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When Globalisation Meets Geopolitics in the Semiconductor Supply Chain

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ANALYSIS

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Introduction

The focus of this policy paper is the global semiconductor industry's supply chain. This will be used as a case study through which broader issues, including globalisation and the relationship between states and markets. The first question it asks is: is it possible for countries to delink from the semiconductor supply chain? Looking at the two dominant global powers—the U.S. and China—their narratives are not straightforward. Though during the Trump administration, the rhetoric of 'decoupling from China' was seemingly louder after the 2018 trade war, under Biden's administration, officials emphasised that *'there is a difference between a narrow de-risking and a broad decoupling'* (Crabtree, August 2023). It was also Biden's administration that promulgated extensive rules to limit Chinese access to technology and investment. Those regulations were refreshed and redefined with speed and comprehensiveness (*Ibid*). To be more precise, the U.S. restrictions on Chinese investment (or vice-versa) cannot be taken as the complete picture of the Sino-US relationship: As Nye indicated in his recent work, there are different dimensions of US-China interdependence, including trade, foreign direct investment, technology, education, military, environmental issues to name a few. Among those dimensions, technology is the field that these two powers have decoupled more thoroughly (Nye 2020: 9-11). It was not only because of the U.S.'s intention but also the Chinese government's initiative in 2015, Made in China (MIC) 2025[1], to expect Chinese companies to apply a higher percentage of indigenous innovation and know-how instead of relying on foreign companies' knowledge transfer. Decoupling here was, therefore, not purely US-led but something that was propelled from both sides.

Following this line of discussion, it is clear that more attention has been focused on the U.S. and China. This policy paper, on the other hand, focuses more on the in-between countries, Taiwan, Japan and South Korea, and the role they play in the technology battle between two superpowers. Many states lie between the U.S. and China in the production chain, but they tend not to side with one or the other. This policy paper argues that these 'in-between countries,' including Taiwan, South Korea, and Japan, play key roles in the production chain and are, therefore, important actors in the unfolding Sino-US technology rivalry. Apart from providing an analysis of key East Asian countries which are on the production chain of semiconductor development, the policy paper also addresses the ripple impact on the U.K. and EU in the section on policy suggestions.

The complexity of whether or not to decouple lies not only in the geopolitical concerns of different countries but also in the fundamental conflict between national interest and commercial interest. In many cases, it transpires that decoupling is not a valid option. Globalisation is well advanced, and international trade is closely linking almost all parts of the world. If a state is looking to mitigate the risk of (too) close relations with another state while at the same time acknowledging the realities of the intertwinement, then de-risking might be seen as the more feasible approach. What de-risking refers to exactly is the second question that this policy paper aims to answer.

Finally, whether it is 'decoupling' or 'de-risking,' from what is reflected in the rivalry of the semiconductor supply chain, the government's intervention in the commercial supply chain is obvious. Whether such visible intervention is sustainable or distorted for the market ecosystem, is the third puzzle that this paper seeks to solve.

To address the three core questions, this paper collects empirical data from interviews in Taiwan, Japan, and South Korea. The objective is to assess the possibility of state intervention in the semiconductor supply chain, taking into account both technological complexities and considerations of cost-effectiveness. The paper is organised as follows:

- The first section provides a foundational understanding of geopolitics and the semiconductor supply chain.
- The second section elaborates on the critical importance of semiconductors.
- In the third section, the development of the semiconductor industry in Taiwan, Japan, and South Korea is examined, with a particular focus on Taiwan Semiconductor Manufacturing Company (TSMC) as a leading producer.
- The fourth section assesses China's political economy, specifically its efforts to advance in semiconductor manufacturing amid geopolitical tensions with the U.S.
- In the fifth section, the paper answers the initial three questions based on the insights from previous sections and offers policy recommendations for the EU and the U.K. While not primary manufacturers, these regions are significant contributors to the broader semiconductor supply chain, particularly in terms of machinery and design.

This organisation aims to provide a thorough understanding of the complexities involved in the semiconductor supply chain.

1 More discussion of MIC 2025 is in sections 1. and 4.1.

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1. From Decoupling to De-Risking: How Do Semiconductor Supply Chains Relate to Geopolitics?

The concept of supply chain, regardless if it is the semiconductor supply chain or any other industrial supply chain functions according to Ricardo's principle of comparative advantage theory (Irwin a, 2017): If a country excels in producing a specific type of product, it should focus on manufacturing that product to maximise profits. Even if the item is not a finished product but rather a component, the country can still benefit due to the interconnected nature of global trade. The concept of comparative advantage has been fundamental in shaping international trade practices, particularly since the costs of logistics have significantly decreased in the era of globalisation. This principle is central to the structure of supply chains.

In the scenario of China, Asian countries and the U.S.'s manufacturing, in 2009, Hung's seminal discussion made the point that China has led the Asian countries (including Japan, South Korea and Taiwan) time to 'serve' the U.S. in terms of production. After the global financial crisis in 2008, the Anglo-Saxon capitalism model, which emphasised deregulation and the principle of a free market, has been respectful towards Asian partners in many ways to mutually rely on the manufacturing supply chains (either in China, Asia or elsewhere), to be built by cheap labour (Hung, 2009:25). Ten years later, Kennedy and Lim positioned their research in the great power competition in the field of international relationship and innovation.

They indicated that the rising power has the ‘innovation imperative’ (Kennedy and Lim, 2018: 556), which will push rising states to acquire technology from dominant states through three pathways: ‘making,’ ‘transacting,’ and ‘taking.’ China was a case in their study. Kennedy and Lim indicated China was not only making most of the high-technology products for the U.S. but also aiming to purchase key technology in 2016 and 2017 in order to take a quicker knowledge transfer. The technology transfer that Kennedy and Lim referred to in their research might be different from this specific sector, semiconductor manufacturing, since in the case of the semiconductor sector, the know-how cannot be easily bought off. However, it is still valid to argue that the concerns of a rising power, China, which might take over the U.S.’s technology supremacy and potentially pursue activities that would be against the U.S.’s national interests, have seeded since then.

The observations made by Hung in 2009 and those by Kennedy and Lim a decade later in 2019 differ markedly. Kennedy and Lim focus on the 'innovation imperative,' emphasising the urgent need for emerging states like China to learn from, engage with, and acquire technology from established economies, primarily the U.S. In contrast, Hung's 2009 perspective posited China as a 'head servant,' orchestrating other Asian production powers to cater to the economic needs of the U.S., Western Europe, and the U.K. What has caused this shift over a decade? Several factors contribute, including a global increase in reliance on internet technology and the emphasis on reliable production, which encompasses both cost and timeliness. Additionally, end-user countries such as the U.S., EU, and U.K. have realised that they have lost significant production capabilities in the age of globalisation. In addition, China's role has also evolved dramatically. Once viewed as a victim of globalisation, exporting cheap labour and compromising environmental standards to attract low-technology investment, China has become a major beneficiary since the 2000s. This is evident not just in GDP growth but also in the transfer of technological expertise through foreign direct investment and, crucially, in production capabilities (Heydarian, 2016).

The notion of a 'China threat,' broadly speaking and not limited to technology, gained traction in the early 2000s. China's entry into the WTO in 2000 necessitated severe financial reforms to meet the WTO's criteria. However, there was no indication that these economic changes would lead to political reforms or a move away from China's one-party system. The emergence of the 'China threat' theory mainly reflects the disappointment of democratic countries, spearheaded by the U.S., in realising that economic engagement was insufficient to transform China into a stable, peaceful, and legitimate global player (Broomfield, 2023: 226). It can be suggested that the thought of decoupling from the U.S. side was seeded then. In 2013, Xi announced the infrastructure investment plan in Astana, Kazakhstan (Gabuev, 2017), the One Belt and One Road (OBOR). From 2013 to 2018, the whole world was in awe of China for building a comprehensive infrastructure network, especially in developing countries, for instance, Central Asia (Aminjonov et al., 2019), Africa (Risberg, 2019), and East Asia (Chan, 2017). No matter whether the goal of China to invest in all these connectivity projects was for its strategic aim or the host countries’ benefits, the infrastructures were laid out by the Chinese companies and Chinese workers. From the logic of economic development, this is what differentiates China from the liberal economies’ developmental strategies. For China and many neighbouring countries, the way to development lies in infrastructure rather than liberal financialization. One needs to pave the road and ports then all the positive externalities will come (Lampton et al, 2020). If we extend from the developmental logic that Lampton et al. addressed, the way that China sees itself to power regional economic development is by building up the logistic network first. It would be logical to consider the logistic network to be linked back to China to prosper both China and the recipient countries’ economies.

China's Belt and Road Initiative (BRI) can be interpreted as an early step towards reducing dependency on the U.S. and Western economies. In 2015, China began efforts to secure its supply chain by initiating the 'Made in China 2025 (MIC)' programme, as announced by China's State Council. The objective of this policy is to bolster China's own research and innovation capabilities. Notably, the inspiration for MIC came from Germany's 'Industry 4.0' (I40) strategy, a state-led initiative launched in 2013 aimed at maintaining German leadership in technology and mechanical engineering (Anonymous contributor, Backgrounder, June 2018). It's important to recognise that MIC is comprehensive in scope. While it emphasises the integration of I.T. and industry, the policy also aims to elevate China's capabilities in innovation, quality, value, and environmentally friendly industrial practices.

Interestingly, today, both the U.S. and China aim to decouple from each other, and their rationales are the same: national security. It is for this reason economic nationalism prevails after the trade and technology war in 2018. One has to understand economic nationalism from the perspective of a nation's insecurity of its position in geopolitics and global economy; it is not much about economy or commercial interest but about the national interest (Pickel 2003:106). In the case of the U.S., the existing hegemony, the worry of fast-catching geopolitics and geo-economic power of China is obvious. A classic realist, Mearsheimer warned the U.S. that China would not rise 'peacefully' in 2006 (Mearsheimer, 2006). In the case of China, despite being a rising power with rapidly increasing capabilities, the country has never sought to align with U.S.-led technological standards (Yao et al., 2009). Instead, China aims to establish its own standards. While the U.S.'s concerns stem from the possibility of China usurping its hegemonic position globally, China's apprehensions relate to the impact of global economic integration on its domestic market. The fear is that such integration could lead to a market economy so pervasive that it triggers a shift in political power within China. Thus, while the origins of the U.S. and China's insecurities differ, the responses are strikingly similar. Both nations are motivated by their respective insecurities to consider decoupling from each other, if possible.

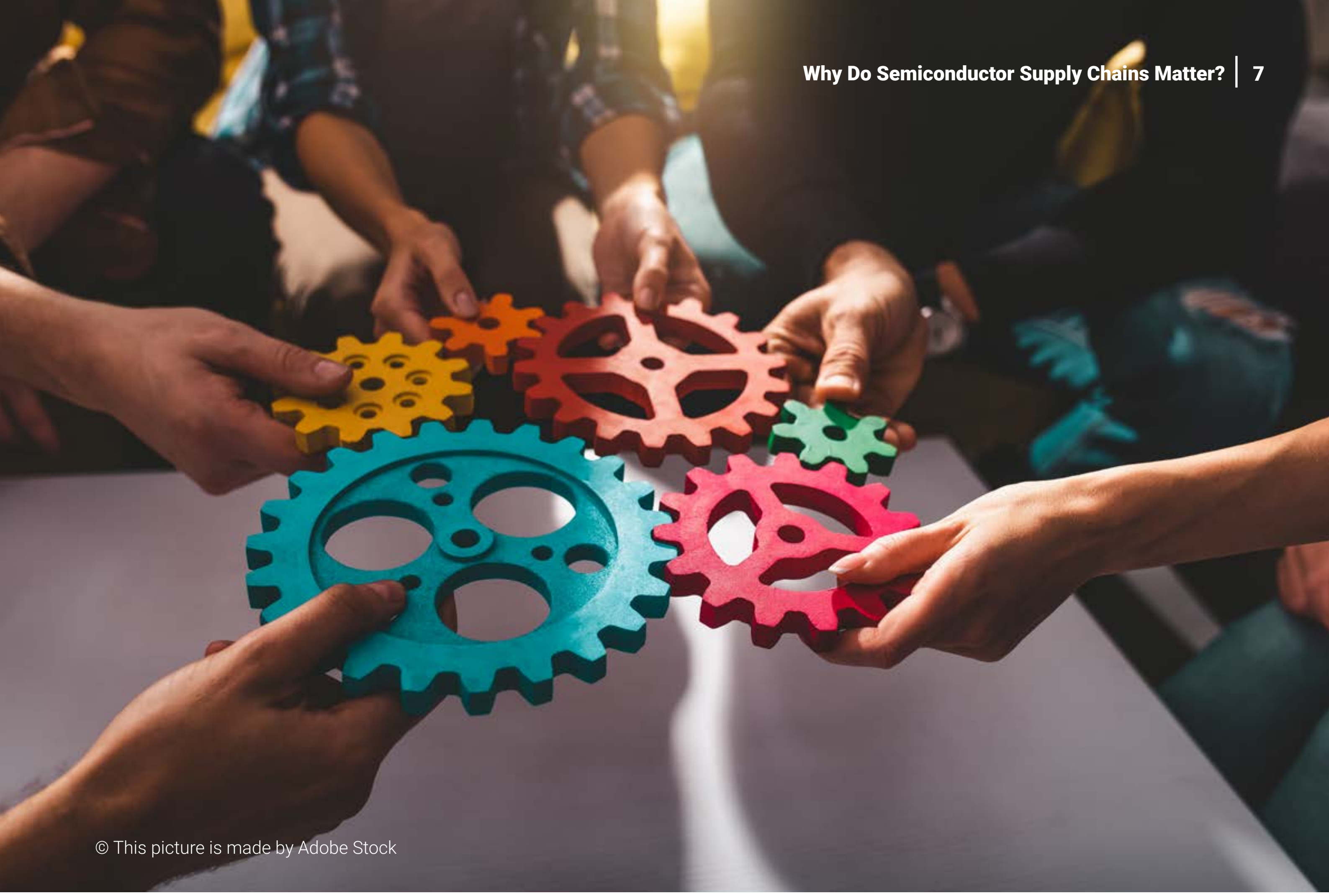
Inkster (2019: 165) contends that the technology sector most vividly illustrates the challenges of decoupling from China. However, this policy paper identifies two major reasons why democracies will find such separation difficult. First is China's ample, low-cost labour force. Ricardo's theory of comparative advantage remains relevant today as the world continues to depend on China for packaging and assembly tasks. Second, and perhaps more crucially, is the enormity of China's domestic market. For example, China's portion of the global semiconductor import market expanded dramatically from just 1 percent in 1995 to 23 percent in 2019 (Bowen, 2020: 15).

Today, China continues to grapple with a significant challenge in attempting to decouple from the U.S.: the quality of its semiconductor products still falls short of that of foreign competitors (Ji, 2023). By staying integrated in the supply chain, China acquires the necessary skills and expertise to enhance its own semiconductor manufacturing capabilities. For the 'in-between' countries like Taiwan, Japan, and South Korea, their geopolitical positions and roles in the supply chain make the notion of decoupling not just complicated but also impractical.

Nevertheless, it is rightly because of the obstacles of decoupling (from both sides of the U.S. and China) that the term de-risking has been more widely used after March 2023. In fact, de-risking first appeared in 2015 from Europe. It aimed to establish the extent to which "de-risking" is given consideration by MONEYVAL[2] States and territories and how regulated entities manage risks, as opposed to avoiding them (Anonymous contributor, Report, 2015). In March 2023, the concept of 'de-risking' resurfaced but in a substantially different context. Ursula von der Leyen, President of the European Commission, invoked this idea prior to her joint visit to Beijing with French President Emmanuel Macron. The topic garnered broader attention during the G7 meeting in Japan in late May 2023 (Moriyasu, May 20, 2023). Gerwitz suggests that the term 'de-risking' is deliberately vague, allowing governments more latitude in forming a consensus on how to engage with China (Gerwitz, May 2023). It's crucial to recognise that the U.S., EU, U.K., Asian democracies, and China, lack a shared understanding of 'common national security,' which would give rise to 'common national interests.' This absence of a unified perspective makes the application of the 'de-risking' concept among these nations a complex endeavour.

Conversely, the term 'decoupling' has not been employed to describe the Sino-EU relationship. Despite significant differences, such as those related to human rights standards (Taylor, 2020), full market economy status, and arms embargoes (Yu, 2017:111-112), the Sino-EU relationship has maintained a constructive equilibrium between cooperation and competition (Geeraerts, 2019). Therefore, von der Leyen's emphasis on 'de-risking' aligns with the EU's consistent approach to addressing all potential risks, including efforts to bolster the EU's standing in the semiconductor supply chain.

2 MONEYVAL is a permanent monitoring body of the council of Europe entrusted the task of assessing compliance with the principle of international standard to counter money laundering, financial terrorism and other international challenges (Council of Europe).



2. Why Do Semiconductor Supply Chains Matter?

Semiconductors (commonly referred to as 'chips') are components that enable electronic devices to function. They have both civilian and military applications. Semiconductors are found in a wide range of goods, including computers, mobile phones, vehicles, and household appliances. Their production is closely linked to the global value chain (GVC), meaning that semiconductor production occurs in different parts of the world. Most semiconductor design companies are in the U.S. and are both leaders in semiconductor R&D as well as the holders of core intellectual property rights. However, companies in the U.S. do not actually produce semiconductors—the leading high-end producers (foundries) are all in East Asia, with TSMC and Samsung from South Korea being two prominent examples. TSMC and Samsung account for 70% of global semiconductor manufacturing (53.6% and 16.3%, respectively) (Financial Times, 2022). TSMC was the leading manufacturer of the advanced logic chip at the time of the writing (August 2023). TSMC can volume production 3nm technology (N3) (TSMC, 2022). Samsung, on the other hand, is chasing TSMC with great efforts. Samsung announced that they started volume production of 3 nm in June 2022 (Hwang, 2023), a few months earlier than TSMC. However, the yield rate of Samsung is far behind TSMC, a reason why TSMC still secured much bigger market share globally (interview data: Taiwan interview 4, 6).

Apart from the market value of the chips, the semiconductor as well as the general technology sector is one of the specific sectors that have strategic value to any country which aims to upgrade their industrial production and economic development. Scholars have pointed out how the reliance of businesses on technology development and the role of government as a supporter of technological advancement for various purposes continues to grow (Etzkowitz and Gulbrandsen, 1999:61). Incentives to promote technology development in the U.S. have formed a network of industrial policies, domestically and internationally. Several countries, including the U.S., China, the U.K., and Japan, understand this strategic value of the technology sector, the second reason why semiconductor, as the core of the technology sector, matters to the national interests (and/or security) to most of them.

When the Global Value Chain (GVC) is stable, it is cheaper to pursue an integrated, global production process than it is to produce goods locally. However, in the past two years, two significant alerts deepened the governments' worries about relying on the international division of labour in semiconductor production. The first alert was the 2020 COVID-19 pandemic that severely disrupted pre-existing logistics and production chains. Chip production is a highly complicated process and takes a long time; the average manufacturing cycle time of a semiconductor may take up to twenty-six weeks, without the preparation of wafer before the production and testing-packing process after the production (Mohammad et al. 2022: 479). Apart from the long production cycle, the work-from-home practice, which made the demands for laptops/smartphones/tablets surge dramatically, contributed to the shortage of chips.

The second alert emerges since Russia's invasion of Ukraine in 2022, which indicated that authoritarian power could ignore the rule of order to wage a war against a democratic country. The ripple effect of this invasion triggered people's further consideration of China's aggressive claims towards Taiwan (Culver and Kirchberger, 2023). This concern grew even further, especially after former U.S. House Speaker Nancy Pelosi visited Taiwan in August 2022. China subsequently held military exercises in the Taiwan Strait, crossed the median line and even threatened to blockade Taiwan, a series of move that heated global tension (Wu, 2022). Questions arose about what would happen if China invaded the island, where TSMC is headquartered and where the most sophisticated chips are manufactured.

Stakeholders thus asked whether it would be possible to produce semiconductors locally rather than rely on offshore supply chains. However, according to a 2021 Semiconductor Industry Association (SIA) report (Varas et al., 2021), developing fully self-sufficient local supply chains in the U.S. to support current levels of demand (both civilian and military) would require at least USD one trillion in incremental upfront investment, and increase the price of goods by 35-65%. For other countries, this endeavour would be even more costly. One also has to remember the key reason that U.S. design firms outsource semiconductor production is that it is more cost-effective and shortens production time. It is based on these reasons this policy paper asks whether such disruption to the market is desirable or feasible. Additionally, the semiconductor supply chain is composed of not only the U.S. and China; the key manufacturing power lies in Taiwan and South Korea, with Japan newly re-joining the production line. The next section explains these three actors' positions.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3. The In-between Countries: Taiwan, South Korea and Japan

This section explores the development of semiconductor production in the 'in-between' countries: Taiwan, South Korea, and Japan. Particular attention is given to Taiwan due to TSMC being a pivotal player in the global chip market. After a comprehensive overview of TSMC and Taiwan's semiconductor manufacturing landscape, brief sections will introduce the industries in Japan and South Korea. The concluding part offers an analysis of the feasibility of the 'Silicon Allies'—a proposed coalition of developed economies interested in achieving semiconductor self-reliance. It also acknowledges that collaboration with China in the GVC involves specific risks (Park and Grotto, 2022).

3.1 Why TSMC in Taiwan Occupies Most of the Global Chip Market

Taiwan entered the low-value end of the production chain in the 1960s, beginning with semiconductor assembly and packaging (Bown, 2020: 11). In 1973, the Industrial Technology Research Institute (ITRI) was established under the Taiwanese government's initiative, following in 1980, the Taiwanese government began investing in the Hsinchu Science Park, laying the foundation for the establishment of Taiwan's high technology manufacturing hub, including TSMC.

How did the TSMC grow up to such a giant in chip-making on the small island of Taiwan? Hsu's explanation from political geography was, apart from Taiwan's economic development following the pattern of the East Asian Developmental State, the Taiwanese government under the Kuomintang (KMT)'s[3] reign also decided to develop the semiconductor industry out of geopolitical and economic crisis (Hsu 2017: 168). The characteristic of the developmental state is to rely on strong and even 'authoritarian-executives' to design and implement coherent, meritocratic or 'Weberian' bureaucracies (Haggard 2018:9). The origin of the developmental state was set out by Chalmers Johnson in his 1982 seminal book *MITI and the Japanese Miracle*. The emphasis on a small but elite state bureaucracy was, at the time, Japan, South Korea and Taiwan's political and economic background. The states' technical bureaucrats selected certain industry(ies) to invest in, and fostering such industry (ies) was the key to understanding the concept of the developmental state. In short, it was the state's intervention to improve the market economy (Stubbs, 2009: 1). Due to the characteristic of strong government, the developmental state most likely cannot happen in democracies. Democracies, with their openness and guaranteed freedoms, are quite the opposite of a developmental strong state. In the 1970s, Taiwan was not a democracy but under the one-party dictatorship of the KMT. It was a historical period for a strong government to support certain industries. The reason to indicate this point here was not to promote authoritarian governments but to present how, historically, the semiconductor industry developed in Taiwan in this section and later on in Japan and South Korea.

The economic recession triggered by the oil crisis in the early 1970s also had a profound impact on Taiwan, a country reliant on export orders from advanced economies (Zarnowitz and Moore, 1977). In addition to this economic setback, Taiwan, also known as the Republic of China (ROC), faced a series of geopolitical challenges. The ROC lost its United Nations seat to the People's Republic of China (PRC) in 1971. Additionally, the relationship between the U.S. and Taiwan during the 1970s did not evolve as favourably as the KMT government had hoped. Official diplomatic ties between the U.S. and Taipei were severed in 1979, although the U.S. had enacted the 'Taiwan Relations Act' after the formal dissolution of their relationship. It was against this backdrop of multiple crises in the 1970s that the then Minister of Economic Affairs, Sun Yun-xuan, was franticly looking for a way to stabilise Taiwan's economy and decided to focus on developing a national semiconductor industry (Hsu, *Ibid*: 169). It was not a normal path for a developing economy to pursue such advanced technology from scratch, but the setting up of the ITRI in 1973 and the Electronics Research and Service Organisations (ERSO) in 1975 was a sign that the decision was taken on the path of developing semiconductor industry. Not only setting up the institutional support, but the Taiwanese government also negotiated with Radio Company of America (RCA) for technology transfer in 1980 and sent forty experts from Taiwan to RCA to learn the skill (Lin, 2023: 55). Robert Tsao, the founder and chairman of United Microelectronics Company (UMC) was among those forty 'students,' at the time, Tsao was working in the ITRI. The establishment of UMC, or spinoff from the ITRI in 1980, was right after Tsao's return to Taiwan from RCA (Rasiah et al, 2016: 70). Ouyang came from a principle-agent's perspective (Ouyang 2006:1320) argues that at the time, top KMT ministers not only made decisions to develop semiconductor industry in Taiwan, they were also able to mobilise top Taiwanese engineers returning from the U.S. to Taiwan. The most notable example is Morris Chang, the founder of the TSMC, a graduate of Stanford University who spent twenty-five years in Texas Instruments and was hired to lead the ITRI in 1985. (Hsu, *Ibid*: 168-169). Around ITRI and HSP are two prominent universities, National Tsinghua and Chiao Tung[4] universities, which are the incubators of talents, especially in the fields of electronic engineering physics, pumping the need for semiconductor manufacturing.

For the TSMC, the Taiwanese government also negotiated with the Dutch multinational company Philip's for technology transfer. Philips also shared 27.5% of the stock of TSMC, coupled with strong financial backing from the public-sector China Development Corporation (CDF)[5]. Morris Chang created TSMC to establish the large-scale integrated circuits manufacturing capacity and to offer foundry-only services, mostly for Silicon Valley and Taiwanese chip design companies (Wu et al., 2006:442). Later, in 1994, TSMC entered into a long-term agreement for the fabrication and supply of microcontroller chips, application-specific I.C.s (ASICs) and other logic I.C.s for Fujitsu, with the Japanese company agreeing as part of the deal to transfer the required 1.0-um and 0.5-um process technology. Furthermore, TSMC reached a long-term foundry agreement with a Japanese company, Nippon Electric Company Limited (NEC), in 1995 to cover many of its ASIC products in exchange for the required technology. Over time, TSMC's emphasis was to leverage the relevant process technologies to expand its platform of technological competencies (*Ibid*, 449). Forty years afterwards, Morris Chang indicated that the Taiwanese government was playing the role of 'reluctant investor' to TSMC (Central News Agency, March 16 2023), the establishment of ITRI and ERSO. However, the fact that the state facilitated the transfer of knowledge from RCA and Philips seems to carry more weight than one would expect from a reluctant investor.

3 The KMT is one of two major parties in Taiwan. It was the political party that ruled mainland China from 1927 to 1949 prior to its relocation to Taiwan as it was defeated by the Chinese Communist Party (CCP). The KMT's political identity opposes Taiwan independence.

4 On February 1, 2021, National Chiao Tung University merged with National Yaming University, renamed as National Yaming Chiao Tung University (NYCU webpage, 2021).

5 Back in 1980s, the CDF was still a joint or collective efforts of the Economic Stabilization Committee of the Executive Yuan, the World Bank and private capital. It was the first privately run financial institution focusing on direct investment. The CDF is revamped as National Development Fund, which is regulated still by the Executive Yuan of Taiwanese government.

The historical background cemented the technology link between the U.S. and Taiwan, along with the TSMC's technological link/learning with other multinational technology companies such as Philips, Fujitsu and NEC, but three reasons contributed to the success of TSMC. The first one related to the TSMC's or, to be precise, Morris Chang's business decision in the 1990s. TSMC decided not to have its brand in any devices but to provide chips to global brands, including Apple, Intel, Huawei (until 2020)[6], and Samsung. This means their customers would not feel threatened if they contracted to the TSMC for chip production. As one of the interviewees mentioned, *'Not like if you contracted to manufacture a mobile chip from Samsung, you would worry whether the contracted project would lead to leak the confidential technology. This is the key reason why Apple would not feel comfortable to contract Samsung.'* (Interview data: Taiwan Interview 2; Japan Interview 2). This quote reflects the business strategy of the TSMC, which is to 'serve' the customers rather than 'compete with' the customers. This strategic decision is the key reason why TSMC greatly surpasses other suppliers from Taiwan, such as the UMC, which was already established in 1980, prior to TSMC.[7]

The second reason is TSMC's dedication to research and development in manufacturing. TSMC works with approximately 500 customers in the world. According to Kawakami, TSMC has developed an extensive library of semiconductor intellectual property core (IPC) or integrated circuit layout design blocks to meet the needs of its customers (Kawakami, 2022: 6). In many ways, because of extensively working network with global customers, TSMC became the encyclopaedia of chip manufacturing, and this collected knowledge is growing and updating every minute through TSMC's network. Such development is what Samsung or Intel, companies that work with a smaller number of customers, cannot and perhaps will not be able to catch up. TSMC's customers' network is an accumulation of time as well as great efforts in working on earning the trust of customers.

The final reason is the trust between the designers and makers is crucial. To this end, TSMC emphasises taking great care of their customers. At the initial stage of TSMC's establishment (early 1990s), certification through a series of qualification procedures by large U.S. semiconductor firms such as Intel was conducted to foster customers' faith and confidence in manufacturing quality.[8] TSMC's care of customers can be seen in the fact that each customer has a team to work for them. Engineers in TSMC would not know about other sections' production. This is done to prevent any possible leaking of technology (Interview data: Taiwan Interview 3). Engineers would work with the customers from beginning to end, including all troubleshooting after sales. This "customer-first" spirit also leads to the disciplined spirit in the TSMC working environment: 12-hour shifts while wearing uncomfortable and hot cleanroom suits for highly-skilled engineers is common for TSMC staff in Taiwan.[9] The production of a chip requires more than one hundred steps; hence, a disciplined working environment is necessary because of the importance of a high yield rate. *'If you made 1% errors in one step, then considering there are more than one hundred steps, the final product's yield rate would be less than 50%'* (Taiwan Interview 6). Considering the high yield rate being the key reason that TSMC holds their customers, the company thus trains their highly skilled engineers to be disciplined, meticulous, and devoted in their work. In return for these encompassing demands on their lives, TSMC offers considerable monetary rewards: reportedly, TSMC employees will, on average, receive NT $1.87 million (US$61,600) in bonuses based on performances (Everington, February 15, 2023). This is the key reason that although young graduates in Taiwan know that the work at TSMC is demanding, they are willing to attempt it.[10]

6 TSMC stopped order from Huawei in 2020 (Hille and Stacey, *Financial Times*, June 9 2020).

7 Though the development of UMC's advanced chips lagged off from the TSMC, UMC occupies more market share on the matured chip making (bigger than 28 nm) used mainly in the automobile industry. UMC has been an integrated device manufacturer (IDM) company since 1980 but only until 1995 did UMC turn into a pure-play foundry. An IDM company cannot concentrate on manufacturing; hence, though UMC was established earlier than TSMC, but not able to compete in advanced chip making (Interview data: Taiwan interviews 4, 10). On the other hand, UMC contributed to other parts of the semiconductor supply chain. It fostered many important I.C. design companies (fabless companies) in Taiwan, for instance, Mediatek, Novatek and others (Lin 2023: 71).

8 Access to Intel was secured partly through the personal connection and professional background of Morris Chang (Wu et al, 2006:442).

9 With the TSMC's investment to Arizona, the 12 hours shift was found 'hard to accept' among the American skilled engineers (*Taipei Times*, June 7 2023).

10 As stated from one of my interviewees, *'I knew the turnover rate is high at TSMC, but the pay is so high. I am young. I don't mind to take hardship work in the next 3 to 5 years. I also take this opportunity not only for monetary reason, but to broaden my horizon. If I decided this kind of high-pressure job is not suitable for me in the future, I will leave but by then, I already reserved a small pot of money and capacities for me to work in other companies'* (Taiwan Interview 8).

3.2 Will Japan Return to the Semiconductor Manufacturing?

The development of Japanese advanced technology followed the doctrine of the developmental state as indicated in the section on Taiwan. In fact, the term ‘developmental state’ was coined by Johnson to describe Japan’s economic development, especially in the high technology sector, which was led by the Ministry of International Trade and Industry (MITI) (Johnson, 1999: 32-61). Japan was the leading goose in the flying geese model (Kojima, 2000: 375), a term defining how Japan as the most advanced economic country (especially in the high-technology sector), successfully led the Newly Industrialised Countries (NICs) in East Asia, including Taiwan, South Korea, Singapore, Hong Kong, to catch up in their economic development. How exactly did Japan lead the other countries into development? Kojima argues that it was through foreign direct investment and also ‘agreed specialisation’ (*Ibid*, 376). Because Japan was advanced in its economy and consumer electronic production, their investment in other less developed countries would not only help recipient countries’ economic development but also, to some extent, transfer technology to recipient countries. The term ‘agreed specialisation’ follows the concept discussed in the first section, which refers to Ricardo’s comparative advantage theory. The theory suggests that each country agreed to produce a specific product in the supply chain based on their comparative advantages. Therefore, Japan, as the leading goose in the regional economy in the 1980s, has the full potential to become the leader of semiconductor production. Yet, currently, there is no pure-play foundry in Japan.[11] What were the reasons for Japan to recess to less than 10% of global semiconductor production? Furthermore, what is the role of Japan in current and future semiconductor supply chains? These questions will be answered in this section.

Two reasons account for Japan’s reduction in semiconductor production. The first one is the U.S.’s countermeasure of Japan’s high technology development in the ‘80s. After the Second World War, Japan received the U.S.’s economic and technological support, but the U.S. did not expect to see Japan growing as a technological giant in the 1980s.[12] Though the overarching purpose of government support for Japan in semiconductor production was to create a competitive indigenous computer industry, in the U.S., the government objectives in the semiconductor industry were military-focused at the time (1980s) (Tyson, 1993:93). Therefore, seeing Japan seize over half of global production in such a strategic sector, the U.S. government started to worry about national security concerns. Such worries were coupled with Japan’s exports to the U.S., especially in the automobile industry. Moreover, the anti-Japanese sentiments arose in the 1980s. A poll by Potomac associates showing that 29 per cent of Americans had an unfavourable attitude towards Japan in 1982, compared with only 12 per cent in 1980 (Matthews, 1982).[13] The U.S.’s countermeasure of Japan’s semiconductor development in the 80s was the US-Japan semiconductor trade agreement. In this agreement, the government of Japan agreed to end the ‘dumping’ of semiconductors in the world market (not only to the U.S. but to the global market) and agreed to secure 20 per cent of their domestic market for foreign producers within five years (Irwin b, 1996:5). It was an ultimate sanction for Japan to keep their high production in semiconductors.

There is currently no concrete evidence that points to the signing of the US-Japan semiconductor agreement in connection with the establishment of TSMC in 1987. Nevertheless, this agreement had a negative impact on Japan’s semiconductor production. The subsequent establishment of TSMC also posed significant challenges for Japanese companies in terms of their business models. According to a senior analyst from the Institute of Development Economy, it is worth noting that while Japan accounted for 50 per cent of global semiconductor production in the 1980s, its semiconductor sector has never operated with an ‘independent’ foundry model. Instead, it is always a part of the sub-sectors of brand companies such as Sony, Toshiba, and Honda. (Interview data, Japan interview 2). In other words, Japanese semiconductor production is part of the IDM system in brand companies, and their main purpose is to serve their brands. If they have extra production, they will export it out to other customers. Compared with TSMC’s strategy, which is centred around wholeheartedly serving customers, one can understand why Japanese semiconductor producers lost out to TSMC, especially after TSMC focussed more on R&D in semiconductor manufacturing throughout the years.

11 In the 1980s, Japan was the world’s largest semiconductor producer, accounting for over 50% of global semiconductor production. In the 2020s, Japan accounted for only 9% of global semiconductor production (Japan-country commercial guide, 2022).

12 American scholarship focused on why and how Japan could be in the driving seat of the high-technology sector (Johnson *Ibid*, Patrick 1986). Correct industrial policy, which targeted developing the high-technology sector, along with the government’s technocrats’ support and implementation, was the answer.

13 However, arguably, there were still higher percentages of Americans who liked Japan at the time compared to those who had ill feelings (Matthews, 1982).

With the understanding of these two reasons, one should not ignore that Japan still plays a key role in the semiconductor supply chain even before the trade/technology war in 2018 (Japan-country commercial guide, *Ibid*). Japan is strong in Memory chip-NANDs. In 1987, the Toshiba Corporation renamed Kioxia Corporation and invented in NAND. It was then applied to all devices needing storage space, for instance, S.D. cards and USBs. Sony semiconductor solutions (SSS) are also strong in sensors, which are used in smartphones, digital cameras, and car stereos, among others. In November 2021, TSMC invested US$2.12 billion in Kumamoto fab as a joint venture with Japan Advanced Semiconductor Manufacturing (JASM and SSS). It was a business strategy created by TSMC to be closer to their customers (SSS in sensors), and the production focus on matured 12 nm chips. Recent news revealed that TSMC agreed to invest in a second foundry in Japan and that they may spend more than 1 trillion Japanese yen on it (Focus Taiwan, July 2023). Japan was also strong in providing equipment for semiconductor production, which will be discussed later in section 3.4.

Apart from inviting TSMC's investment, Japan also built a national championship team 'Rapidus' in the wave of governmental support to their semiconductor industry. Rapidus was established in 2022, apart from the Japanese government's financial support, and it merged eight companies in the related fields of the semiconductor industry. That is the reason why it appeared as a national championship team to challenge the production of 'next-generation chips' (Ota, July 25 2023). This is a very recent development, but back in January 2023, scholars and experts in the field were rather conservative on the ambitions of Rapidus: the production of the most advanced 2 nm chips. The reason is simple: though Japan has occupied a key role in the semiconductor supply chain, jumping from matured to advanced chip production takes time to accumulate skills and experience, along with the incubation of talents (Interview data, Japan interviews 2, 3).

3.3 A formidable Competitor, Samsung in South Korea

Innovation in South Korea has been pushed through the Ministry of Science and ICT (MSIT), the Ministry of Industry, Trade and Energy (MOTIE), the Ministry of SMEs and Startups (MSS), Ministry of Education (Park and Kim, 2023). Furthermore, there are more than fifty semi-governmental policy institutes to suggest and advise the technology development in South Korea (Interview data, Korean interview 4). In the field of semiconductors, Samsung and S.K. Hynix are two leading companies. Samsung, which accounts for 18 per cent of the global chip market, was described by Morris Chang as 'a formidable competitor' (Lin 2023: 90). This section aims to first explain Korea's political economy structure, the backbone of the making of Samsung, before it explores the competition between TSMC and Samsung. Then, the section will end by providing a brief analysis of the close production line between Samsung and China.

South Korea was one of the poorest countries in the world in the 1960s but joined the ranks of industrial democracies in less than two decades before it became a member of the Organisation for Economic Cooperation and Development (OECD) in 1996 (Staff writer, *The Guardian*, November 11 2011). The 'Korean Miracle' embodies the government and family-controlled business groups known as *chaebol*. On the contrary, financial institutions played a relatively minor independent role since the financial institutions were mostly under the control of the government or *chaebol* (Lim 2012: 69). The formation of the *chaebol* allowed Korea to concentrate the whole country's resources into one or two certain company in one industry. For instance, Samsung in technology-related production such as chip making and other ICT products, or Hyundai in automobile industry. Both companies are national champions of South Korea and also have respectful share of global market. The significant drawback of such a close government/business relationship is crony capitalism, which refers to a system where stocks are purchased and loans are made on the basis of association, not economic value (Greenspan 1998 cited in Kang, 2003: 439). It is believed that such a 'guanxi'/relationship-based economy rather than a value/capacity-based economy seeded the reason why South Korea was impacted severely by the 1997 Asia financial crisis (Ha and Lee, 2007). It is under this background, with the government's utmost support and connection, that Samsung and S.K. Hynix emerged as two national brands of chip making.

Within Korea, Samsung and number two memory chip player S.K. Hynix constantly compete for the next generation's chip supremacy (Kim, July 2023). As indicated previously, the share of Samsung in the global logic chips market is much less than TSMC, but Samsung is the leading company in the global memory chips market,[14] a field TSMC decided not to compete with Samsung, especially after 2008 financial crisis (Lin 2023: 94). If Samsung has received extensive government backing and maintains a competitive rivalry with second-tier memory chip manufacturer S.K. Hynix, why does it still trail behind TSMC in mass-producing the most sophisticated logic chips, specifically those under 10 nm? Two reasons to be presented here. Firstly, as mentioned in section 3.1, Samsung is not a pure-play foundry; its customers, for instance, Apple, would worry about contracting Samsung in chipmaking because Samsung also produces mobile (Interview data: Taiwan Interview 2). Samsung only started to have a foundry in 2009; in many ways, Samsung is an IDM company which faced the same dilemma as UMC faced in the past. Samsung cannot fully concentrate on 'serving' the customers' needs because they have their own brand to serve.[15] In the field of foundry business, contracted manufacturers' capacities are growing with the designed contractors' capacities. That means the first-tier contract manufacturers need to work with the frontier designers in order to manufacture the most advanced chips (Interview data, Taiwan interview 4), the reason why Nvidia contracted TSMC, not Samsung. The loss to Samsung including not only the money but also the opportunities to manufacture the most advanced A.I. chips. If Samsung keeps losing such opportunities, the gap in innovation capacity between Samsung and TSMC will be enlarged even further. Apart from the challenge to gain customers' trust, Samsung, as an IDM company, still needs to take care of other parts of the business such as branding marketing. All these diversifications reduced Samsung as a company to compete with a pure-play foundry, TSMC.

Since the US-China trade/technology war, Samsung has faced quite a lot of challenges, especially after the U.S. tightened the export control in October 2021, which specified recipients of the U.S. chip act cannot make new, high-tech investments in China or other 'countries of concern' for at least a decade if they are to receive U.S. subsidies (Shivakumar et al., 2022). Samsung has a foundry in Xian, China that accounts for nearly forty per cent of its entire NAND production in the global market. The company invested USD 25.8 billion in its Xian foundry since 2021, and customers of this foundry including Xiaomi, Oppo and Vivo (Hwang and Kang, March 2023). Given the big scale of such investment, it would be very difficult for Samsung to retreat from China, even though Samsung received a one-year exemption from the U.S. In addition, Samsung also invested in Texas, U.S. since November 2022 with a USD 17 billion project to build a foundry (*Ibid*). One can see this investment as to respond to the U.S. Chips and Science Act, but on the other hand, one can also see this as Samsung's business strategy to be closer to their clients, for instance, Nvidia or Qualcomm, in order to keep their catching up with TSMC (Interview data: Korean interview 2). No matter which is the 'real' motivation for Samsung to invest in Texas, the action put Samsung under the U.S.'s export control list as a 'recipient country,' hence severely impact on Samsung's continuous investment in China, especially if the negotiation with the U.S. to secure extension is on a yearly basis. Experts in Korea expect at the time (before October 2023) that the U.S. will extend again of the exemption (Interview data, Korean interviews 1, 2). In fact, the U.S. not only extended the exemption for a year but waived the export control indefinitely. On October 9 2023, the U.S. Department of Commerce updated its 'validated end user' list, allowing both Samsung and S.K. Hynix to keep certain U.S. equipment in their China factories (Lee, Reuters, 2023). The updated restrictions included banning any chips that are used in 'advanced computing and artificial intelligence applications' from being sold to China, nor any chips containing U.S. technology or software (Cherney, *Protocol*, 2022). However, there is no concrete view to see how this dilemma that Samsung is in can be easily solved in the long run.

14 Logic chips are in charge of processing data in order to complete a task, memory chips are for information storage. Dynamic Random Access Memory (DRAM) chips can only store data when they are powered, while NAND flash chips can also store data after the power supply has been cut (Staff Writer, Apex Waves, April 2022).

15 A recent example is, Samsung was about to get order from Nvidia if Samsung successfully developed 3nm chips, but because Samsung has competition with Nvidia in AI chips, plus Samsung still produced lower yield rates than TSMC in the advanced chips, Nvidia still not yet confirmed their contracts to Samsung (Liu, July 2023).

3.4 The Practicality of 'Silicon Allies'

In order to deter the potential threat from China, one school of scholars proposes that democracies who function as market-driven economies, should form 'Silicon Allies' to deter potential threats (both natural and manufactured) to semiconductor supply chains (Park and Grotto, 2022). The U.S. government's initiative of the 'Chip 4 alliance' in March 2022 can be seen as a policy realisation as such. The idea of the 'Chip 4 alliance' means the U.S. to be the lead chip designer, Japan to be the leading country in supplying key materials and equipment, and Taiwan and South Korea be the key manufacturing countries; this idea was first proposed by the US government at the end of 2021(Kaur b., 2023). To this date, there has not been concrete decisions have been made despite two virtual conferences being held among countries involved in this Chip 4 alliance. The positive progress for this alliance is that in January 2023, the U.S. inked an agreement with the Netherlands and Japan to extend the export control on advanced chip manufacturing equipment and technologies to China (Staff writer, Reuters, January 2023). ASML holding N.V. (the Netherlands) is the only company which provides photolithography machines for chip making. Two Japanese companies, Nikon Corporation and Tokyo Electron, also play crucial roles in material supply and semiconductor equipment. As a result, on paper, the agreement between US-Japan-the the Netherlands, topped with the Chip 4 alliance, aims to nail the progress of China's semiconductor development.

It has to be noted that this is a proposal from the U.S., presenting an ideal alliance to work with like-minded countries in the semiconductor supply chain. Several difficulties for this idea alliance to work. Firstly, it would be difficult for the states which are members of the 'Silicon Allies' to implement developmental state type of industrial policies in the semiconductor supply chain. Noted that though the beginning of the semiconductor development in Taiwan, Japan, and South Korea started under strong governmental support in respective countries, but through the process of democratisation, the strength of government decreased, and it would be rather difficult for the governments to 'command' the industries in democracies. The agencies of businesses in democracies are not exactly the arms of their governments; as Lindblom argued (Lindbolm 1977, 1982), it is rather difficult for democracies to implement policy changes which are against those capital holders' commercial interests.

Secondly, even though states still have certain influences in the strategic industry, such as the semiconductor industry, each country in this proposed 'Silicon Allies' has different geopolitical interests entangled with their existent commercial interests in China. For example, TSMC has invested in Nanjing (Taipei Times, 2021). It is also worthy to consider how sustainable such control can last and, more importantly, whether such expensive action only delayed China's semiconductor development rather than curbed it (Allen and Benson, 2023). Lastly, all members in this potential alliance initiated their own domestic chip-related legislations.[16] They are also competitors rather than collaborators in the existing supply chain (for instance, Taiwan and South Korea); therefore, in many ways, to what extent the alliance can be established is the question that needs time to answer.

The idea of forming a 'Chip 4 alliance' or 'Silicon Allies' could be interpreted as the U.S. government's method of 'de-risking,' especially when considering U.S. export controls as a more severe step towards decoupling from China. There are two purposes for the U.S. to aim for such an alliance. The first purpose is to avoid the threat of China; the U.S. hopes to bypass China in the semiconductor supply chain. The second purpose is to provide a more sustainable supply chain in the semiconductor, rather than relying mainly on the TSMC in Taiwan. Such an alliance is logical from the perspective of U.S. national interests, but as mentioned in section one of this policy paper, de-risking requires consensus on the 'risk.' As a result, the lack of consensus regarding each country's national interest of member states in Silicon Allies, casts a heavy shadow on the practicality of its formation.

16 The United States introduced the Chips and Science Act, which was initiated on January 7, 2021, and became a public law on September 8, 2022 (Congress.Gov. January 2021). The European Commission followed suit with the European Chips Acts, unveiled on February 8, 2022 (European Commission, February 2022). Japan, deviating from the U.S. and EU approaches, allocated a $6.4 billion budget from a state-sponsored fund to bolster its semiconductor equipment industry (Lewis and Inagaki, June 2023). Lastly, South Korea's legislative body passed the K-Chips Act on March 30, 2023. This legislation involves a comprehensive $422 billion investment in key domains, along with the establishment of industrial centers and substantial tax incentives for chip manufacturers (Staff writer, *Taipei Times*, March 31, 2023).

4. China's Economic and Technology Development

China's economy has previously been described as a form of state capitalism—an economic model that shares similarities with the developmental state. The first part of this section is about the importance of economic development that serves as the legitimacy of a one-party state in China. Technology development and technology diplomacy drive economic development for all countries, and China is no exception. Huawei was the leading company of 5G originally, but Huawei, in fact, was also TSMC's customer until 2020, as indicated earlier. Why did Huawei not rely on domestic Chinese-made chips, given China also intended to rely on its own innovation capacity (the logic of MIC 2025)? The second section provides an analysis of China's semiconductor development.

4.1 Does the Legitimacy of China Come from the Economic Development?

China's economy is at a pivotal juncture, facing the need for a fundamental transformation of its growth model. The export-driven growth strategy that leveraged inexpensive resources for over three decades has now led to several internal contradictions. These include increasing social inequalities, declining competitiveness in industries reliant on low-skilled labour, and a rise in labour disputes. To comprehend why economic development is a major focus for China and its government, it's essential to examine the intricate relationship between the market and the governing authorities.

The concept of legitimacy is vital for any state, whether democratic or authoritarian, to effectively govern and mobilise its population. Johnson left this notion somewhat unexplained, only stating that 'bureaucratic rulers have legitimacy to rule' (Johnson 1999:52) without elaborating on the origins of such legitimacy. To address Johnson's vague assertion about legitimacy, Castells offers a more concrete, materialist interpretation. According to Castells, the most convincing form of 'legitimate legitimacy' arises from the actual improvement in the living conditions of the working population. This argument counters other less convincing explanations, such as the purportedly submissive nature of Asian cultures or the influence of Confucianism (Castells, 1992:54-55). This perspective is particularly relevant when considering the legitimacy of the Chinese Communist Party (CCP) in China, where economic performance serves as a key pillar supporting the legitimacy of a one-party state (Laliberte and Lanteigne, 2008). However, as Holbig and Gilley argued, using economic growth as the sole basis of legitimacy meaning there would be a challenge of the ruling regime when the economic growth declines. Other related issues coming with economic growth, such as the internal wealth gap, inequality, and industrial disputes, might also pose threats to legitimacy in different ways (Holbig and Gilley, 2010: 400-401).

In the case of China, the GDP growth started to pick up in the early 1990s and 2000s. In 1992, the GDP growth was 14.22%, a double-digit growth sustained from 1992 to 1995. Then, in 2003, China's GDP growth was 10.03%, and the percentage increased until 2007, when the GDP growth reached 14.34% (China GDP Growth Rate 1961-2023).[17] Nevertheless, post-2010, the rate of economic growth in China, if measured by GDP percentage, has not reached double digits. Concurrent with this two-decade period of economic expansion, China has faced numerous domestic challenges such as environmental issues and a rise of strikes after the mid-1990s (Elfstrom and Kurvilla, 2014). State-Owned Enterprises (SOEs) have undergone reforms, resulting in a large number of layoffs. This, coupled with the increasing number and complexities related to migrant workers—those who have moved from the hinterland to coastal provinces—poses a range of challenges and concerns for the leadership of the CCP.

Given these challenges, it becomes increasingly important for the CCP to add new elements to bolster its legitimacy. As discussed in Section 1, the BRI which China started to pave for the world, is a fitting extension for the CCP to maintain its governance legitimacy. The economy development of China also turned to an innovation-driven, resource-efficient and domestically-centred economy, aiming to sustain a certain level of growth and social cohesion. Both the past Twelfth Five-Year Plan and current Thirteenth Five-Year Plan, as well as the State Council's 'Made in China 2025' initiative, map out measures to promote efficiency and indigenous innovation. Though the rhetoric of 'made in China 2025' has not been heard loudly in the last five years, the concept stays in the Chinese government, which aims to prepare Chinese companies to become global leaders in core industries in 2025 and to pave the foundation of China being a technological superpower in 2049 (Zenglein and Holzmann, 2019). Furthermore, in 2020, the Chinese government introduced the concept of the 'dual circulation development model,' which emphasises both growth exports (international circulation) and expanded domestic demand, powered mainly by rising consumption (internal circulation) and these two reinforced with each other (Pettis, 2021). Though two years later, in 2023, the Chinese real estate crisis and the decline of the Evergrande revealed the unstable foundations of the dual cycle model (Tham et al., Reuters, 2023). It is a big wonder whether the collapse of Evergrade is the tip of the iceberg, which has exposed problems with domestic demand and economic growth and thus put the "dual cycle" model into question. One needs some time to provide a more evidence-based answer to this question.

4.2 Unsuccessful US-China Trade/Technology War, Huawei and TSMC

Chinese corporations are increasingly focused on securing natural resources and acquiring technological expertise. Huawei serves as a prime example of China's innovation diplomacy, particularly in the realm of 5G technology (O'Flaherty, 2019). In fact, China began laying the groundwork for global connectivity in the Internet of Things (IoT) nearly two decades ago, largely through companies like Huawei. Prior to the Sino-U.S. trade and technology tensions that began in 2018, Huawei was well-positioned to compete with Apple, holding the second spot in the global mobile market, right behind Apple (Su, 2018). Huawei's initial competitive advantage was the cost of its researchers and engineers. A cheaper and more dedicated high value-added labour force was key for Huawei when entering markets in developed countries (Ernst and Naughton, 2008: 54). Huawei is like an agent to exercise China's technology diplomacy, to 'conquer' the world's telecommunication network before 2019. Apart from the cheap and high-skilled labour that Huawei could dispatch to the world, the core of Huawei's technology had outsourced to TSMC through its subsidiary company HiSilicon Technology (which does not have its own fab) of the advanced I.C. chips for smartphones and telecom base stations (Kawakami, 2022:8). The connection between Huawei and TSMC was close, as of the first half of 2020, Huawei was the TSMC's second-largest customer after Apple (*Ibid*). However, due to the Sino-USA trade and technology rivalry, TSMC stopped orders from Huawei in 2020 (Hille and Stacey, *Financial Times*, June 9 2020).

17 The source is from Macrotrends, not from the Chinese government, but one has to be cautious about the reliability of Chinese statistic figures in relation to their economic development.

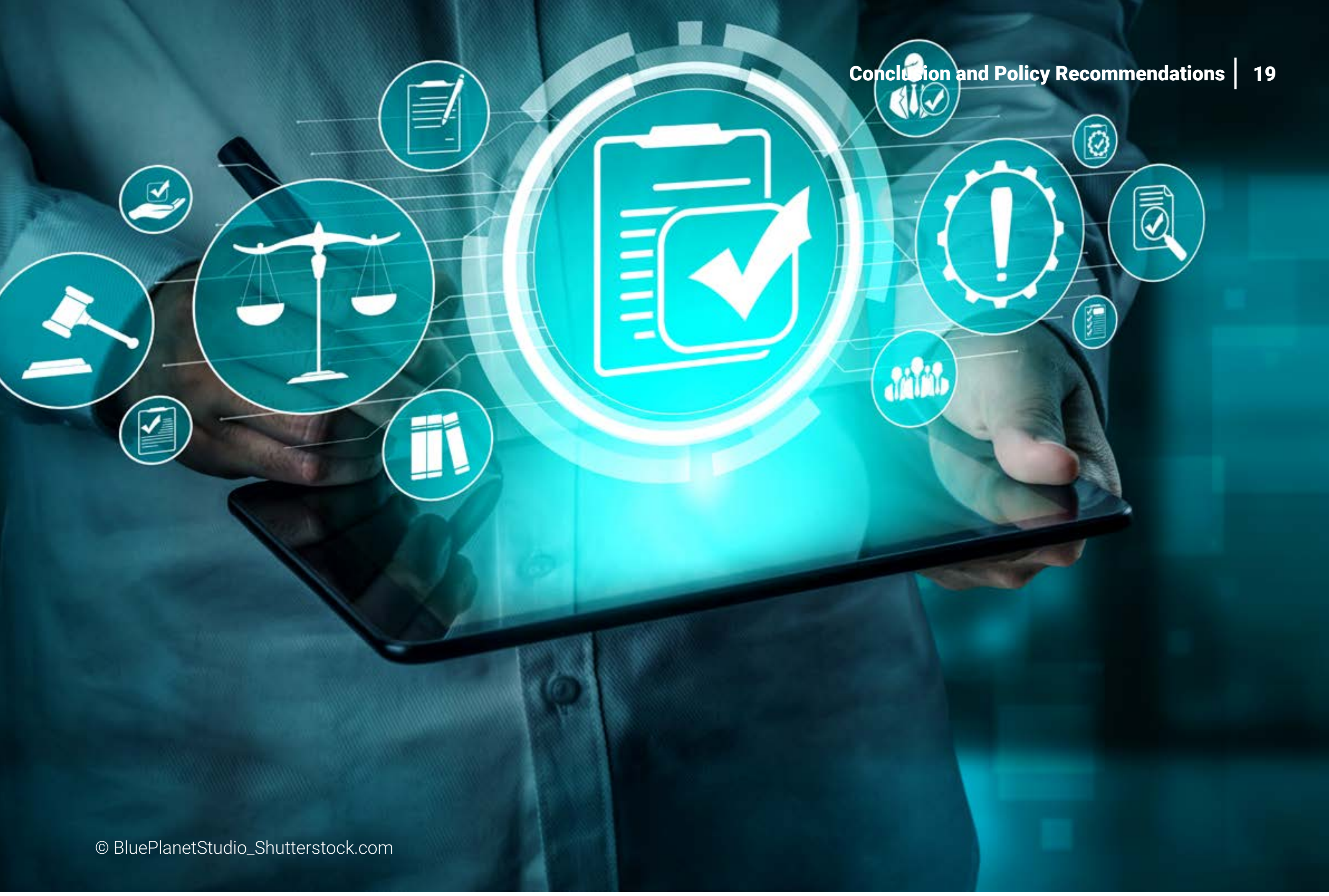
Why didn't Huawei contract their advanced chips from Semiconductor Manufacturing International Company (SMIC), the state-owned pure-play foundry? There are several reasons to answer this question. Firstly, the Chinese state's involvement is the problem. The SMIC was founded in 2000, and it was a successful story at the beginning. According to Fuller, SMIC began producing wafers at a technological level just two years later and soon positioned itself as a competitor in the industry. After a decade, in 2012, SMIC was able to produce 40 nm logic chips. Judged from the speed of a latecomer in the foundry, SMIC was taking a fast-track (Fuller 2016: 132). A bigger share of private ownership was the key to the early success of SMIC; recruiting many Taiwanese engineers and head-hunted Richard Chang from a Taiwanese foundry World Semiconductor (WSMC)[18] was another key reason. However, the state always wanted to have a bigger share in SMIC. The Chinese government initiated a megaproject for the I.C. industry in June 2014, which aims to boost the I.C. industry, including semiconductor manufacturing. The aim back then was to buy more shares of SMIC, up to 46 per cent (Fuller, *Ibid*: 145). Though the semiconductor industry needs the state's support, as we can see in countries of Taiwan, Japan, South Korea and even in the U.S., the support should not equate to regulate, and this is the myth that the Chinese government has not yet understood. The top-down Soviet mandate to provide lots of money and or subsidies did not work in the semiconductor industry, which requires much more sophisticated production knowledge than the manufacturing of solar panels, for instance. In 2022, more than 3000 Chinese 'semiconductor companies[19] declared bankruptcy (Pino, 2022). Ironically, countries which have capacities to initiate chip acts (see footnote 7) only started to pump resources into semiconductor manufacturing in 2021. China started way earlier with a similar logic as the Chip Act, but the rigid structure, which was controlled by the state, severely hampered China's semiconductor development.

The second reason is about timing. Though SMIC was a fast follower, it was established in 2000. No matter how fast SMIC can learn, eighteen years (from 2000 to 2018 trade war) was still too short for a late comer to turn into a master (Interview data: Taiwan Interview 6). Advanced semiconductor manufacturing needs time to accumulate experiences, to earn customers' trust and to train talented, high-skilled engineers. Though China head hunted many Taiwanese high-skilled engineers since the 2000s, most Taiwanese engineers returned to Taiwan after some years. The reason is they felt after the Chinese company learned about their talents, they would not appreciate them by providing them sustainable career future (Interview data: Taiwan Interview 4). It does not mean 'only' Taiwanese engineers can establish the Chinese semiconductor industry, but 'learning' from the Taiwanese experiences would be a fast-track. Apart from human talents, the U.S. export control (discussed above) also delayed, if not curbed, China's indigenous advanced semiconductor development. China has its allies, mostly developing countries, and none of those countries' semiconductor manufacturing capacity is more advanced than China. Technology-wise, there is not much room for China to replace the lost which caused the U.S.'s export control.

Nevertheless, China still has some bargaining chips. As mentioned in the section of Taiwan, Japan and South Korea, they all have quite a lot of bilateral investments with China, if it is not in the field of semiconductors. Apart from this, China also started to impose export controls on critical raw materials to be used in manufacturing semiconductors, communication equipment and solar panels (Razdan, July 2023). Moreover, China is the third biggest importer of semiconductor products and its share has been growing exponentially, as indicated in the first section. Lastly, China might not be able to compete with Taiwan and South Korea in advanced chips, but the country has increased its wafter capacity by 26%, mostly in matured chips (SIA, January 2022). One of the Japanese experts interviewed by the author warned that *'All countries are paying attention to competing advanced chips, but not many countries noticed that China is the biggest manufacturer of matured chips, which powered cars, trains, and all other machinery which we still need to use daily'* (Interview data: Japan interview 3). The role of China in the semiconductor supply chain remains crucial, even though it does not seem like this from the perspective of advanced semiconductor manufacturing.

18 WCMC was merged into TSMC in January 2000, then Richard Chang went to China to establish SMIC in April 2000 (Lin 2023: 79).

19 The reason to put quotation mark on semiconductor is because those companies were not actually semiconductor companies, they used the name of semiconductor in order to receive governmental support.



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5. Conclusion and Policy Recommendations

The policy paper starts with three questions. Firstly, is the decoupling approach possible? Secondly, if the decoupling approach is not possible, what does it mean for de-risking? Thirdly, whether the state's intervention in the semiconductor supply chain is sustainable? This section concludes the findings throughout the policy paper to answer these three questions and provides policy recommendations.

The answer to the first question is obvious: decoupling is not desirable nor feasible. It is not only because of the high cost of decoupling but also the fact that no one country could produce a whole supply chain from beginning to end since all countries are economically interdependent. Currently, China still depends on working with democracies, mostly the U.S., to continue its economic growth. In other words, though both China and the U.S. had already started to move towards decoupling in 2018, as explained in the paper, the ironic truth is they both cannot afford to decouple.

With this understanding, the de-risk scenario is more practical or possible. Section 3.4 discussed the 'Chip 4 Alliance' or 'Silicon Allies' as the way that the U.S. government wish to foster de-risking. As discussed, there exists a lot of difficulties among potential members of such an ally. Section 4.2 indicates that China has obstacles from both domestically (for instance, the state's control of SMIC) and externally (for instance, the U.S. recent export control) to advance its semiconductor production. Nevertheless, China holds a strong share of matured chip production. The purposed suggestion of potential de-risking is for countries to work with China in matured chip production but limit the investment to China in advanced chip production. However, this was not a 'new' finding. This scenario is the reality even before the 2018 trade war. One might argue a small difference in the current understanding of 'de-risking' to the prior 2018 trade war is to acknowledge that China might really have two potentials: one is to suppress U.S. technology supremacy as SMIC was fast learning; the second is to use military power to invade the democratic country as to simulate what Russia did in 2022. Clearly, these are two hypothetic potentials, but de-risking is to take into consideration potential risks and work around them rather than avoiding them.

The answer to the third question involves policy recommendations to countries who are involved in the semiconductor supply chain as well as those who are the end-users of semiconductors. Notably, the government efforts of the U.S., EU, U.K., Japan, and South Korea were all aiming to pump into large amounts of financial support to supper the manufacturing of the semiconductor industry. While the intent behind these efforts is good, it is crucial to acknowledge the semiconductor production, especially advanced chips, takes years of capital accumulation and human talents. The whole production process also sacrifices a significant toll on environmental resources, including electricity and water. For instance, Taiwan and South Korea dedicated decades to achieving the excellence demonstrated by TSMC in the logic chip and Samsung in the memory chip production fields, respectively. Therefore, governments must understand that state-sponsored legislation may pump into short-term capital, but a sustainable and long-term commitment cannot solely rely on government support.

In the era of uncertain globalisation, it's understandable that governments express concerns about the critical semiconductor industry, whose division of labour and sources of resources are highly complex. Considering this, the following policy recommendations are proposed:

1. Collaborate with local companies to enhance their market capacity, thereby strengthening their position within the semiconductor supply chain.
2. Facilitate interaction among global human talents specializing in semiconductor design and production. This can stimulate further innovation breakthroughs across the entire supply chain.
3. Encourage joint investments between countries. For instance, TSMC's recent investment in Dresden, Germany as a joint venture with local semiconductor companies, signifies a step in the right direction (Staff Writer, DW, August 2023).[20] Joint-investment as such might encounter fewer obstacles than those faced in the U.S., due to the presence of local semiconductor companies with the ability to provide insights into local working culture and regulations. This not only fosters cooperation but also helps diversify the global supply chain, mitigating overreliance on a single country, as discussed in section 4.2, where China holds a significant share in mature chip manufacturing.
4. Countries that are end-users of semiconductors, such as the EU and the U.K., should recognize the interconnected nature of the supply chain, where every country plays a non-replaceable role. Striking a balance between economic nationalism and market principles is essential. Governments need to understand better their countries' comparative advantages within the semiconductor supply chains and maximise those advantages, rather than attempting to reshore the entire supply chain back to any single country.

In conclusion, the semiconductor industry faces multifaceted challenges. To navigate these challenges successfully, governments should adopt policies that leverage existing strengths, foster innovation, and promote international collaboration, thereby ensuring a resilient semiconductor supply chain.

20 This is a joint venture investment in which TSMC is the biggest investor (70%), with three other German semiconductor companies, Bosch, Infineon and NXP, each holding a 10% equity stake and strong support from the European Chips Act and German government (TSMC News, August 2023). It is expected that this fab can start functioning in 2027 and produce monthly 40,000 of 300mm (12 inch) wafers on TSMC's 28/22 nm planar CMOS and 16/12 nm FinFET process technology (TSMC News, August 2023).

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Since 2018, Dr. Lee has edited numerous books. In 2023, in collaboration with Michael Reilly, she co-edited the book *"China, Taiwan, UK, and the CPTPP: Global Partnership or Regional Stand-off?"* published by Palgrave. Currently, Dr. Lee is working on her second single-authored monograph project 'Sticky Decoupling: Geopolitics and the Semiconductor Supply Chain.'

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Interview data

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- Korean Interview 2. (2023, May 18). Senior analyst of Korean Semiconductor Industry Association (KSIA). Interview conducted in Seoul.
- Korean Interview 4. (2023, June 7). Senior research fellow, division of global innovation strategy research, science and technology policy institute. Online interview.
- Japan Interview 2. (2023, January 10). Senior analyst, Institute of Development Economy. Interview conducted in Tokyo.
- Japan Interview 3. (2023, January 11). Senior technology columnist in Nikkei Asia. Interview conducted in Tokyo.
- Taiwan Interview 2. (2022, November 30). Chief of investment services division, Hsinchu science park management bureau. Interview conducted in Hsinchu.
- Taiwan Interview 3. (2022, December 6). Engineer in TSMC. Interview conducted in Hsinchu.
- Taiwan Interview 4. (2023, December 7 & August 16). Senior analyst from market intelligence and consulting institute, advanced technology and policy Research Centre, Institute for Information Industry. Multiple interviews.
- Taiwan Interview 6. (2022, December 15). Senior strategy executive director, ITRI. Interview conducted in Hsinchu.
- Taiwan Interview 8. (2022, December 15). Junior engineer in TSMC. Interview conducted in Hsinchu.
- Taiwan Interview 10. (2022, December 30 & 2023, August 14). Senior analyst, ITRI. Multiple interviews.

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