

The geopolitics of semiconductors

The US has a chokehold on China when it comes to the semiconductor industry, as China lacks the technical capacity to make chips sophisticated enough to power the next generation of machines



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For *The Straits Times*

United States-China relations are in a new phase of heightened strategic competition. Nuclear deterrence makes war highly improbable. The fear of mutually assured destruction will keep the peace between the US and China, as it kept the peace between the US and the Soviet Union for more than 40 years during the Cold War. As during the Cold War, the US and China will avoid direct military confrontation and find less dangerous ways to compete. The US and China are interdependent as the US and Soviet Union never were, and in a way never before experienced in history by strategic rivals. They are enmeshed in a complex web of supply chains of an intricacy and sophistication previously unknown in the global economy. This makes complete across-the-board decoupling or the creation of two completely separate systems improbable.

But interdependence also accentuates strategic mistrust by highlighting critical vulnerabilities. Supply chains in some domains are being disrupted and reoriented as China tries to mitigate its vulnerabilities and the US gains strategic advantage.

SERIOUS VULNERABILITY FOR CHINA

Technology, in particular semiconductors, has emerged as a critical arena of US-China geopolitical competition, far more critically so than during the Cold War. Semiconductors are a very serious vulnerability for China. Semiconductors of some sort are used in almost everything that is not purely mechanical. American efforts to pressure or persuade countries not to adopt Huawei for 5G networks have drawn the most attention. But this is really a second-order issue.

Without semiconductors of the right type, Huawei's ability to win contracts to run 5G networks is moot. China has made remarkable progress in many areas of high technology. But to apply and take full economic advantage of

what it has achieved, China needs semiconductors, which it does not have, or does not have enough of the right type.

Semiconductors are China's largest import, larger than oil. China accounts for 40 per cent of the global semiconductor market. But only about 9 per cent of China's needs is made in China. And of the 91 per cent that China needs to import, 56 per cent comes from the US. And even the 9 per cent produced in China is mostly from foreign firms. In 2018, Chinese semiconductor companies accounted for only US\$4.78 billion (S\$6.5 billion) of the US\$23.8 billion worth of local production and were mainly at the low end of the semiconductor value chain.

The high-end semiconductor industry is dominated by just three firms: Intel, Samsung and Taiwan Semiconductor Manufacturing Company (TSMC), which are capable of producing at the most advanced process nodes, the industry term for a specific generation of manufacturing process and named according to its smallest feature size. The three industry leaders are producing at 7 nanometres (nm) and pushing towards 5nm and smaller.

It would not have escaped the notice of Chinese strategists that two of the three industry leaders are from jurisdictions highly dependent on the US for security (TSMC from Taiwan and Samsung from South Korea) while the third (Intel) is American.

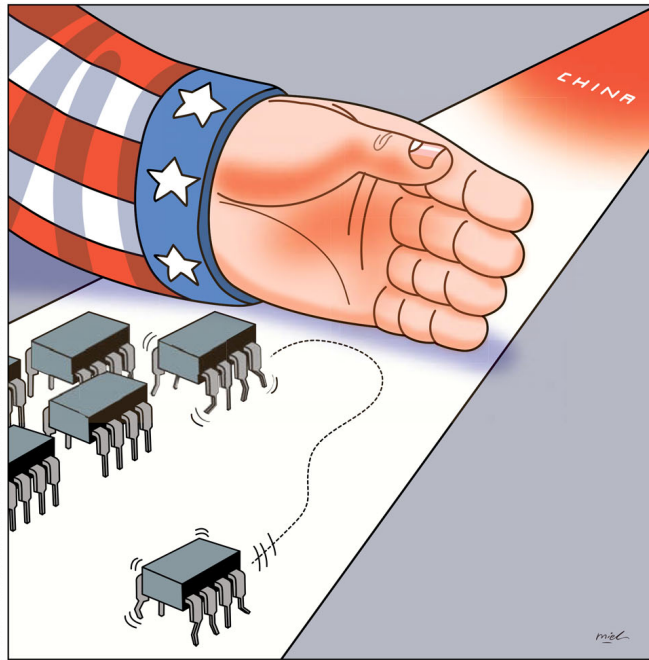
Industry experts estimate that Semiconductor Manufacturing International Corp (SMIC), China's principal semiconductor fabricator, is several generations, or three to five years, behind these leading-edge foreign designers and manufacturers, and the frontiers of semiconductor design and production are continually moving outwards.

SMIC only recently began producing semiconductors of 14nm. China's average is 28nm. China is highly dependent on TSMC for semiconductors of 7nm.

China does not need high-end semiconductors for everything. But it needs them for the new technologies that are expected to drive what has been termed the fourth industrial revolution.

This gap in the country's capabilities is a failure of Chinese industrial policy which Beijing is now scrambling to rectify.

The "Made in China 2025" vision envisages China producing 80 per cent of its semiconductor needs. That is a very ambitious target.



China has many creative scientists and is trying to attract more through its "thousand talents" programme. It will certainly pour vast amounts of money into its semiconductor industry. But it is still going to be very hard for the country to move up the semiconductor value chain.

The US and its allies control critical technology choke points in the semiconductor manufacturing process, among them, electronic design automation (EDM) and extreme ultraviolet lithography (EUV). EDM is a category of software tools used to design electronic systems such as integrated circuits and printed circuit boards. As high-end chips can have billions of components, it is basically impossible to design them without EDMs – which is a technology controlled by just three firms, two of which are American and the third German.

It is also basically impossible to manufacture high-end chips without EUV, a technology critical to developing next-generation chips that allow more components to be built inside a chip, packing more speed and power onto smaller chips.

The US has successfully pressed the Netherlands to block the sale of EUV technology by a Dutch company to SMIC. EUV technology

contains substantial amounts of American intellectual property.

AMERICAN RESTRICTIONS

The US recently put in place an array of restrictions on the sale of semiconductors to China. The latest restrictions, which came into force on Aug 20, prohibit any firm "where US software or technology is the basis for a foreign-produced item" from supplying Huawei without a licence from the US Commerce Department. This applies to any semiconductor company anywhere that uses American intellectual property at any stage of production. In effect, this means just about everyone and certainly all three industry leaders.

If strictly applied, these regulations have successfully "decoupled" China from the international semiconductor supply chain.

These sweeping restrictions can hamper China's long-term growth trajectory and its ability to harness new technologies at a time when the old Chinese growth model is nearing the end of its shelf life, when the expectations of the Chinese people are rising, when structural problems are accumulating in the Chinese economy, and when the Covid-19 pandemic has already lowered China's growth prospects.

China will not collapse. Given sufficient time and resources, it could perhaps produce its own versions of EDMs and EUVs and whatever else it needs.

But resources are never infinite and, in strategic competition, time is a precious resource. The objective of strategic competition in the nuclear age is not to destroy the adversary. That is simply too dangerous. Rather, the objective is to disrupt and delay your adversary's plans and force your adversary to divert resources from other uses.

So far the latest restrictions apply only to Huawei.

CHINA'S OPTIONS

Once its stockpile of semiconductors runs out, which industry experts think will be some time next year, Huawei will collapse, unless it receives a reprieve by way of its suppliers receiving a licence. But the restrictions could easily be extended to other Chinese firms too. SMIC is the next logical target.

The US will probably eventually grant some licences to export some types of semiconductors to Huawei and other Chinese companies. After all, denying exports to the major market imposes costs on suppliers as well, and many suppliers are American companies

or companies of friends and allies. Nor will the US want to make China desperate, as it made Japan desperate before the outbreak of World War II by cutting off its oil supplies.

But licences granted can also be licences denied. The decision is entirely in the hands of the US. The US government has its hands around the throats of Huawei and other Chinese users of semiconductors, and can strangle them whenever it considers expedient. Decisions on licences will be made according to strategic and not purely commercial considerations.

Semiconductor supply chains are very intricate. The new restrictions give the US the discretion to intervene at any point of a very complex and geographically widely distributed production process, from design to fabrication.

The uncertainty this generates for China and suppliers is a potent strategic weapon. Foreign suppliers will not abandon the China market, but they will certainly become far more cautious about what they do in China and for China. Some will shift part of their operations out of China and divert planned new facilities home or to other countries.

It is not clear that China can effectively retaliate or circumvent the restrictions. All the major advanced economies capable of providing the technology that China needs – Japan, South Korea, Australia, the United Kingdom and, in the European Union, Germany, France and the Netherlands, among others – share American concerns about Chinese behaviour. Retaliation could only harden those concerns.

While China is important, the US is even more important to them in both economic and strategic terms. Beijing's best hope is that a new US administration will take a different approach. This is a forlorn hope.

A Biden administration – if there is a Biden administration, which is not yet to be taken for granted despite polls suggesting Democratic Party nominee Joe Biden has more support than incumbent Donald Trump – is unlikely to remove or even substantially modify the restrictions. It would probably implement them within a more orderly and transparent decision-making process. This may mitigate conditions for suppliers, but not for China.

The Asian countries in the semiconductor supply chain, including Singapore, will have to deal with the geopolitics of semiconductors as a long-term factor. Techno-nationalism is here to stay.

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