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A trip along the semiconductor supply chain

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It is more than ten years since I left Japan as The Economist's bureau chief. On my return this June, I found that in the business world, a lot of things had changed for the better. Many executives that we met spoke English and were dressed casually, rather than in jackets and ties (we were the ones whose Japanese was lousy and were overdressed). There was more interest in venture capital than there used to be, especially among large corporations; they hoped that by investing in start-ups, corporate venture capitalists would not only give rise to new businesses, but also import a greater risk-taking culture into the parent companies. And there was a renaissance in part of Japan's manufacturing sector, especially the semiconductor industry, which was led by global demand for graphics processing units (GPUs) for artificial intelligence (AI) and reinforced by the cheap yen.

My colleagues and I were investigating the silicon supply chain, to assess the impact of geopolitical tensions between America and China as well as the effect of the rise of generative artificial intelligence (AI). We visited Japan, South Korea and Taiwan, meeting companies such as Resonac and Advantest in Tokyo, SK Hynix and Samsung in South Korea and TSMC and UMC in Taiwan. We came away with two conclusions. Firstly, along the supply chain in Asia there is widespread frustration at America's efforts to prevent the sale of advanced chips to China; several executives we spoke to saw "decoupling" as a way of promoting American manufacturing at Asia's expense. Secondly, demand for GPUs was pushing Nvidia's suppliers to increase investment, but some companies – aware of the cyclicality of the chip industry – were concerned about the risk of over-capacity.

We started with the supply chain in Japan. Resonac makes chemicals used in chip substrates. Advantest makes testing equipment, and its business testing high bandwidth memory chips used in GPUs is growing. Japan has a very strong position in parts of the supply chain; according to one company's estimates, the country is source of almost a third of equipment and more than half of the materials used in the global semiconductor supply chain. Dozens of companies are involved. Some, such as Resonac, are working with others to improve packaging solutions for semiconductors. It is a cat's cradle of relationships.

The boom in demand for GPUs, especially in America, has caused rising demand for Japanese products. But decoupling between America and China is also raising concerns that America is pressuring its allies in East Asia to cut China off from the market for advanced semiconductors. By one estimate, China accounts for about 25% of Japan's semiconductor-related exports. So sanctions on tech firms such as Huawei, and export controls on the sale of many microchips to China have a meaningful impact on Japanese business. One executive accused the US of being "selfish" in trying to suppress China's advanced semiconductor industry; some saw it as an underhand way of stifling competition. Whatever the geopolitical tensions, they couldn't imagine the semiconductor industry without the Chinese market, because it is so big.

Yet at the same time, executives understood that every country is looking for more strategic autonomy for its semiconductor industry, including Japan. Though the semiconductor industry is an example of globalisation at its best, it is also one originally built on government subsidies and industrial policy. In Japan, the government has used subsidies to attract TSMC to Kumamoto. It is also backing Rapidus, a joint-venture between eight big Japanese corporations, which is planning to make logic chips in Hokkaido. An expert on the geopolitics of semiconductors described this effort to safeguard the supply of chips in case of a Chinese invasion of Taiwan as the "silicon island chain," which sums up the sense of insecurity. It stretches from Taiwan to Hokkaido.

Across the region, we heard a common refrain. Not only was America being heavy-handed in trying to isolate China. The US government's efforts to use subsidies to persuade parts of the chip supply chain to relocate to the United States were not well thought out, either. One example people pointed to was TSMC. In making advanced chips for Nvidia and Apple, it coordinates a vast network of suppliers across East Asia, including makers of memory chips and packaging components. That includes companies ranging from big firms like SK Hynix to tiny mom-and-pop outfits that launder the "bunny suits" TSMC uses in its clean rooms. So far, only some of its suppliers have committed to move with it to Arizona. It will have to build up more resources locally, but this is difficult, considering how interconnected the supply chain is, and how small but crucial some of the Asian players are.

The task is complicated by the physical distance and time-zone differences between Taiwan and America; analysts said it was easier to resolve problems in manufacturing industries between Taiwan and Japan, for instance., because the latter was only a short plane journey away. The workplace culture in America is considered another potential problem; it is more unionised and there is more focus on work-life balance, which makes it difficult to engage engineers at short notice, day or night, to fix problems.

In the long run, TSMC is clearly convinced that it needs to diversify its operations, including to the US, in order to put the industry on a trajectory that is sustainable for the long term. But in

order to make that profitable, it will have to convince its biggest customers in America to pay more for chips produced locally, as an insurance premium. Otherwise an industry that through its history has struck a clever balance between state support and the free market will have to become more dependent on subsidies and handouts, sapping its dynamism.

The decision by companies like TSMC and Samsung to make big investments in America also raises the question of capacity. Is excitement over AI creating a boom-like mentality leading to overinvestment in advanced chipmaking in America, Europe and Asia? The question was brought home to us at SK Hynix. There is so much demand for HBM that shortly after we left it announced $75bn in investments by 2027, much of which is memory-related. It is a challenge to make such investments in South Korea because of geographical constraints: its fabs are built on several stories to make the best use of space. It suggested how strong demand for HBM is anticipated to be.

In Japan companies are being a bit more restrained in their investments. That may because the further you get down the chip supply chain, gross margins shrink, making it more risky to spend large amounts on new capacity – especially when there is concern over restrictions on the ability to sell to China.

But companies are also cautious to see whether end demand materialises from corporations around the world for generative AI, in order to justify the spending, estimated at $200bn this year by Alphabet, Amazon, Meta and Microsoft alone, for investment in GPUs, data centres, model training etc. If that demand does not materialise soon, and the yen continues to strengthen, it won't just be the Japanese semiconductor industry that suffers. Global stock markets riding on a wave of exaggerated expectations about generative AI, and fuelled by cheap money via the carry trade, will be vulnerable too.

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