The Impact of Export Controls in 2022 Targeting the Import of US Made Integrated circuits, Semiconductors and Processors to China

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ABSTRACT: Modern computing power is a commodity derived from the heightened awareness that all competitive nations will naturally try to leverage in the 21st century. Including air, land, sea, and outer space; the acquisition, conditioning and controlling of data harvested from our vast informational landscape is regarded as a coveted cutting-edge advantage as we transition from the Information Age to the Experience Age. Nations who are not prepared, either theoretically or practically (for example a nation who is intellectually competent but lacks an effective supply chain) will spend money or create disruptions (externalities) to level the playing field and remain in contention. There is a subtle maneuver that can provide some degree of security or handle on an emerging or persistent economic risk. Sometimes not as subtle, and more of a political joust; export controls can serve as a limit or warning to a nation that their productivity can be hobbled by decree, levied by a council of their peers. This paper will serve to examine whether current export controls placed on China from the Biden administration can be considered a success or a publicity device.

Keywords: computing power; data; externalities; limits; China; risk; export controls

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1. *Introduction*

The idea of an export control originates back to the early days of the colonial empire (Export Controls, 2023). US Export controls were developed to combat the logistics plans of the early revolutionary war enemy, Great Britain. The US carried this

war doctrine forward since the revolutionary war, effectively restricting the military and civilian supply chains of their opponents and shrinking or disrupting production, thereby limiting the range or variety of competitive military power. (Export Controls, 2023)

COCOM - a weapons exchange compliance structure, replaced.

In modern developments, the identity and use of export controls has shifted due to drastic policy changes occurring during 1993-1996. The reigning, antiquated, export control council, COCOM (Coordinating Committee for Multilateral Export Controls) was replaced in a move which enabled a reorganization known as the Wassenaar Arrangement in July 1996. The focus improved upon Cold War weapons proliferation doctrine and aimed to contribute a greater stability, regionally and internationally that is specifically focused on promoting increased responsibility in weapons and technology transfer. Along with the added responsibility, this meant the official council of knowledge and communication, a long standing and guiding authority on export rules and regulations was now in contention between these two ruling councils. Ultimately, a verdict was established during a series of conferences in Vienna and the “New Forum” as it was named, (Grimmett 1996) was partitioned into two basic areas; the conventional weapons exports Munitions List (ML) and the sensitive commercial dual-use (DL) items and technologies. Extra consideration was placed on those items where the end user included non-Wassenaar members. Although this arrangement sounds novel, the details carried within this policy agreement are not original (Grimmett 1996). Under those two divisions of the Wassenaar arrangement, (DL and ML) items were to be catalogued according to their intended end use and application, with particular attention paid to any ‘distinguishing’ characteristics. This language provides a focus on materials to be controlled and how to handle them within the organization. From this frame, the members constituted a collection of countries that were genuinely interested in controlling weapons and emerging technology derived from innovative nations, reducing global risk, and focusing on limiting accessibility to bad actors virtually inhabiting “pariah nations”.

2. Export Control use in the field

Beginning in October 2022, the export of microprocessors (specifically targeting Chinese and Russian Nvidia GPU procurement) has been under constant focus and scrutiny within the cybersecurity policy creation field. Since the Biden administration announced export controls on the Chinese mainland and subsequently declared and earmarked a staggering $250 billion dollars to fund the CHIPs Act, the United States has been rumored to be attempting a technological revival. Based upon actions from the

Biden administration, specifically their adjustments and dedication to issues in cybersecurity including the production of competitive, dual-sourced technologies, a widespread effort to recapture and reshape the digital landscape has gained needed momentum. Hitting at the heart of the silicon trade, economic attacks on Chinese import and delivery of integrated circuits has curbed anticipated demand in China, stifling the acquisition of American technology and manufacturing equipment.

Included in new guidance delivered by the U.S. Commerce Department, Bureau of Industry and Security ("BIS"), two rules have since been introduced with the intention of limiting Chinas ability to create, purchase, or otherwise obtain advanced computing chips and supercomputers. These restraints have effectively targeted the production of advanced semiconductors (Lockett, 2022). Following the policy amendments and pointed execution by the US government, Chinese markets, and media report that China is losing semiconductor and microprocessor manufacturing market value. Sources have directly attributed the downtrend to the initial export controls instituted by the US initiated in October of 2022. Some responses have been monitored and include a shift in domestic demand, signaling a slight boost to the internal Chinese manufacturing firms, albeit the sudden increase in demand is likely to be short lived. Due to their own dependencies and supply chain limitations, this increased economic activity (higher demand for mainland Chinese chip machines and semiconductors) is not a welcomed increase and may cause more internal disruptions and externalities than can be predicted by close economic examination. For example, in 2022 Advanced Micro-Fabrication Equipment commented on the current expected downtrend in demand, and disclosed their economy would be projected to lose 20 percent of forecasted revenue (Liu 2022) possibly creating feuds between firms leading to a possible market failure, negatively impacting consumers across the globe.

The change in exports and global trade means that any business exchanges between the two countries of the United States and China will require an export license (Lockett, 2022) to facilitate the exchange of microprocessors or chips made with American technology.

The export controls go further to curtail American entities from engaging in any practices with Chinese firms without explicit approval. Additionally, limiting technologies or materials that would allow Chinese manufacturers to configure their own processes, encourages a derailing of Chinese intentions to develop their own competitive computer chip supply chain.

3. Current export control initiatives

The modern supercomputer requires a host of setup machines and clean rooms to assemble the most competitive semiconductors and circuits on the planet. But, with nearly 80 billion transistors per chip, (Laio 2023) and a required average of $20 billion USD in start-up costs for chip manufacturing in 2023 dollars, the stakes are already high and rising. Increased computing power, cost and demand of semiconductors and discussions regarding Chinese dependence on the global market of computer chips, (US, South Korean, Taiwanese, Malaysian and Japanese) have all paved the way for the most recent and serious export controls to take shape in decades. In October 2023, the US Commerce department took a big step and initiated the restriction of sales to China, specifically targeting computer chips and processing hardware with Artificial Intelligence (AI) and supercomputing capabilities. The newest exclusions to hit China include virtually every piece of hardware and processor including all newly released NVIDIA products (Shilov 2023). In the year of 2023, the company of NVIDIA has faced major pressure to surrender all business ties with China and has been slowly delisting their products for sale (Kan 2023). Based upon these most recent events, the list is likely just the beginning of a campaign focused on steering demand toward friendlier nations while limiting accessibility to our adversaries and enemies. A complex set of challenges includes the high likelihood of inside actors, agents from the CCP (Chinese Communist Party) who may be in position to make supply chain and management decisions as well as steer the company's strategic outlook. Although there is no definitive proof, it remains another risk of externality to occur especially with articles highlighting the pressure to continue supplying China, circumventing US export limitations. Again, this is not proof of Chinese influence, but it is an example that US firms are able to maneuver around those strategic attempts to curb US demand in China. (Cheng 2023)

4. Underlying strategy

The background noise on this issue is quiet and low key, due to the world's top producers of high-end chips being limited to three companies, TSMC, Samsung and Intel. But behind the scenes there is a plan underway for the US to disengage from the Chinese supply chain (Choyleva, 2022), who is lagging further and further behind the high-end market but still a solid player in legacy model chips, those that fueled the "Shortage" headlines in 2021 to today. The plan to diversify the supply chain of the US to other, friendlier nations is a balancing act between national security and maintaining

the flow of cash that supports critical cutting-edge research. The research and development departments of Intel and TSMC, Samsung firms can push the margin of ingenuity with Chinese money which, among prior noted causalities, gives China some leverage today. For example, the United States depends on China for those legacy chips mentioned above, which proves their market power, giving some economic leverage in the global semiconductor trade. For clarity purposes, those legacy chips can be found in a wide range of quality American manufactured products such as automobiles, computers, and home appliances. In 2021, due to Covid-19 and subsequent cascade of economic effects, the public felt the impacts and externalities associated with the pain of waiting for parts, or the rise in cost of used automobiles due to fewer new cars available. This economic externality was a direct result of the Chinese chip shortage, which was interestingly linked to legacy products only.

Moreover, this approach provides for a slow metered strategy to leaving the Chinese industry all together. In the headlines for the upcoming 2024 election, some candidates are asking, “How can we leave the Chinese markets for good?” In 2022 the company Intel employed more than 12,000 Chinese people and secured more than 17 billion in revenue from China, which is reported by the New York Times as being 17 percent of their global total revenue. Intel has had a presence in China since the 1980’s, so, understandably this is a very sensitive topic for their team.

Virtual disentanglement of our supply chain with China requires the US to obtain steady guidance from multiple sources of information while managing the common and unique hardships associated with a spin off from the Chinese economy. If the Chinese demand for processors from the United States were to be completely erased, it is believed that US firms supporting Chinese demand would lose 1/3 of their annual revenue (Murgia, 2023). The US will undoubtedly be focused on limiting the unnecessary costs during any transition.

5. Findings

After completion of this study, it was evident the export controls from the US government did have a significant impact to the Chinese economy. However, the country still imports nearly 221 billion USD in 2023, with 32 billion USD imported in November 2023 according to China Customs. This is a low not seen since 2014 and shows the balancing act the US must perform to stabilize their economy, while protecting their interests. Conversely, the country was able to secure upwards of 420 billion in 2021, so this proves the export controls have successfully hit demand and reduced it by half. This is to be compared with 2011 when China was importing $171,492,579.482 USD of integrated circuits. Therefore, it appears these political tools

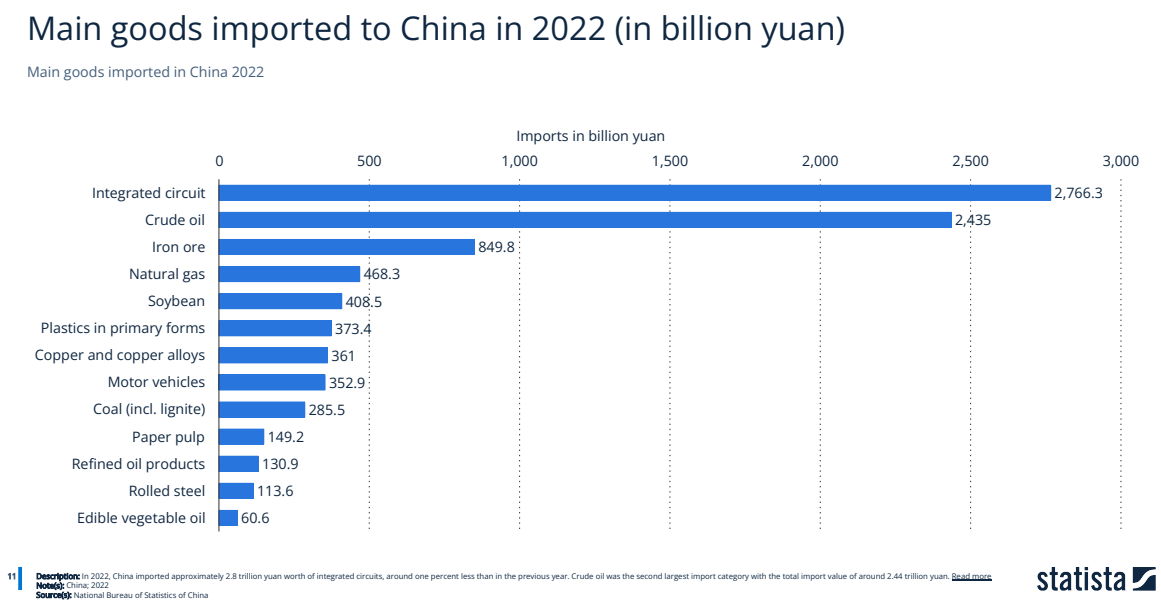
have curbed the countries demand, but it is important to note, the effects of the repercussions (externalities) have not been studied. This is a developing issue and based upon the facts collected, the use of export controls does appear to have the intended impact.

After review of many sources, sifting through quantitive data sources, I have developed Fig. 3 below. Here is a visual representation of what has occurred over the last 10 years:

See the below figures for a graphical representation of the effect on export controls as represented by the data collected from China Customs.

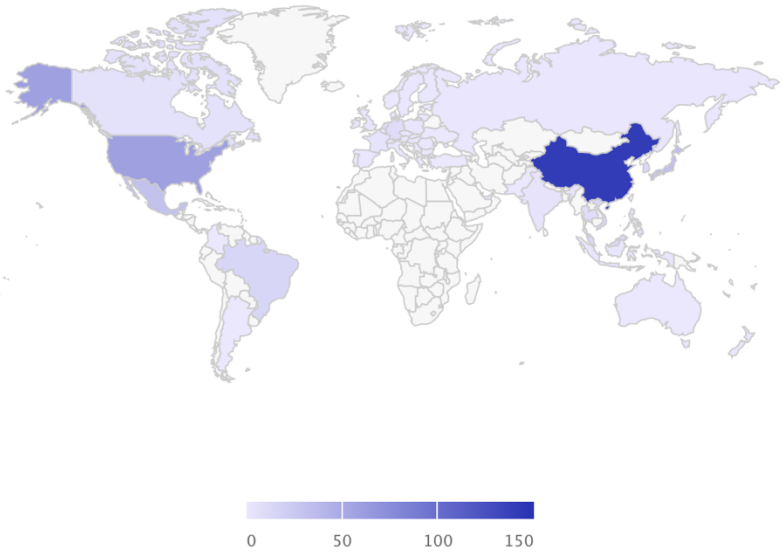
Make note of the top export, integrated circuits, and the strategic importance, overtaking the import of oil. – Fig 1.

Fig 1. Integrated circuits shortly after trade restrictions



Here is a look at how semiconductors are exchanged across the world – Fig 2.

Fig 2. Semiconductors – China



Top 5 (2023) in billion USD (US$)	
1. China	141.80
2. United States	59.23
3. Singapore	39.07
4. Japan	33.31
5. Mexico	30.67

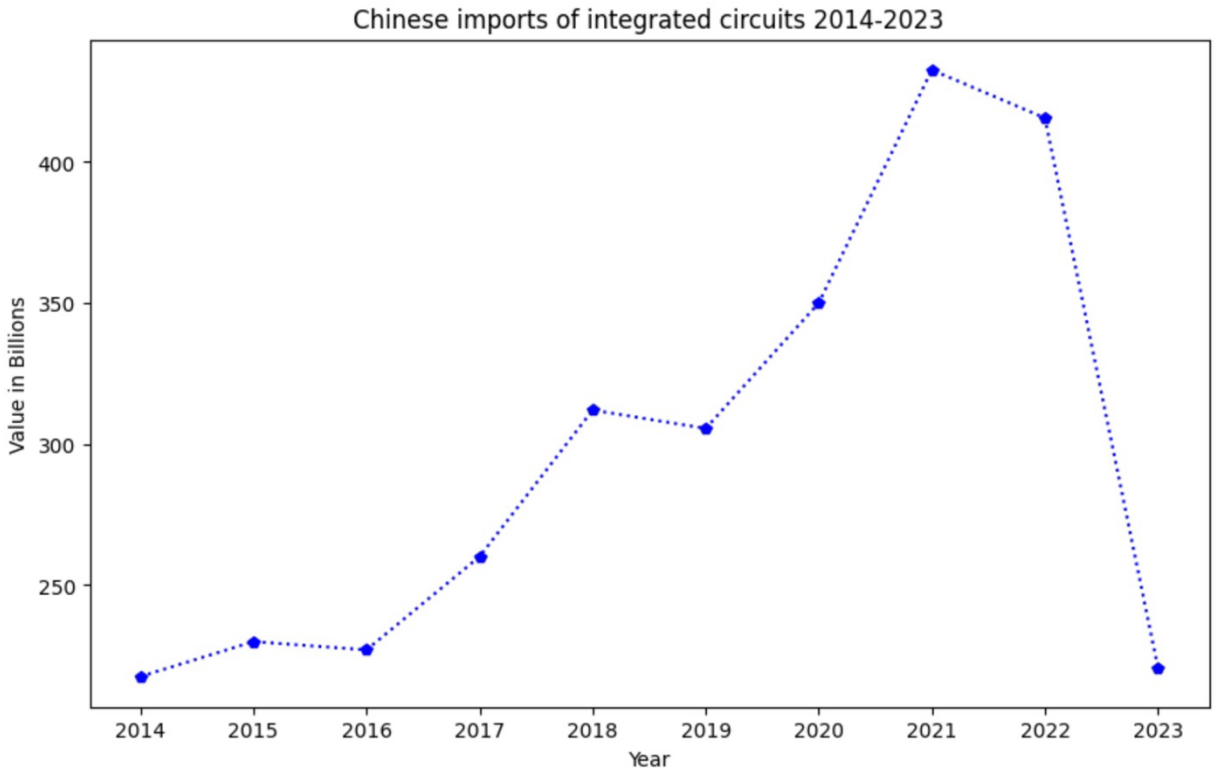
Notes: Data shown is using current exchange rates and reflects market impacts of the Russia-Ukraine war.

Most recent update: Aug 2023

Source: Statista Market Insights

Finally, in Fig. 3, you can see a steep decline in this graph produced by (H)automate Industries LLC.

Fig 3. Chinese imports 2014-2023 (integrated circuits)



Reference: Forward Intelligence (Qianzhan); China Customs

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