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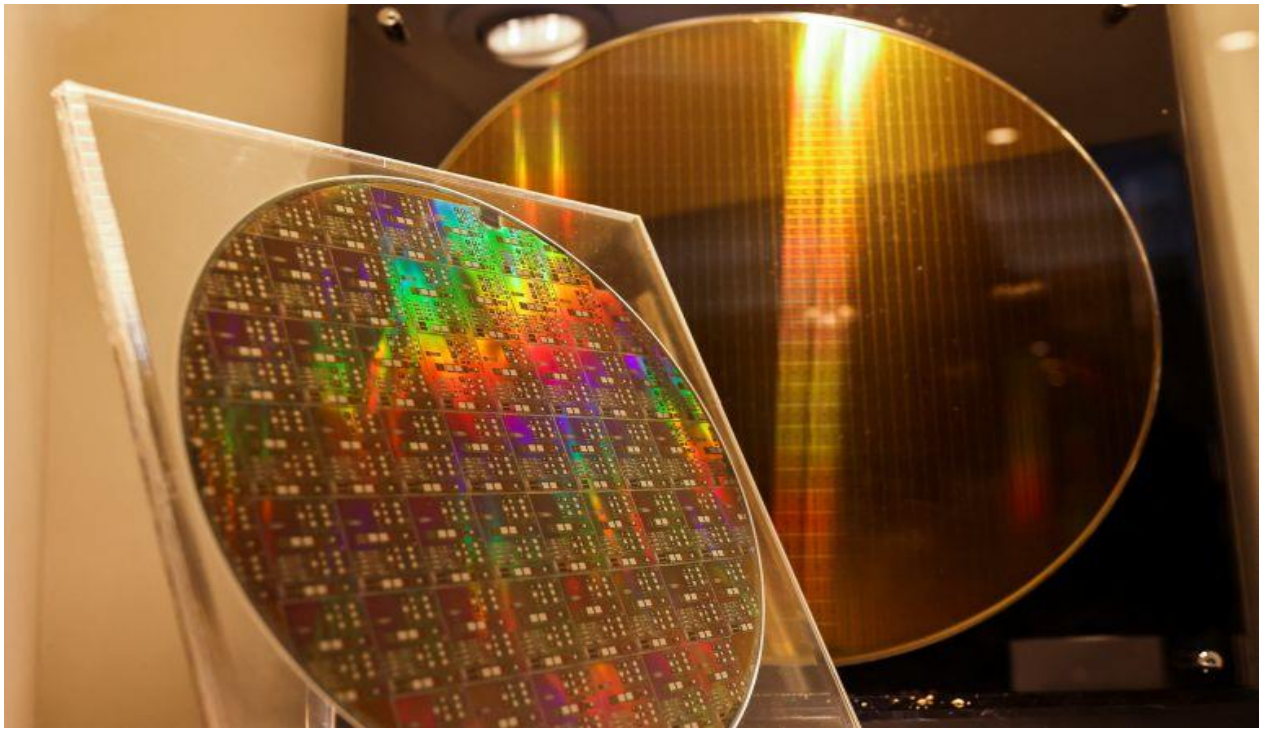

Balancing global industries and national defence: Taipei's path

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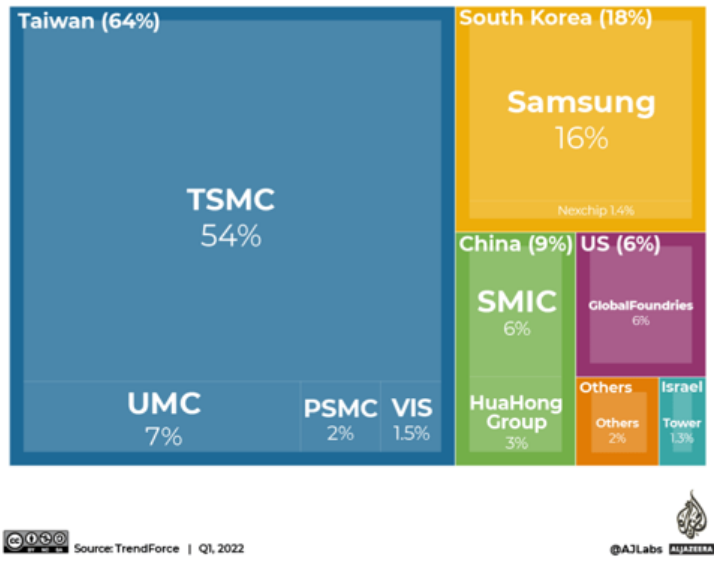
Globalization of the domestic industrial base is presenting a challenge for U.S. policymakers attempting to maintain national defence with global high-tech industries. Given Taiwan Semiconductor Manufacturing Company (TSMC)'s near monopolistic position in production of advanced (below 10 nanometre) semiconductors, Taiwan is emerging as a linchpin in supply chain security for the U.S. and her allies.



Nonetheless supply chain security of dual-use technologies remains problematic. On the 9th of February 2023, following a classified briefing with military and intelligence officials, Republican senators expressed concern that U.S. manufacturing may have helped build the Chinese spy balloon that recently violated U.S. air space. According to a source familiar with the briefing, the Chinese balloon had English writing and western made parts.

Others previously expressed similar concern about western and allied technology ending up in Chinese weapons. Back in 2019, U.S. officials warned Taiwanese diplomats that Huawei was using TSMC semiconductors in Chinese missile guidance systems aimed at Taiwan. In 2021, a *Washington Post* story also reported that Chinese company Phytium Technology Co. was using TSMC chips in advanced Chinese military systems, to which Taiwan Minister of Economic Affairs Wang Mei-hua responded that "to the best of our knowledge" the Chinese military are not the end-users for TSMC's chip exports.

Nonetheless, Ou Si-fu, a research fellow at the Institute for National Defense and Security Research in Taipei, pointed out challenges facing export control of semiconductors. "The problem is that the chips are dual-use technology," Ou said. As such "they can be bought off the shelf for one application and then used in military equipment that is aimed right back at Taiwan."

This thus is the heart of the dilemma currently facing policymakers in U.S., Europe and Asia: how to maintain national security in the face of an increasingly globalized defence and high-tech industrial base? Because the desire to maintain, or acquire, production capability in key military related industries

can easily insert a national security requirement into the management of the economy, since threats to such supplies feed quite quickly through into military capability, this can thus almost be seen in the same light as military threats. The semiconductor industry, by virtue of its dual-use application in both the commercial and military sectors and as part of the technological root in the national defence industrial base, is especially prone to government intervention.

"Strategic industry" rationale for intervention

Besides the fact it is a dual-use technology, the semiconductor industry is also viewed as a "strategic" or "critical industry" due to various economic characteristics.[1] In general, a strategic industry is one characterized by high entry barrier, first mover advantage, high sunk cost and externalities. High Research and Development (R&D) expenditure and a steep learning curve create entry barriers for firms lacking sufficient capital, and as a technology driver—a high-volume product with a relatively simple design—it would hone its manufacturing skills and transfer its learning to more complicated, lower volume, high value-added devices. The relatively fixed sunk cost of R&D and capital equipment investments and the decreasing unit costs with improved yields create first mover advantage, in which a privileged position in one market can create scale economies over rivals and capture more technological externalities (positive externalities) in future generations of semiconductor products. For example, with a price tag of more than US$20 billion to build a new chipmaking plant, this has largely reduced the number of competitors with leading-edge technology to the three companies of TSMC, U.S' Intel and South Korea's Samsung.

Food chain theory. The chip industry is also "strategic" due to its linkages to the rest of the economy and the possibility of monopoly profits in this sector, as outlined in a U.S. National Advisory Committee on Semiconductors (NACS) report during the 1980s U.S.-Japan chip war. The linkage argument is best illustrated by the electronics "food chain" theory.

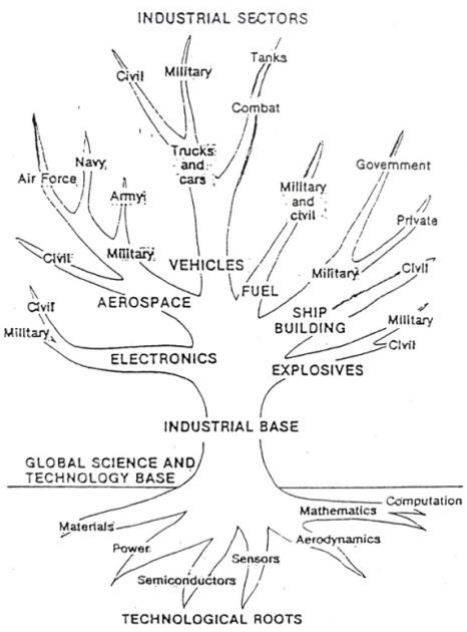
[1] National Advisory Committee on Semiconductors (NACS). *A Strategic Industry at Risk: A Report to the President and the* Congress (Washington, D.C.: 1989).

Figure 1: Semiconductors: A Foundation for Preeminence

Sources: National Advisory Committee on Semiconductors, Dataquest, and American Electronics Association.

According to this food chain theory, upstream and downstream industries' competitive fortunes are interlinked in a complex ecological system that makes each dependent on the health of the others. Each component level—from silicon wafers up to finished electronics products—is dependent on the others so that if one link is damaged, the other links are automatically injured. Indeed as witnessed during the Covid-19 pandemic and chip shortages, damage to the chip sector caused the German auto industry to suffer losses, culminating with German Economy Minister Peter Altmaier writing to his Taiwanese counterpart Wang Mei-hua for TSMC to ramp up production. When there was a shortage in the component level of advanced (smaller than 10 nanometre) chip from TSMC, this also posed a serious risk to other high-tech sectors given they are inputs in smartphones, computers, military and space equipment. Moreover, the role of semiconductors as an important input to many other sectors makes the potential exercise of monopoly power an extremely important concern, since market power in such an input may be extended downstream into user industries, by acquisition or vertical integration, allowing even greater monopoly rents to be collected.

Technology tree. The semiconductor industry is also a key input in the national industrial base, as evidenced in a 1991 report published by U.S. Congress's Office of Technology Assessment.



Looking at the figure, the position of the semiconductor industry at the very bottom of the technological roots in this tree underscores the importance of the industry in the perspective of the U.S. government. According to Erik Pages (1996), who was a Congressional staff member during the mid-1980s, this report reflected the perspectives among policymakers of supporting industries not just with military significance, but rather industries with importance on both commercial and military grounds.[2] The industries designated as "technological roots" were most frequently cited on various critical technology list in the U.S. government.

In short, the semiconductor industry is "strategic due to (1) the economic welfare significance in terms of rents and externalities; (2) its importance for the economy as a vital intermediate input (a quasi-security rationale); and (3) its importance as a direct input for producing weapons. Given this, it is not surprising that the U.S. semiconductor industry is characterized by repeated government intervention during the chip war with Japan in the 1980s, and now with China in the 2020s.

Chip war with Japan in 1980s and China in 2020s

The 1980s was characterized by greater integration of the commercial and defence sectors and the globalization of an increasingly commercial defence industrial base, and the Japanese semiconductor industry emerging as a major force in the world market. By 1985, Japan's share of the global market for Dynamic Random Access Memory (DRAM) chips had surpassed the U.S., with Washington accusing Tokyo of dumping chips to cripple the U.S. industry. The trade friction was exacerbated by comments from an ultranationalist member of the Japanese Diet, Shintaro Ishihara, who threatened to cut off semiconductor supply to the U.S. and sell them to the Soviet Union instead. Eventually, with concern on growing defence dependence on foreign—especially Japanese—sources of supply,

[2] Erik R. Pages, *Responding to Defense Dependence: Policy Ideas and the American Defense Industrial Base* (Westport, Conn.: Praeger, 1996).

U.S. policymakers established SEMATECH in 1987 — a joint government-industry consortium to revitalize the U.S. domestic semiconductor manufacturing industry.

Now history is being repeated with the U.S.-China chip war, and formation of the U.S.-led Chip 4 alliance to ensure a resilient semiconductor supply chain involving the four countries of Taiwan, South Korea, Japan and the U.S. The American Institute in Taiwan (AIT) hosted its first virtual meeting on September 28, 2022., with Taiwan's TSMC playing a key role in this alliance, given its near monopolistic power of dominating 92% of market share for advanced semiconductors. Given the U.S. Department of Defense needs secure and reliable chip supply, reshoring semiconductor manufacturing capability is at the top of the U.S. agenda, and the new TSMC fab in Arizona is one such example.

Taiwan's role in supply chain security

Reshoring and regionalization. Besides reshoring, TSMC in Kaohsiung is also playing an important role in Indo-Pacific supply chain regionalization. To that end, Nanzih Technology Industrial Park will become the core zone of Taiwan's "Southern Semiconductor S Corridor", a policy priority envisioned by Kaohsiung Mayor Chen Chi-mai's administration of forming a new technology industrial cluster in Kaohsiung. The project will connect Tainan Science Park, Renwu Industrial Park, Ciaotou Science and Technology Park, and Nanzih Technology Industrial Park in an S-shaped corridor. Besides TSMC, it has already attracted other major technology companies such as Win Semiconductors Corp, Netherlands-based NXP, Germany-based Merck Group, and Nanzih Technology Industrial Park is already home to Taiwan's second largest semiconductor company, Advanced Semiconductor Engineering (ASE). In August 2022 TSMC held a ground-breaking ceremony for their new plants in Nanzih, slated to first produce 28 nanometre chips used mainly in the automotive industry, and 7 nanometre chips in the near future.

Friendshoring and cooperative security with NATO. Kaohsiung Port is also emerging as a key logistics hub in support of President Tsai's New Southbound Policy for further trade integration in the Indo-Pacific region. It ranks as the 15thlargest port in the world, and Taiwan defence analysts have proposed that the port could become a cooperative security location (CSL) now that the U.S. no longer has access to Hong Kong port. This may work in conjunction with NATO's current exploration for cooperative security and Enhanced Opportunities Partner (EOP) roles for Asian partners such as Japan and South

Korea, and possibly Singapore and Taiwan, given they are world leaders in multiple emerging and disruptive technologies (EDT) sectors. In view of the US$1 billion NATO Innovation Fund launched in June 2022, Taiwan can also play a role in friendshoring—to ensure strategic supply chains are based in allied and trusted partner countries. To that end Taiwan can participate in NATO-launched technology development projects to become part of the alliance's defence technology ecosystem, as recommended by former NATO assistant secretary-general for executive management Giedrimas Jeglinskas during a visit to Taipei in January 2023. This follows a flurry of NATO-Taiwan exchanges with former NATO Secretary-General Anders Fogh Rasmussen's visit to Taipei in the same month.

Nonetheless, despite increasing NATO-Taiwan ties and U.S.-China trade friction in semiconductors, it is important to underscore this is not a form of decoupling from China's economy, but rather selectively diversifying and remapping the high-tech supply chain. After all China remains a top trading partner for Taiwan and other allies such as Japan and South Korea, and as Taiwan Deputy Economic Affairs Minister Chen Chern-chyi observed, "I don't see [how] we can completely decouple from China. That's not realistic." Moreover, as Major Jessica Taylor and Jonathan Corrado argued in their article in *The National Interest,* due to the globalized nature of the chip supply chain, decoupling would be expensive and potentially alienate U.S. partners, as well as inhibit the innovative capacity of U.S. companies. Thus, at this juncture, the Chip 4 alliance and cooperative security with NATO seem to be a prudent way forward to build resilience in the supply chain, as policymakers in Taiwan, U.S. and allied countries continue to balance the trade-off between maintaining national defence and innovation in an increasingly globalized defence industrial base.

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