SEMICONDUCTORS, SUPPLY CHAINS, AND THE FATE OF TAIWAN

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> Innovation in science and technology has become the main battleground of the global strategic contest.[1]
>
> — Xi Jinping, 28 May 2021

> Realising the complete reunification of the Motherland is the shared longing of all Chinese sons and daughters and represents the essence of National Rejuvenation.[2]
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> — Xi Jinping, 13 March 2023

Introduction

At the Two Sessions in March 2023, the president of the People's Republic of China (PRC), Xi Jinping, defined complete 'reunification'[3] with Taiwan as the 'essence' of China's goal of national rejuvenation, to recover the partly imagined power, dignity, and territory enjoyed by China's last imperial dynasty at its apex. However, the 'Taiwan problem' in recent years has been complicated by an issue that dominates global headlines: the emergence of Taiwan Semiconductor Manufacturing Company Limited (TSMC) as the global leader in the manufacturing of advanced logic chips. Taiwan now sits at the centre of a global contest for hard power and systemic legitimacy.

A country's access to — or control over — TSMC's advanced semiconductor manufacturing capabilities determines its ability to acquire the critical military and economic power enabled by frontier technologies such as artificial intelligence (AI). TSMC's leading role has complicated both the Chinese and the US strategic calculus on Taiwan. On the one hand, the company's advance to global prominence has increased both China's incentive to pursue reunification and the United States' incentive to prevent it. On the other, the reliance of both countries on TSMC has historically acted as a deterrent to any conflict that would compromise their access to its critical technology. The United States' move to sever Chinese access to TSMC

and reshore its own manufacturing capabilities could decrease the deterrent value of the company to both sides, further destabilising what President Xi in his report to the Twentieth Party Congress described as a 'turbulent period of transformation' 动荡变革期 in global affairs.

At a deeper level for the Communist Party of China (CPC), Taiwan's leadership in a fundamental technology also inflames deep-rooted historical wounds. China was forced to cede Taiwan in 1895 after losing a war against Japan, which had beaten China to the modernisation process and grown strong by adopting Western technology from the Industrial Revolution. Taiwan is therefore a symbol of national humiliation as well as a cautionary tale of the risks of falling behind the global technological frontier. These issues of power, technology, and history are crystallised in US–China competition over TSMC.

The Global Semiconductor Industry

Semiconductors 半导体 — also called chips 芯片 and integrated circuits 集成电路 — fall into three categories. Logic chips act as the processing centre of devices and systems; memory chips store information; and analogue chips typically convert electrical signals into another type of energy, such as sound or movement, which interacts with the real world.

The semiconductor supply chain has three main steps — design, manufacturing, and assembly — that are underpinned by intellectual property, specialised software, equipment, and chemicals. Because of its high capital costs and complexity, the semiconductor supply chain has evolved to become globally distributed and specialised in a small number of countries. These global hubs of specialisation have created mutual dependencies across national borders, but also strategic chokepoints in the supply chain. Through its world-leading corporations, the United States occupies a dominant position in several crucial segments: the industry's underlying intellectual property (IP), chip design — especially electronic design automation (EDA) software — and manufacturing equipment. Over the past ten to fifteen years, TSMC has become the world's leading contract manufacturer of advanced logic

chips, serving global giants such as Apple and Qualcomm, and conveying a major geopolitical advantage to Taiwan. China, a late starter in the global technology race, has long been uncomfortable with its dependence on foreign, and especially US and Taiwanese, semiconductor technology.

Hard Power

Semiconductors, as a fundamental and enabling technology, go to the core of hard-power considerations in Beijing and Washington. They are the building blocks of the digital world and a prerequisite for any country intending to lead the technologies of the future, including AI, quantum computing, biotechnology, and next-generation weaponry. The State Council's *Outline for Advancing the Development of the Nation's Integrated Circuit Industry* 国家集成电路产业发展推进纲要, published in 2014, offers the following assessment: 'Accelerating the development of the integrated circuit industry is of major strategic significance to the transformation of the model of economic development, to safeguarding national security, and to increasing comprehensive national power.'[4]

It is advantageous for any nation to have a certain level of self-sufficiency in semiconductor technology. Defensively, it offers secure priority access to the semiconductor technology required for the economic and military applications that underpin national strength. Offensively, it provides leverage over weaker countries, whether deployed as strategic denial through trade restrictions or as offensive cyber-capabilities. It is worth noting that in the wake of the revelations of Edward Snowden in 2013, official Chinese media insinuated — despite a lack of evidence in the public domain — that US semiconductor companies were complicit in the extraterritorial data-collection activities of the US National Security Agency.[5]

Advanced logic chips — the production of which TSMC leads — are especially significant as they are crucial to AI, which the State Council's 2017 New Generation Artificial Intelligence Development Plan identified as 'a new focus of international competition' and 'a strategic technology that will lead in the future'.[6] AI supports a wide range of Chinese government

objectives, such as an 'intelligent' 智能化 military, an upgraded industrial base, and 'smart' government.[7] Given the centrality of AI to the economic and military goals of Beijing, Washington, and other capitals, the stakes for access to TSMC-produced leading-edge logic chips are only rising.

The Historical Stakes for China

> In modern history, one of the root causes of China's backwardness and vulnerability to attack was its backwardness in science and technology.[8]
>
> — Xi Jinping, 9 June 2014

For China, the presence of TSMC in Taiwan is not simply a hard-power consideration. It is inseparable from Beijing's deeper historical commitment to 'reunify' with Taiwan and a present-day incarnation of old anxieties. Central to the narrative of China's Hundred Years of Humiliation is the decisive role played by advanced technology in determining national power. Recent official accounts trace the Qing dynasty's (1644–1912 CE) most shameful defeats to its failure to grasp critical inflection points in the global development of technology.[9]

According to CPC historiography, the failure of the Qing to engage with the First Industrial Revolution that emerged in the United Kingdom in the 1760s led to China's vulnerability to attack and exploitation by the British Empire in the Opium Wars. Likewise, the failure of the late-Qing reforms starting in the 1860s — often called the Self-Strengthening Movement 自强运动 or Western Affairs Movement 洋务运动 — saw China miss the Second Industrial Revolution and lose the First Sino-Japanese War (1894–1895) that resulted in Taiwan coming under Japanese control. That is, the loss of Taiwan itself is directly connected to China's historical failure to, in the party's language, 'occupy the strategic high ground' in advanced technology.

Since the turn of the twenty-first century, the party has identified developments in information technology, biotechnology, new materials, and new energy as an emergent technological revolution on the scale of the

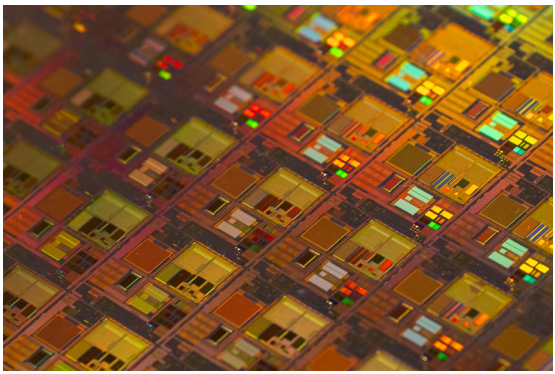
Industrial Revolution.[10] The opportunity to seize the unfolding technological revolution is 'fleeting'[11] and the spoils of history await those who can successfully translate technology into power and prosperity. For Beijing, against the backdrop of China's history of missed opportunities, US actions to deny its access to TSMC are freighted with a sense of foreboding that likely informed Xi's prediction of 'high winds and even stormy seas' in his report to the Twentieth Party Congress.[12] That is, for China's leaders, acquiring world-leading capabilities in science and technology is central to the broader goal of 'recovering' national strength, dignity, and prosperity — an objective described by Xi as 'growing strong' 强起来 and achieving national rejuvenation. Taiwan, by offering a version of Chinese modernity that differs from Xi's 'Chinese-style modernisation'[13] but has also successfully developed world-leading capabilities in a technology central to the new technological revolution (that is, semiconductors), represents an existential threat to the party's claim to being the sole steward of Chinese civilisation. In this respect, power and history converge in the 'problem' of TSMC.

Towards Decoupling

The Biden administration's move on 7 October 2022 to significantly broaden technology export restrictions on Chinese semiconductor firms was the latest major step in an unravelling in relations over a decade or more.[14]

Since at least the issuance of the US White Paper on China in 1949, Beijing has been concerned about US subversion, which evolved into a fear of containment during the Cold War.[15] This translates into a longstanding discomfort with its dependence on foreign, and especially US, technology. This discomfort informed China's renewed drive for technological self-sufficiency in 2006 with the issuance of its National Medium and Long-Term Plan for the Development of Science and Technology (2006–2020), the techno-nationalist ideas of which took shape in the Made in China 2025 initiative.

Since the release of the State Council's 2014 *Outline*, China has intensified its campaign to increase self-sufficiency in semiconductor technology. The first major pillar of this effort was the establishment of the two so-called Big



Semiconductor chips
Source: Maxence Pira, Unsplash

Funds, capitalised in 2014 and 2019 with a total of 343 billion yuan.[16] These are state-funded investment vehicles designed to support China's domestic semiconductor industry. They were complemented by generous tax, land-use, and financing policies. The second pillar was an aggressive international mergers and acquisitions drive, often funded by capital from the Big Funds, to acquire overseas talent and technology. These strategies, combined with China's willingness to use its increasing economic and military power in ways potentially damaging to US interests, alarmed business, political, and military constituencies in the United States and elsewhere, leading to a US policy response with two dimensions.

The first is a strategy to constrain China's advanced semiconductor capabilities for the stated reason of safeguarding US national security. Starting in 2019, the United States utilised its dominance of the research and development that underlie the global semiconductor supply chain to target China's two most important semiconductor companies: the semiconductor design company HiSilicon (a Huawei subsidiary) and foundry player Semiconductor Manufacturing International Corporation (SMIC). Both firms were added to the US Bureau of Industry and Security's Entity List,[17] which names companies and individuals subject to licence-based trade restrictions. The US Foreign Direct Product Rule (FDPR), meanwhile, restricted HiSilicon's access to third-nation suppliers that use US technology, including TSMC, for advanced manufacturing.[18]

The United States' diplomatic strategy to convince allies and partners to constrain China's advanced semiconductor capabilities has scored key victories. Most recently, Japan announced — without naming China — that it plans to impose export restrictions on twenty-three types of semiconductor manufacturing equipment.[19] Dutch company ASML, the world's monopoly supplier of extreme ultraviolet (EUV) lithography, has withheld or restricted the sale of key manufacturing equipment to Chinese firms.[20] Without EUV lithography machines, SMIC will be unable to manufacture commercially at leading-edge nodes of five nanometres and below. Logic chips of that complexity — over which TSMC has a near production monopoly — are vital to advanced industrial economies because they enable the most powerful computational capabilities.

The second US policy response is a state-led effort to ensure US leadership in semiconductor technology and the reshoring of production of advanced semiconductors, for which the United States currently depends on Samsung and TSMC. The enactment of the *CHIPS and Science Act* on 9 August 2022 appropriated US$52.7 billion dollars to this end, of which US$39 billion is for manufacturing incentives.

In an important speech on 16 September 2022, National Security Advisor Jake Sullivan signalled an expansion of US technological containment of China. He discarded the previous approach of maintaining 'relative' advantages over competitors in a small subset of critical technologies: 'Given the foundational nature of certain technologies, such as advanced logic and memory chips, we must maintain as large of a lead as possible.'[21] He also conceptualised technology export controls as 'a new strategic asset in the US and allied toolkit to impose costs on adversaries'. On 7 October 2022, the Department of Commerce's Bureau for Industry and Security issued a set of rules that restrict China's ability to obtain advanced computing chips, develop and maintain supercomputers, and manufacture advanced semiconductors.[22] At the core of these rules is a broadening of the scope of companies and persons restricted from selling to China and the deployment of the FDPR against a further twenty-eight Chinese advanced computing

companies, preventing them from benefiting from US-origin technology that would enable access advanced semiconductors (defined as sixteen nanometres or below) for logic chips.[23]

As the decoupling of US and Chinese supply chains continues, there are implications for TSMC and its function as a deterrent to war.

Declining Deterrent: Taiwan's 'Silicon Shield'?

In her article in the November–December 2021 issue of *Foreign Affairs*, entitled 'Taiwan and the fight for democracy', Taiwanese president Tsai Ing-wen referred to her country's semiconductor industry as 'a "silicon shield" that allows Taiwan to protect itself and others from aggressive attempts by authoritarian regimes to disrupt global supply chains'.[24] There was a degree of consensus among technologists and those engaged with global trade that TSMC acted as a strong deterrent to a hot war over Taiwan.[25] Before the United States severed China's access to TSMC's manufacturing capabilities, both Chinese and US corporations were dependent on TSMC for the production of their leading-edge logic chips. TSMC's factories operate under specific conditions and depend on uninterrupted sources of materials, water, and energy, as well as the highly trained scientists and professionals that operate them. A hot war would imperil these conditions and prove disastrous for both US and Chinese technological ambitions. But US measures to cut off China from TSMC's advanced logic-chip manufacturing capabilities reduce the costs to China of any disruption to TSMC caused by war, thereby decreasing the deterrent effect of the 'silicon shield'.

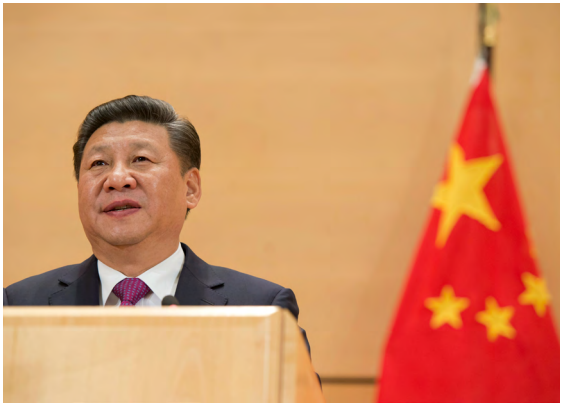
If technologists approached the question of war over Taiwan in terms of the stabilising role of TSMC, military planners saw the problem in terms of relative military capabilities. While the enormous costs of any war are obvious, some military experts are expressing concern about the deterrent effect of US military capabilities. Oriana Skylar Mastro of Stanford University has written that, in late 2020, her contacts in the Chinese military expressed for the first time the belief that the People's Liberation Army (PLA) could successfully invade Taiwan.[26] A March 2023 piece by veteran defence

intelligence officer Lonnie Henley offered a sobering assessment of US military capabilities to overcome a sustained Chinese blockade of Taiwan.[27] If the Chinese side perceives a favourable military balance or tentative US resolve, it will only further destabilise an already fragile status quo.

The strategic situation surrounding Taiwan is deteriorating, as longstanding and irreconcilable Chinese and US strategic interests with respect to the island move to the surface. The visit to Taiwan of Nancy Pelosi's delegation on 2 August 2022 precipitated extensive military exercises by the PLA Eastern Theatre Command that effectively blockaded the island and triggered an increase in military activity in the Taiwan Strait.[28] In his report to the Twentieth Party Congress in October, President Xi reaffirmed that unification with Taiwan 'will certainly be realised, and can certainly be realised', preferably by peaceful means, but by other means if necessary.[29] Around the same time, the US secretary of state, Antony Blinken, and the chief of naval operations, Admiral Mike Gilday, both asserted the possibility that China's timeline for unification with Taiwan had been brought forward.[30] While the looming danger of US power is a constant in the party's collective psyche, at the Two Sessions in March 2023, Xi for the first time squared off against the United States directly. He named the 'unprecedentedly severe' threat of US-led containment, foresaw a deteriorating international environment in which 'the risks and challenges China faces will only become more and more severe',[31] and used a more decisive formulation to signal that reunification with Taiwan is absolutely integral to the destiny of the Chinese nation.[32] Xi's carefully chosen words matter, and these rhetorical shifts indicate that Beijing's strategic posture is hardening against the perceived Western threat. The gravity of such pronouncements should not be underestimated.

Wartime Stories

Amid worsening relations and as the fabric of the globally integrated supply chain in advanced technology continues to fray, both Washington and Beijing are employing wartime metaphors and rhetoric to inspire national efforts for strategic security in semiconductors.



President Xi Jinping delivers a speech in 2017
Source: UN Geneva, Flickr

In his remarks delivered on 16 September 2022, Jake Sullivan referred to the *CHIPS Act* as 'an investment larger than the real cost of the Manhattan Project' — the United States' era-defining acquisition of the atomic bomb, which ended the Pacific War and laid the foundation for the postwar order that China sees as preserving US interests.[33] China's leaders, state media, and the scientific community have long touted the Two Bombs, One Satellite 两弹一星 achievement of the Mao Zedong era as the model for China's proven ability to realise technological breakthroughs that dramatically improve its security situation.[34] China's successful testing of an atomic bomb through the Two Bombs, One Satellite program in 1964 provided an effective deterrent to US encroachment into Asia and attack from the Soviet Union, with which it had severed relations. In a January 2021 interview, the prominent scientist and fellow of the Chinese Academy of Engineering Li Guojie 李国杰 referred to lithography machines, etching technology, and EDA semiconductor design software as the 'Two Bombs One Satellite project for the new era'.[35]

Achieving self-sufficiency in core technologies that convey strategic advantage now sits at the centre of China's economic model. This was reinforced by bureaucratic reforms announced at the Two Sessions that restructured the Ministry of Science and Technology to focus on breaking

technological chokepoints. China's quest for strategic autonomy in a febrile geopolitical context recalls the 1950s and early 1960s: it signifies a broadened role for the party-state and a likely return to major national technology projects led by scientists who will devote their efforts to the patriotic cause. Mao called such reliable technocrats 'red and expert' 又红又专.[36]

Despite SMIC's reported breakthrough in manufacturing at seven nanometres,[37] the medium-term prospects for China's advanced semiconductor capabilities are not bright. It is uncertain how the US Department of Commerce's rules will be implemented, but the stated intention of the Biden administration, building on the strategy of the Trump administration, is to utilise its extraterritorial reach to contain China's development in advanced semiconductor technology to the greatest possible extent. The wheel of decoupling is now turning with its own internal momentum.

Conclusion

> Since the 16th century, the world has gone through several revolutions in science and technology, each of which has profoundly shaped the structure of global power. In a sense, strength in science and technology determines the changes in the balance of political and economic forces in the world, and also determines the future and destiny of all countries and nations.[38]
>
> — Xi Jinping, 9 June 2014

The lessons of history are never far from President Xi's mind. He gave the above speech in 2014, which he observed was a *jiawu* 甲午 year in the traditional Chinese calendar of sixty-year cycles — one of 'special meaning'. The most famous *jiawu* year in modern Chinese history was the disastrous year of 1894 when the Sino-Japanese War broke out, resulting in a humiliating peace treaty that granted sovereignty over Taiwan to the Japanese Empire. Xi's mention of the *jiawu* year freights China's pursuit of technology with existential significance and indirectly links it to the fate of Taiwan.

From his recent language at the Two Sessions, President Xi appears to perceive that the party's protracted struggle against the US-led capitalist West has entered a new and potentially decisive phase. In attempting to deny China the very lifeblood of the new technological revolution — advanced semiconductors — the United States has struck at the heart of both Beijing's anxieties and its ambitions. For US policy not only threatens China's ability to rectify its history of missed technological revolutions; in doing so, it also imperils Xi's vision for a rising Chinese world order that would use control over Taiwan to break through the US postwar 'island chain' containment strategy. In the narrow battle for technological primacy and the broader contest of systems between Beijing and Washington, history, power and destiny converge on Taiwan.

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