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## **Semiconductors & Artificial Intelligence: High Stakes Chips in the US-China Competition**

*By Cung Vu*

### **SYNOPSIS**

*Semiconductors are often referred to as the new "oil" of the digital era. They are the foundation for enabling technologies such as artificial intelligence and have emerged as key players in the geopolitical competition between the United States and China.*

### **COMMENTARY**

Semiconductors are indispensable in every aspect of daily life, from smartphones, computers, and energy to military and defence applications. They provide computational power and memory to support artificial intelligence (AI) across a wide range of applications. The US and China are engaged in a competitive race for AI leadership, recognising its potential for driving economic growth, innovation and military power.

### **Semiconductors and Artificial Intelligence**

Semiconductors are essential materials in the digital world and form the basis of electronic devices such as diodes, transistors, and integrated chips. They act as conductors or insulators based on specific conditions. Due to globalisation, the semiconductor/chip supply chain, spanning research, production, and distribution, is complex. The recent chip shortage and disruptions during the COVID-19 pandemic exposed vulnerabilities in the global supply chain.

Over 75 per cent of global semiconductor manufacturing is currently concentrated in China and East Asia. Additionally, 100 per cent of the world's most advanced semiconductor manufacturing capacity (below 10 nanometers) is currently located in Taiwan (92 per cent) and South Korea (8 per cent).

AI refers to machines or computing systems capable of performing intelligent tasks, such as pattern recognition and problem-solving. A crucial aspect of AI is machine learning, which allows systems to learn and improve without explicit programming. With current enhanced computing power, advanced algorithms and data availability, AI has been widely used in national defence, healthcare, finance, transportation, and other areas.

## **US-China AI Competition**

The US benefits from a robust research and development ecosystem, advanced technology infrastructure, and a large, dynamic economy. Renowned academic and research institutions in the US have consistently produced top-tier AI researchers and globally influential companies, with pivotal breakthroughs often originating from researchers based in the US.

The huge US economy provides considerable resources and incentives for AI research and development. Leading technology giants such as Google, Facebook, and Microsoft actively contribute to the commercialisation of AI across diverse industries. Government support, including investments from agencies like the National Science Foundation and DARPA, has been pivotal in fostering AI research.

China has made significant investments in AI development to establish itself as a global leader in research and development. The Chinese government underscores its commitment through substantial investments and funding in national AI research institutes. This effort is further supported by prominent technology companies like Alibaba, Tencent, and Baidu, which have dedicated AI research labs. The country's expanding market acts as a compelling incentive for AI development across diverse industries.

Chinese internet companies are recognised for their advancement in specific aspects. China enjoys the advantage of a larger consumer base and less strict privacy regulations, facilitating the availability of abundant data for AI learning. Notably, China excels in particular AI applications, such as facial recognition and natural language processing.

## **US-China Geopolitics**

The relationship between the US and China has deteriorated, beginning in 2015 when China launched its "Made in China 2025" initiative. This initiative aimed to reduce China's dependence on foreign technology and promote Chinese high-tech manufacturers globally. Semiconductors are one of the key areas, as they are essential in nearly all electronic products.

China accounts for about 60 per cent of global demand for semiconductors but produces only 13 per cent of global supply. Tensions escalated in April 2018 when the US imposed stringent export controls on ZTE, a major Chinese telecommunications company. This event prompted China to shift its emphasis on the semiconductor industry, prioritising national security over economic considerations. By October 2020, China officially declared the semiconductor industry a top technology priority, emphasising its strategic importance.

In recent years, China has increased its assertiveness in the South China Sea, claiming that international military presence in the region challenges its sovereignty. Between the autumn of 2021 and the autumn of 2023, the US documented over 180 instances of China's coercive and risky air intercepts of US aircraft in the region.

China remains [steadfast in its policies](#), rejecting cooperation with the US on national security, economics, and trade. High-level meetings result in promises for further talks without substantial changes in China's course, signaling a diplomatic approach to delay US pressure while advancing Chinese economic, military, and technological capabilities.

The US regards China as a significant global competitor with ambitions to reshape the international order and become the world's leading power. The competition is most intense in the Indo-Pacific but has increasingly global implications, influencing economics, technology, diplomacy, development, security, and global governance.

To sustain a competitive advantage over China in AI, the US concentrates on controlling semiconductors, which are identified as the most manageable among the three foundational blocks of modern AI, i.e., data, semiconductors, and engineering talent. Cutting-edge chips and the specialised tools for their fabrication are predominantly located in a limited number of facilities, often aligned with the US government.

The export controls implemented by the US in 2022 and 2023 have notably curtailed China and 21 other countries (subject to US arms embargos) from accessing critical computing chips and semiconductor manufacturing equipment crucial for advanced weapon systems, high-end computing semiconductors, and artificial intelligence.

China retaliated in 2023 by implementing export restrictions on gallium and germanium (essential materials for the semiconductor industry), three highly sensitive graphite items, and a ban on rare earth extraction and separation technologies exports.

The US, Taiwan, and South Korea are collaborating to challenge China's ambitions across nearly every segment of the semiconductor value chain, including design, software, fabrication, materials, and manufacturing equipment. Regarding the latter, the combination of US, Dutch, and Japanese controls covers nearly every type of advanced chip-making equipment, including etching, lithography, deposition, and metrology, among others.

### **Million-dollar Question?**

Where all these will lead is a million-dollar question. The US is facing challenges on many fronts: China's attitude in the South China Sea, its support for Russia in the Ukraine-Russia war, its goal to reunify with Taiwan, and the conflicts in the Middle East, including that between Israel and Iran.

However, there has been some encouraging news. The UK, US, EU, Australia, and China, among 28 governments, signed the Bletchley declaration in November 2023 during an AI safety summit hosted by the British government. The signatories

committed to collaborating on AI safety research, emphasising the need for cooperation in promoting economic growth, sustainable development, innovation, the protection of human rights, and fostering public trust in AI systems.

In the same month, US President Joe Biden and Chinese President Xi Jinping announced at a meeting in California that they would focus on AI as part of their key points of agreement. Both countries plan to convene experts to discuss risk and safety issues associated with AI, indicating a shared interest in understanding its impact on various aspects.

On 21 March 2024, the United Nations General Assembly unanimously adopted the first global resolution on AI, which encourages countries to safeguard human rights, protect personal data, and monitor AI for risks. This nonbinding resolution was proposed by the US and co-sponsored by China.

## **Conclusion**

Going forward, it does not seem the US and China are ready to negotiate on semiconductors and artificial intelligence as global geopolitics and conflicts are still in play. Any little sign of multilateral cooperation, such as the Bletchley summit, the Biden-Xi meeting, and the recent UN resolution, are welcome signs of diplomacy in managing competitive tensions.

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*Cung Vu is a Visiting Senior Fellow at the S. Rajaratnam School of International Studies (RSIS), Nanyang Technological University (NTU), Singapore. He was an Associate Director of the Office of Naval Research Global and Chief Science and Technology Adviser of the National Maritime Intelligence-Integration Office, US Department of the Navy.*

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**S. Rajaratnam School of International Studies, NTU Singapore**  
Block S4, Level B3, 50 Nanyang Avenue, Singapore 639798