Rare Earths and Semiconductors in US Policymaking Amidst US-China Rivalry

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Just like coal and oil in the past, rare earth elements (rare earths) and semiconductors have become vital to economic development and national security today. Unlike other strategic interests, rare earth and semiconductor chips require enormous intelligence and capital inputs to produce. Other than economic factors in production and manufacturing, geopolitical considerations are inevitably directing the path of technology policy, especially under the intensified US-China competition after the Trump Administration initiated the tech war and trade war against China. As strategic goods, rare earths and semiconductors show their significance toward unlocking the potential of green tech for the next-generation industrial revolution, such as producing efficient communication equipment and batteries. The sustainable supply of rare earth and semiconductors also involved substantial American interests in economic development and national security. Under the background of the US-China competition, as 90% of the supply of rare earth is controlled by China, rare earth elements could be politically weaponized. For semiconductors, under its Civilian-Military Integration Strategy, China seeks to develop the most advanced technology, evading American sanctions, and to use rare earths as a political weapon to paralyze the manufacturing supply chain are detrimental to American national interests and security.

Rare earths and semiconductors are strategic goods that empower the development of a high-tech economy. Producing semiconductors requires the application of rare earths during the process. Rare earths are also used in various industrial products, such as batteries, computers, wind turbines, catalysts, televisions, lighting, and lasers (Reuters 2019; Hui 2021). For military purposes, rare earths are a critical element in many US weapon systems “including lasers, radar, sonar, night vision systems, missile guidance, jet engines, and even alloys for armored vehicles,” and acquiring rare earth elements is significantly reliant on imports, especially from China (US Department of Defense 2018 pp, 29-30). China not only extracts rare earths domestically but also imports and processes them, leading to a near-monopoly in the global rare earth market (Baskaran 2024). Semiconductors are used “in supporting critical national security applications and in underpinning geopolitically significant technology and critical infrastructure” (Griffith & Goguichvili, 2021). Semiconductors are a key component in manufacturing and economic infrastructure for everyday electronic devices, from cars to phones to household devices. Close to 80% of semiconductor manufacturing is dominated by Taiwan and South Korea (Counterpoint 2024). The only American firm of note, GlobalFoundries, reaches only 6% in market share – showing how dependent the United States is upon its allies, Taiwan and South Korea.

As Paul Kennedy notes, “grand strategy lies in policy, that is, in the capacity of the nation’s leaders to bring together all of the elements … for the preservation and enhancement of the nation’s long-term best interest (Kennedy 1991, p. 5). When facing the challenges of China and putting effort into maintaining its hegemony, the United States needs a strategy that can employ the resources to meet its long-term interests. Given the complex nature of the supply and production of rare earths and semiconductors, although the former is natural resources while the latter is manufactured products, in America’s case so as in China’s, both require coordination from different actors in the dynamic with the massive input of resources to achieve the policy goal- sustainable supply. Building up and

maintaining access to strategic goods and the predominance in the technology sector resemble the guiding principles of developing a grand strategy, which requires a domestic foundation, asserting leadership, and forging partnerships.

William Martel outlines three guiding principles in developing a grand strategy: 1) rebuilding the domestic foundation of power; 2) restraining the threats to vital American interests through exercising American leadership; and 3) forging partnerships and alliances to counter global stability threats. (Martel 2015 pp. 355–359) This article applies these three principles to build the theoretical foundation to argue that access to strategic goods matters to building and realizing the American grand strategy. Meanwhile, the three guiding principles also shed some light on the solution to reduce America's dependence on strategic goods of East Asian countries.

First, on rebuilding the domestic foundation of power, the indicator of a nation's domestic foundation of power is the state of its infrastructure. To be a hegemon and to compete economically, a state must have world-class infrastructure. In the case of rare earths and semiconductors, producing both strategic goods domestically would require advanced infrastructure to make the manufacturing functions and exercise American influence. Therefore, developing mining and refinery systems on a substantial scale and setting up semiconductor production fabs domestically would enable the United States to maintain the power to counter other countries' behaviors. Besides the industrial implications, building up this infrastructure also has political implications, showing the potential for unifying bipartisan goals.

Second, the United States should take the lead in defending specific values and practices for the benign development of the global supply chain of both strategic goods. In the case of rare earths and semiconductors, American interests are based on a stable supply of rare earths and a leading position to control the utilization of cutting-edge technology in producing advanced semiconductor chips. China's practices contradict and threatening American national interests due to the state's deep links to industry, espionage and the potential for weaponisation. The United States should employ its advanced position in the semiconductor industry to counter China's practices, such as sanctioning Chinese firms to restrain the threats posed to American interests.

Third, given the complex ecosystem of semiconductor productions, the United States would need to achieve its goal to sanction through multilateral coordination with other states to confront the threats to the stable global supply of the strategic goods. More specifically, when sanctioning Chinese tech firms, the United States needs to focus on those tech firms that have serious business collaborative relations with China. On the production side, the complex ecosystem of semiconductors shows the importance of partnerships and alliances, preventing China from accessing the most advanced technology. With patents and niches on semiconductors, the United States can exercise its leadership by forming a global alliance in the technology sector based on political ideology. Similar to dealing with American oil dependency in the '90s by diversifying the sources of oil from relying on the Middle East (David 1992, pp.156-157), the same logic can work in the case of rare earths. By diversifying the sources of rare earth from a 90% dependency on China, the United States can fund and support other countries with lower domestic pressure on loosening the environmental regulations over rare earth mining and transforming such sources of rare earth as a stable sources to meet the American demand.

A US-China tech 'war' followed the Trump Administration-initiated trade war in July 2018, when 25% of tariffs were imposed on China-imported goods, triggered by concerns that China used "unfair means, including state power and IP theft, to achieve its goal of becoming a global leader in core technologies like AI, semiconductors and 5G" (SCMP 2020). Prominent Chinese companies, such as ZTE, Huawei, and SMIC, were sanctioned by the US government. For example, SMIC, the major Chinese chip maker, needed permits from the US Department of Commerce to acquire essential software and other production equipment from its American providers – which in a worst-case scenario could halt its ability to produce (Financial Times, 2020). The complex nature of the semiconductor ecosystem made it impossible for Chinese firms to avoid the US sanctions and apply American technology unless it could produce its chips in a self-sufficient way with alternative production processes and materials. A government agency led by Vice-Premier Liu He, a trusted political ally of Xi Jinping, was established to mobilize and integrate 'resources of universities, research institutions, and private businesses to seek breakthroughs in next-generation chips for the "post-Moore Era"' (SCMP 2021). Even with such an ambitious goal, China still needs to rely on the

international supply chain to achieve its aims. Although it may be a double edged-sword, playing the card of rare earths has become one possible option to counter American sanctions, given that China controls over 90% of the global supply due to its lower labor cost, less restricted environmental regulations, and substantial state subsidies (Dreyer 2020).

Among all the four segments in semiconductor production, China does not possess significant advantages in any of them. China has involvement in the lower level (larger than 10 nanometers) of semiconductor production, and the lower end of testing. However, it does not possess any dominance or significance in core intellectual properties, equipment, and materials. Based on the quality of Chinese semiconductor manufacturers and the investments made by Taiwanese and South Korean semiconductors firms, it would be fair to assume that companies like Samsung, TSMC, and UMC largely influence Chinese involvement in production. Yet, almost all of the value chain activities are dominated by American allies, signalling that it would be tough for China to break through the technology net formed by the United States. However, China's geopolitical clout over the region could endanger the stable supply of semiconductors to the US should they continue their manoeuvres in the South China Sea and escalate tensions with Taiwan (See Calhoun 2021).

Another threat posed by China's effort to close its gap in the semiconductor sector is "China's state-directed strategy to vault into a leadership position … with massive subsidization (of) IP theft, state-financed foreign firm acquisitions, and other mercantilist practices" (Ezell 2021). Huge government-led investments pouring into in to the semiconductor sectors "are likely to disproportionately impact other global companies attempting to compete on market-based terms", either damaging American market share in the Chinese market or posing threat to the competitiveness of non-Chinese semiconductor firms, and could threaten the stability of global supply chain as China rises to a more dominant position (Bean and Ezell, 2021). For example, under the cover of civilian companies, and using software developed by American firms and semiconductors produced by TSMC, China's People's Liberation Army produced a supercomputer to develop hypersonic missiles (Washington Post 2021). The concern is more than the just the allocation of resources, but about balancing an ambitious China as it seeks to surpass America's dominance in the technology sector, and perhaps beyond.

The challenges and risks in rare earth and semiconductor issues for the United States can be summarized into four categories: (1) the halt or disruption of supply in advanced semiconductors and rare earths; (2) China's catching up to American primacy advantages in the semiconductor industry; (3) the mercantilist practices in both the markets of semiconductors and rare earths; and (4) China's application of American civilian technologies to develop advanced weapons. Therefore, the goal for the US seems clear: securing the sources of a stable supply of rare earths and semiconductors while suppressing China from eroding American advantages.

There has been a bipartisan consensus that the lack of domestic production is a weak point to American national security, given that almost all defense systems need rare earths to produce, and to keep functioning. To counter the risk that rare earths could be weaponized by China, the United States should either find alternative supplies from other countries (such as Japan) which have stable and positive relations with the United States, or promote the private sector to invest and produce domestic supply of rare earths (Bryen 2019). Both options are costly and will take time to develop. Previously, the Obama Administration made attempts to produce rare earths, but none were successful due to high costs and tight environmental regulations. These remain obstacles to any attempts to go back to the market conditions of the 1990s when United States actually dominated rare earth production (Bell 2012). Today the scale of building up the capabilities for more production, according to one analyst, "simply do not exist in the West" (CNBC 2021). As Bell (2012) pointed out, "the Chinese didn't create our present rare earth challenges. We alone did through increasing dependence upon confused and conflicting government policies".

In terms of policy, firstly, as there are no independent authorities in China to monitor the use of American technology, the United States should continue sanctions on Chinese tech firms in order to prevent China acquiring sensitive American technology – either through acquisition or reverse engineering. Secondly, having more advanced semiconductors domestically produced is essential. The CHIPS (Creating Helpful Incentives to Produce Semiconductors) provides over $50 billion in federal funding to this end, and can be seen as signs of early momentum in this area – though the investment needs to go far beyond physical infrastructure. The US would need

to increase education, research, and development in the relevant industries in order to produce sufficient amounts of scientist and engineers, and not just reply on importing talent. Thirdly, given the complexity of the semiconductor production process and its globalised ecosystem, the United States should strengthen its ties with its allies to stabilize the supply chain by using whatever multilateral means it has at its disposal. This is especially important because American sanctions could be ineffective if other key players in the production process do not participate with America's agenda (He 2021).

These efforts seem to promote decoupling between the US and China, which is warned against by some as it ignores the complexity of the market, and could hurt US access to the wider Chinese economy (see Allison 2021 and Dreye 2021). Yet, even assuming China will emerge as a leading state in the semiconductor industry eventually, it is a smarter move to leverage US technological and strategic superiority to take preemptive measures now – when considering the wider national security picture.

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