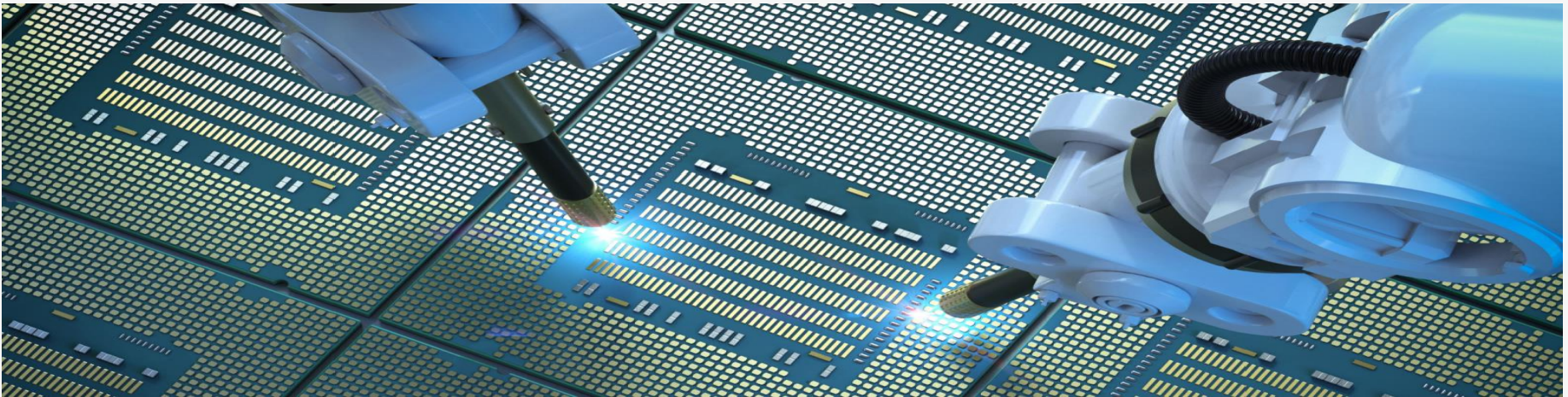


Special Report

# Impact of China–Taiwan Geopolitical Risks on Semiconductor Sector

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# Contents

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<b>Introduction</b> Scope of report	02
<b>Taiwan's position in semiconductor market</b> Market size, regional semiconductor players, global importance	03
<b>TSMC dominates semiconductor foundry market</b> Market share, competitive edge, customers, performance	04
<b>TSMC and Samsung dominate advanced chip development</b> Matrix on advanced semiconductor chips, usage of advanced chips, key players' position	05
<b>Measures being taken by TSMC to avoid crisis</b> Key risks, steps for averting crisis	06
<b>Major winners and losers from the crisis</b> Competitors, customers	07

# Introduction

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- We discuss the impact on the global semiconductor industry if geopolitical risks between China and Taiwan aggravate.
- Our study is limited to semiconductor foundry operations in Taiwan since the region is the world's largest foundry market.
- In our analysis of the semiconductor sector of Taiwan, we have mainly focused on Taiwan Semiconductor Manufacturing Company (TSMC) as it accounts for more than half of the global foundry market and produces the most advanced semiconductor chips. No other Taiwanese foundry matches TSMC in scale or capability.
- Furthermore, we discuss the impact on processing chips only as Taiwan dominates the supply of these chips.
- Our analysis includes potential winners and losers from the disruption of Taiwanese semiconductor operations.
- In our study, we have assumed that Taiwanese foundries could face severe disruption if China takes control of foundry operations.
- To understand more about the global semiconductor sector, we recommend other special reports on the semiconductors sector such as [Valuation of Semiconductor Companies](#), [Global Semiconductor Chip Shortage](#), and [Semiconductor Supply Chain Analysis](#) published by Aranca.

# Taiwan's commanding position in semiconductor market

Regarded as the “**new oil**” of the 21st century, semiconductors are deployed in many products ranging from electronics such as smartphones and computers to cars and highly advanced fighter jets.

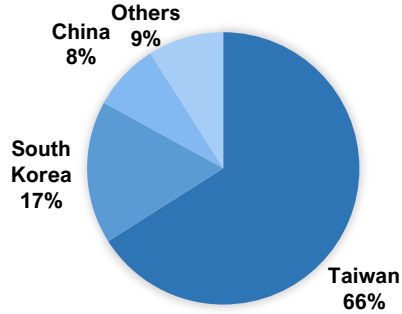
Taiwan is the **world's largest** semiconductor foundry region with roughly 2/3rd market share globally. The global foundry market is valued at ~USD100 billion (~20% of the global semiconductor market). Taiwan holds **>90% market share** in the production of **advanced semiconductor chips** (chips that have process nodes less than 10nm).

TSMC and United Microelectronics Corp (UMC) are the **two largest Taiwanese** contract chipmakers (foundries), accounting for >60% share of the global foundry market. Apart from foundries, MediaTek is the 4th largest fabless semiconductor company globally, and ASE Group is the world's largest semiconductor OSAT provider from Taiwan.

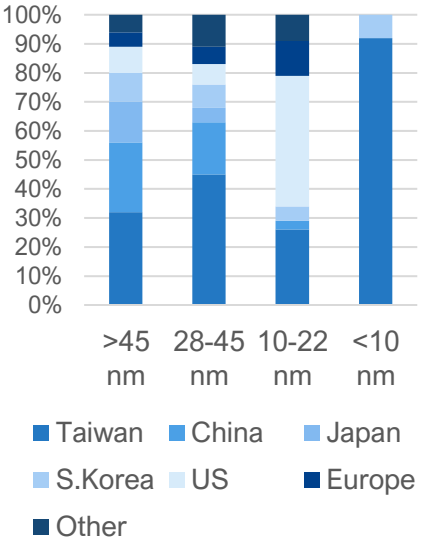
Currently, other major regions such as the US, the EU, China, and Japan do not have the scale and capability to produce advanced chips. The production **cost advantage** in Taiwan, coupled with a large pool of **experienced workforce** and **extensive policy support** from the government, provides a competitive advantage to Taiwanese semiconductor companies.

Taiwan's strength in semiconductors is often referred to as its “**Silicon Shield**” – it is argued that any threatening actions against Taiwan's foundries could prove risky as the world heavily depends on the semiconductors produced by Taiwan.

Foundry region market share



Region-wise market share in advanced chip production



Source: Bloomberg, EIAS, IC Insights, BCG, SIA

# TSMC dominates semiconductor foundry market

- TSMC is the **world's largest** dedicated independent (pure-play) semiconductor foundry and one of Taiwan's largest companies.
- TSMC **manufactures >50% of semiconductors** required globally and has **>90% market share in advanced chips**.
- TSMC and Samsung are the **only producers of 5nm chips** and are gearing up for 3nm chip production.

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- TSMC's advanced (below 10nm) chips account for half of the total revenues.
- TSMC dominate due to its **advanced manufacturing capabilities** as well as its ability to produce chips **rapidly and consistently at high-yield rates** and on a large scale.

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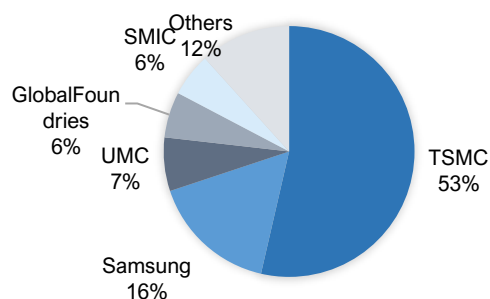
- TSMC's customers include **large tech companies** such as Apple, AMD, Nvidia, Qualcomm, and MediaTek.
- As per the US administration's report, "**US is heavily dependent** on a single company (TSMC) for producing its leading-edge chips. As it can make the most advanced chips, the national security and critical infrastructure are at risk".

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- TSMC has fabs in Taiwan, China, the US, and Singapore. It produced 14 million 12-inch equivalent semiconductor wafers in 2021. It has announced plans to incur a **capex of over USD 100 billion** over the next three years.
- TSMC is **performing strongly**. In 3Q22, revenue grew 36% y/y to USD 20.2 billion, due to rising adoption of 5G, AI, and HPC.

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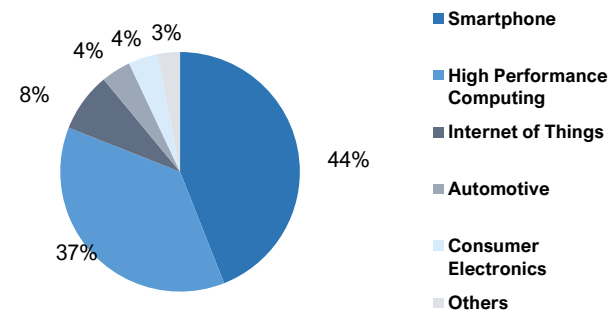
Market Share of Foundries (2022)



Top Customers of TSMC in 2021

Customer	% Share
Apple	25.9%
MediaTek	5.8%
AMD	4.4%
Qualcomm	3.9%
Broadcom	3.8%
Nvidia	2.8%

TSMC's Net Income, by Segment (2021)



Source: TSMC Website, Company filings

# TSMC and Samsung dominate in development of advanced semiconductor chip

## Foundries' existing advanced chip production capabilities

- Samsung and TSMC are neck and neck in developing advanced (under 10nm) chips.
- TSMC has a large capacity with proven technology for producing advanced chips and has high yield rates compared to Samsung.
- Other Taiwanese foundries such as UMC are not as advanced as TSMC.
- Intel designs and develops chips for itself but does not operate as a contract manufacturer. It will start foundry operations in 2025.
- SMIC has scaled to 7nm chip development but has been placed on the chip export blacklist by the US administration.
- GlobalFoundries manufactures less advanced (more than 10nm) chips.

Company	Region	3nm	5nm	7nm	10nm	>10nm
TSMC	Taiwan	In 2023	✓	✓	✓	✓
Samsung	S. Korea	✓	✓	✓	✓	✓
Intel	US	X	X	In 2023	✓	✓
GlobalFoundries	US	X	X	X	X	✓
UMC	Taiwan	X	X	X	X	✓
SMIC	China	X	X	✓	X	✓

Source: SIA, Company filings, Wikipedia, elnfochips

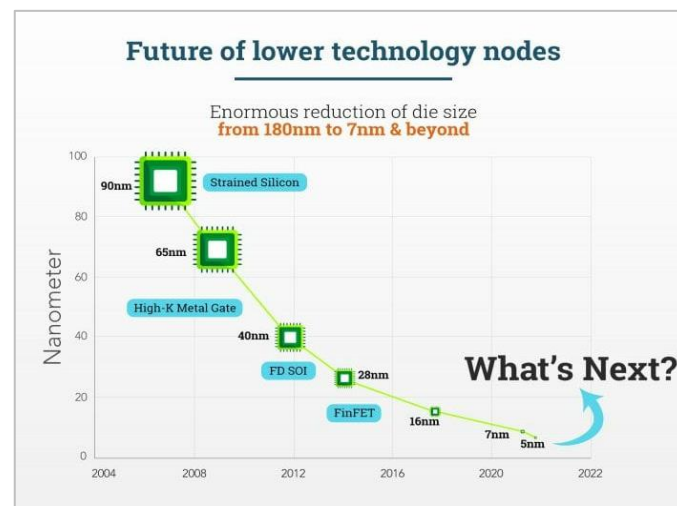
## What are low-nm chips? Where are they used?

The lower the nanometer (nm), the more advanced the chips are.

Low-nm chips provide faster processing and consume less power than high-nm chips.

Emerging technologies such as high-performance computing, AI, 5G, autonomous vehicles, cloud computing, high-end gadgets, and metaverse rely on low-nm chips.

Day-to-day components such as vehicles, refrigerators, calculators, and television use high-nm (>10nm) chips





# What could happen if TSMC's operations are disrupted?








Geopolitical risks	Technological risks	Impact on economy
<ul style="list-style-type: none"> <li>• High possibility of economic sanctions on China</li> <li>• TSMC's fabrication units will become inoperable as announced by its Chairman Mark Liu</li> <li>• Possibility of dismantling of TSMC's plants by the armed forces to avert secret technology transfer</li> <li>• Suppliers such as ASML, Tokyo Electron, and Applied Materials may stop supplying machines and raw materials to TSMC for operations</li> </ul>	<ul style="list-style-type: none"> <li>• Production of advanced technologies such as AI, HPC, high-end smartphones and computers, graphics, and military equipment will come to a halt</li> <li>• Customers will switch to high-nm chips, which will make their products slow and less efficient and consume more power</li> <li>• Microprocessors, graphics, and data center products that require high-end chips will suffer the most</li> </ul>	<ul style="list-style-type: none"> <li>• Semiconductor chip shortage will become acute</li> <li>• Prices of chips will increase, leading to a rise in prices of end products such as PCs, gaming consoles, and cars</li> <li>• The lead time to procure semiconductor chips will further increase</li> <li>• Other possibilities: Job losses and spiraling impact on other sectors</li> </ul>

## What is TSMC doing to avert the crisis?

TSMC is diversifying its manufacturing base across key locations to reduce concentration risks in Taiwan.	It is building a 5nm plant in Arizona, the US, and is evaluating the construction of a 2 <sup>nd</sup> plant in the US.	It is building a 12–16nm plant in Japan in collaboration with Sony; operations will commence in 2024.
It already has semiconductor plants in China and Singapore, but its main fabrication units are in Taiwan.	However, the Arizona unit will just contribute ~2% of the total output. The unit will start its production in 2024.	Furthermore, it is evaluating setting up 22nm and 28nm fabrication plants in Singapore.
<p>TSMC is taking advantage of subsidy support offered by regional governments for setting up fabrication units. However, given the long build-up period required, the plants will take 2–3 years to fully commercialize.</p>		

Source: TSMC, Company filings

# Who will be major winners and losers from disruption of TSMC's operations

<b>Samsung</b>		<ul style="list-style-type: none"> <li>▪ Samsung will be a <b>clear winner</b> in acquiring customers for advanced (&lt;10nm) chips.</li> <li>▪ Samsung also produces high-end (e.g., 5nm) chips like TSMC. It has even raced to 3nm chip production.</li> <li>▪ It has also produced advanced semiconductor chips for Apple, Nvidia, AMD, etc. in the past.</li> <li>▪ However, Samsung's production capacity is not large to accommodate high demand (it is ~1/3<sup>rd</sup> the size of TSMC).</li> <li>▪ Also, its average production yield rates are very low (&lt;60%) compared to those of TSMC (&gt;80%).</li> <li>▪ A few companies do not trust Samsung because it competes directly with them in some areas (e.g., Apple iPhone).</li> </ul>
<b>Intel</b>		<ul style="list-style-type: none"> <li>▪ Intel could regain its lost share in the microprocessor market from AMD whose exclusive supplier is TSMC.</li> <li>▪ Intel might not directly win customers of Taiwanese foundries, as it does not operate a semiconductor foundry.</li> <li>▪ However, Intel plans to start a foundry in 2025. Some customers might choose Intel to diversify their supplier base.</li> <li>▪ Intel also remains slow in innovating advanced chips, and its yield rates are low compared to that of rivals.</li> </ul>
<b>Other Foundries</b>		<ul style="list-style-type: none"> <li>▪ Foundries that focus on advanced (low nm) chips may benefit.</li> <li>▪ However, there will be a moderate impact on high-nm chip foundries such as GlobalFoundries, Texas Instruments, and Micron Technology, as high-nm chip manufacturing plants are located globally.</li> </ul>
<b>SMIC</b>		<ul style="list-style-type: none"> <li>▪ SMIC will be at an advantage because it has raced to 7nm chip production.</li> <li>▪ However, it has been placed on a blacklist by the US since 2020.</li> <li>▪ SMIC could provide requisite advanced chips in its home market (China).</li> </ul>
<b>Apple</b>		<ul style="list-style-type: none"> <li>▪ Apple will face a huge impact as it is the largest customer of TSMC, contributing 1/4<sup>th</sup> of total sales.</li> <li>▪ It will have to switch to high-nm chips, which will make its products (e.g., iPhone) slow and consume more power.</li> <li>▪ Apple will have to rely on chips from Samsung, its competitor. Apple used to source chips from Samsung a few years back, but it moved to TSMC as the latter doesn't compete with Apple directly.</li> </ul>
<b>Fabless Chip Cos.</b>		<ul style="list-style-type: none"> <li>▪ Nvidia, Qualcomm, AMD, MediaTek, Broadcom, etc., relying heavily and exclusively on TSMC will suffer the most.</li> <li>▪ High-performance computing, cloud computing, AI, metaverse, data centers, advanced graphics, 5G, smartphones, etc., which rely on advanced chips designed by fabless companies, will face severe disruptions.</li> </ul>
<b>Others</b>		<ul style="list-style-type: none"> <li>▪ Large tech players such as Amazon, Alphabet, and Microsoft could face disruptions in sourcing high-end chips.</li> <li>▪ Auto companies and other electronic products utilize high-nm chips. Hence, the impact will be moderate.</li> </ul>

Source: Company filings, SC-IQ





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