

Book Review

Chip War: The Fight for the World's Most Critical Technology. By Miller, Christopher (2022). New York: Scribner, 2022. 464 pp.

The book describes decades of development of semiconductor technology and industry, from the day the technology was first theorized by William Shockley in 1945 to modern days when “war” on the pieces of silicon intensified between two rival countries – the United States (US) and China. It helps the reader to understand the geoeconomics behind the microchips that are stuffed into daily used devices and appliances, and its complex supply chain that cuts across continents, mainly North America, Europe, and East Asia. A chip can contain billions of transistors, as predicted by Moore’s law, named after Gordon Moore, the cofounder of Fairchild Semiconductor and Intel, who predicted an exponential increase in the number of transistors per chip, supported by billions, perhaps cumulatively trillions, of money invested in research and development (R&D), either by private entity or the state. Understanding of the workings or the know-how of the industry and technology is often depicted in the book as the key to win the “war” of microchips.

The production of microchips involves two main segments, namely the design and the manufacturing or the fabrication. The separation between these segments lowered the barriers to entry into the design segment because these new firms no longer need to invest millions in capital expenditure to own their own fabrication facility. This allowed small start-ups to enter the market, thereby intensifying competition. On the other hand, the fabrication of microchips, that is subject to high capitalization as the cost of fabrication machines reaches millions and requires specialized expertise to operate, creates huge barriers to entry. Thus, the fabrication segment is characterized by the monopolization of big firms, like the Taiwan Semiconductor Manufacturing Company (TSMC), Advanced Semiconductor Materials Lithography (ASML), Samsung, Huawei and other firms that produce specialized components for lithography machinery. Despite the different market structure, innovation remains the key to keeping these firms competitive, particularly for firms in the fabrication segment.

Even though the supply chain involves multiple players from different countries, the US has retained its dominant position in microchip

technology. The question of how long the US will assert its leadership in microelectronics, however, remains an open question. Even with the recent rise of China as another semiconductor superpower, the Chinese are not able to shake the US dominance in this industry. This is reflected by the episode where the US successfully destroyed one of China's most advanced chip maker, Jinhua, through trade restriction.

The semiconductor industry, in fact, took off when the US raced against its archrival, the Soviet, in space exploration, which subsequently opened a market for Fairchild's integrated circuit. The development in the semiconductor industry helped the US to become the most powerful country in terms of military power and she won the Cold War against the Soviet, which also symbolizes a winning of democracy and free market over communism. Even though the Soviet tried to "copy" the technology of the US and build its own Silicon Valley, the controlled ecosystem did not allow its industry to flourish at a similar pace. Microchip is also a weapon used by the US to keep communism influence out of East Asian countries, including Japan, Taiwan, Singapore, and Malaysia. Besides cheap labour and weak labor unions, the decision to locate plants in East Asia was driven by geopolitical reasons, that is to maintain the US's market and technology dominance over the region. In return, countries like Taiwan, that currently control microchips supply worldwide, used microchips as their insurance to seek US protection. After the US defeat in the Vietnam war, there was a question over the US protection to Taiwan against threats from its socialist neighbour, China. Being important players in the US semiconductor supply chain, however, guaranteed the much-needed protection. Likewise, the governments in East Asia were also looking at the semiconductor industry to promote economic growth and therefore offered lucrative packages to draw American firms to locate their plants in their countries. Government involvement was also evident since many of the large players in the semiconductor industry in these economies are mainly state-backed firms.

The importance of microchip technology in military weaponries and national security keeps the US government concerned over the transfer of know-how to foreign countries. Crisis in the US semiconductor industry in the 1970s and 1980s allowed Japanese firms to take a leap forward to overtake the US as leader in semiconductor manufacturing and release themselves from the US dominance. The US government was not happy because the Japanese had been imposing high trade barriers against American firms; overly subsidizing its firms to keep costs low. Most importantly, the

rise of Japan in East Asia also threatened the US position in the region. These developments pushed the American industry players to lobby for protection in the name of national security. The trade war with Japan triggered innovation in the US, whereby the undercutting of the cost of chip production by one firm, Micron, allowed the US to successfully to regain its dominance in this industry. On the other hand, the trade war between the US and Japan paved the way for South Korea, namely Samsung, to emerge as a primary player in the industry. Taking the advantage of the desperate need of the US to find an alternative to counterpart to Japan, the South Korean government soon made Samsung a global player in chip production.

Alternatively, China entered the semiconductor industry after the era of Mao. Like other East Asian countries, the semiconductor industry in China was developed with heavy backing by the government. Among the main Chinese firms are Huawei and Yangtze Memory Technologies Corp (YMTC). Some firms, however, are surrounded by controversies – fraud and technology theft. Any action taken against China posts a threat to the industry since China is the largest market for the US semiconductor, coming from not only its huge population but also the thirst of the Chinese government for security protection. For example, China is the most surveilled country in the world, and surveillance requires devices with microchips installed in it. On the other hand, China also realizes its overdependence on US's microchips. China's efforts to secure critical chips, particularly through Huawei, producer of advanced telecom and networking gear, has raised security concerns in the US and tensions between the two world superpowers.

The rich information and elements of excitement in the book is derived from Miller's intense effort to gather information from over a hundred interviews and archival research across different parts of the world. The book therefore helps readers to not only understand the history of the industry, but also ponder upon the future. How dependent will we be on microchips and the technology that is monopolized by certain countries.

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