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CHINA:

RIDING THE SILICON OX?

09 February 2021

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EXECUTIVE SUMMARY

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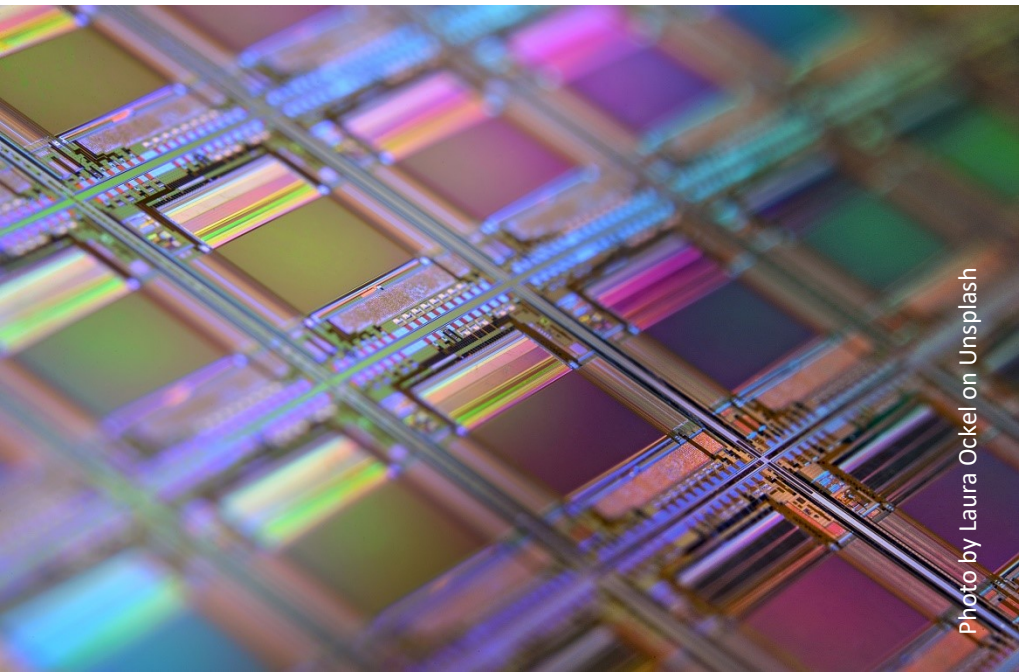
- The recent shortages of chips used in the automotive industry highlight the growing ubiquity and critical nature of semiconductors, which are the essential components that power the USD3,000bn IT industry[1].
- Semiconductors have been identified as a priority target for China's Dual Circulation strategy introduced in 2020. Drawing on the Made in China 2025 plan introduced in 2015, the country's 15th five-year plan (2021-2026), due to be presented in March, will seek to accelerate its transformation into a major high-tech manufacturing hub.
- China's ambitions are the continuation of a successful strategy initiated decades ago that saw it emerge as the world's factory for consumer electronics goods in the 2000s. **After joining the WTO in 2001, China generated a cumulated USD3,700bn trade surplus from computers, televisions sets and telephones over the next two decades**. Chinese brands then emerged in the 2010s as strong challengers to well-established US, South Korean and Japanese consumer electronics brands, featuring prominently across all major product markets. **More than 60% of the 1.3bn smartphones sold in the world in 2020 were designed and marketed by China-based companies**.
- **China's rise as a top assembler and designer of consumer electronics has come along with a trade deficit oscillating around USD200bn per year for semiconductors. The country has fallen short of its objective to cover 40% of its domestic semiconductor needs by 2020 and cannot realistically hope to reach the 70% target assigned for 2025.** No Chinese company has yet emerged as a strong challenger to the American, South Korean and Taiwanese companies that dominate the semiconductor value chain.
- **However, it would be misleading to judge China's progress by only looking at its capacity to reach targets that were puzzling from the start.** The past examples of South Korea and Taiwan show that strong positions in key segments of the semiconductor industry take decades to build.
- **Quite the contrary, Chinese semiconductor companies have broadly outperformed global competition in terms of growth in the past few years. Because they started from a too distant position, with a very significant technological lag, and because progress has been patchy across segments, they do not show up yet in the leaders ranking.** Very tangible progress has also been made in the acquisition of more advanced capabilities in semiconductor design and manufacturing or the US would not have taken measures aimed at slowing down China's emerging champions in the first place.

[1] Our estimates show that in Europe shortages of diverse inputs (including semi-conductors) over the last 5 months of 2020 have the potential to cost -1.1 ppt of growth in 2021

- **The Chinese market for semiconductors and semiconductor manufacturing equipment will generate opportunities close to USD1,000bn by 2025.** While Chinese authorities will double down on efforts to promote domestic companies, **we also anticipate renewed incentives aimed at stimulating foreign investment in the semiconductor sector** – China is just not in a position yet to rely exclusively on homegrown technologies.
- Irrespective of its exact outcome, **China's strategy will create a risk of import substitution by local production for countries exporting chips relying on mature technologies and serving well-established industries**. It is also likely to create **additional significant credit incidents among Chinese companies because of the high stake, high risk nature of breakneck expansion** in such a R&D and capital-intensive industry. **Because China's strategy is intended to boost both supply and demand, it could also reinforce volatility** in an industry seeing one recession every four to five years on average. Last, there is also higher risk of the US starting a new trade dispute with China over worries of the use of advanced chips in critical industries (defense, aerospace etc.) and the idea of its leadership in semiconductor technology being threatened.

USD200bn

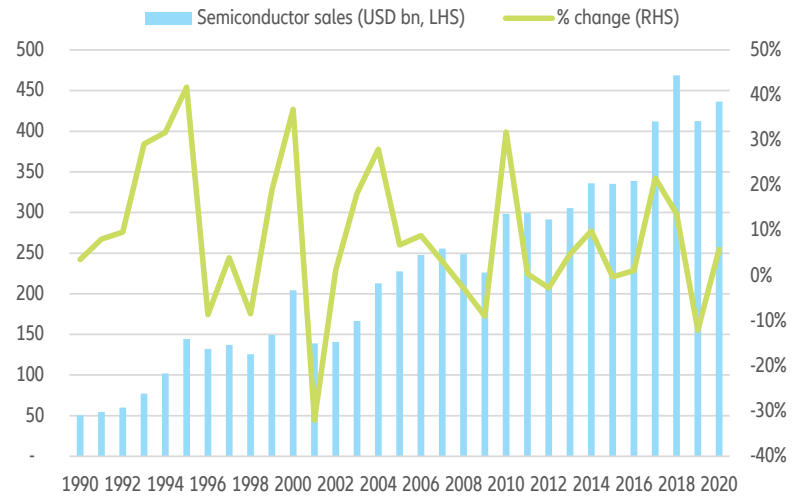
China's annual semiconductor trade deficit.



SEMICONDUCTORS: POWERING THE WIDER IT INDUSTRY

Semiconductors are a thriving USD430bn industry that has powered the wider USD3,000bn IT sector and everything electronic since the invention of the transistor in 1947. The growing use of electronics in virtually every industry has propelled global revenue by about +7.5% per annum over the past 30 years, more than twice global GDP growth (Figure 1). Defying the global sanitary and economic crisis of 2020, the industry bounced back from its 2019 slump with global revenues up +5.9%, driven by a recovery in prices and the launch of new generation chips.

Figure 1: Global semiconductor sales



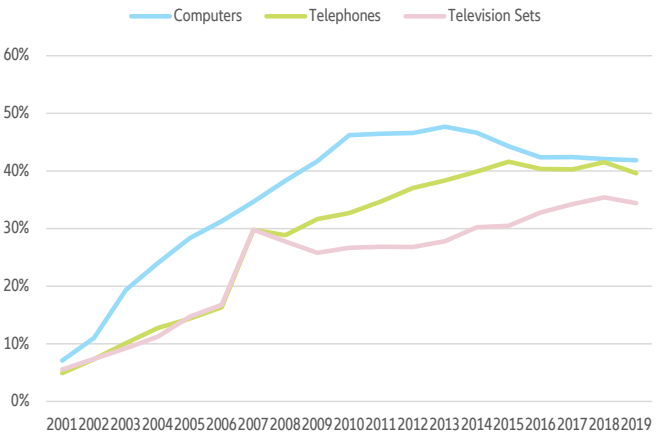
Sources: WSTS, Euler Hermes, Allianz Research

2000s: China becomes the world's factory for consumer electronics

China's growing attention to the semiconductor industry materialized in the form of specific provisions in the 2015 Made in China 2025 plan. China was, at the time, capable of supplying an estimated 15% of its domestic semiconductor needs (i.e. excluding semiconductors used in exported goods) and set an ambitious 70% autonomy target by 2025. Measures aimed at stimulating the local semiconductor ecosystem included, among others, lower income taxes on semiconductor companies, lower import tariffs on semiconductor material and equipment, a fast-track access to equity markets and funding from the National Integrated Circuit Industry Investment Fund. This development was at the time the latest step in China's 30-year-long march in the electronics industry, which is important to understand the country's current ambitions. China first established itself as the world's factory for consumer electronics in the 2000s, following its entry to the WTO. It share of world exports of iconic consumer electronics products (computers, mobile phones, TV sets) grew from 5-10% to 35-45% (Figure 2). Between 2001 and 2019, those three product lines generated a cumulated trade surplus in excess of USD3,700bn. Taking into account production for domestic needs to exported goods gives China a share of global consumer electronics production of between 60- 70%.

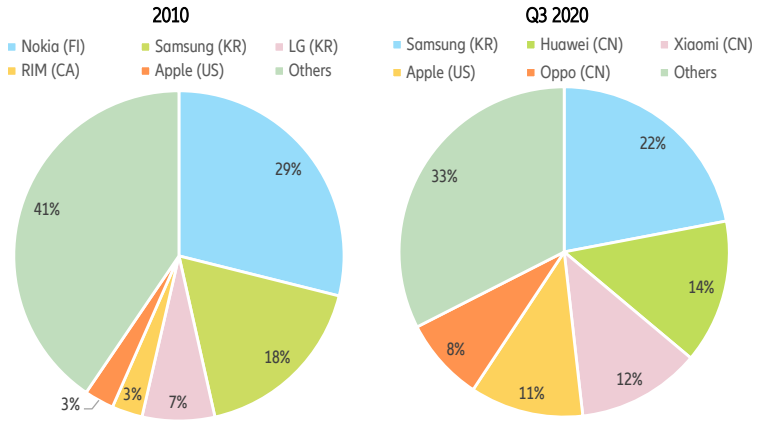
China's comparative advantage in the assembly of consumer electronics relied on a mix of abundant and cheap labor in a particularly labor-intensive industry, improving transport infrastructure, proximity with leading electronic technology providers (Japan, Taiwan, South Korea), capacity to design and execute supply chains at an unmatched scale and a fast-growing domestic market. chips.
China's share in global consumer electronics exports already peaked in 2015. Production has been more scattered ever since, with no single clear big winner but many small wins for countries like Vietnam, Thailand or Mexico.

Figure 2: China's share in world exports (%)



Sources: : Intracen, Euler Hermes, Allianz Research

Figure 3: Global smartphone shipments by vendor (%)



Source: Gartner

2010s: Chinese brands drive foreign competition out of business

China's growing importance as an assembly hub was followed by the rise of homegrown brands, first serving the domestic then international markets and capturing higher value added activities such as product design and marketing with some success. The largest segment of the consumer electronics industry, smartphones are a good reflection of the rise of Chinese players.
Competition has been heating up since 2010 with the exit of once dominant firms, including Nokia, Sony, Research in Motion (BlackBerry), Ericsson, NEC, Fujitsu or Toshiba, which were driven out of competition by the likes of Huawei, Xiaomi, Oppo, Vivo etc. These have not only taken a commanding share of their domestic market (84% for these four companies only) but also grabbed a significant share of other large markets (France, Germany, UK, India etc.). In 10 years, the competitive landscape in the segment has been completely transformed, with three Chinese companies among top five players and another three among top 10 players (Figure 3). The success of Chinese brands is generally attributed to a mix of good value-for-money, good performance in key features (camera quality, memory capacity) and innovative marketing (reliance on digital distribution channels, presence in social media etc.).

CHINA'S SUCCESS IN PRODUCT ASSEMBLY, MARKETING AND DESIGN RELIES ON HUGE CHIP IMPORTS

For all its success, China's strategy to move up the value chain has come at the price of a huge increase in imports of the semiconductors used in the smartphones, computers, televisions sets and servers it assembles. Subtracting China's USD195bn trade deficit in semiconductors from its USD330bn trade surplus in finished goods tells a different story, with the overall balance standing at "only" USD135bn for 2019 and significantly down from its 2014 peak. Together with the growing maturity of the consumer electronics market and China's slow decline as a manufacturing hub, its large deficit in semiconductors was undoubtedly in mind for policymakers during the preparation of the Made in China 2025 plan and the country's so-called "Dual Circulation Strategy" outlined in 2020, due to materialize in the country's next five-year plan.

Figure 4: China's trade balance (USDbn)

Sources: Intracen, Euler Hermes, Allianz Research

Growing autonomy in semiconductors would serve three main targets

The Made in China 2015 provisions for the semiconductor industry were actually more a confirmation than a revelation of the country's growing ambitions in high-technology components, reminiscent of both Taiwan and South Korea's strategies to rise as semiconductor powerhouses, initiated in the 1980s. Chinese ambitions in semiconductors would serve three objectives:

- Help the Chinese electronic ecosystem find new growth opportunities and anticipate further erosion of the country's market share in global exports.
- Support China's broader ambition to transition to a more knowledge-oriented economy with the development of high valued added manufacturing and services, and help reduce the country's largest trade deficit source.
- Reduce reliance on foreign parties for the manufacturing of chips with potentially strategic purposes (surveillance, aerospace, defense).

Chinese players are nowhere close to industry leaders…

Figure 5 provides an overview of the leading listed companies of the wider semiconductor ecosystem, including the suppliers of critical silicon material and semiconductor manufacturing equipment, to assess China's current position and its capacity to reach its semiconductor autonomy targets. The overall picture is pretty straightforward: no Chinese company has yet emerged as a heavyweight.

- Silicon wafer production is an oligopoly dominated by Asian players, with Shin Etsu and Sumco of Japan accounting for more than half of global segment revenues. Of note, Globalwafers of Taiwan has reached an agreement to acquire Siltronic of Germany, meaning four companies will control about 90% of the market. Emerging Chinese wafer manufacturers have a combined market share inferior to 5%.
- Semiconductor manufacturing equipment is similarly a collection of oligopolies with a handful of companies dominating the machine tools specific to each step of semiconductor manufacturing (deposition, lithography, etching etc.). American firms and technologies are ubiquitous and have been used as powerful leverage in the US-China tech and trade dispute.
- Foundry capacities are dominated by Taiwanese firms, with TSMC alone accounting for more than half of global capacities and the only company, together with Samsung, to master the industry's most advanced manufacturing standard. Two significant foundry companies are Chinese: SMIC and Hua Hong Grace. SMIC joined the same trade blacklist as Huawei in late 2020, making it more difficult for the company to buy US equipment and technologies.
- Fabless companies, i.e. companies designing chips while leaving manufacturing to foundries, often have little in common and specialize in a limited number of semiconductor applications (power, memory, telecom etc. chips). The biggest players are mostly American or Taiwanese, but it is definitely in this segment that China's progress is the most tangible, with many small yet fast-growing players
- Integrated design manufacturers, engaged in both chip design and manufacturing, also operate across diverse industries and applications. The leaders are mostly American and European companies.

A striking feature of the industry is the high degree of specialization of companies and countries: no country can claim a dominant position all along the value chain.

Figure 5: Leading players in the semiconductor value chain

Semiconductor material and manufacturing equipment companies				Semiconductor design and manufacturing companies					
Silicon wafers	% share of segment revenue	Semiconductor manufacturing equipment	% share of segment revenue	Foundry companies	% share of segment revenue	Top fabless companies	CY 2019 revenue (USD bn)	Top Integrated design manufacturers	CY 2019 revenue (USD bn)
Shin Etsu (JP)	30%	Applied Materials (US)	19%	TSMC (TW)	55%	Qualcomm (US)	14.64	Intel (US)	71.97
Sumco (JP)	23%	ASML (NL)	18%	Samsung (KR)	16%	Broadcom (US)	17.27	Samsung (KR)	64.94
Globalwafers (TW)*	15%	Lam Research (US)	14%	UMC (TW)	7%	Nvidia (US)	10.92	SK Hynix (KR)	23.19
Siltronic (DE)*	12%	Tokyo Electronic (JP)	14%	GlobalFoundries (US)	7%	Mediatek (TW)	7.97	Micron (US)	23.41
SK Siltron (KR)	11%	KLA Tencor (US)	7%	SMIC (CN)	4%	AMD (US)	6.73	Nvidia (US)	10.92
Others	10%	Screen (JP)	3%	PSMC (TW)	2%	Xilinx (US)	3.16	Texas Instruments (US)	14.38
		Others	25%	HuaHong (CN)	2%	Realtek (TW)	1.97	Kioxia (JP)	9.06
				VIS (TW)	1%	Novatek (TW)	2.08	Infineon (DE)	9.05
				Others	6%	Marvell (US)	2.70	ST Micro (FR/IT)	9.56
						Dialog (UK)	1.57	NXP (NL)	8.88

Sources: Euler Hermes, Allianz Research, Gartner, TrendForce, company information.
Figures are for semiconductor operations only wherever possible

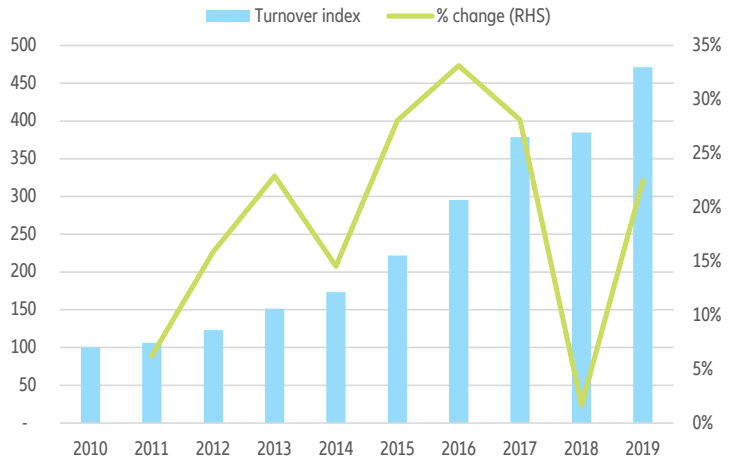
… but are growing at a very fast pace

The absence of Chinese players among top tier companies all along the value chain does not mean that China is not moving up the value chain:

- Looking at a sample of 25 leading listed Chinese semiconductor companies since 2010 (Figure 6), we observe a more than fourfold increase in combined revenue, or about +18% per annum, vs about 4% per annum for the wider industry over the same period. This means China is definitely winning market shares, but from such a minor and distant position compared to industry leaders that it generally does not appear yet in rankings. This is made more acute by the fact that China targets growing autonomy across all segments, rather than focusing efforts on selected activities.
- Rankings also fail to capture the activity of foreign firms in China. Industry leaders including Intel, Samsung, SK Hynix, Micron, Texas Instruments, Infineon, NXP, UMC and TSMC manufacture semiconductors in the country and play in important role in training the country's labor force and reducing its reliance on imported components. Their local capacities, however, generally play a secondary role in their manufacturing mix and rely on mature technologies.
- They also cannot account for the growth of private and/or diversified and/or state-run companies, some of which, such as Tsinghua Unigroup or HiSilicon, are among China's largest semiconductor companies.

While China strived to provide for 70% of its domestic semiconductor consumption by 2025 in the Made in China 2025 plan, consultancy IC Insights believes this share has only marginally improved from 15% in 2015 to 16% in 2019, and forecasts a 20% share by 2025. This pace of progress would be consistent with the cases of South Korea and Taiwan, two of the industry's leading designers and manufacturers of semiconductors, whose success must be traced back to government plans initiated in the 1980s. It was only in the mid-2000s that both countries started to generate recurring trade surpluses in semiconductors, and with a clear focus on a narrower set of segments compared to China's very broad approach.

Figure 6: Listed Chinese semiconductor companies' turnover index (2010=100)



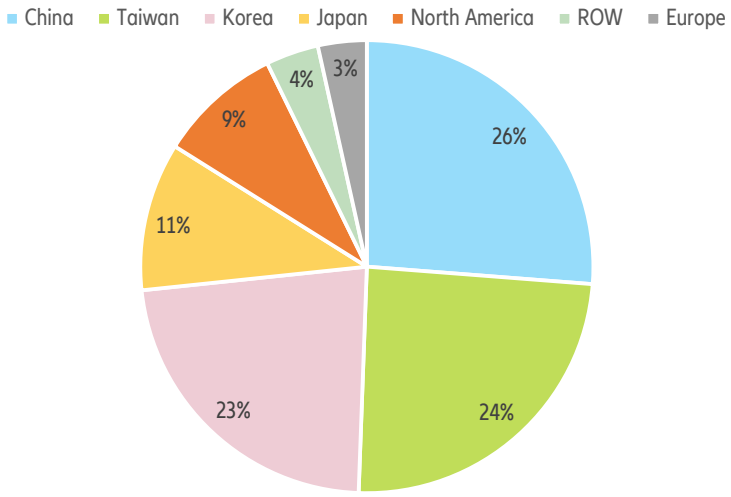
Sources: Euler Hermes, Allianz Research, Thomson Reuters Eikon

HOW FAR, HOW FAST?
MAKE-OR-BREAK FACTORS DECIDING CHINA'S QUEST FOR AUTONOMY

While China's progress has fallen short of its own targets, there is little doubt that its support to domestic companies will continue to translate into dynamic growth and slow but steady gains in market shares in the next decades. The exact timing at which it will reach autonomy or technological parity is far too uncertain and remote to be precisely assessed, but a few factors will play a crucial role in shaping the country's future progress:

- The magnitude of the country's efforts to fund and channel private capital to its 50,000 company-rich semiconductor ecosystem and further attract foreign manufacturers. The country's financial arm for the support of its semiconductor industry, the China Integrated Circuit Investment Industry Fund (CICIIF, also known as "The Big Fund") was able to invest an estimated RMB340bn (about USD50bn) in Chinese semiconductor companies in its first two rounds (2014 and 2019). Following the introduction of the new Dual Circulation doxa in 2020, Chinese ambitions in semiconductors will most likely materialize into new provisions in the country's 15th five-year plan for the 2021-2026 period.
- Investors' confidence in the capacity of Chinese companies to eventually turn a profit, especially in the most R&D and capex-intensive segments of the industry such as foundries. SMIC, China's largest foundry player, has alone burnt about USD6.9bn of cash over the past 10 years.
- Beijing's patience as regards the progress made by state-owned semiconductor companies. The decision to let Tsinghua Unigroup, a holding company with ownership of some of China's largest and most advanced semiconductor companies, go insolvent in 2020 has sent a signal that the country may not be ready to fund its champions at all costs.
- The state of the US-China relationship on technology and trade, because current restrictions placed on companies such as Huawei (which faces restrictions for its chips manufactured by a third-party company using US technologies) or SMIC (which can no longer buy state-of-the-art US machine tools) are effectively slowing down China's capacity to manufacture and design advanced chips. This leverage comes at a price for US equipment makers: China is the world's largest market for semiconductor manufacturing equipment, generating an estimated 26% of a USD70bn industry (Figure 7). Lasting restrictions could result in US firms' losing market shares to foreign competitors and stir retaliation targeting US tech firms operating in China. As of February 2021, the newly elected Biden administration has not committed to clear actions regarding the future of the sanctions targeting Chinese companies inherited from the previous administration.

Figure 7: Semiconductor manufacturing equipment sales by region, 2020 (%)

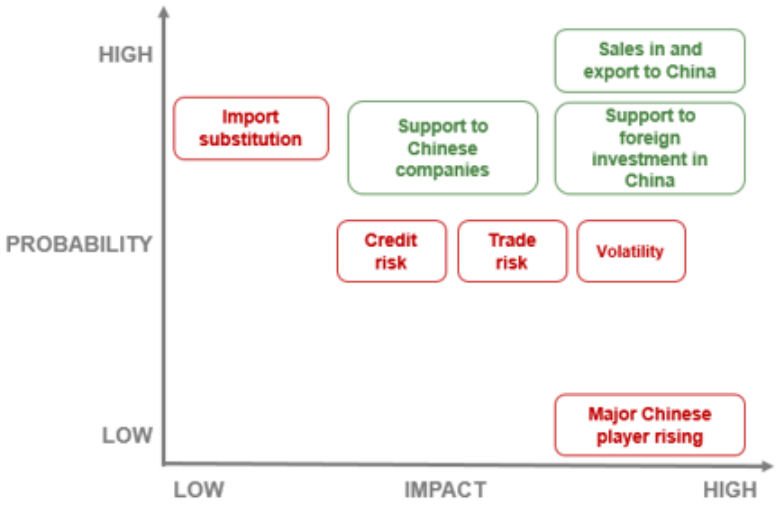


Source: SEMI

What does this mean for companies?

China's case shows that progress can only be sped up to a certain extent: substantial investment has proven efficient to help domestic companies gain momentum in their semiconductor design and manufacturing capabilities. But it cannot make miracles in terms of the pace at which a large and highly skilled labor force can be trained, experience can be accumulated and trust can be built in an industry where tight cooperation is crucial between upstream and downstream companies, chip designers and manufacturers, the public and the private sectors, universities and companies and across countries. Growing fast in a fast-growing industry dominated by undisputed leaders means that gains in market shares are slow, and that China's march towards greater semiconductor autonomy will be a matter of decades. But irrespective of their exact outcome, China's efforts to become more self-sufficient in semiconductors will have a strong impact on the industry in the next five years (Figure 8).

Figure 8: Risk and opportunity matrix – China's impact on the industry by 2025



Sources: Euler Hermes, Allianz Research

Plotting the main risks and opportunities depending on their likelihood and impact on the industry, we anticipate the following developments for the years to come:

- As discussed above, the semiconductor industry's powerful long-term growth drivers, combined with China's efforts to capture a growing share of global revenues, will create substantial opportunities by 2025. Assuming the same compound annual growth rate observed over the 2010-2020 period, and keeping China's share in revenues constant at 35%, **the Chinese market would reach at least USD185bn in annual sales by 2025 and generate more than USD850bn in revenues by then**. As regards **semiconductor manufacturing equipment**, China's ambition to have more chips made domestically has already translated into a 3.5 times increase in sales to China between 2015 and 2020; assuming softer sales growth because of US sanctions but still strong government support to local foundries, **cumulated sales to China could represent somewhere between USD70bn and 100bn by 2025**.
- For all its desire for greater autonomy in semiconductors, China will necessarily rely on domestic investment by foreign leaders to move up the technology ladder and cut its huge deficit in chips. Its current competitive positions along the value chains are too weak and its distance from leaders too important for the country to realistically reach its autonomy targets without further international investment. **Foreign companies will have to strike the right balance between reaping the benefits granted by Chinese authorities (typically grants and tax breaks) and the risk of accelerating China's progress along the learning curve**. Domestic companies will most likely see a new round of support measures in the next five-year plan. Rather than playing catch-up in markets where domestic companies are small and late, **Chinese authorities could adopt more of a "leapfrogging" stance by which more emphasis would be placed on product markets that are still emerging and whose competitive positions can still be disputed** (typically, artificial intelligence).
- Turning to the risk side, we do not see how a global Chinese champion could emerge within five years in any of the major segments discussed previously. We do see, however, how progress made in domestic chip design and manufacturing capabilities could reduce the need for imported components with comparatively lower value added. The risk of import substitution is obviously higher in product markets relying on mature technology nodes and serving well-established industries. **We find hints of countries facing growing Chinese competition** by looking at trade data: among China's top suppliers of semiconductors, **Malaysia, the Philippines, Singapore and Thailand have been losing market shares nearly continuously in the past few years (16% of Chinese semiconductor imports combined, vs 24% in 2010)**. Those countries are known as local manufacturing hubs for international players that could typically consider growing their presence in China.
- **New developments in the trade and technology war between China and the US could also tip the scale in one direction or another**. As discussed previously, US measures preventing Chinese companies from using advanced US technologies are slowing Chinese progress, but hurting US equipment makers and leaving opportunities to competitors. Should the situation worsen, **China could retaliate by targeting US semiconductor firms** generating the majority of their revenues in the country with little contribution to the local ecosystem.
- **The increasing share of China in both demand and supply could also reinforce the volatility of the sector**, known for its boom-and-bust cycles with a recession every four to five years on average. The fact that Chinese players enjoy generous public support could, in periods of downturn, slow down the necessary cuts in supply that allow prices to recover.
- Last, as evidenced by the default of Tsinghua Unigroup in late 2020, Chinese authorities will not support their domestic players at all costs and could let market mechanisms decide the fate of non-performing companies as a way to consolidate the domestic industry, translating into a higher risk of payment incidents or defaults.

APPENDIX - Glossary

Silicon wafer companies manufacture the round silicon substrate known as wafers used by foundries and integrated design manufacturers. Standard wafer diameters include 150, 200 and 300mm.

Semiconductor manufacturing equipment companies provide foundries and integrated design manufacturers with the necessary machine tools to turn silicon wafers into chips.

Fabless companies focus on designing semiconductors whose production is outsourced to foundry companies.

Foundries are companies focusing on manufacturing semiconductors for third-party clients.

An integrated design manufacturer (IDM) is a company both designing and manufacturing semiconductors. They may out-source part of their production to foundries.

A process node can be broadly defined as a generation of manufacturing process. An advanced process node can, on a given surface of silicon, have a higher density of transistors than an older process node because it uses smaller transistors. The feature size of a transistor is measured in nanometers (nm). Today's most advanced manufacturers use 5nm process nodes.

Semiconductor companies form a very heterogeneous sector made of hundreds of different product markets that only have in common the use of silicon for the production of integrated circuits. Product markets can be loosely divided according to:

The process node used. Not all product markets require semiconductors made using the most advanced technologies.

The wafer size used. Much like for process nodes, there is no ideal wafer size.

The application or purpose of the chips (memory, telecommunications, computing, power etc.)

The end-use industry (smartphones, computers, automotive, industrials, etc.).

Trade data

Data for trade are based on HS4 product codes and include, depending on the indicators, one or more of the following items:

8471	Computers
8517	Telephones
8528	Television Sets
8541	Semiconductors
8542	Integrated circuits

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FORWARD-LOOKING STATEMENTS

The statements contained herein may include prospects, statements of future expectations and other forward-looking statements that are based on management's current views and assumptions and involve known and unknown risks and uncertainties. Actual results, performance or events may differ materially from those expressed or implied in such forward-looking statements.

Such deviations may arise due to, without limitation, (i) changes of the general economic conditions and competitive situation, particularly in the Allianz Group's core business and core markets, (ii) performance of financial markets (particularly market volatility, liquidity and credit events), (iii) frequency and severity of insured loss events, including from natural catastrophes, and the development of loss expenses, (iv) mortality and morbidity levels and trends, (v) persistency levels, (vi) particularly in the banking business, the extent of credit defaults, (vii) interest rate levels, (viii) currency exchange rates including the EUR/USD exchange rate, (ix) changes in laws and regulations, including tax regulations, (x) the impact of acquisitions, including related integration issues, and reorganization measures, and (xi) general competitive factors, in each case on a local, regional, national and/or global basis. Many of these factors may be more likely to occur, or more pronounced, as a result of terrorist activities and their consequences.

NO DUTY TO UPDATE

The company assumes no obligation to update any information or forward-looking statement contained herein, save for any information required to be disclosed by law.