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Techno-nationalism via semiconductors:

Can chip manufacturing return to America?

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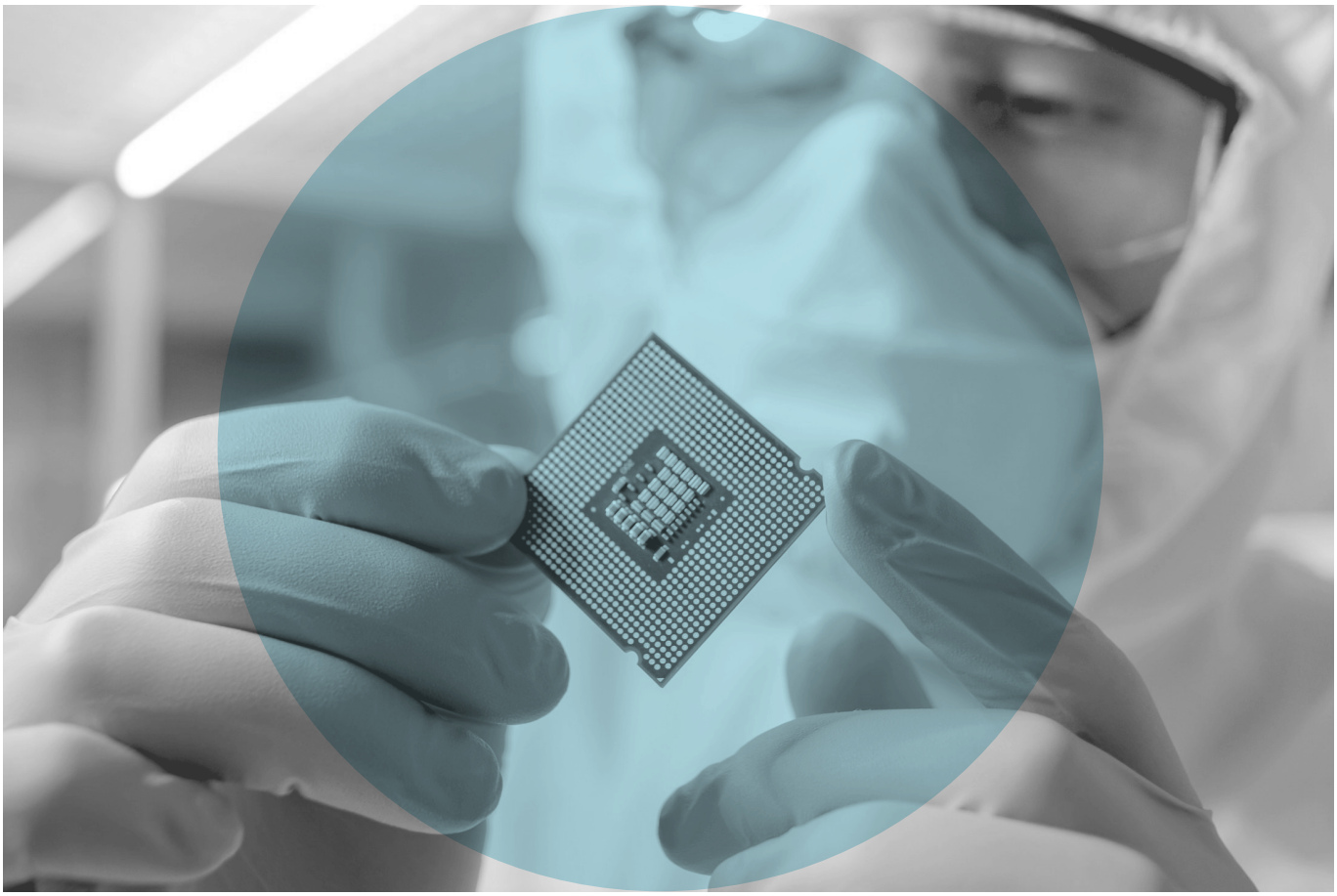


Contents

Introduction

The COVID-19 pandemic and ongoing US-China geopolitical tensions have converged to create a global shortage of semiconductors. In 2021, this "perfect storm" marked a milestone in public perception with the world learning the crucial role of semiconductors in virtually every aspect of the global economy.

A global chip shortage

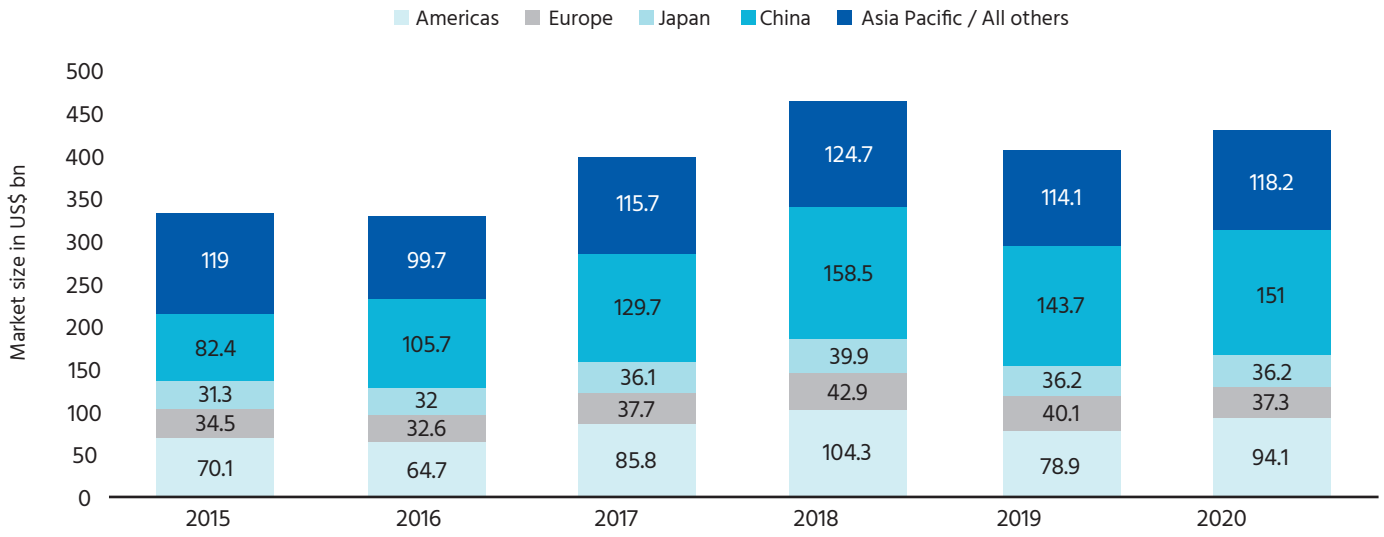
Almost every industry of the future – from fintech to cleantech and even quantum computing – depends on semiconductors.

Semiconductors represent the world's most essential and coveted technology. They comprise the "brains" for everything, from AI to machine learning and the internet of things (IoT). Almost every industry of the future – from fintech to cleantech and even quantum computing – depends on semiconductors.

The COVID-19 pandemic has transformed the semiconductor industry. Lockdowns and remote work and learning led to more use of laptops, smart phones, and other connected devices. Tech companies and service providers expanded their broadband infrastructure, digital platforms, and AI to accommodate surging online loads. Demand for microchips – the popular term for semiconductors – skyrocketed.

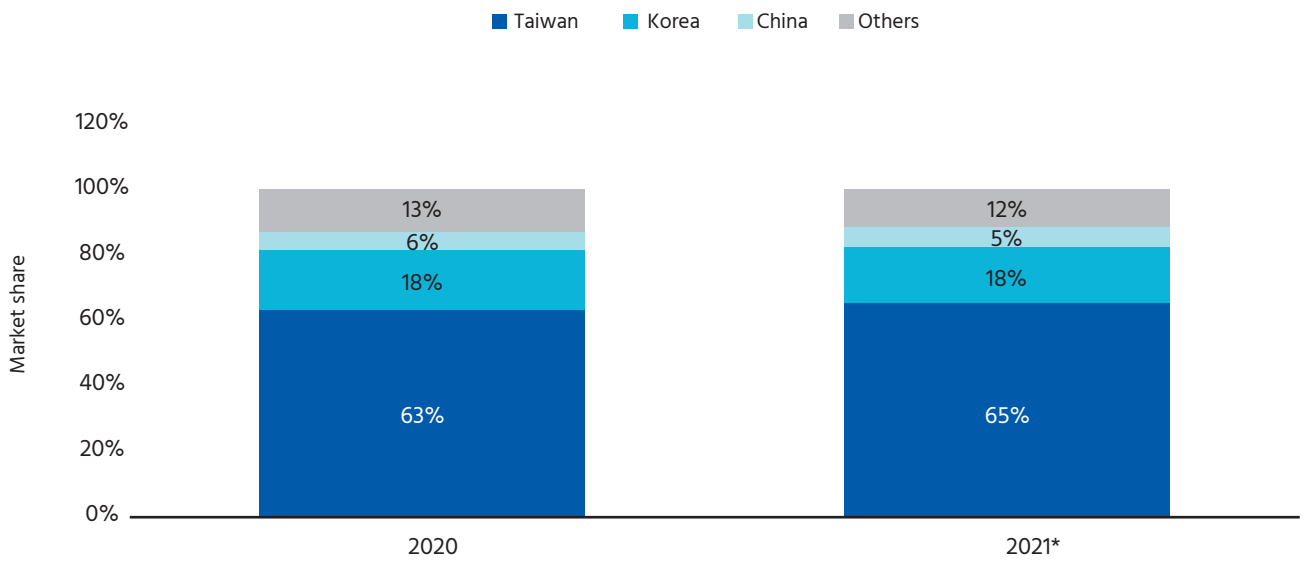
The electric vehicle (EV) industry also experienced surging demand as manufacturing in China restarted. After suspending assembly lines in early 2020, global EV producers such as GM, Nissan, Volkswagen, and Ford Motors ramped up production for waiting customers. Still, the EV sector will not get enough chips to meet demand in 2021.[1]

Figure 1 – Semiconductor sales worldwide from 2015 to 2020, by region (US$ bn)



Source: Statista 2021

Figure 2 – Semiconductor foundries revenue share worldwide in 2020 and 2021



Source: Statista 2021

*Forecasted

Fear of new US sanctions and export controls on American semiconductor technology drove Chinese tech companies to stockpile advanced chips as a way of hedging against future supply restrictions. The chip shortage grew worse.

Geopolitics also played a role. Fear of new US sanctions and export controls on American semiconductor technology drove Chinese tech companies to stockpile advanced chips as a way of hedging against future supply restrictions. The chip shortage grew worse.

An unbalanced landscape

The increased attention on semiconductor global value chains brought stark realities to light.

First, semiconductor manufacturing is disproportionately concentrated in Asia, especially in Taiwan. Single-source supply chains are fragile and highly vulnerable.

Second, China's increasingly competitive relationship with the US and its allies is accelerating strategic decoupling, reshoring, and ringfencing throughout the semiconductor landscape. This runs against the grain of decades of relatively unrestrained flows of goods and services across borders. Semiconductor value chains have benefitted from geographic specialization and rationalized production networks.

Semiconductor manufacturing is disproportionately concentrated in Asia, especially in Taiwan. Single-source supply chains are fragile and highly vulnerable.

Beyond geopolitical pressures, supply chains will face increased pressure to localize to meet goals of low-carbon environmental sustainability. The perfect storm is just beginning.

The emergence of techno-nationalism

This study is Part 2 of the comprehensive primer *Semiconductors at the Heart of a US-China Tech War* by the Hinrich Foundation in January 2020. Intended as a side-by-side resource to the initial study, this report explains important

developments. Part 2 of the series will focus on the actions the United States has taken to try and revitalize its semiconductor industry.

Part 3 of the series will explore China's continued efforts to catch up to US tech firepower.

This report also revisits the concept of techno-nationalism – the neo-mercantilist mindset that links a nation-state's technology prowess with its national security, economic prosperity, and socio-political stability. A series of studies on techno-nationalism followed the initial Hinrich Foundation semiconductor report and introduced the key themes in this report.

Four key themes

There are four themes of the report. The first theme is **strategic decoupling, reshoring, and ringfencing**. Non-tariff measures such as export controls and restricted entity lists continue to be weaponized in semiconductor supply chains. Critical developments include the overhaul of the United States' "foreign direct product rule", US efforts around strategic decoupling, linkages with the EV sector, and attempts to move semiconductor manufacturing back to the US, with significant investments by TSMC, Samsung and Intel.

The second theme is **techno-diplomacy and tech-alliances**. US President Joe Biden is creating semiconductor-focused partnerships involving multinational companies, industry associations, and other governments. The coalition-building semiconductor summits could affect reshoring and diversification of global value chains.

China and America share a common goal: They both want to localize semiconductor manufacturing.

The third theme is **innovation mercantilism**. China and America share a common goal: They both want to localize semiconductor manufacturing. Both have resorted to massive spending campaigns to incentivize research & development (R&D) and production ecosystems. Consider Washington's funding initiatives such as CHIPS for America and the Endless Frontier Act and China's US$1.4 trillion digital infrastructure plan.

The last theme is the conundrum facing manufacturers to produce '**In-China-For-China**'. China's insatiable demand for semiconductors will continue to benefit American companies. But while US semiconductor companies do not want Washington to disrupt their markets, they do want financial support for R&D, human-capital development, and new manufacturing capacity in the US. This prompts the question: Should US and other foreign firms ask their governments for help? Should they also be supportive of their governments' attempts to slow down their opponent? Washington has already decided. It is doing both.

Strategic decoupling, reshoring & ringfencing of semiconductors

Efforts by the US and China to decouple semiconductor supply chains, which began accelerating in January 2020, typifies behavior of early-stage techno-nationalism. In this stage, governments look to weaponize their supply chain strengths and attack their opponent's vulnerabilities. It is also a time to hedge against strategic vulnerabilities.

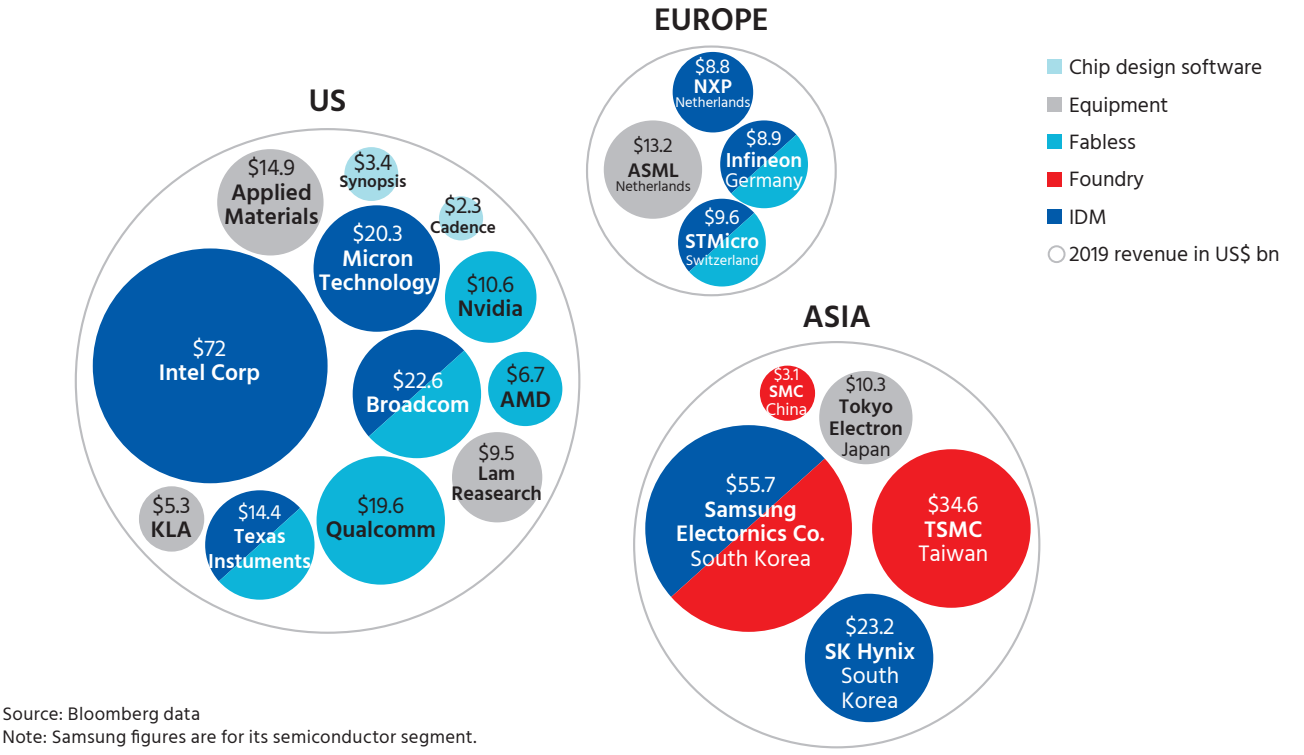
The US government has taken numerous steps to accelerate decoupling.

Closing the "foreign direct product rule" loophole

One key action took place in August 2020, with the closing of a legal loophole called the "foreign direct product rule".

One key action took place in August 2020, with the closing of a legal loophole called the "foreign direct product rule".[2] Prior to the rule change, if inputs of dual-use US technology fell below "de minimis" value thresholds in finished products, these products generally no longer required export licenses. Suppliers and manufacturers could manipulate de minimis levels by moving their value chains to different locations outside the US, thereby dispersing and diminishing the percentage of US technology in the overall value of a finished item.

Figure 3 – Semiconductor global value chain leaders, by region



Source: Bloomberg data
Note: Samsung figures are for its semiconductor segment.

New US Department of Commerce rules were crafted to end the de minimis game. The primary target was Chinese telecommunications giant Huawei. The endgame: to prevent Huawei's acquisition of advanced semiconductors. According to the updated regulations, any US software or technology (regardless of value) that is used to produce a finished microchip anywhere in the world and by any producer makes the finished item a direct product of the US. As such, any company on a restricted entity list would be effectively cut off.

What began as an initiative to prevent Huawei from expanding its 5G global footprint[3] morphed into a campaign to persuade other governments to remove Huawei technology entirely from their networks.

By May 2020, the Trump administration had bipartisan Congressional support to launch an all-out techno-nationalist offensive against Huawei. What began as an initiative to prevent Huawei from expanding its 5G global footprint[3] morphed into a campaign to persuade other governments to remove Huawei technology entirely from their networks.[4]

The supply chain weaponization strategy shifted to HiSilicon, Huawei's fabless semiconductor entity. Again, the aim was to block Huawei from obtaining microchips from its prime chip subcontractor Taiwan Semiconductor Manufacturing Company (TSMC). To continue making high-end smartphones with the Huawei Kirin chip, or to build and service 5G networks at home and abroad, Huawei's only option was to quickly stockpile TSMC-made microchips before Washington's new rules went into effect.

Between May 2020 and September 2020[5], when an interim law allowed for a grace period, Huawei's management pressed TSMC to ramp up production for an additional 2 million units of 7-nanometer chips, which were critical for Huawei's 5G network base stations.[6]

By September 2020, Huawei had stopped producing its flagship Kirin chips, which were designed by its engineers but could only be manufactured by TSMC. Because TSMC uses US technology in its manufacturing process, Washington had effectively choked off Huawei's vital supply of microchips. Soon after, Richard Yu, President of Huawei's consumer unit, lamented at an industry conference: "This year may be the end of our Huawei Kirin high-end chips. Huawei's smartphone production has no chips and no supply."[7]

The foreign direct product rule amendment revealed the criticality of US technology throughout semiconductor value chains – and across China's tech companies.

Expanding the restricted entities list

In 2020, the Trump administration added 108 Chinese entities to the Bureau of Industry and Security (BIS) restricted entity list – double the amount added in 2019 and ten times the number singled out in 2018.

The ban list would grow. In 2020, the Trump administration added 108 Chinese entities to the Bureau of Industry and Security (BIS) restricted entity list – double the amount added in 2019 and ten times the number singled out in 2018.[8]

Many large Chinese technology companies have built their product offerings by relying on US semiconductors and related technologies. The companies include iconic Chinese brands SMIC (China's leading chip manufacturer), HikVision (surveillance, facial recognition), SenseTime (AI); DJI (commercial drones), Dahua (surveillance, CCTV), and Alibaba (Cloud, e-commerce, fintech). All these companies have joined the US restricted entity list.

In 2021, US President Joe Biden continued the decoupling trajectory from the previous administration by signing an executive order mandating 'China-free' supply chains within strategic industries. Semiconductors were at the top of the list.

Washington's weaponization of semiconductor supply chains has focused on dual use items covered by license restrictions and firms on the BIS restricted entity list. Any item that is "uniquely required" by a restricted entity to produce a chip of 10-nanometers or below would be subject to a "presumption of denial". Even for chips above 10-nanometers, sales to restricted entities are considered on a case-by-case basis. That distinction led to China's Semiconductor Manufacturing International Corporation (SMIC) making the BIS restricted entity list in December 2020.[9]

The Biden administration has also continued to use sanctions, export controls, and blockages of investments and acquisitions in strategic sectors.

The Biden administration has also continued to use sanctions, export controls, and blockages of investments and acquisitions in strategic sectors.[10] In February 2021, the Committee on Foreign Investment in the United States (CFIUS) blocked the US$580 million acquisition of Excerra, an American maker of semiconductor testing equipment. This is significant because testing equipment is not generally regarded as the most sophisticated or complex part of the semiconductor value chain.

In April 2021, six of China's preeminent supercomputing centers were placed on the BIS restricted entity list, most notably the Shanghai High-Performance Integrated Circuit Design Center.[11] Supercomputing requires large numbers of advanced semiconductors. Notably, it has military applications such as cyber warfare, advanced data analytics, hypersonic weaponry, and nuclear armaments. As such, a wide range of US semiconductor and other indirectly related technologies will likely decouple from China's supercomputing ecosystem.

Weaponization of supply chains, however, is less effective over the long-term and must be done in tandem with reshoring and ringfencing strategies.

Returning semiconductor manufacturing to the US

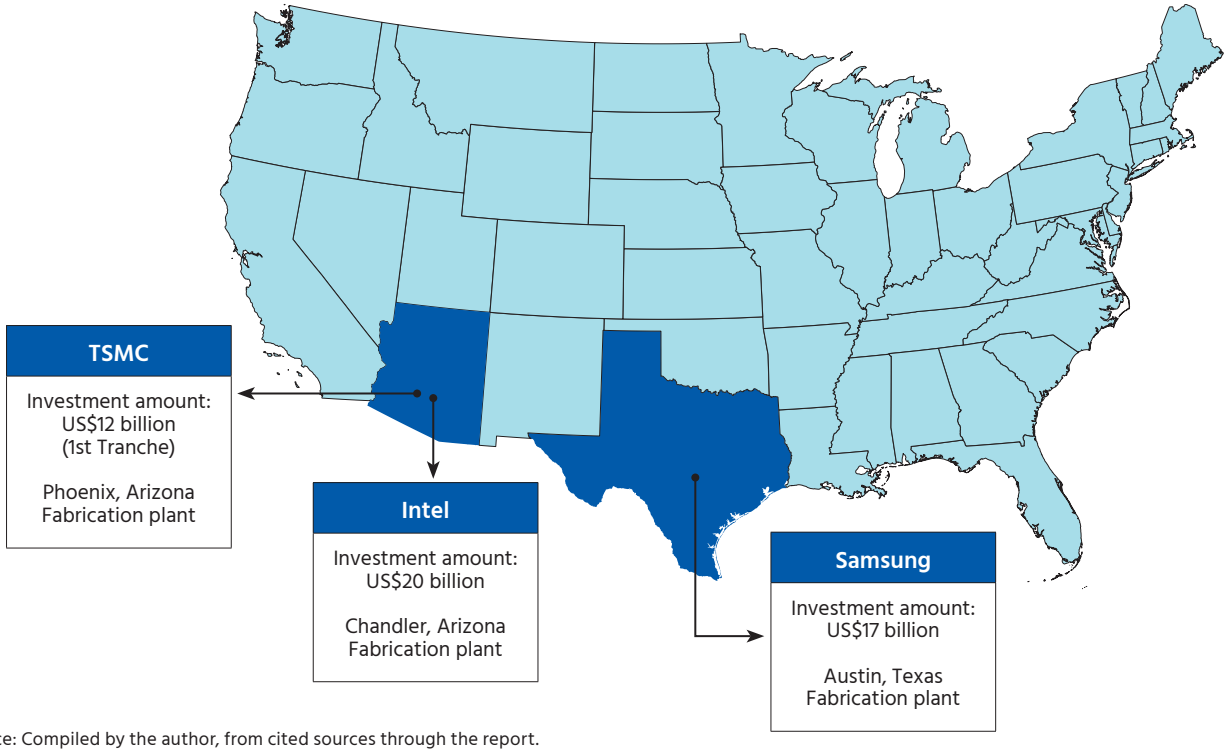
Between 1990 and 2021, the share of global semiconductor manufacturing capacity in the US dropped from 37% to just 12%.

The US semiconductor industry was once the global leader. However, between 1990 and 2021, the share of global semiconductor manufacturing capacity in the US dropped from 37% to just 12%. Costs partly explain the industry decline. According to the Semiconductor Industry Association (SIA), building and operating a semiconductor fabrication plant (fab) costs at least 30% more in the US than in Taiwan, South Korea, or Singapore.[12]

Other developments shifted the semiconductor industry to East Asia. An earlier Hinrich Foundation report on strategic decoupling examined the market forces that drove a wave of technology licensing and outsourcing agreements which led to today's imbalance in manufacturing capacity. This outcome was enabled by decades of carefully planned investment initiatives, technology-transfer policies, and specialized funding for local firms, orchestrated by Beijing's central planners.

Do not count the US out yet. Despite higher costs and the absence of a large-scale local manufacturing ecosystems, semiconductor manufacturing looks set to

Figure 4 – New semiconductor fabrication: US lower 48 states



Source: Compiled by the author, from cited sources through the report.

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https://www.bloomberg.com/news/articles/2021-03-03/samsung-details-plans-for-17-billion-chip-facility-in-u-s
https://www.cnbc.com/2021/03/23/intel-is-spending-20-billion-to-build-two-new-chip-plants-in-arizona.html

return to the US. This is a testament to the primacy of geopolitics over markets and the role of techno-nationalism in shaping the future.

The 2020s techno-nationalist era could be compared to the 1960s space race with the Soviet Union.

The 2020s techno-nationalist era could be compared to the 1960s space race with the Soviet Union or even the race in the 1940s to develop the atomic bomb. While the challenges of shifting semiconductor manufacturing are great, the vast financial, academic, entrepreneurial, and technological resources of the US are compelling.

Consider recent developments. After months of diplomatic pressure from Washington, TSMC announced in May 2020 its plans to build a 5-nanometer technology fabrication plant outside Phoenix, Arizona, with the capacity to produce 20,000 wafers per month. Capital expenditure was initially announced at US$12 billion.[13] The rationale: to provide a ringfenced ecosystem for US companies in strategic industries and, by extension, to ensure US military access to a secure supply of microchips.

Figure 5 – Present and future semiconductor fab investment in the US

Company	Location in the US	Investment amount	Investment area	Tentative timeline
Taiwan Semiconductor Manufacturing Company (TSMC)[1]	Phoenix, Arizona	US$12 billion US$23 billion – US$25 billion US$20 billion+	5-nanometer technology. 20,000 wafers per month. 3 nanometer fab (future mega-site with up to 6 separate fabs) 2-nanometer plant, under discussion	Operational by 2024 Over next 10-15 years *To be determined*
Samsung Foundry[2]	Austin, Texas	US$17 billion	Fabrication plant for computing chips	Operational in the third quarter of 2023
Intel Foundry Services[3]	Chandler, Arizona	US$20 billion	2 factories on computing chip manufacturing	*To be announced*
GlobalFoundries[4]	New York (Germany and Singapore)	US$1.4 billion	Fab expansion to produce chips from 12 to 90 nanometers	Ramp up output through 2022

1 https://pr.tsmc.com/english/news/2033; https://www.abc15.com/news/business/taiwan-semiconductors-phoenix-plant-likely-three-times-larger-than-originally-announced
2 http://www.businessworld.in/article/Samsung-Considers-Austin-For-17-Billion-Chip-Plant-Eyes-Tax-Breaks-Of-At-Least-806-Million-Documents/05-02-2021-373969/
3 Citied from report
4 https://www.reuters.com/article/us-globalfoundries-expansion-chips-idUSKBN2AV0RV

Challenges in catching up

Reshoring chip manufacturing to the US will not be an easy task. TSMC founder Morris Chang described the lack of a US manufacturing base and the dearth of highly skilled labor required for complex chip manufacturing as problematic. He noted differences in the management style and work ethic between Taiwanese and American engineers and managers.[14]

TSMC has acknowledged, however, that the Arizona fab may be the first of six new fabs. The next fab would focus on more advanced 3-nanometer technology and incur additional costs of up to US$25 billion. During the next 10 to 15 years, TSMC is reportedly drawing up plans to make next generation 2-nanometer chips – the leading edge of innovation – on US soil.[15]

For an Arizona mega-fab to come to fruition, especially to produce 2-nanometer chips, TSMC will have to displace large numbers of engineers from its R&D centers in Taiwan and move them to the US.

However, for an Arizona mega-fab to come to fruition, especially to produce 2-nanometer chips, TSMC will have to displace large numbers of engineers from its R&D centers in Taiwan and move them to the US. This is not likely to happen easily, given the importance of TSMC to Taiwan's national and economic security.

Nonetheless, other semiconductor heavyweights have shifted their attention to the US. South Korea's Samsung, the world's largest semiconductor company, filed

paperwork in March 2021 to build a US$17 billion fab next to its existing factory in Austin, Texas.[16] Looking to recapture lost market share, Intel announced a US$20 billion investment on two new fabs in Chandler, Arizona.[17] The 2021 chip shortage in the electronic vehicle industry has inspired Intel to reorient a portion of its chip-making.

These developments signal that the US can arrest the free-fall of its chip manufacturing ability despite there still being a lot of ground to recover. Government funding and incentives worth US$50 billion over five years, for example, would only claw back America's share of global chip manufacturing from 12% to about 15%. More progress will require a long and sustained effort.

One question for Washington to resolve involves the extent to which US chip manufacturing should focus on less sophisticated trailing-edge nodes of 22-50 nanometers. This segment represents a massive market in micro-controllers and logic chips – and a niche where China has made rapid progress in manufacturing capacity.

Techno-diplomacy, tech-alliances and partnerships

As explained in an earlier Hinrich Foundation report, techno-diplomacy is the realpolitik behavior of advancing a nation's techno-nationalist agenda. For the US, this means engaging in coalition building with Japan, South Korea, Taiwan, and the EU.

The 'Semiconductor Summits'

Semiconductors have been the lead topic for a series of high-profile meetings between the US government and the global business community.

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This was the new techno-diplomacy in action. While participants asked which sector should have priority access to microchips in a time of shortage, discussions returned again and again to the importance of increasing US production capacity at home.

In April 2021, at a virtual "CEO Summit on Semiconductor Supply Chain Resilience", President Biden underscored the need to reshore manufacturing to the US.

Organizations such as the SIA and the US Chamber of Commerce are also playing influential and inclusive roles in the Biden administration's formulation of tech policy. While the SIA is a 'pro-market' advocate and frowns upon government meddling in markets, it has been instrumental in shaping the public-private narrative.

SIA CEO John Neuffer acknowledged publicly that US decline in semiconductor manufacturing capacity was "largely due to substantial subsidies offered by the governments of [America's] global competitors, placing the US at a competitive disadvantage."[18]

The US Chamber of Commerce in Korea has also inserted itself into the techno-diplomacy debate. While the Chamber was actively lobbying for the release of former Samsung Chairman Lee Jae-Yong from his 15-month prison sentence,[19] Samsung announced a possible US$17 billion investment in a new fab in Texas.

Japan, Taiwan, South Korea, and India

There is a clear link between geopolitics, semiconductors, and the race for competitive advantage in the industries of the future.

China's dominant position in the 5G space via Huawei and ZTE has prompted the US to foster strategic partnerships in Asia. Ties between the US and Japan in particular look set to grow stronger through new techno-diplomacy initiatives.

In April 2021, the US and Japan agreed to jointly invest US$4.5 billion for the development of next-generation communication, known as 6G, or "beyond 5G". Each country will focus on research, development, testing, and deployment of secure networks, as well as advanced information and communications technology.[20] The plan is to level the 6G playing field for more participants under an O-RAN environment.

Whoever can produce and control the supply of leading-edge semiconductors will have an advantage in the race for 6G.

Whoever can produce and control the supply of leading-edge semiconductors will have an advantage in the race for 6G. That may partly explain Japan's proposed collaboration with TSMC. The partnership entails TSMC investing an initial US$186 million in an R&D center in Tsukuba outside of Tokyo – the first of a series of initiatives by Japan's Ministry of Trade and Industry to bolster ties with the Taiwanese giant through subsidies and other incentives. The center will focus on 3DIC technologies, which allow the integration of multiple silicon wafers, thereby increasing a chip's transmissive power.[21]

Japan, South Korea, and Taiwan also feature prominently in US efforts to decouple, increasingly in the name of economic security. Tech ecosystems are in the process of diversifying and shifting out of China. For example, Apple's transfer of one-fifth of its iPhone manufacturing operations to India includes its Taiwan-based contract manufacturers Foxconn, Wistron, and Megatron.[22]

India is increasingly important, as both America's strategic partner in the Indo-Pacific Quadrilateral Security Dialogue and as a tech manufacturing hub.

Indeed, India is increasingly important, as both America's strategic partner in the Indo-Pacific Quadrilateral Security Dialogue and as a tech manufacturing hub. Both TSMC and Samsung will eventually have to build semiconductor manufacturing capacity in India to feed large-scale production ecosystems around smart phones, laptops, and a growing list of consumer-related connected devices.

However, in techno-nationalism, even friends and partners can pursue their own interests. South Korea's "K-Semiconductor Belt" strategy entails a plan to build the world's largest semiconductor supply chain by 2030.[23]

Innovation mercantilism

As the microchip dominates the 21st century tech race, state-actors will become increasingly active around techno-nationalist agendas.

CHIPS for America Act and USICA

In May 2021, the CHIPS for America Act made its way through the US House of Representatives. CHIPS is the acronym for "creating helpful incentives to produce semiconductors". Enjoying strong public support from the White House and from the private sector, the bill may be a launching pad for additional policies.

The bill underscores the realization in the US that it cannot advance its semiconductor agenda alone. Success needs international alliances.

As part of the 2021 National Defense Authorization Act, CHIPS for America allocated US$50 billion for semiconductor research and development and manufacturing in the US.[24] The bill provides for income tax credits and mechanisms to match state and local investment incentives through 2026. Among its provisions is a reference to promote international partnerships that have "alignment in policies towards nonmarket economies"[25] – a clear reference to China. The bill underscores the realization in the US that it cannot advance its semiconductor agenda alone. Success needs international alliances.

Domestically, a coalition of semiconductor companies including Qualcomm, Nvidia and Intel and their "downstream" customers – Apple, General Electric, Cisco Systems, Microsoft, and Hewlett Packard, among others – formed the Semiconductors in America Coalition (SIAC). This new organization is a strong backer of ongoing government funding.

In June 2021, the US Senate voted 68-32, to commit US$250 billion in funding for scientific research, subsidies for chipmakers and robot makers, and an overhaul of the US National Science Foundation (NSF). The semiconductor sector ended up getting US$52 billion in new funding for CHIPS for America.[26]

This was made possible by the Endless Frontier Act, later renamed the US Innovation and Competition Act (USICA), originally conceived in May 2020 by Democractic senator Chuck Schumer and Republican senator Todd Young. The swift passage of USICA reflects the strong bipartisan support to counter China's ongoing techno-nationalist initiatives, which will be discussed in Part 3 of this series.

A precedent with SEMATECH

The last time the US semiconductor industry lobbied for strong government support was in the 1980s.

The last time the US semiconductor industry lobbied for strong government support was in the 1980s, when Japan's semiconductor industry dominated in terms of sophistication and production capability. In 1987, the US government and 14 US-based semiconductor manufacturers formed SEMATECH (Semiconductor Manufacturing Technology).[27]

Thanks to a successful combination of government and industry funding as well as collaboration in R&D, manufacturing, and strategic planning, by the 1990s the US semiconductor sector had significantly increased its manufacturing capacity and emerged once again as the global leader for innovation.

Together, USICA and CHIPS for America could funnel money and other resources into the semiconductor sector by orders of magnitude larger than SEMATECH.

Conclusion

This report has served to provide updates and analysis of recent techno-nationalism in the semiconductor sector, with a focus on developments in the United States.

Key findings and observations include:

- The Biden administration has continued the techno-nationalist policies of the previous Trump administration and is ramping up decoupling, reshoring, and ringfencing efforts in its bid to return chip manufacturing capacity to the US.

- Washington is continuing to weaponize semiconductor supply chains by leveraging export controls, sanctions, and CFIUS blockages of strategic acquisitions. Chinese companies will continue to be targeted with these restrictive measures.

- Unlike the previous US administration, President Joe Biden and his team are leaning heavily on public-private partnerships with a broad cross-section of industry actors and other friendly governments, namely Japan, South Korea, Taiwan. The goal is to build coalitions that support US policy objectives.

Despite challenges, Washington has at its disposal abundant resources, capital, a deep reservoir of academic human capital for R&D ventures, and plentiful entrepreneurial power.

- TSMC, Samsung and Intel – the world's most important fabricators of semiconductors – have all announced major investments to build new, advanced fabs in the US. Despite challenges, Washington has at its disposal abundant resources, capital, a deep reservoir of academic human capital for R&D ventures, and plentiful entrepreneurial power.

- But US$50 billion in funding will only claw back about 3 percent of lost manufacturing capacity in the US. More sustained funding over a longer period of time will be required.

- Washington is investing historical amounts of funding into their respective semiconductor sectors, with the aim of achieving self-sufficiency. New funding is oriented toward accelerating innovation and manufacturing capabilities. US semiconductor companies must decide how to allocate resources for both "leading edge" and "trailing edge" chip manufacturing capacity.

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Other reports written by Hinrich Foundation Research Fellow Alex Capri include:

- *Semiconductors at the heart of the US China tech war*
- *Strategic US-China decoupling in the tech sector*
- *Techno-nationalism and the US-China tech innovation race*
- *Techno-nationalism and diplomacy*
- *Techno-nationalism and corporate governance*
- *India: A 21st century technology hub?*

Researcher bio: Alex Capri

Alex Capri is a research fellow at the Hinrich Foundation and a senior fellow and lecturer in the Business School at the National University of Singapore.

He is the author of *Techno-Nationalism: How it's reshaping trade, geopolitics, and society* (Wiley), due out in 2021.

From 2007-2012, Alex was the Partner and Regional Leader of KPMG's International Trade & Customs Practice in Asia Pacific, based in Hong Kong. Alex has over 20 years of experience in global value chains, business and international trade – both as an academic and a professional consultant.

He advises governments and businesses on matters involving trade and global value chains. Areas of focus include: IT solutions for traceable supply chains, sanctions, export controls, FTAs and trade optimization.

Alex has been a panelist and workshop leader for the World Economic Forum. He writes a column for Forbes Asia, Nikkei Asia and other publications and is a frequent guest on global television and radio networks.

He holds a MSc from the London School of Economics in International Political Economy and a BSc in International Relations from the University of Southern California.

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Endnotes

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