Semiconductors in Key European and Indo-Pacific Economies
Geopolitical Risk in the Supply Chains into 2030 and Beyond

June Park
October 2023
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This paper is part of the HCSS Europe in the Indo-Pacific Hub.

November 2023

The research for and production of this report was made possible by a financial contribution from the Taipei Representative Office in the Netherlands to the Hague Centre for Strategic Studies. The conclusions and recommendations presented in this report are the result of independent research. Responsibility for the content rests with the authors and the authors alone.

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1. Introduction: ‘Self-Aggrandisation’ for Chips amid Geopolitical Conflict

What are the core factors that drive semiconductor supply chains amid the current geopolitical climate post-pandemic, and into the near future by 2030? Will there be a secure supply and if so, why or why not? This article analyses the chip supply chain in the context of multiple geopolitical risks, reflecting the industry and government perspectives of countries involved in the supply chain. It looks specifically at the flow of chip supply between the key EU member states and main chip manufacturing economies in East Asia – Taiwan, South Korea, Japan, and China – amid the ongoing technological conflict between the U.S. and China. The article looks to the EU Chips Act as the source of demand from the European region, along similar lines of other industrial economies for ‘self-aggrandising’ in semiconductor manufacturing capabilities by subsidisation. In the short term, it looks to U.S. pressures to impose export controls on production in mainland China as a critical source of supply chain disruption, while the new developments in chip foundry construction are still underway for the next few years. In the mid-to-long term, it points to the potential geopolitical clash on the Taiwan Strait as the main source of uncertainty in the chip supply chain.

This article is a query into two crucial questions: 'Will supply chain risks of the present persist into the near future?' and 'What are the impediments to securing stable flows of chip supply to the European region from East Asia amid the U.S.-China tech conflict?' The global supply chain has been at the centre of geopolitical risk since the COVID-19 pandemic. The pandemic caused rolling shutdowns of vehicle assembly plants, when wafer and chip manufacturers diverted the parts to other sectors such as consumer electronics needed for work-at-home environments due to social distancing or stay-at-home orders. The shortage of automotive chips squeezed the number of newly produced cars, and even well into 2023, is easing unevenly amongst auto producers. When the chip shortage hit the U.S. auto sector hard, the Biden administration sought to respond by incorporating the risk into the tech war with China through the expansion of its export controls, sending a strong political message to sustain the auto industry, which is a powerful support base for the Democrats. When the U.S. embarked on a series of export controls, defying the decades-long division of labour in global chip supply chains – semiconductor design, manufacturing, and testing/packaging – each jurisdiction was faced with the reality of elevating its level of self-sufficiency, if not ensuring full-fledged self-delivery.

Industrialised economies are now driven by competition to self-aggrandise their semiconductor industries by subsidy provision, anxious of another contingency that may jeopardize chip supplies for their economies. Such policy moves (see Figure 1) are evidenced not only by the beefing up of subsidies for domestic chip industries via legislations (e.g., EU Chips Act, U.S.
Chips and Science Act, South Korea’s K-Chips Act and Advanced Industries Act), but also by industry players’ moves to secure future sources of revenue (e.g., ASML seeking to consolidate partnerships with non-China East Asian players following U.S. measures). Whether such ‘self-help’ oriented approaches outside the traditional architecture of global trade will benefit the industry remains to be seen\(^1\) \(^2\), while the need for geopolitical risk analysis of the chip industry grows.

### Figure 1. Legislations for ‘Self-Aggrandising’ of Chip Manufacturing Across Jurisdictions

**GLOBAL SEMICONDUCTOR FAB INVESTMENT ACTIVITIES**

Of the 39 new fab projects announced globally in 2021, only 4 are in the U.S.

- **EUROPEAN UNION**
  - European Chips Act doubling global market share to 20% by 2030
  - France’s $1.9 bn investment in joint EU investment projects for semiconductors
  - Germany’s $1.2 bn in microelectronics projects

- **UNIFIED STATES**
  - CHIPS Act enacted in June 2021 but not yet funded
  - 4 new fab projects
  - $32 bn before CHIPS Act passed and $47 bn after

- **CHINA**
  - Renewed tax incentives on corporate income and imported semiconductor equipment for sub-28nm, sub-65nm, sub-130nm fabs
  - 10 new fab projects

- **KOREA**
  - “K-Semiconductor Belt” strategy on 5452 bn investment in semiconductors by 2030
  - 20% tax credits for new fabs
  - 5 new fab projects

- **TAIWAN**
  - “Invest in Taiwan” initiatives
  - 15% R&D tax credit; income tax exemptions for royalties on imported production technologies; import tariff exemptions for companies located in Science Parks
  - 10 new fab projects

- **SINGAPORE**
  - 1 new fab project in Singapore

**Source:** Semiconductor Industry Association, February 2022.\(^3\)

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1. China’s complaint against U.S. measures is in consultation at the WTO, but the appellate body of the dispute settlement body is dormant as the U.S. has not approved appellate body judges. ‘DS615: United States — Measures on Certain Semiconductor and other Products, and Related Services and Technologies,’ Complaint by China, under consultations as of December 12, 2022. [https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds615_e.htm](https://www.wto.org/english/tratop_e/dispu_e/cases_e/ds615_e.htm).


2. Projection of Chip Supply under Current U.S. Measures

The incumbent geopolitical risks amid the war in Ukraine and the tech conflict with China compel potential disruption in chip supply chains for three reasons:

1. **Current U.S. measures before new fab projects are finalised:** The latest licence requirements announced by the Bureau of Security and Industry (BIS) of the U.S. Department of Commerce on October 7, 2022 were for items destined to chip fabrication facilities in China, blocked based on the following thresholds: logic chips 16nm or 14nm or below (targeting SMIC), D-RAM memory chips of 18nm half-pitch or less (targeting CXMT), and NAND flash memory chips with 128 layers or more (targeting YMTC). In other words, the announced measures were meant to halt Chinese chip producers at their current levels of progression. TSMC of Taiwan and South Korean firms Samsung and SK Hynix received one-year waivers of the October 7, 2022 measures for their continued operations in China. There has been a round of talks with Japanese and Dutch chipmaking equipment producers (notably ASML), and the Japanese government and the Dutch government each laid out their export control measures following bilateral negotiations with the U.S. government. While the main policy drive for the U.S. is to deter AI chipmaking capability that may be used for future military warfare by China, and thus to halt China’s progression, foundries that are in operation in China are already impacted due to the sluggish performance of the Chinese economy (Samsung and SK Hynix have been heavily impacted in Q4 of 2022). Additional U.S. curbs, if implemented, will cause the foundries to ultimately close or be sold because they cannot be updated with new EUV machines and will lose competitiveness and marketability. The new fab projects announced by jurisdictions around the globe will require at least two to three years to materialize. In the meantime, South Korean chipmaking is likely to be capped by the U.S. government (see next paragraph).

2. **Additional U.S. measures to come:** Under the current geopolitical climate, it is highly likely that there would be additional measures by the Biden administration to curtail China’s progression in advanced chipmaking. There is a bill being circulated in the U.S. Congress that may delegate export controls to the Pentagon for reviews of AI chips. Chipmakers

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operating in China have been granted one-year waivers for the BIS license requirements (outlined above) after the October 7, 2022 export controls by BIS but there were concerns that once that lapsed in October 2023, there is a high likelihood, based on statements by Alan Estevez, Under Secretary of Commerce for Industry and Security, to limit the production of chips in detail based on the level of progression.\textsuperscript{8} However, media reports have speculated that the U.S. extended the chip curb waiver by another year, although not yet made official.\textsuperscript{9} As of October 2023, the U.S. is slated to announce an indefinite waiver for companies operating foundries in China, while the risks of U.S. government shutdown may delay the announcement from being made. Samsung and SK Hynix would be exempt from the rules based on the Validated End User (VEU)\textsuperscript{10} list they are on, which would allow them to be granted the permission by BIS to import machinery into their foundries in China. However, the indefinite waiver will still be temporary, contingent upon U.S. policymaking, and it will not be guaranteed when the doors will close for upgrading their businesses in China, due to the need for expansion and upgrading of equipment for the fast-paced semiconductor market. If such circumstance arises, chipmakers such as SK Hynix will reluctantly contemplate selling or relocating their equipment in China. Pull-outs will impact their earnings and the cost will be imposed on the consumers, and possibilities of supply disruption may be anticipated. In the event of a dissolution of the factories or removal of equipment for relocation, it would cause instability in the intended supply of final chips. Relocation of facilities to the home country of chip manufacturers or elsewhere also requires a fit environment for foundry operation, such as ample supply of electricity and water.

3. \textbf{Uncertainty in Allied Coordination and U.S. Conditions for Chip Subsidies:} The U.S.-East Asia Semiconductor Supply Chain Resilience Working Group, colloquially referred to as Fab 4 or Chip 4 was launched in September 2022, and after five months of deliberation, the Group conducted a videoconference on February 16, 2023, hosted by the American Institute in Taiwan. At the meeting, Taiwan pushed for discussing the creation of an early warning and mutual reminder system to ensure a stable supply chain for chip manufacturers. The meeting was attended mainly by directors-general of ministries of foreign affairs and/or industries and commerce, and there was no official announcement on the outcomes of the meeting. The anticipated official policy outcome would be the U.S. consolidating Taiwan, Japan, and South Korea as those falling in line with the tech limit to China on chips, abiding by export controls under the entity list by U.S. Commerce BIS, and launching initiatives to begin working on chip information exchange (details on respective chip supply chains, R&D, investment incentives). The scenarios of contingencies including natural disasters and military attack raised by countries like Japan and Taiwan are unofficial circumstances that Chip 4 supposes, albeit Taiwan not being an official U.S. ally. More uncertainties have arisen due to lack of incentives portrayed in the latest U.S. Commerce announcement of thresholds for chip subsidy applications on February 28, 2023, which requires of the chipmakers that apply for and receive the U.S. subsidies ($38.22 billion and up to $75 billion in direct loan or guaranteed principal amounts) to allow for monitoring of facilities and balance sheets by the U.S. government, as well as upside sharing of up to 75%


\textsuperscript{9} ‘U.S. to extend China chip export waivers for Taiwan, Korea chipmakers,’ Nikkei Asia, August 24, 2023. https://asia.nikkei.com/Business/Tech/
Semiconductors/U.S.-to-extend-China-chip-export-waivers-for-Taiwan-Korea-chipmakers

of the subsidy amount received in case of excess returns earned. Chip manufacturers are in a dilemma, as they seek potential benefits from the U.S. subsidy, but the net revenue may not be as big as originally expected. In September 2023, the finalized guardrails for limiting foundry expansion were announced by the National Institute of Standards and Technology (NIST) of U.S. Commerce. Contrary to the South Korean firms’ requests to the proposed rule by the U.S. Commerce (to allow for foundry expansion beyond 10% for advanced chips in China) announced in March 2023, the final rule on guardrails for preventing expansion of foundry capacity (beyond 5% for advanced chips, beyond 10% for legacy chips of 28nm and above) for ten years if receiving U.S. subsidies under the CHIPS & Science Act were maintained. In other words, the U.S. is decided on restricting foundry operators in China from receiving U.S. subsidies, so that they maintain status quo but not do more than what is currently allowed. In a similar move, the EU is also likely to place measures on outbound investment to China to control some chips for artificial intelligence and quantum computing within the year.

These developments raise questions regarding chip accessibility into the near future up to 2025, if chipmakers fail to secure revenue for next stage developments, or even by 2030, if there are troubles met in the new fab constructions or operations (notably regarding employable, eligible workforce in the operations). While most of the current discussions are on hardware and manufacturing for now (for the production process of an integrated circuit, see Figure 2), potential concerns remain on business models, foundry and talent management, and the continuous flow of eligible engineers. The most likely impact onto consumers – not only the EU but globally – would be the latency in the delivery/upgrading of certain electronic goods that rely on chips, and the possibility of price increase due to chip producing firms having to make their losses, amid pressures to earn the equivalent of their earnings outside the Chinese market.

11 Notice of Funding Opportunity (NOFO): CHIPS Incentives Program – Commercial Fabrication Facilities, U.S. Department of Commerce, February 28, 2023. It is noted under ’UPSIDE SHARING’ on page 22 that “Recipients receiving more than $150 million in CHIPS Direct Funding will be required to share with the U.S. government a portion of any cash flows or returns that exceed the applicant’s projections (above an agreed-upon threshold specified in the award). The Department expects that upside sharing will only be material in instances where the project significantly exceeds its projected cash flows or returns and will not exceed 75% of the recipient’s direct funding award. Because successful projects will differ considerably in their key attributes, upside sharing arrangements may vary by project, and, in exceptional circumstances, may be waived.”


Figure 2. Steps in making an Integrated Circuit


Note: The 2019 export curbs by Japan centered on the latter part of stage D (etching), which require hydrogen fluoride and photoresist. The 2022 U.S. Commerce BIS export controls (EUV) are at the initial part of D, which would render chip making impossible under current chipmaking technology.
3. Projection of Geopolitical Risks in 2030-2035: Whither Taiwan’s Silicon Shield?

In recent months, war game simulations have led to varied speculations regarding the U.S. capability to deliver in the event of China’s invasion of Taiwan. Given Xi Jinping’s timeline serving a third term and China’s aspirations to absorb Taiwan since the Deng Xiaoping era, concerns over future chip shortages are constantly discussed in the U.S. policy sphere, as well as a contingency scenario possibly by 2027, also gaining traction in the policy circles of U.S. allies South Korea and Japan. In the U.S., it is anticipated that Biden’s pressures against China will continue to be manifested by reinforced measures via export controls, and even in the case of a change in U.S. leadership in 2024, the political consensus on countering China is likely to be maintained. How China will respond remains to be seen, but there are views that the one-year waivers that were handed out have held back China from lashing out and retaliating.

Nonetheless, in the event of a Chinese invasion of Taiwan, disruption in the chip supply chain is highly likely, as it may not suffice to relocate all TSMC facilities elsewhere. Such speculations are still up in the air, as the Chinese economy dwindles amid the CCP’s grip on tech firms is affecting the overall economic performance. Given the hurdles to finalize the Arizona plant amid difficulties of finding sufficient qualified labour to run the operations, TSMC is speeding up on its foundry project in Kumamoto, Japan towards finalization by first

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16 “War Game Finds U.S., Taiwan Can Defend Against a Chinese Invasion: All sides would pay a heavy price if ever there were a military conflict over the island,” The Wall Street Journal, August 9, 2022. https://www.wsj.com/articles/war-game-finds-u-s-taiwan-can-defend-against-a-chinese-invasion-11660047804

quarter of 2024 and start production by end of 2024. TSMC’s pledged foundry installation in Germany will also be of solace to German automakers and the EU in general in mitigating risks from the contingency, but TSMC will strive to maintain the advanced node production line within Taiwan.

TSMC’s-8bn-Japan-chip-project-steams-ahead-as-U.S.-site-hits-snags

June Park, PhD, is a political economist working on the geoeconomics of conflict in the digital economy, observing East Asia, the U.S., Europe and the Gulf. Her work focusses on trade, energy and tech conflicts among nation states as they navigate their distinctive paths into the digital future. Park is an inaugural Asia Fellow of the International Strategy Forum at Schmidt Futures (2022 cohort) and a Nonresident Fellow at the National Bureau of Asian Research in Washington, DC. She also contributes her expertise to the experts group at the Center for East Asia Policy Studies of the Brookings Institution.