

## ***Power Trip Chip: Potential Implications of the US-China Technology Trade War***

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A recent article by Evelyn Cheng of CNBC, *Chinese chip stocks tumble after U.S. calls for new curbs on high-end tech*, details the many economic consequences of new trade limitations announced on October 7th by the U.S. Department of Commerce's Bureau of Industry and Security (BIS) (Cheng, 2022). In order to "protect US national security and foreign policy interests" and restrict China's ability to 1) obtain advanced computing chips, 2) develop and maintain supercomputers, and 3) manufacture semiconductors, the BIS announced rules that force companies to apply for a license in order to sell specific advanced computing chips or manufacturing equipment to China. This also applies to any foreign companies who use American tools to produce high end chips, a provision included presumably to deliver an additional blow to China, as the entire global semiconductor industry is almost entirely dependent on American chip design tools. The rule also prohibits "US persons", a term which includes both American citizens and green card holders, from providing any kind of support for "development or production" of chips at Chinese chip manufacturing facilities (US Department of Commerce, 2022). Overall, the new ban blocks China's access to make or buy advanced semiconductor chips that the US thinks will serve as the key to supremacy in the future. As a result of these new BIS regulations, Cheng reported, several stocks slipped in value - Semiconductor Manufacturing International Corporation (China's largest chipmaker) was down 3% amidst broader market sell off, Hua Hong Semiconductor was down 9%, and Shanghai Fudan Microelectronics was down more than 20%. Mao Ning, a spokesperson for the Chinese Ministry of Foreign Affairs, responded to the new restrictions in a briefing, stating that "The US has been abusing export control measures to wantonly block and hobble Chinese enterprises. Such practice runs counter to the principle of fair competition and international trade rules."

Recent American policies meant to slowly block China's access to semiconductor chips will surely have some immediate consequences for China, as displayed by the tumbling stocks mentioned in the article. *Despite these "benefits", however, I think it is entirely possible that an attempt to buckle China's ability to develop advanced semiconductor capabilities will backfire in more ways than one. The policies have some inherent flaws because of their reliance on international cooperation, and even if the plan does work, the policies will inevitably hurt American businesses as well. Additionally, restricting China's semiconductor ability might lead them to both retaliate and pave the way for China to build an even stronger, more independent semiconductor ecosystem.*

This BIS filing is just the latest of a string of US efforts to curb China's access to semiconductor innovation. In May of 2020, the United States prohibited companies from exporting chips made with American technologies to Huawei, the massive Chinese telecom company (Shepardson et al., 2020). In the past few months, President Biden has ordered the Committee on Foreign Investment in the United States to more critically examine Chinese investment in American semiconductor businesses (Alper & Holland, 2022), the CHIPS and Science Act prohibited any recipients of its funding from expanding chip production in China for at least the next decade (Lo, 2022), and the Biden Administration recently ordered Nvidia, one of America's foremost hardware companies, to stop selling advanced AI chips to China (Nellis & Lee, 2022). Notably, this latest BIS regulation is the most significant

restriction attempt against China, as it not only bans exporting chips themselves to China (no matter where they were made, as long as they were made using US design tools), but also bans the export of the tools used to make the chips themselves. The restriction against any US personnel working at Chinese chip companies is a stark one, as personnel restrictions like this have typically only been used against “rogue states” such as North Korea and Iran, and many executives at Chinese chip companies (more than a dozen Chinese chip firms have several senior executives with US citizenship or greencards) will be forced to resign or risk breaking the law (He, 2022). These policies together represent the most significant technology export restrictions against China implemented by the US in decades, marking a turning point in what is sure to become a trade battle between the two powerhouses.

So what is it exactly about these chips that make them worth fighting over? Most people might not know it, but in the course of any given day, we touch hundreds of computer chips - from laptops and smartphones and vehicles to home appliances and consoles and voice-activated speakers (Ovide, 2021); with society become increasingly digitized, the number of chips that the U.S. civilian economy relies on will only continue to grow. Semiconductor chips are also especially relevant for national security - advanced military applications, defense systems, and national cyber infrastructures are all completely dependent on semiconductor progress. The United States remains the world's foremost leader in chip *design*, producing almost all of the most groundbreaking research and thought leadership on chip design. Furthermore, 85% of the global EDA market is controlled by 3 American companies (Cadence, Synopsys, and Mentor Graphics), and most EDA startups specialize in a niche subarea and aim to be bought by one of the “big three” (Yang, 2022). Unfortunately, the United States has a deeply lagging ability to actually *manufacture* these crucial chips. 90% of the world's supply of advanced semiconductor chips is produced in Taiwan, a country only around 100 miles from China's coast and one that Beijing claims is a part of the PRC (Brown, 2020). Taiwan Semiconductor Manufacturing Co. (TSMC) is the world's largest contract manufacturer of semiconductor chips, and has been called by Time Magazine “the world's most important company you've never heard of” (Cambell, 2022). The US itself does not officially recognize Taiwan's independence from China (US Department of State, 2022), and amidst statements from Beijing threatening to “reunify” Taiwan with the rest of Mainland China (Ma, 2022), US officials have expressed fear that China could use a blockade of Taiwan to cut off the US's access to fundamental semiconductor technology in a time of war or a national security crisis. In an interview with Vox, Tufts professor and *Chip War* author Chris Miller has likened the world's reliance on chips to its reliance on oil. “If Taiwan chipmaking were to be knocked offline, there wouldn't be enough capacity anywhere else in the world to make up for the loss. Even simple chips will become difficult to access, just because our demand outstrips supply” (Heilweil, 2022). When asked about the impact of a potential war on TSMC's productivity, the company's chair Mark Liu stated that “[if Taiwan were invaded by China], you will render [the] TSMC factory not operable” (Leswing, 2022).

Given this context into the importance of semiconductors for national security and the potentially disastrous consequences if the extremely sensitive current supply chain system fails, America's reasoning for wanting to buckle Chinese semiconductor capabilities makes sense. I think that one of the fundamental flaws in this plan, however, is that it relies on international cooperation. Even if the United States puts export holds on China, the semiconductor industry has a supply chain that is inherently multinational - each step of the manufacturing process is typically almost completely based in a different country. The United States handles most of the design, the Netherlands builds equipment to manufacture the chips, Taiwan and South Korea manufacture most of the chips, and China handles most of the assembly, packing, and testing (other countries are also involved in this process). In this “winner takes all” ecosystem, especially given that China imports more than \$300 billion of semiconductors every year (Thomas, 2021) (not all of which is from the United States), there is a high probability that despite being US allies and/or with US pressure, many nations will not want to fully stop semiconductor

trade with China. Netherlands-based company ASML, for example, is the only company in the world able to make specific, complex machines needed to produce advanced chips, and China is one of their largest customers - they have projected that if they halt all trade with China, they will lose 16% of their sales in 2023 revenue (He, 2022). In yet another example of international reluctance, according to a recent *BusinessKorea* article, authorities in Seoul responded to a plan cutting off semiconductor trade with China by calling it "not fully acceptable" (Pan, 2022). Given South Korea's large investment in China, this is a reasonable response: according to data reported by a Representative of the Democratic Party of Korea's Ministry of Trade, South Korean semiconductor giant Samsung Electronics has invested over \$17.1 billion in the Chinese market between 1997 and 2000, which is over 5 times the amount they invested in the US market, at \$3.8 billion (Yon-se, 2022). Given this large investment, and the power of China in the region, it makes sense that many foreign authorities would fear retaliation from Beijing, and thus would not commit to breaking all business relations with China, thereby weakening the "chokehold" the US hopes to put on China.

Even if the United States is able to successfully rely on international cooperation, however, I think that massive restrictions like these will deliver a solid blow to American companies themselves. Major American semiconductor companies get at least 25% of their sales from China (Thomas, 2021) - Lam Research (an American semiconductor equipment firm), for example, has stated that new American regulation will cost them \$2.5 billion in 2023 revenue (He, 2022). This forced decrease in demand might significantly hurt companies who traditionally relied on China for a large percentage of their sales. In this way, while the original aim of Biden's export bans was to hurt China, they will inevitably hurt American companies as well. (Presumably, however, Biden's cabinet and advisory team took this into account before announcing their decisions, and decided that the benefits of delivering a heavy blow to China was worth the damage to American companies.)

Another unintended consequence of Biden's export bans might be a Chinese retaliation against the West. The series of blows delivered by restrictive American policies have antagonized Chinese authorities. Mao Ning, a spokesperson for the Chinese Ministry of Foreign Affairs, responded to the new restrictions in a briefing, stating that "The US has been abusing export control measures to wantonly block and hobble Chinese enterprises. Such practice runs counter to the principle of fair competition and international trade rules" (Cheng, 2022). Chinese leaders likely see these new bans as an attack on Chinese progress (which they are). Xi Jinping's fundamental platform has been based on Chinese supremacy, self sufficiency, and grand plans to show strength against American power - recently, in the CCP's 20th congress on October 16th, he delivered a speech that contained 91 mentions of the word *anquan* ("security") (compared with 35 mentions in Xi's predecessor Hi Jintao's farewell address in 2012), 22 mentions of *douzheng* ("fight"), and 21 mentions of *junshi* ("military") (The Economist, 2022). His speech described "external attempts to blackmail, contain, blockade and exert maximum pressure on China" and declared that China had "shown a fighting spirit and a firm determination to never yield to coercive power" (The Economist, 2022). With these bold, nationalistic declarations, Xi might feel the need to show a grand display of retaliation, grandstanding on his agenda. The nature of the interconnected global economy and supply chain means that there aren't many major actions he could take against the US that wouldn't also deeply wound the Chinese economy (i.e. targeting Apple, which employs a large number of people in China), but he *could* restrict American access to rare earth metals, the global supply chain of which China dominates 80% (Subin, 2021). It could also start imposing restrictions on the exports of products it dominates. A strong retaliation is a rare possibility, but if China is truly angered by the scale of recent semiconductor export restrictions and their crippling effects, Beijing might decide that it is worth the cost to retaliate.

Perhaps most importantly, choking off China's access to semiconductor chips and advanced AI capabilities will likely force them to grow their own industry that is even more advanced in its capability than it would have been

had they not been forced into isolation. Self sufficiency, a theme that has already proven to be deeply important to Xi (as we saw above), applies to technology as well, and China will employ bold industrial policies to more rapidly build their own semiconductor capabilities. Industry police refers to any government policy that changes input costs, output prices, or other regulatory treatment in order to encourage resources to shift into a certain industry. It is especially used to encourage growth in sectors that a government feels will be absolutely critical for national security or economic competitiveness (Yang, 2022). Beijing has taken several avenues to both outline and implement such industrial policies.

China's 14th Five Year Plan, a "manifesto" of sorts that features targets for social and economic development for the years 2021-2025, included a bold chapter titled "A Vision for a Technologically Advanced and Self-Reliant China" (Kaja et al., 2021). The chapter, which detailed frontier technology fields that Xi believes should be at the forefront of the vision for the future, prominently highlighted Semiconductors and New Generation Artificial Intelligence and aims to bolster domestic semiconductor manufacturing. Beijing published *Guidelines to Promote National Integrated Circuit Industry Development* in 2014, outlining a plan to increase the local content of semiconductor chips by 70% by 2025 (Kennedy, 2015), which they revised in 2019 to 80% (Congressional Research Service, 2021).

The government has already taken actionable steps to implement these goals, including several of the practices it typically employs in order to influence industry: "subsidies, tax preferences, trade and investment barriers, and discriminatory antitrust, IP, procurement, and standards practices" (Congressional Research Service, 2021). Beijing created the China Integrated Circuit Investment Industry Fund (CICIIF) in order to route more than \$150 billion into the domestic semiconductor industry. The central government waived taxes on imported materials for any chipmaking plants that produced advanced semiconductors (Pan, 2021). Because these goals were integrated into the "incentive system" for local governments and government officials, Shanghai introduced a plan to subsidize 30% of investment in semiconductor projects in the city (Pan, 2022), while Zhejiang's local government introduced a plan to ease the financial burdens of those working in semiconductors by \$47.42 billion (Qu, 2022). China also has several advantages when it comes to talent - China has emphasized STEM education to a point where it now produces significantly more STEM PhDs than the USA (49,498 vs. 33,789), and it is on track to produce nearly double the number of American STEM PhDs by 2025 (Nietzel, 2021). Beijing has also implemented several foreign talent acquisition programs, through which they have wooed almost 3,000 Taiwanese semiconductor engineers and recruited several top executives from TSMC to return to China's SMIC (Congressional Research Service, 2021).

Building a completely independent semiconductor supply chain from scratch would come at an immense cost to China - Boston Consulting Group has estimated that achieving core semiconductor independence would cost between \$900 billion and \$1.23 trillion (Shankland, 2022). Despite this, Xi Jinping's deeply nationalistic, self-reliant, and determined language in recent speeches suggests that China is determined to prove itself. One of the main reasons China has been able to become the US's main competitor is because of this extreme determination to a cause, and I think this spirit will carry through in this case as well. China has taken a rapid number of steps to work towards this goal, and given their industrial policy focus on semiconductors, it would not be surprising if they were able to slowly and surely build up major parts of their own semiconductor supply chain network, limiting the impact of US export restrictions. This would prove disadvantageous to American goals of completely limiting China's advanced semiconductor abilities, and might also lead to a world in which the East and the West have two completely different semiconductor ecosystems (analogous to how the US and EU have different electrical outlets), which would result in high costs to users across the world.

There are a few action items that the US could possibly take in order to more both specifically protect the US and curb Chinese semiconductor progress. In order to address the uncertainty of the export regulation's current cooperation dependencies on foreign nations, the State Department could consider negotiating with key trade

and political allies such as the EU, Japan, and South Korea in order to write into stone official multilateral policies to counteract Chinese semiconductor progress. Additionally, although academic openness is absolutely integral to research progress worldwide, the government could consider potentially limiting the amount of software and open source content itself that is shared with China, as well as limiting the flow of information across international borders in large tech companies that deal with semiconductors, some of which are headquartered and based in the US but have large research and development labs internationally (including IBM, Apple, etc.)

Overall, the US's recent export regulations will likely prove to be incredibly effective, at least in the short term, at curbing Chinese semiconductor progress. In the long term, however, these regulations might be difficult to fully enforce (as companies can apply for licenses and it involves international cooperation) and might hurt American technology companies. Additionally, although these policies will likely immensely hurt China's immediate ability to deal with semiconductors, they might also deepen Chinese motivation to accelerate their semiconductor research and manufacturing efforts, running the risk of creating a situation analogous to a hydra - cut off one head, and two shall return.

## References

- Alper, A., & Holland, S. (2022, September 15). *Biden tells foreign investment panel to screen deals for data, cyber risks*. Reuters.  
<https://www.reuters.com/world/us/biden-tells-foreign-investment-panel-screen-deals-data-cyber-risks-2022-09-15/>
- Bown, C. P. (2020). *How the United States marched the semiconductor industry into its trade war with China* (20-16). Peterson Institute for International Economics.  
<https://www.piie.com/sites/default/files/documents/wp20-16.pdf>
- Campbell, C. (2021, October 1). *From phones to cars and fridges, this Taiwan firm powers the world. But success brings problems*. Time. <https://time.com/6102879/semiconductor-chip-shortage-tsmc/>
- Cheng, E. (2022, October 10). *Chinese chip stocks tumble after U.S. calls for new curbs on high-end tech*. CNBC.  
<https://www.cnbc.com/2022/10/10/chinese-chip-stocks-tumble-after-us-calls-for-new-curbs-on-high-end-tech.html>
- Congressional Research Service. (2021, April 20). *China's New Semiconductor Policies: Issues for Congress*. <https://crsreports.congress.gov/product/pdf/R/R46767>
- The Economist. (2022, October 20). *In his reports to the party, Xi Jinping signals change subtly*.  
<https://www.economist.com/china/2022/10/20/in-his-reports-to-the-party-xi-jinping-signals-change-subtly>
- He, L. (2022, October 10). *US curbs on microchips could throttle China's ambitions and escalate the tech war* | CNN business. CNN.  
<https://www.cnn.com/2022/10/31/tech/us-sanctions-chips-china-xi-tech-ambitions-intl-hnk>
- Heilweil, R. (2022, September 28). *Why computer chips are now at the center of global politics*. Vox.  
<https://www.vox.com/recode/2022/9/28/23375712/chips-semiconductors-china-taiwan-conflict>
- Kaja, A., Stein, S., & Xiang, T. (2021, July 7). *China's 14th five-year plan (2021-2025): Signposts for doing business in China*. Global Policy Watch.  
<https://www.globalpolicywatch.com/2021/04/chinas-14th-five-year-plan-2021-2025-signposts-for-doing-business-in-china/>
- Kennedy, S. (2015, June 5). *Made in China 2025*. Center for Strategic and International Studies |.  
<https://www.csis.org/analysis/made-china-2025>
- Klein, J. X. (2021, June 17). *Restrictions are needed but full US-China tech decoupling isn't wise: Yellen*. South China Morning Post.  
<https://www.scmp.com/news/world/united-states-canada/article/3137573/united-states-may-decouple-china-protect-security>
- Leswing, K. (2022, August 2). *Apple chipmaker TSMC warns Taiwan-China war would make everybody losers*. CNBC.

<https://www.cnn.com/2022/08/02/apple-chipmaker-tsmc-warns-taiwan-china-war-would-make-everybody-losers.html>

- Lo, K. (2022, September 7). *No 'advanced tech' factories in China for US firms getting chips act money*. South China Morning Post.  
<https://www.scmp.com/news/china/article/3191596/us-chips-act-bars-american-companies-china-building-advanced-tech>
- Ma, J. (2022, October 16). *Beijing will do its utmost for peaceful reunification with Taiwan, Xi says*. South China Morning Post.  
<https://www.scmp.com/news/china/politics/article/3196158/beijing-will-do-its-utmost-peaceful-reunification-taiwan-xi>
- Nellis, S., & Lee, J. L. (2022, September 1). *U.S. officials order Nvidia to halt sales of top AI chips to China*. Reuters.  
<https://www.reuters.com/technology/nvidia-says-us-has-imposed-new-license-requirement-future-exports-china-2022-08-31/>
- Nietzel, M. (2021, August 7). *U.S. Universities Fall Further Behind China In Production Of STEM PhDs*. Forbes.  
<https://www.forbes.com/sites/michaelnietzel/2021/08/07/us-universities-fall-behind-china-in-production-of-stem-phds/?sh=c54271946067>
- Ovide, S. (2021, May 13). *Computer chips are the new toilet paper (Published 2021)*. The New York Times - Breaking News, US News, World News and Videos.  
<https://www.nytimes.com/2021/05/07/technology/computer-chip-shortages-toilet-paper-pandemic.html>
- Pan, C. (2021, March 30). *China to waive import taxes for semiconductor companies until 2030*. South China Morning Post.  
<https://www.scmp.com/tech/policy/article/3127632/china-semiconductor-beijing-waive-taxes-imported-materials-parts-until>
- Pan, C. (2022, January 19). *Shanghai offers big subsidies to attract chip talent and investment*. South China Morning Post.  
<https://www.scmp.com/tech/tech-war/article/3163966/us-china-tech-war-shanghai-showers-cash-woo-semiconductor-talent-and>
- Pan, C. (2022, March 30). *Washington eyes chip alliance with Asian Allies to squeeze China: Report*. South China Morning Post.  
<https://www.scmp.com/tech/tech-trends/article/3172418/us-china-tech-war-washington-said-eye-chip-alliance-japan-south>
- Qu, T. (2022, January 24). *Alibaba's home province to offer preferential tax policies*. South China Morning Post.  
<https://www.scmp.com/tech/policy/article/3164557/alibabas-home-province-offer-preferential-tax-policies-and-promote-hard>

- Shankland, S. (2022, August 11). *Global chip shortage and \$53B subsidy boosts US manufacturing*. CNET.  
<https://www.cnet.com/tech/computing/global-chip-shortage-gives-us-manufacturing-a-boost/>
- Shepardson, D., Freifeld, K., & Alper, A. (2020, May 15). *U.S. moves to cut Huawei off from global chip suppliers as China eyes retaliation*. U.S.  
<https://www.reuters.com/article/us-usa-huawei-tech-exclusive-idUSKBN22R1KC>
- Subin, S. (2021, April 17). *The new U.S. plan to rival China and end cornering of market in rare earth metals*. CNBC.  
<https://www.cnbc.com/2021/04/17/the-new-us-plan-to-rival-chinas-dominance-in-rare-earth-metals.html>
- Thomas, C. A. (2021, January 8). *Lagging but motivated: The state of China's semiconductor industry*. Brookings.  
<https://www.brookings.edu/techstream/lagging-but-motivated-the-state-of-chinas-semiconductor-industry/>
- US Department of Commerce. (2022). *Commerce Implements New Export Controls on Advanced Computing and Semiconductor Manufacturing Items to the People's Republic of China (PRC)*. BUREAU OF INDUSTRY AND SECURITY, Office of Congressional and Public Affairs, US Department of Commerce.  
<https://www.bis.doc.gov/index.php/documents/about-bis/newsroom/press-releases/3158-2022-10-07-bis-press-release-advanced-computing-and-semiconductor-manufacturing-controls-final/file>
- US Department of State. (2022, May 28). *U.S. relations with Taiwan*. United States Department of State.  
<https://www.state.gov/u-s-relations-with-taiwan/>
- Yang, D. (2022, September 29). *Industrial Policy*. Harvard University, Economics 1133, Political Economy of China.
- Yang, Z. (2022, August 18). *Inside the software that will become the next battle front in US-China chip war*. MIT Technology Review.  
<https://www.technologyreview.com/2022/08/18/1058116/eda-software-us-china-chip-war/>
- Yon-se, K. (2022, October 24). *Chip firms invested 10 times more in China than US: Lawmaker*. The Korea Herald. <https://www.koreaherald.com/view.php?ud=20221024000595>