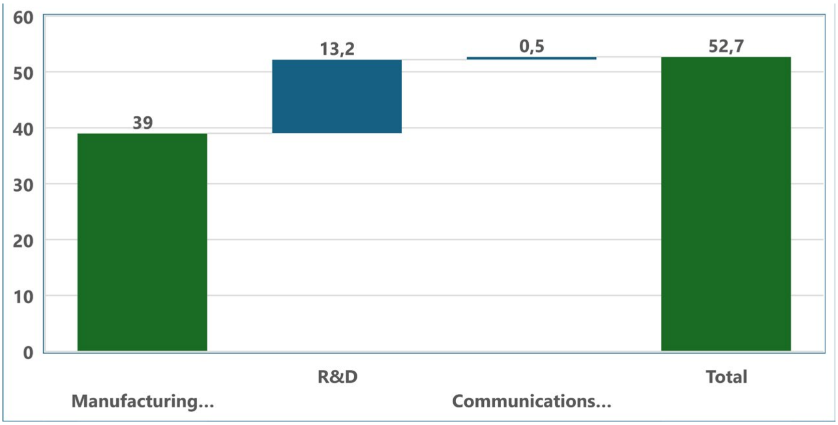
Trade policy measures included some activities enabling the United States to maintain its technological advantage in the world. The second part of consolidating US technological supremacy was the adoption of industrial policies that promoted high-tech industries. The trade war for global technological dominance has led to developed countries, including the United States and the European Union, adopting industrial policy and subsidizing the strategic semiconductor manufacturing industry. The effect of the trade war between the United States and China is the emergence on a global scale of the so-called "technonationalism" and directing technological development towards closed economies (Bradford, 2023).

Subsidizing production by the United States government, introducing industrial policy, financing domestic investments in the advanced technology industry will allow for an increase in the production of semiconductors and will ensure the development of innovations in the following industries: computer science, quantum technology, nanotechnology, clean energy, artificial intelligence. The Chips and Science Act of 2022 guaranteed funding for research and development spending, creating production incentives and ensuring that the United States pursued its national security argument (Semiconductor Industry Association, 2023). The main objectives of the Chips and Science Act were to restore jobs in the industrial sector and "win the race for the 21st century" (White House, *Fact Sheets*, 2022).

The technological importance of semiconductor production will increase due to their use in the industrial sector, in the production of aircraft, microelectronics equipment, microwave ovens, televisions, computers, watches, and cars (Irwin, 1996). In the 21st century, the United States' position in semiconductor production has weakened due to the development of global supply chains and the relocation of production abroad. The United States was mainly involved in the production of older chips, while the most advanced chips were manufactured abroad, including in East Asia (White House, 2023).

By adopting the Chips and Science Act in 2022, the United States initiated an industrial policy to pursue specific economic and political goals of strengthening the United States' technological advantage in semiconductor production. The United States has a total budgeted $52.7 billion for research and development spending, as well as manufacturing. An amount of $39 billion was allocated for manufacturing incentives. Under the Chips and Science Act, $13.2 billion was allocated for research and development and job creation in the semiconductor manufacturing industry. An amount of USD 0.5 billion has been allocated to guarantee the international security of information technologies and the functioning of the semiconductor supply chain (Figure 1). Tax credits of 25% for public investment in semiconductor production increased the possibility of creating new jobs in the high-tech industry

Figure 1. Spending under the Chips and Science Act of 2022, in billions of dollars



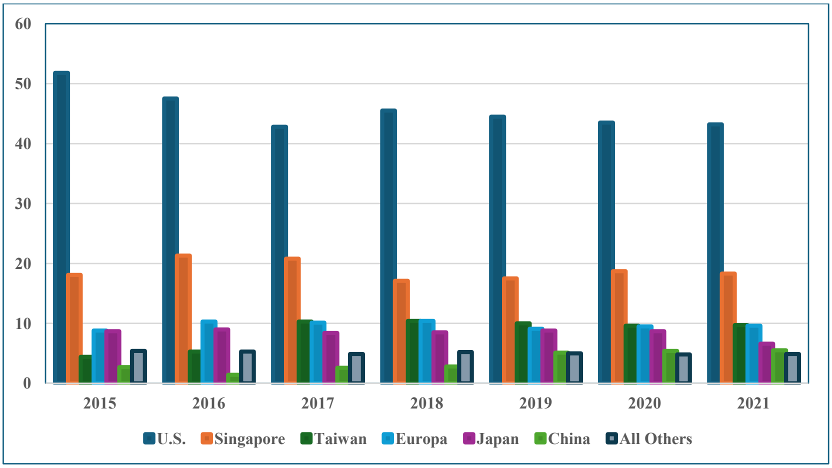
Source: White House, Fact Sheets (2022).

The United States has made the largest public industrial policy investment in the development of artificial intelligence and research and development covered by the Chips and Science Act since the end of the Cold War (Gross & Sampat, 2023).

The implementation of the assumptions of the Chips and Science Act allowed for an increase in investments in expanding the semiconductor production base and creating programs for the development of a highly qualified workforce. There has been a clear economic recovery and employment in the semiconductor production industry (Alfaro & Chor, 2023).

Implementation of industrial policy assumptions will increase the United States' production potential in the field of advanced technologies. In the 21st century, the United States' leading role in semiconductor production has weakened, in 2021 US production amounted to 43% of global production. The technological potential of Asia has increased, both in China (5.5%), as well as in Singapore (18%) and Japan with a share of 9% (Figure 2). The production of semiconductors is associated with relatively high expenditure on research and development, and companies achieving profits then increase their investments in scientific research. Companies producing semiconductors often find themselves without production factories and only have research projects (Dachs & Bernhard, 2023).

Figure 2. Share of the United States in global semiconductor production in alts 2015-2021, in %



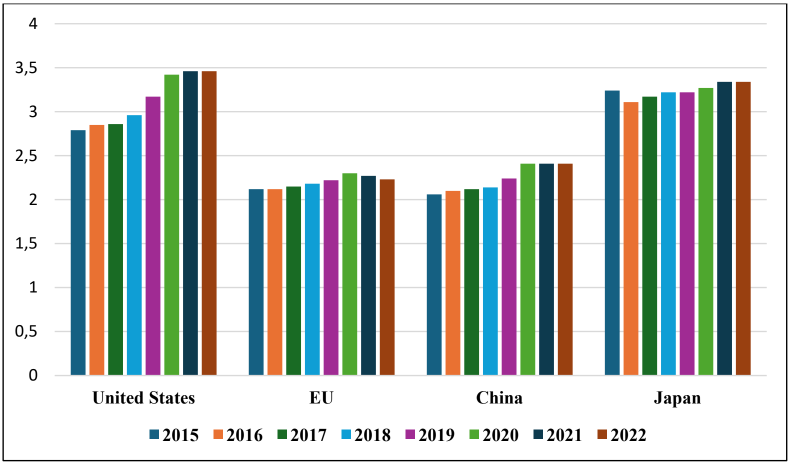
Source: Semiconductor Industry Association 2022, Factbook.

In 2022, total U.S. semiconductor exports were $61.1 billion, the fifth highest among U.S. exports behind refined crude oil, crude oil, natural gases and aircraft. Exports from the United States amounted to over 80% of the total production of the US semiconductor industry.

The technological development of the United States and the economies competing for a dominant position in the production of advanced technologies in the world depends largely on research and development spending, which enables the growth of innovation incentives. China belongs to the group of middle-income countries where research and development expenditure constitutes a high percentage of GDP

(2.41%). The percentage of EU research and development expenditure reached 2.24% of GDP, in Japan (3.34% of GDP), (Figure 3).

Figure 3. State expenditure on research and development as % of GDP, in 2012-2022



Source: Eurostat: https://ec.europa.eu/eurostat/statistics-explained/index.php?title=R%26D_expenditure#Gross_domestic_expenditure_on_R.26D, (accessed on 27th February 2024).

China is currently one of the largest economies allocating significant financial resources to research and development, increasing the production capacity of advanced technologies.

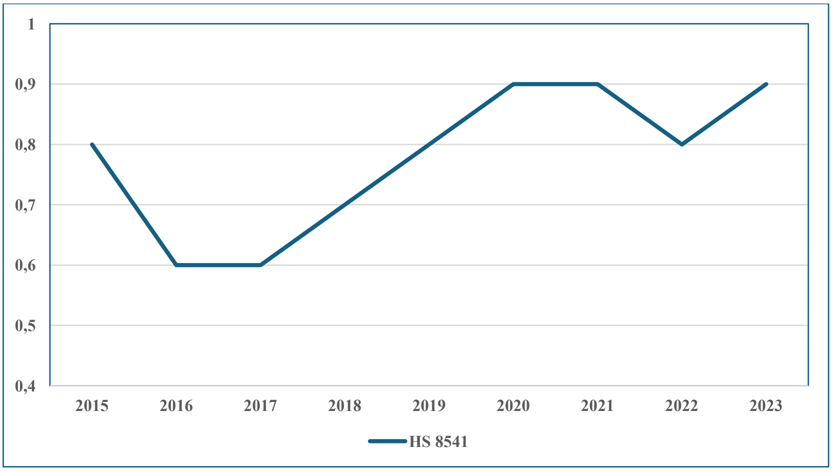
ECONOMIC EFFECTS OF THE TRADE WAR BETWEEN THE UNITED STATES AND CHINA FOR TECHNOLOGICAL ADVANTAGE IN THE GLOBAL ECONOMY

Restrictions on technology transfer have had the intended effects in separating the interdependence of economies within the global supply chain. The implementation of the national security argument by the United States will increase the intensity of separation of the interdependence of economies in the production of goods using advanced technologies (Shivakumar & Wessner, 2024). During the presidency of J. Biden, the United States recognized the semiconductor production industry as a priority for the economy, creating the possibility of increasing the USA's self-sufficiency in the production of advanced technologies.

Trade restrictions from the United States have resulted in restrictions on trade with China for goods involving advanced technologies. After the United States initiated an investigation under Section 301 of the Trade Act of 1974 on August 18, 2018, examining technology transfer practices to China, it established trade barriers to imports from China (Office of the United States Trade Representative Executive Office of the President Update Concerning China's Acts, 2018). An import duty of 25% was introduced on parts necessary for the production of semiconductors against China for diodes (HS 85411000); diodes for semiconductor devices (HS 8541.40.60); electronic integrated circuits and parts thereof (8542), including processors and controllers (HS 8542.31.00), semiconductor memory (HS 8542.32.00), electronic integrated circuits, amplifiers (HS 8542.33.00), other parts (HS 8542.39.00), electronic integrated circuit parts and micro assemblies (HS 8542.90.00) (Office of the United States Trade Representative, Notice of Action Pursuant to Section 301, 2018).

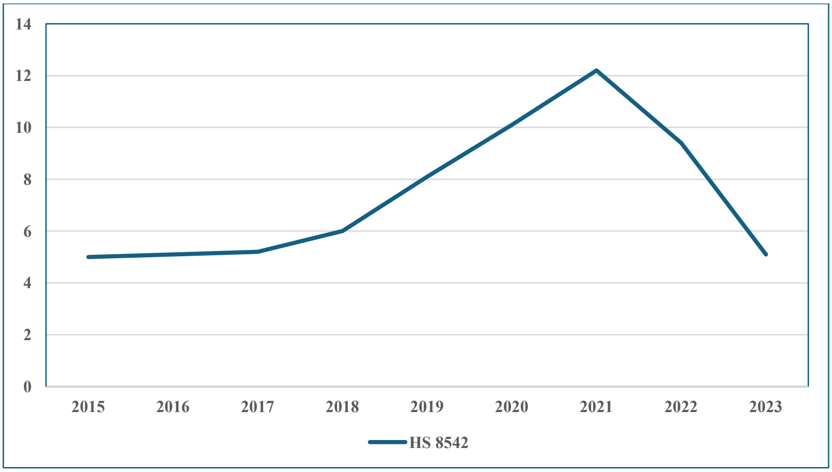
Integrated circuits, discrete devices and optoelectronic components play the most important roles in the production of semiconductors. US exports of electronic integrated circuits (HS 8541) increased from USD 0.7 billion to USD 0.9 billion (Figure 3). In the initial period after 2018 of the trade restrictions, there were no restrictions on the export of semiconductor devices (diodes, transistors, photosensitive semiconductor devices. The situation regarding the possibility of exports to China was changed by the export controls on advanced technologies introduced by the United States in 2022 and in October 2023 r. Similarly, in the case of electronic integrated circuits, exports from the US to China decreased after 2021 (Figure 5). In response to the protectionist actions of the United States, China increased the level of subsidies for technology production (Triolo, 2024).

Figure 4. US exports to China of semiconductors (HS8541), billion dollars



Source: UN Comtrade basis.

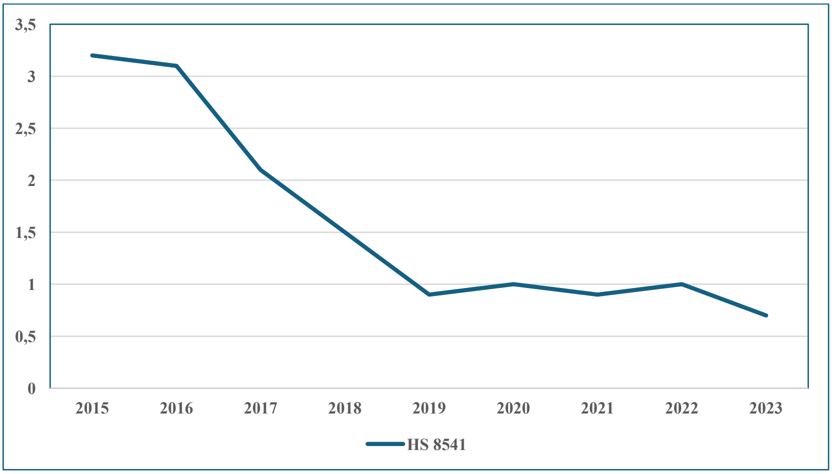
Figure 5. US exports to China of semiconductors (HS 8542 electronic integrated circuits), in billions of dollars



Source: UN Comtrade basis.

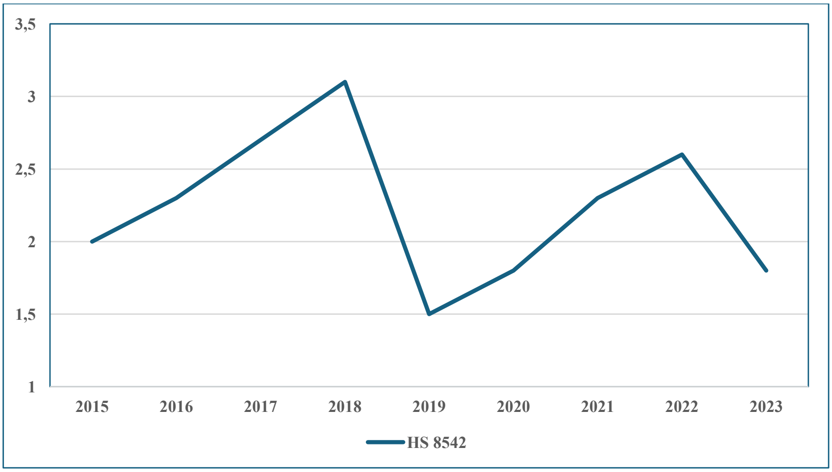
As a result of the technological trade war, there has been a decline in imports from China to the United States of semiconductors (HS 8541). Imports decreased from USD 1.5 billion in 2018 to USD 0.7 billion in 2023.

Figure 6. Imports of semiconductors to the USA from China (HS8541), in billions of dollars



Source: UN Comtrade basis.

Figure 7. Imports to the United States from China (HS 8542), in billions of dollars



Source: UN Comtrade basis.

Trade in semiconductors between the United States and China has decreased (Figures 6 and 7). The production structure in this industry is monopolized and is subject to significant regionalization of production in the global economy. China, being a key producer of semiconductors in the world, depends on supplies of parts and production materials from developed countries, such as the Netherlands, Japan, and Germany (Ren, Yang, Wang & Liu, 2023). To achieve technological dominance in semiconductor production, China needs to maintain participation in global value chains and international trade.

The implementation of the "Made in China 2025" strategy did not bring the expected results, subsidies under industrial policy led to a reduction in the economic growth rate. The trade war with the United States has weakened the ability to achieve the goals included in the "Made in China 2025" program and has led to economic costs for the Chinese economy (Branstetter, 2022).

Protectionist tools of the United States trade policy in the field of advanced technologies in the long term may lead to a significant reduction in the spread of technology around the world and limit the access of innovation to emerging economies and developing countries (Cerdeiro, Eugster, Muir & Peiris, 2021).

In response to the threat to security of supply and the need to maintain a leading position in the production of semiconductors, the European Union adopted an industrial policy program and the "European Chips Act" (The EU Chips Act). Similarly, Japan, being the largest producer of semiconductors in the world in the 1980s with a subsequent sharp decline in global production, adopted an industrial policy program (World Trade Organization, 2023).

CONCLUSIONS

The actions of the United States seeking to maintain technological dominance in the world have translated into protectionism in trade policy in the form of protection against imports and export controls of advanced technologies and the use of strategic trade policy.

The trade war over U.S. technological dominance has led to shortages in the global economy of some high-tech goods, particularly semiconductors. The US-China trade war has also led to uncertainty over high-tech manufacturing capacity in East Asia.

References

118th Congress (2023), Intellectual Property and Strategic Competition with China. Part I, https://www.congress.gov/event/118th-congress/house-event/115441/text?s=1&r=80 (accessed on 27th February 2024).

Aghion, Ph., Akcigit, U., & Howitt, P. (2013). What do we Learn from Schumpeterian Growth Theory? *NBER Working Paper*, *18824*.

Alfaro, L., Chor, D. (2023). Global Supply Chains: The Looming "Great Reallocation". *NBER Working Paper Series*, *31661*.

Arrow, K.J. (1962). Economic Welfare and the Allocation of Resources to Invention. In R.R. Nelson (Ed.), *The Rate and Direction of Economic Activity*. New York: Princeton University Press.

Bradford, A. (2023). The Battle for Technological Supremacy: The US–China Tech War, *Digital Empires: The Global Battle to Regulate Technology*. DOI: 10.1093/oso/9780197649268.003.0006

Branstetter, L., & Guangwei, L. (2022). Does 'Made in China 2025' Work for China? Evidence from Chinese Listed Firms. *NBER Working Paper*, *30676*. Cambridge, MA: National Bureau of Economic Research.

Brown, E., Chin-Rothmann, C., Brock, J. (2024, 29th February). *Exploring the white House's Executive Order to Limit Data Transfers to Foreign Adversaries*, CSIS, https://www.csis.org/analysis/exploring-white-houses-executive-order-limit-data-transfers-foreign-adversaries (accessed on 1st March 2024).

Buera, F.J., Oberfield, E. (2020). The Global Diffusion of Ideas. *Econometrica*, *88*(1), 83–114.

Cartner, U. (2023). Industrial Policy and Technological Sovereignty. In S. Tagliapietra, & R. Veugelers, *Sparking Europe's New Industrial Revolution. A Policy for net zero, growth and resilience*. Brussels: Bruegel.

Cerdeiro, D.A, Eugster, J., Muir, D., & Peiris, S. (2021). Sizing Up the Effects of Technological Decoupling, *IMF Working Papers*, 2021/069, WP/21/69.

Chorzempa, M. (2019, 10th October). *New CFIUS Regulations: More Powerful, Transparent and Complex, Trade and Investment Policy Watch*. PIIE, https://www.piie.com/blogs/trade-and-investment-policy-watch/new-cfius-regulations-more-powerful-transparent-and-complex (accessed on 27th February 2024).

Dachs, B. (2023). *FIW-Kurzbericht*, *58. The European Chips Act*. Vienna: FIW – Research Centre International Economics.

Deardorff, A.V. (1998). Technology, Trade, and Increasing Inequality: Does the Cause Matter for the Cure?, *Research Seminar in International Economics School of Public Policy*, *428*. Michigan: The University of Michigan.

European Commission, The EU Chips Act, https://ec.europa.eu/commission/presscorner/detail/pl/ip_23_4518 (accessed on 27th February 2024).

Federal Register (2017, 24th August). Initiation of Section 301 Investigation; Hearing, and Request for Public Comments: China'a Act, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation. 82 FR 40213.

Federal Register (2018, 16th August). Vol. 83, No. 159. Notices 40823.

Federal Register (2018, 20th June), Vol. 83, No. 119.

Federal Register (2019, 21th May). Vol. 84, No. 98.

Geng, D., & Kali, R. (2021). Trade and innovation: Unraveling a complex nexus. *International Journal of Innovation Studies*, *5*(1), 23–34.

Gross, D.P., & Sampat, B.N. (2020). America, Jump-Started: World War II R&D and The Takeoff of The U.S. Innovation System. *NBER Working Paper Series*, *27375*.

Helpman, E. (1993). Innovation, imitation and intellectual property rights. *Econometrica*, *61*, 1241–1280.

Hua, S., Zeng, K. (2022). The US–China Trade War: Economic Statecraft, Multinational Corporations, and Public Opinion. *Business and Politics*, *24*(4), 319–331. DOI: 10.1017/bap.2022.18

Irwin, D.A. (1996), Trade Policies and the Semiconductor Industry. In A.O. Krueger (Ed.), *The Political Economy of American Trade Policy*. Chicago: University of Chicago Press.

Jones, R.W. (1970). The role of technology in the theory of international trade. In R. Vernon (Ed.), *The technology factor in international trade* (pp. 73–92). New York: National Bureau of Economic Research.

Krugman, P.R. (1979). A model of innovation, technology transfer, and the world distribution of income. *Journal of Political Economy*, *87*, 253–266.

Krugman, P.R. (1986). A 'technology gap' model of international trade. In K. Jungenfelt & D. Hague (Eds.), *Structural adjustment in developed open economics* (pp. 35–49). London: Macmillan Press.

Lukauskas, A., Stern, M.R., & Zanini, G. (2013). *Handbook of Trade Policy for Development*. Oxford: Oxford University Press.

Melitz, M.J., & Redding, S.J. (2022). Trade And Innovation. *NBER Working Paper Series*, *28945*.

Metcalfe, S. (2012). J.A. Schumpeter and the theory of economic evolution (One hundred years beyond the theory of economic development). *Papers on Economics and Evolution*, *1213*. Jena: Max Planck Institute of Economics.

Nurullah, G., & Serif, D. (2023). US–China Economic Rivalry and the Reshoring of Global Supply Chains. *The Chinese Journal of International Politics*, *16*(1), 61–83. DOI: 10.1093/cjip/poac022

Office of the United States Trade Representative (2018, 19th August). Notice of Action Pursuant to Section 301: China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation.

Office of the United States Trade Representative Executive Office of the President (2018). Findings of the Investigation Into China's Acts, Policies, and Practices Related to Technology Transfer, Intellectual Property, and Innovation, under Section 301 of the Trade Act of 1974, March 2018.

Office of the United States Trade Representative Executive Office of the President (2018, 20th November). Update Concerning China's Acts, Policies and Practices Related to Technology Transfer, Intellectual Property, and Innovation. Washington D.C.

Posner, M.V. (1961). International Trade And Technical Change, *Oxford Economic Papers*, *13*(3), 323–341. DOI: 10.1093/oxfordjournals.oep.a040877

Ren, Y., Yang, Y., Wang, Y., Liu, Y. (2023). Dynamics of the global semiconductor trade and its dependencies, Journal of Geographical Sciences. *Springer Science and Business Media LLC*, *6*, 1141–1160.

Schumpeter, J.A. (1934/1961). *The Theory of Economic Development*. Cambridge, MA: Harvard University Press (New York: Oxford University Press).

Schumpeter, J.A. (1942/1976). *Capitalism, Socialism, and Democracy*. New York: Harper and Brothers.

Semiconductor Industry Association (2023). *2023 State Of The U.S. Semiconductor Industry*. Washington D.C.

Shivakumar, S., & Wessner, Ch. (2024). *Balancing the Ledger: Export Controls on U.S. Chip Technology to China*. CSIS, https://www.csis.org/analysis/balancing-ledger-export-controls-us-chip-technology-china (accessed on 27th February 2024).

Swanson, A. (2023, 8th August). *Biden to Restrict Investments in China, Citing National Security Threats*. The New York Times, https://www.nytimes.com/2023/08/08/business/economy/biden-china-companies-restrictions.html (accessed on 27th February 2024).

Sykes, A.O. (2021), The Law and Economics of "Forced" Technology Transfer and Its Implications for Trade and Investment Policy (and the U.S.–China Trade War). *Journal of Legal Analysis*, *13*(1), 127–171. DOI: 10.1093/jla/laaa007

The State Council of China (n.d.), *China to invest big in 'Made in China 2025' strategy*, http://english.www.gov.cn/state_council/ministries/2017/10/12/content_281475904600274.htm (accessed on 27th February 2024).

Triolo, P. (2024, 5th March). China's Semiconductor Industry Advances despite U.S. Export Controls, Center for Strategic and International Studies, https://www.csis.org/analysis/chinas-semiconductor-industry-advances-despite-us-export-controls (accessed on 27th February 2024).

White House (2022, 9th August). *FACT SHEET: Chips and Science Act Will Lower Costs, Create Jobs, Strengthen Supply Chains, and Counter China*, https://www.whitehouse.gov/briefing-room/statements-releases/2022/08/09/fact-sheet-chips-and-science-act-will-lower-costs--create-jobs-strengthen-supply-chains-and-counter-china/ (accessed on 27th February 2024).

White House (2024, 20th March). *U.S. Semiconductor Joba are Making a Comeback*, https://www.whitehouse.gov/cea/written-materials/2024/03/20/u-s-semiconductor-jobs-are-making-a-comeback/ (accessed on 27th February 2024).

World Trade Organization (2023). *Global Value Chain Development. Resilient and Sustainable GVCs in Turbulent Times. From Fabless to Fabs Everywhere? Semiconductor Global Value Chainsin Transition*. Geneve.