Taiwan

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Taiwan is a major player in the global semiconductor market. The island has a highly developed and advanced semiconductor industry, with companies such as TSMC (Taiwan Semiconductor Manufacturing Company) and UMC (United Microelectronics Corporation) being central players. These companies provide a wide range of products and services to customers in various industries, including computers consumer electronics and telecommunications sectors. Additionally, Taiwan is also a major hub for the design and manufacturing of semiconductor equipment and materials. This industry plays a vital role in the Taiwanese economy and has been a key driver of Taiwan's technology and economic development.

Taiwan has a large number of foundries, which are the companies that manufacture semiconductor devices commissioned by companies that design these chips. Foundries provide a range of services, including manufacturing, testing, and packaging of semiconductor devices. TSMC is the largest foundry company in the world and specialises in the manufacturing of advanced process nodes, such as 7nm, 5nm and 3nm. UMC is also a major player in the foundry market and specialises in the manufacturing of a wide range of process nodes.

Taiwanese foundries are known for their advanced technology and high quality, making them a popular choice for companies in the semiconductor industry. They have a strong network of suppliers, which allows them to provide customers with a one-stop shop for all their semiconductor manufacturing needs. Taiwanese foundries are also playing a vital role in the production of cutting edge technologies like high-performance computing, internet of things, artificial intelligence, and 5G.

1. Government

The government of Taiwan has played an important role in the development of the country's semiconductor industry. It has implemented various policies and initiatives to support the growth and competitiveness of the industry, such as:

- Providing financial assistance and tax incentives for companies in the semiconductor industry

- Investing in research and development to promote innovation and the development of advanced technology
- Building infrastructure and facilities to support the semiconductor industry, such as technology parks and research centres
- Encouraging collaboration and partnerships between industry, academia, and government to drive innovation and promote the development of new technologies
- Promoting the adoption and integration of new technologies such as Internet of Things (IoT), 5G and AI in various sectors to maintain the competitiveness of Taiwan's economy.

The government of Taiwan also works closely with the private sector to identify and address industry challenges and opportunities. This government-industry collaboration has been a key factor in the success of Taiwan's semiconductor industry, and is likely to continue to play an important role in the industry's future growth and development.

2. Overview of the industry

There are several risks that the Taiwanese semiconductor industry faces, including:

1. Dependence on a small number of key customers: Many Taiwan semiconductor companies rely heavily on a small number of key customers for a large portion of their revenue. This can make them vulnerable to changes in demand or shifts in the business strategies of these customers.
2. Strong competition: The semiconductor industry is highly competitive, with companies from different regions vying for market share. Taiwanese semiconductor companies are competing with companies from countries such as South Korea, Japan, and China.
3. Intellectual property risks: The semiconductor industry is heavily reliant on intellectual property (IP) and proprietary technology. Taiwanese semiconductor companies may be at risk of IP infringement, theft, or misappropriation.
4. Political risks: Taiwan is a politically sensitive area, and any political developments or changes in relations between Taiwan and other countries can have a significant impact on the Taiwanese semiconductor industry.
5. Supply chain risks: Taiwan’s semiconductor industry relies heavily on a global supply chain and disruptions in materials, equipment, or logistics can have a significant impact on the production and delivery of products.
6. Technology risks: The semiconductor industry is rapidly evolving, and companies must continuously invest in research and development to stay competitive. Failure to do so can put a company at a disadvantage in the market.

To mitigate these risks, companies in the Taiwanese semiconductor industry are diversifying their customer base, investing in advanced technology, and focusing on IP protection, among other

strategies. Additionally, the Taiwanese government also actively works on risk mitigation plans to ensure the stability and competitiveness of the Taiwanese semiconductor industry.

One specific risk for The Taiwanese semiconductor industry is the potential for a military conflict between China and Taiwan, which has several negative consequences:

1. First, Taiwan's semiconductor industry is closely tied to mainland China, as many of the companies in the industry have production facilities or supply chains in China, and many of the industry's customers are based there as well. In the event of a military conflict, these ties could be severed, causing disruptions in production and supply chain, and resulting in losses for Taiwan's semiconductor companies.
2. Second, a military conflict could also lead to economic sanctions or trade restrictions on Taiwan, which could have a negative impact on the country's economy and the semiconductor industry.
3. Third, a war could also result in severe damage to the infrastructure and facilities, which could take a long time to recover, resulting in long-term impacts on the industry.
4. Fourth, the uncertainty of a potential war could also discourage foreign investment in Taiwan, which could impede the growth of the semiconductor industry.

Given the importance of the semiconductor industry to Taiwan's economy, the government is likely to take steps to protect the industry in the event of a military conflict with China. However, the industry would still face significant risks and challenges in such a scenario.

The defence industry is one of the potential areas where Taiwan's semiconductor industry can play a role. Semiconductors are an essential component in a wide range of defence systems, including radar, electronic warfare, and communication systems.

- Taiwan's semiconductor industry has a strong reputation for producing high-quality, advanced technology products, which makes it well-suited for the defence industry.
- Taiwan's government has been actively promoting the development of the defence industry, including the development of indigenous defence capabilities. As part of this effort, the government has been encouraging the participation of the semiconductor industry in the development of defence systems.
- Taiwan's semiconductor companies have been involved in various defence projects, including the development of radar systems, electronic warfare systems, and communication systems.
- Taiwan's semiconductor industry has also been working with the defence industry on the development of new technologies, such as AI, IoT, and 5G, which have applications in defence systems.

- Taiwan's government also has been actively working on securing the supply chain and protecting the intellectual property to ensure the stability and competitiveness of the Taiwan semiconductor industry, which also includes the defence industry.

Major companies in the Taiwanese semiconductor sector

Taiwan Semiconductor Manufacturing Company (TSMC) is a foundry company based in Taiwan and one the world's largest semiconductor companies.[1] TSMC is a foundry, which means that it manufactures semiconductor commissioned and designed by other companies. TSMC's customers include major companies such as Apple, Qualcomm, and Nvidia. TSMC's focus is on the production of cutting edge technology like high-performance computing, internet of things, artificial intelligence, and 5G. TSMC has been investing heavily in R&D to stay competitive in the industry. TSMC has been actively expanding its operations globally, including building new manufacturing facilities in the United States, to diversify its production base, and to reduce the dependence on China. TSMC has 10 fabs in Taiwan. These fabs are mainly located in two cities: Hsinchu and Tainan. In 2022, TSMC announced that a new fab in the city of Kaohsiung would start operations in 2024.[2] TSMC's most advanced 5 and 3 nm chips are made in Tainan.[3]

United Microelectronics Corporation (UMC) is a semiconductor foundry that manufactures integrated circuits (ICs) for various industries, including consumer electronics, communications, automotive, and industrial. UMC's products include a wide range of ICs, including microprocessors, memory chips, digital signal processors, and power management ICs. UMC also provides services such as design support, technology development, and wafer fabrication. UMC's customers include major companies such as Marvell, Broadcom, and MediaTek. UMC was founded in 1980 as a spin-off of Taiwan's government-backed Industrial Technology Research Institute (ITRI, see below).

Powerchip Semiconductor Manufacturing Corporation (Powerchip/PSMC) is a semiconductor company founded in 1994 and based in Hsinchu City. It offers foundry services, design, and test services. It is one of the largest DRAM memory chips manufacturers in Taiwan. The company provides a range of products, including mobile DRAM, server DRAM, and specialty DRAM, for customers in the computer, consumer electronics, and communications industries.

[1] NASDAQ, "An Overview of the Top 5 Semiconductor Foundry Companies", 1 October 2021.
[2] Taipei Times, "TSMC starts construction of new fab in Kaohsiung", 22 November 2022.
[3] TSMC official website, "Foundry technology", https://www.tsmc.com/english/dedicatedFoundry/technology/logic/l_3nm.

Research and development

Taiwan's semiconductor industry has a strong relationship with universities and research institutions, which plays an important role in the development of advanced technology and the training of a skilled workforce. This relationship allows for the transfer of knowledge and technology between academia and the industry, and helps to ensure a steady supply of skilled workers for the industry.

- Taiwan's semiconductor companies have significant R&D capabilities and invest heavily in R&D to stay competitive in the industry. They invest in the development of new technologies, such as advanced process nodes, and in the improvement of existing technologies to increase efficiency and reduce costs.
- Taiwan has a number of universities and research institutions that specialise in the field of semiconductors and related technologies, such as National Taiwan University, National Tsing Hua University, and National Chiao Tung University.
- These institutions have a strong focus on research and development in advanced technologies, such as 5G, IoT, and AI, and have been working with various companies and organizations to develop and implement these technologies.
- Taiwan's universities and research institutions have a strong collaboration with the industry, with many professors and researchers working on projects with companies such as TSMC, UMC, and Powerchip. This allows for the transfer of knowledge and technology between academia and the industry.
- The universities also have a strong focus on training the next generation of semiconductor engineers and researchers, which helps to ensure a steady supply of skilled workers for the industry.
- Taiwan's government also encourages and funds research and development in the field of semiconductors and related technologies, in order to promote innovation and the development of advanced technology.

The Industrial Technology Research Institute (ITRI) is a government-sponsored research institute in Taiwan. It conducts R&D in various fields such as electronics, materials, systems and communication technologies. The aim of ITRI is to promote technological innovation and industrial competitiveness in Taiwan. ITRI also assists with the development of defence technologies, mainly in the fields of communication, information security, and various inspection & testing programs. [4] ITRI's semiconductor division focuses on developing advanced semiconductor technologies and solutions for various applications.[5] Some of their areas of research and development include advanced process

[4] Global Security – ITRI. & ITRI Announcements - "Ministry of National Defense 5G Private Network Design Planning and Research and Development" plan, visited 8 February 2023; Industrial Cooperative Development Report under the Taiwan Ministry of National Defence and the Ministry of Economic Affairs.
[5] ITRI website – "Intelligentisation Enabling Technology, Semiconductor" visited 8 February 2023, https://www.itri.org.tw/english/ListStyle.aspx?DisplayStyle=01&SiteID=1&MmmID=1071732317047353240.

technologies for manufacturing semiconductors, design of integrated circuits, and the development of advanced packaging solutions. ITRI has close connections to the local semiconductor industry. There are many joint research projects between ITRI and various chip makers. UMC was even established at ITRI, and spun off in 1980.

Industrial Technology Investment Corporation (**ITIC**) is an investment firm wholly owned by ITRI.[6] ITIC invests in high-tech companies active in semiconductors, precision machinery, opto-electronics, biotech, automotive, and other sectors. The firm has invested in various Taiwanese semiconductor companies, including: UMC, APAQ Technology, and GlobalWafers.[7]

The Taiwan Semiconductor Research Institute (TSRI) was founded in 2019 after a merger of two earlier semiconductor research centres. TSRI is a part of the larger government-backed National Applied Research Laboratories (NARLabs). TSRI functions as both a research institute and as a service-provider for the semiconductor industry. In its introduction, TSRI says: "An integrated research environment for related fields of study in Taiwan is urgently required to enhance the overall cultivation of quality talents in response to the introduction of the 3-nm node, [several other new technologies], and challenges posed by countries including European countries, the United States, Japan, and South Korea. "

Connections with the Netherlands

Overall, the relationship between Taiwan and the Netherlands in the semiconductor industry is not as significant as other Taiwanese relationships in the sector, such as the one with the United States, but it has been growing in recent years and has the potential for further growth in the future.

- The Netherlands has a strong semiconductor industry, which is focused on research and development, rather than manufacturing. This has led to some cooperation between Dutch and Taiwanese companies in terms of technology transfer, knowledge sharing, and joint research projects.
- Some Taiwanese companies have established a presence in the Netherlands, mainly to access the European market and to have better access to the Dutch semiconductor ecosystem.
- The Netherlands is also an important hub for the semiconductor equipment and materials industry, which allows Taiwan's semiconductor companies to access the latest equipment and materials.
- Taiwan and the Netherlands have signed a bilateral investment agreement which allows the companies of both countries to invest in each other's economies more easily.

[6] ITIC official website, visited 8 February 2023; CSIS, "The Pillars Necessary for a Strong Domestic Semiconductor Industry", 20 May 2022.
[7] ITIC official website, "Portfolio", visited 8 February 2023.

- Taiwan has also been actively seeking to expand its semiconductor industry relationships with European countries, including the Netherlands, to diversify its partnerships, and reduce the dependence on China and the United States.

TSMC was founded in 1987 as a joint venture between Dutch electronics company Philips, the Taiwan government, and several local investors.[8] Initially, TSMC mainly manufactured chips for Philips. Later, it expanded its sales to other customers. When TSMC was founded, Philips owned 28% of the shares.[9] Starting in the early 2000s, Philips started to reduce its stake in TSMC, and in 2008 Philips sold its final block of shares.[10] TSMC and Philips have had collaborations in research and development projects in the semiconductor industry. TSMC has also supplied semiconductor chips to Philips for use in its products. TSMC is one of the major customers of ASML and uses its advanced lithography systems to manufacture semiconductor devices with smaller feature sizes and higher performance. TSMC and ASML have a strategic partnership, in which they work together to develop and implement new technologies, such as EUV (extreme ultraviolet) lithography, which allows for the production of smaller and more advanced semiconductor devices.

ASML sold its first lithography machine to Taiwan in 1988. In 2003, it established a Taiwanese headquarters in Hsinchu. In its 2021 annual report, ASML says it will continue to expand its operations in Taiwan. Taiwan is already ASML's largest market worldwide. In 2021, customers in Taiwan represented 39.4% of the company's 2021 total net sales. That represented a net sales number of $7.327 billion.[11] Within Taiwan, TSMC is ASML's biggest customer.[12] ASML operates facilities in Taiwan, including: manufacturing plants in Linkou and Tainan for system refurbishment and for optical metrology systems, a 'Global EUV Training Centre'[13], a repair centre, facilities for metrology and inspection system assembly, and a global support centre. TSMC employs about 3600 people in Taiwan.[14]

In the risk category 'Political', ASML says about Taiwan: "Changes in relations between Taiwan and the People's Republic of China, Taiwanese government policies, and other factors affecting Taiwan's political, economic or social environment could have a material adverse effect on our business, financial condition and results of operations." ASML employs only 3% of its total R&D staff in Taiwan, the same as in China. But ASML's Taiwan operations own 5% of its total IP portfolio patents. The rest,

[8] Any Silicon, "History and Milestones of TSMC", 11 November 2019.
[9] SemiWiki, "A Brief History of TSMC", 8 February 2012.
[10] PC World, "Original TSMC Investor Philips Sells off Final Shares"14 August 2008.
[11] ASML 2021 annual report, p. 117 and 189, https://www.asml.com/-/media/asml/files/investors/financial-results/a-results/2021/asml-annual-report-us-gaap-2021-unsvf2.pdf?rev=dc3209ddcdd045589fa34b43e30e6cbf
[12] Reuters, "ASML shares fall 9% after Taiwan customer says it's cutting capital spending", 13 October 2022.
[13] ASML press release, 20 August 2020.
[14] ASML, "Careers", visited 8 February 2023.

95%, is owned by ASML in the Netherlands. ASML has several educational projects in Taiwan, some in cooperation with Taiwanese educators. These projects train teachers and students, and are aimed at improving "basic scientific knowledge".[15]. ASML also donated to scientific programs and runs a scholarship program in Taiwan.

ASMI sells chip-making equipment in Taiwan. Its main customers are TSMC and UMC. ASM has three sales & service facilities in Taiwan but it does not manufacture there.

NXP has four facilities in Taiwan, for design, manufacturing, and sales. NXP is mainly active in the automotive sector in Taiwan. The manufacturing (back-end) focuses on technology and products in the fields of automotive (car-access, in-vehicle networking, ADAS), NFC, and Mixed-Signal & Power. TSMC produces semiconductors designed by NXP, including 16 nm and 5 nm radar and vehicle-network chips.[16] NXP runs several joint ventures in Taiwan and recently announced two new ones: In mid-2022, NXP announced it would form a joint venture with Taiwanese electronics firm Invented to create an "ecosystem" for automotive electronics.[17] Also in mid-2022, NXP and Taiwanese electronics & manufacturing firm Foxconn announced they would jointly develop "platforms for a new generation of smart-connected vehicles".[18] Foxconn is best known for producing iPhones in China, but the company also has an automotive division. It wants to expand to contract-car manufacturing and launch its own line of vehicles as well.

3. International positioning and connections

The relationship between Taiwan and the **United States** has been a significant factor in the development and success of the Taiwan semiconductor industry. The United States is one of Taiwan's major trading partners and a major customer for Taiwan's semiconductor products. Overall, the relationship between Taiwan and the United States has been positive for the Taiwanese semiconductor industry and is likely to continue to play an important role in the industry's future growth and development.

- United States companies such as Apple and Qualcomm are among the major customers of Taiwan's semiconductor industry. This has helped Taiwan's semiconductor companies to grow and become major players in the global market.
- The US government has also provided Taiwan with financial and technical assistance to support the development of its semiconductor industry. This assistance has helped Taiwan to

[15] ASML 2021 annual report p. 79 and 138.
[16] Taiwan News, "Taiwan's TSMC working with NXP to release 5nm automotive chip", 25 May 25 2022.
[17] Digitimes, "NXP, Inventec team up for automotive electronics ecosystem in Taiwan", 5 August 2022.
[18] Taipei Times, "Hon Hai, NXP partner to enhance EV development", 22 July 2022.

build infrastructure and develop advanced technology, which has been key to the industry's success.

- The US government has also worked to promote Taiwan's participation in international organizations and has supported Taiwan's participation in various trade agreements, which has helped Taiwan's semiconductor industry to access global markets.
- The US government has also been a vocal supporter of Taiwan's political and economic independence, which has helped to provide stability and predictability for Taiwan's semiconductor industry.
- However, the US government has also been increasing its pressure on Taiwan to reduce its reliance on China, as Beijing has been becoming more assertive on the international stage.

In July 2022, TSMC completed the initial construction phase of its first fab in the United States, near Phoenix in Arizona. The 12 billion USD plant was completed in less than a year, which is very quick for US standards, underlining the importance of the project.[19] Currently, TSMC is outfitting the plant with chip-making tools from, among others, ASML, Applied Materials, KLA, Lam Research, and Tokyo Electron. The fab will mainly produce 5 nm chips, with production set to start in early 2024.

But that is just the beginning. In late 2022, TSMC announced it intended to expand the facility with a second production line and with tools to produce 3 nm chips. The added investment is 28 billion USD, bringing the total investment of TSMC in the Arizona project to 40 billion USD.[20]

The Chinese government has not officially responded to TSMC's investment in the US. But various 'opinion/editorial' pieces and news articles in state-media make clear that Beijing is not happy. Fuzzily enough, the various experts quoted in the articles are mainly expressing their worries about Taiwan losing its edge in chip-making to the US. This seems intended to stir up more division in Taiwan, where opinions about the US investment are divided. A nice example is the headline of an editorial in Global Times: "Alarm is sounded after TSMC becomes 'USSMC'."[21] At the same time, media articles also try to frame the move as a disruption of global supply chains. For example: "The US' selfishness behind TSMC's manufacturing outflow will only further disrupt the international supply chain, deepen existing conflicts of interest among its allies and undermine its influence in the Asia-Pacific region."[22]

[19] Tom's Hardware, "TSMC Completes Construction of 5nm Fab 21 in Arizona", 29 July 2022.
[20] Anand Tech, "TSMC Unveils Major U.S. Fab Expansion Plans: 3nm and $40 Billion by 2026", 7 December 2022.
[21] Global Times, "Alarm is sounded after TSMC becomes 'USSMC': Global Times editorial", 9 December 2022.
[22] Global Times, "TSMC set to expand US investment under political pressure, but faces huge pains", 6 December 2022.

In January 2023, TSMC said it was considering a fab in **Europe**, "focusing on automotive-specific technologies based on the demand from customers and level of government support"[23]. Earlier, TSMC was more specific, saying it was considering a fab in Germany.[24]

The risks of a military conflict between **China** and Taiwan have been discussed above. Despite the high political tensions, the economic relationship in the semiconductor industry is strong, and Taiwanese companies have many connections with China.

TSMC has a complex relationship with China. TSMC has production facilities in China and many of the company's customers are based in the country. This has led to a strong economic relationship between TSMC and China. However, the Chinese government has been actively seeking to develop its own semiconductor industry and reduce its dependence on foreign companies, such as TSMC. This has led to increased competition for TSMC in the Chinese market. In recent years, the Chinese government has also been tightening regulations and increasing scrutiny of foreign companies operating in China, including TSMC. This has led to concerns about the stability and predictability of the business environment for TSMC in China. Recent US sanctions make it more difficult for TSMC to operate in China, and the company may be forced to cancel contracts with Chinese customers that are blacklisted by the US.

TSMC has two fabs in China, in Nanjing and Shanghai. The company names are TSMC Nanjing Company Limited and TSMC China Company Limited (Shanghai) respectively. Due to new US sanctions, it has become increasingly difficult for TSMC to send chimp-making equipment to these fabs. In October 2022, the US granted TSMC a "one year waiver" to send equipment to its fabs in China.[25] Whether this waiver will be extended is yet unknown. If not, operating these fabs will become much harder in the near-future.

The $3 billion Nanjing fab was completed in 2017 and mainly produces 14, 16 and 28 nm chips.[26] In 2021, TSMC announced a US$2.87 billion plan to expand its 28 nm line, a move that worried both Beijing and Taipei. Beijing because the expansion would mean more competition for local Chinese chip makers and Taipei because it doesn't want TSMC to outsource more production to the Chinese mainland.[27] A Chinese IT expert, quoted by a South Korean newspaper, said: "TSMC is going to dump 28-nm process semiconductor products in China. This will pose a threat to Chinese semiconductor

[23] Bits & Chips, "TSMC is mulling an automotive fab in Europe", 13 January 2023.
[24] Bits & Chips, "TSMC mulls building a fab in Germany", 28 July 2021.
[25] South China Morning Post, "TSMC gets one-year equipment waiver for mainland China chip plant", 13 October 2022.
[26] Securities and Exchange Commission, "Taiwan Semiconductor Manufacturing Company Ltd.", 28 March 2016.
[27] South China Morning Post, "Why has TSMC's Nanjing expansion plan stirred up a hornets' nest in Beijing and Taipei", 1 May 2021.

companies."[28] However, the project was eventually approved by the Taiwanese government and the Chinese government didn't officially object.[29] The new expansion is expected to begin operations by mid-2023. Partially in response to TSMC's expansion, China's SMIC announced in September 2021 it would build a new $8.87 billion fab in Shanghai.[30] That is also where TSMC's second China-fab is based.

TSMC's Shanghai fab is much older. It was completed in 2004 and expanded in 2010.[31] This fab mainly makes less-advanced 180 nm chips.[32] However, this may be a blessing in disguise, as US sanctions against China currently do not include 180 nm chips. The US has not announced an exact 'sanction size', but the current unofficial sanction-limit is at 14 nm. However, this will probably be expanded to 28 nm. That means that TSMC's Nanjing fab is in trouble, as discussed above, but the Shanghai fab is not, at least not yet.[33]

UMC also has a significant presence in China. UMC has manufacturing facilities in Xiamen and Suzhou and a design centre in Shanghai. These facilities in China allow UMC to serve the growing demand for semiconductor products in the Chinese market, as well as provide support for UMC's global customers who have operations in China.

Hejian Technology Corporation (HJTC) is a chip company founded in 2003 and based in Suzhou. In 2013, HJTC was fully acquired by Taiwan's United Microelectronics Corporation (UMC), making it one of the very few Chinese chip makers with 100% foreign ownership. HJCT makes relatively basic chips, the most advanced is 110 nm, that are mainly used in consumer electronics and automotive applications.[34]

United Semi[35] was established in 2014 as a joint venture between UMC, the city government of Xiamen, and several local-state owned electronics companies.[36] Over the years, UMC enlarged its stake in United Semi, and in 2022 it said it would take full control and turn United Semi into a 100% owned subsidiary in 3 years.[37] United Semi makes 40-28 nm chips.

Nexchip Semiconductor Corporation (Nexchip) is a foundry joint venture between Hefei City Construction Investment Holding and PSMC, founded in 2015 and based in Hefei. Nexchip makes 90 -

[28] Business Korea, "TSMC Nanjing Plant Heightens Tension between China and Taiwan", 6 May 2021.
[29] Taipei Times, "Taiwan approves TSMC's plan to expand in Nanjing", July 31, 2021.
[30] Seeking Alpha, "SMIC building $9 billion Shanghai chip fab in capacity battle with TSMC", 3 September 2021.
[31] EE Times, "TSMC signs Shanghai wafer fab deal, says report", 6 June 2003.
[32] Used for, among others, applications in automotive, industrial, controls, and aerospace.
[33] Twitter, Wen-Yee Lee 李玟儀., July 29, 2022, https://twitter.com/Wenyee_Lee/status/1553072449285066753.
[34] Evertiq, "UMC's Hejian subsidiary resumes production", 24 February 2022.
[35] Also known as United Semiconductor or United Semiconductor Xiamen Co. Ltd.
[36] UMC, press release, 16 November 2016.
[37] Digitimes, "UMC to make United Semi into 100% owned subsidiary in 3 years", 28 April 2022.

150 nm chips. Hefei City Construction Investment Holding (HFJTJT) is a state-owned investment holding company based in Hefei, Anhui Province, China. The company is involved in various construction and real estate development projects. The main aim of the company is to promote economic development in Hefei and the surrounding areas.[38]

Taiwan and **Japan** have a competitive relationship in the semiconductor industry, as both countries have developed advanced technology and have significant market share in the industry.

- Taiwan's and Japan's semiconductor industries are complementary, with Taiwan focusing more on the manufacturing of semiconductor devices and Japan focusing more on the development of advanced technology and the design of semiconductor products.
- Both Taiwan and Japan have been investing in the development of new technologies, such as 5G, IoT, and AI, and have been working with various companies and organizations to develop and implement these technologies.
- Taiwan and Japan have been actively seeking to expand their semiconductor industry relationships with other countries and regions, such as the US and Europe, to diversify their partnerships and reduce their dependence on China.
- Both countries have also been working on technology transfer agreements with each other, to share their expertise and knowledge and develop mutually beneficial relationships.

Taiwan and **South Korea** have a competitive relationship in the semiconductor industry, as both countries have developed advanced technology and have significant market share in the industry.

- Taiwan and South Korea have a similar focus on the production of cutting edge technology like high-performance computing, internet of things, artificial intelligence, and 5G.
- South Korea's semiconductor industry is heavily dependent on Samsung, which is the largest player in the industry and generates significant revenue for the country. Taiwan's semiconductor industry is more diversified, with a number of companies with different specialties and capabilities.

TSMC has a significant presence in **Singapore**. The company has been operating in Singapore since 1984, and currently has multiple fabs in the country. TSMC's Singapore fabs produce a wide range of semiconductor products, including microprocessors, memory chips, and image sensors. The company's Singapore facilities are considered to be some of the most advanced and efficient in the world, and are equipped with the latest semiconductor manufacturing technologies, including the latest 5nm and 3nm processes.

[38] Hefei City Construction Investment Holding. Official homepage.

TSMC's Singapore operations are an important part of the company's global semiconductor operations, and the company has been investing heavily in the country to expand its production capacity and capabilities. In May 2022, media reports claimed TSMC was considering a new "multibillion-dollar factory" in Singapore, partially funded by the Singapore government.[39] The facility would make 7 to 28 nm chips. In addition to production, TSMC also has a strong research and development presence in Singapore, with a dedicated R&D centre in the city-state. The company has also been working closely with the Singaporean government and local universities to support the development of the country's semiconductor industry and to nurture talent.

Systems on Silicon Manufacturing Company (SSMC) is a Singapore-based joint venture between Dutch NXP and TSMC, founded in 1998. SSMC makes 110 - 250 nm chips for automotive, RFID, smartphone, and IoT applications.

UMC has one fab in Singapore, making 130-40 nm chips, and a R&D facility. In early 2022 the company announced it would invest 5 billion USD in a second fab in the country. This new fab will start production in 2024 and make 22-28 nm chips for 5G, IoT, and automotive applications.[40]

Systems on Silicon Manufacturing Company (SSMC) is a Singapore-based joint venture between Dutch NXP and TSMC, founded in 1998. SSMC makes 110 - 250 nm chips for automotive, RFID, smartphone, and IoT applications.

TSMC has been exploring the possibility of setting up operations in **India**. TSMC has reportedly been in talks with the Indian government and local partners to explore the possibility of setting up operations in India.[41]

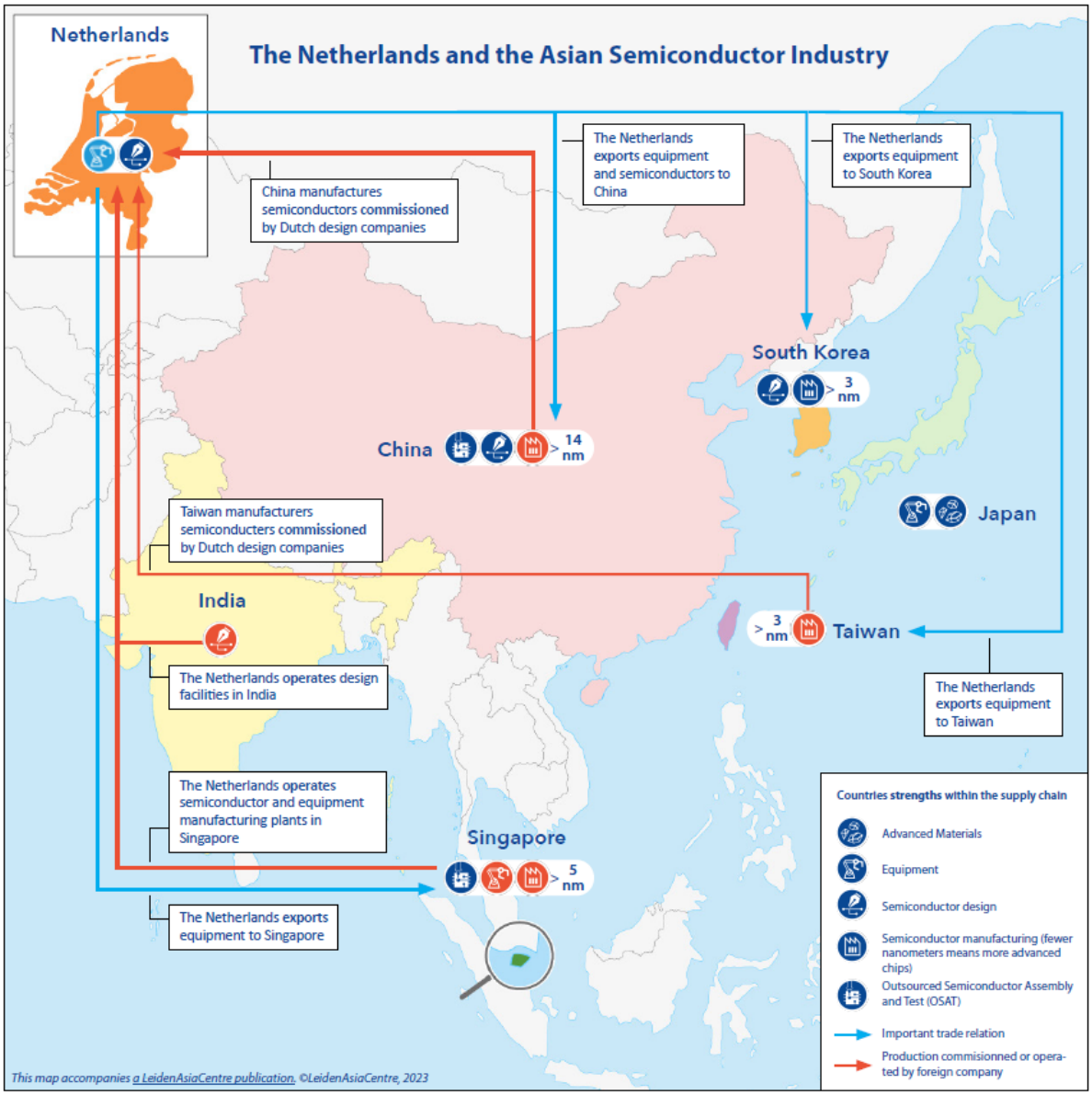
In January 2023 Powerchip officially announced that it is in "preliminary talks" with several Indian companies about jointly producing chips in India.[42] One of the possible partners is reportedly the Tata Group, which said in December 2022 that it wants to produce chips in India either alone or via a partnership.[43]

[39] The Business Times, "World's No. 1 chipmaker TSMC eyes multibillion-dollar plant in Singapore", 23 May 2022.
[40] Businesswire, "UMC Announces New 22nm Wafer Fab in Singapore", 24 February, 2022.
[41] Bloomberg, "India Woos Intel and TSMC to Set Up Local Semiconductor Plants", 26 April 2022.
[42] Moneycontrol, "Taiwanese chipmaker Powerchip in talks with Indian players to help build new plants", 12 January 2023.
[43] Outlook India, "Tata Group To Soon Begin Semiconductor Chip Manufacturing In India: Report", 9 December 2022.

4. Implications for the Netherlands

Dutch companies have a strong presence in Taiwan. However, any heightening of tensions between Taiwan and China and/or between China and the US will have an immediate effect on their operations. ASML especially seems vulnerable to disturbances. US sanctions make it harder for Taiwanese foundries to serve Chinese customers, which over time may reduce demand for specific chip-making equipment. NXP seems less vulnerable, it sells directly to the booming automotive supply chain and has partnerships with several Taiwanese companies. But again, new restrictions on trade or an escalating trade war could risk NXP's operation in Taiwan.

Map of Dutch semiconductor interests in Asia



For an interactive version of this map, visit: https://leidenasiacentre.nl/map-of-dutch-semiconductor-interests-in-asia