Global Asset Management

The U.S./China tech war: a battle for global supremacy

Emerging Markets Equity team

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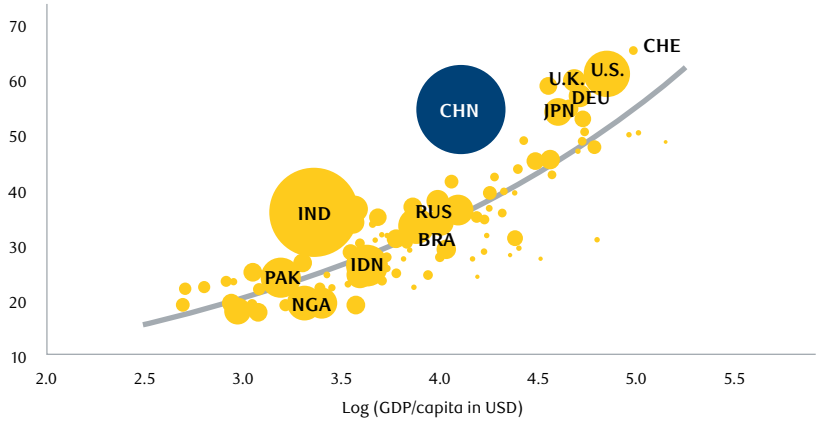
"A select few technologies are set to play an outsized importance over the coming decade... 80% of our overall success will turn on what we do in 20% of the technologies."

National Security Strategy, White House, October 2022

Last October, the U.S. announced a ban on all advanced semiconductor chips and equipment from being sold to Chinese companies, on the grounds of national security. In particular, the U.S. cited concerns regarding China's investments in supercomputers and artificial intelligence for military applications.

Additionally, in January 2023, the U.S. struck a multilateral trade agreement with the Netherlands and Japan to restrict sales of advanced lithography equipment to China. These measures mark a significant escalation in the U.S./ China tech war, as the U.S. looks to close out any loopholes that have enabled China's technological progress to-date, and ultimately reflect the U.S.' deepening concerns over China's strategic rivalry (Exhibit 1).

Exhibit 1: China's innovation performance is better than implied by its development level



Source: Global Innovation Index (GII), World Bank, Citi GPS, as at October 2022.
Note: bubble chart data as at 2021. Circle size = population.

The rivalry between the U.S. and China, and the related restrictions of tech exports to China – often referred to as the 'tech war'– is a trend that we predict is here to stay, and therefore something that we feel is important to consider in terms of our investment positioning. In this report, we look to assess the potential implications of the U.S./ China tech war at the country, industry and company level.

Evolution of the semiconductor industry

Semiconductors are the tiny chips that enable the functionality of smartphones, computers, autos, data centres, weapons and more. They can be broadly categorised into 'Memory' and 'ex-Memory' (or 'core semis'), the latter of which has 'Logic' – or logic chips – as its major sub-category. These chips are at the leading edge of semiconductor manufacturing, with applications in AI and graphics, while memory chips are critical for the storage of information. Exhibit 2 shows the key end markets for semiconductors.

Semiconductors have become a critical enabler of everyday life, representing circa 25% of the value of electronic equipment sales and rising, as more and more chips are required to power novel technologies (Exhibit 3). They have also become a strategically important asset, driving the development of specialised military technologies.

Since its humble beginnings in the U.S. in the 1950s[1], the semiconductor industry has evolved to become a highly efficient, globalised supply chain. The global reduction of trade barriers and transport costs, the integration of China into the global economy, and the reorganisation of the types of firms that make the chips have all contributed to the growth of the industry. Notably, these trends have resulted in a shift away from the U.S. towards Asia in terms of semiconductor manufacturing and consumption (Exhibits 4 and 5), and the emergence of a new 'foundry' business model which allows companies to focus on design and avoid the CapEx burdens associated with manufacturing.

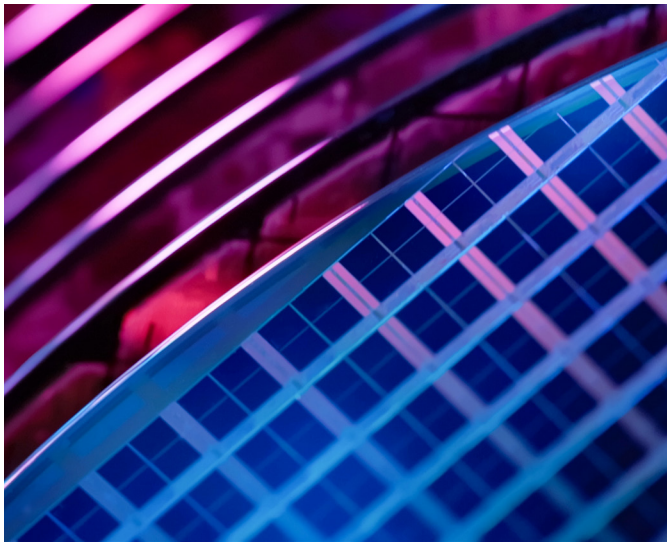
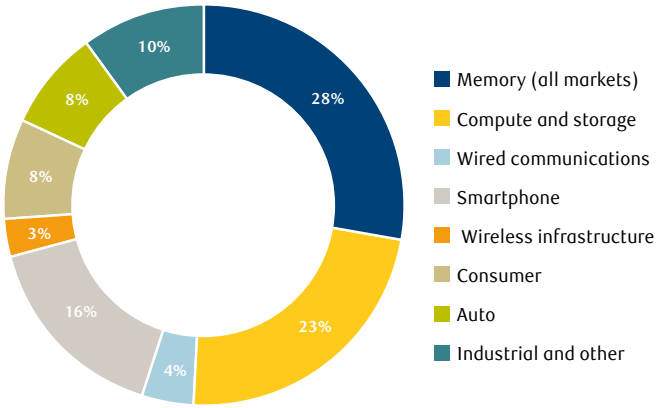


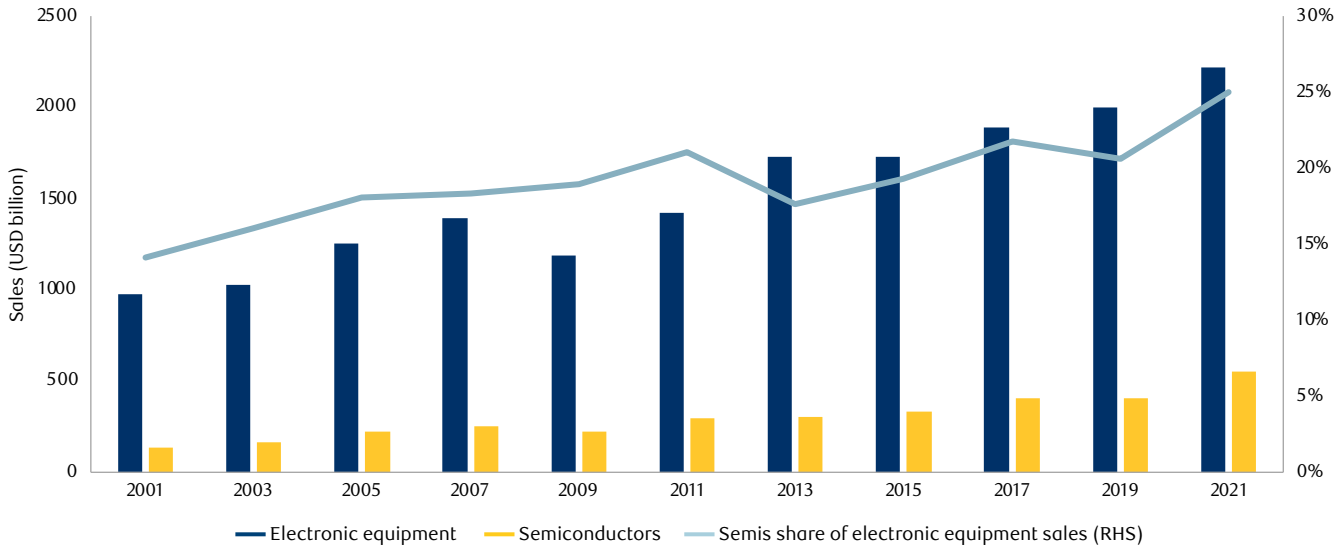
Exhibit 2: Semiconductor sales by end market

Compute and smartphone markets are key revenue drivers



Source: BofA Global Research, SIA, Gartner, IDC.

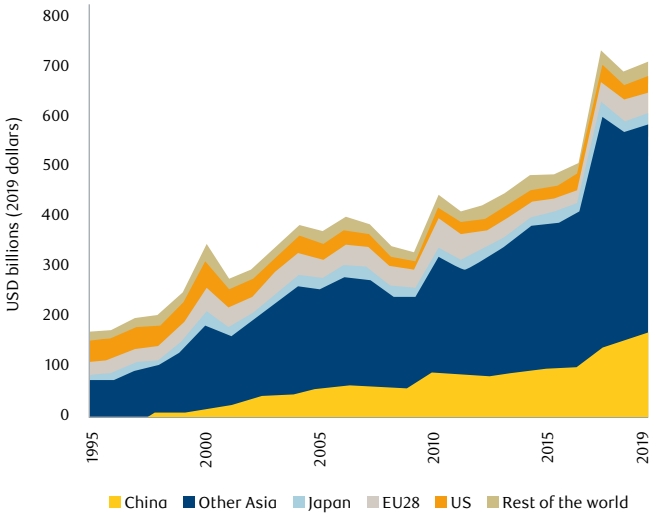
Exhibit 3: Rising share of semiconductors in electronic equipment sales



Source: BofA Global Research Semiconductor Primer, SIA, as at May 2022.

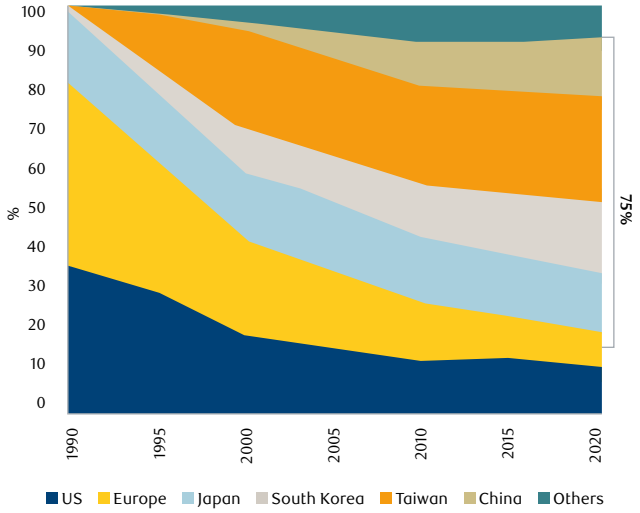
[1] For further reading on the history and evolution of the semiconductor industry: C. Bown: "How the US marched the semiconductor industry into its trade war with China", December 2020; C. Miller: "Chip War", October 2022.

Exhibit 4: Import demand for semiconductors by region: stagnant demand in the west versus surge in China and rest of Asia



Source: Chad P Brown, Peterson Institute for International Economics, as at December 2020. Note: semiconductors defined as in Harmonized System codes 8541 and 8542. Import values converted to constant (2019) USD using the Bureau of Labor Statistics import price deflator.

Exhibit 5: Semiconductor manufacturing capacity by region: US share has fallen to 12% while 75% is concentrated in East Asia



Source: BofA Global Research Semiconductor Primer, SIA, as at May 2022.

The number of companies able to manufacture leading edge chips has declined substantially over the years (Exhibit 6). In 2001, 30 companies manufactured leading edge chips. As these semiconductors have become more difficult and costly to manufacture, the number has fallen to three remaining firms at present: TSMC, Samsung, and Intel. TSMC and Samsung are currently the only two options for Fabless semiconductor companies looking to produce chips on leading edge nodes. Intel, on the other hand, has historically produced these chips internally but recently started investing in opening up its fabrication plants ("Fabs") to external customers[2].

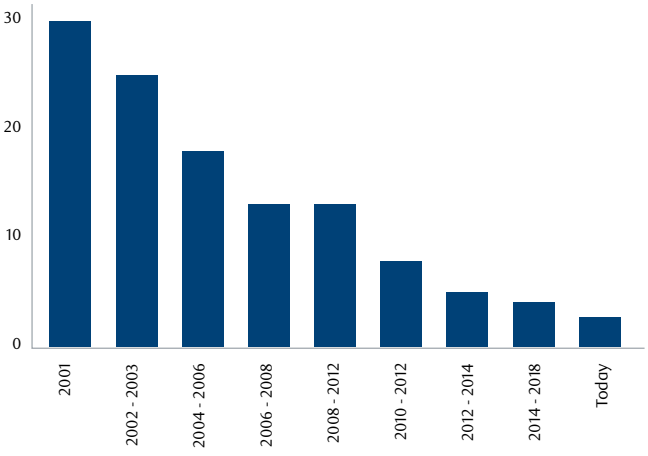
"The number of companies able to manufacture leading edge chips has declined substantially over the years."

Semiconductors have become an issue of national security

Globalisation has brought significant benefits in terms of efficiency, lower costs and innovation. It has also, however, planted the seeds towards a more nationalistic approach in the technology industry, as governments have come to realise the strategic importance of semiconductors and the risks inherent in the supply chains. These risks became particularly evident during the Covid-19 pandemic when chip shortages and factory closures caused disruption on a wide scale. Against this backdrop, governments globally have been proposing bold new incentives to fund and secure local semiconductor manufacturing industries.

First, China set the stage in 2015 towards improving its self-reliance for semiconductors by 2025. The U.S. then rolled out an expanding list of export controls towards mostly China, focused on semiconductor technologies (Exhibit 7). One key casualty has been Huawei, whose smartphones and semis businesses have not recovered from U.S. sanctions. More recently, the U.S. has significantly tightened and broadened its export controls on China, to include all leading edge semiconductor equipment. The multilateral agreement between the U.S., Japan and the Netherlands to restrict sales of advanced lithography equipment to China is also significant given that Japan and the Netherlands control this market.

Exhibit 6: Number of leading edge logic manufacturers has fallen



Source: BofA Global Research Semiconductor Primer, SIA, as at May 2022.

[2] Intel's foundry bet might split the market in three - Taipei Times.

Meanwhile, multiple governments are unveiling subsidy programmes aimed at supporting their semiconductor industries. The U.S., Europe, and to a lesser extent, Japan, are trying to partly rewind the clock to a time when they dominated semiconductor manufacturing. Some of the impetus to this is also heightened by recent geopolitical tensions. In total, those subsidies towards the semis industry are estimated to be in the range of USD350-400 billion, including more recent incremental subsidies enabling semiconductor reshoring/shoring of USD121-136 billion from the U.S., Europe, Japan and India (Exhibit 8).

"The U.S., Europe, and to a lesser extent, Japan, are trying to partly rewind the clock to a time when they dominated semiconductor manufacturing. Some of the impetus to this is also heightened by recent geopolitical tensions."

The U.S. CHIPS Act ("the Act") proposes more than USD52 billion in subsidies and a 25% tax credit towards the domestic semiconductor industry, with two-thirds of this directed towards semiconductor manufacturing. The Act also bars companies that receive funding from investing in and supporting the manufacture of high-tech chips in China or other "countries of concern" for ten years. Semiconductor majors have also come on board, with TSMC pledging to construct a 5nm technology Fab in Arizona expected to cost circa USD12 billion. Intel is poised to benefit from U.S. policymakers' support as it aspires to enter the foundry space, by building two state-of-the-art Fabs in Arizona and Ohio, investing USD20 billion in each.

Exhibit 7: Timeline of key tech-related restrictions on China by the U.S.

Date	Key event
Mar 2016	ZTE added to the US DoC's BIS Entity List
Apr 2018	US DoC issues export Denial Order on ZTE for US core technology
Oct 2018	Fujian Jinhua Interagrated Circuit (JHICC) export restrictions on US technology transfers
May 2019	Huawei and affiliates added to the US DoC's BIS Entity List
May 2020	US DoC revises Foreign Direct Product Rule to further tighten Huawei restrictions
Aug 2020	US DoC widens the list of Huawei affiliates and the US technology restriction scope
Dec 2020	SMIC and affiliates add to the US DoC's BIS Entity List
Feb 2022	33 Chinese companies including HKC added o the US DoC's Unverified List
Oct 2022	**US implements export controls on advanced chips/ICs and semis equipment in China.** **Advanced defined as: Logic chips ≤16/14nm; DRAM memory chips ≤18nm; NAND flash memory chips ≥128 layers.** Item-based export controls - Advanced computing chips - Computers, electronic assemblies and components that contain such chips - Advanced semiconductor manufacturing equipment and software End-use export restrictions - Items destined to a semiconductor facility in China that fabricates advanced chips/ICs - Advanced chips/ICs related to a supercomputer located or destined to China License requirement for US persons supporting development or production of advanced chips at a semiconductor facility in China
Jan 2023	**Multilateral trade agreement between US, Japan and Netherlands** Commitment in principle to restrict sales of advanced lithography equipment to China by ASML and Nikon

Source: UBS: "Is the technology industry heading towards deglobalization?", as at December 2022.

Exhibit 8: Summary of key government incentives for investments in semiconductor manufacturing

	United States	Euorpean Union	India	Mainland China	Taiwan	South Korea	Japan
							
Semi manufacturing capacity (12", k wpm)	**743k wpm (8%)**	**580k wpm (5%)**	**(>2%)**	**1,620k wpm (18%)**	**2,070k wpm (22%)**	**2,113k wpm (23%)**	**1,337 wpm (14%)**
Incentives Overview	**CHIPS and Science Act of 2022**	**Digital Compass Plan and EU CHIPS Act**	**Self-reliant India Plan**	**14th Five-Year-Plan**	**Statute for industrial innovation**	**K-Semiconductor belt strategy**	**National semis project**
Period	**2022 - 2026**	**2022 - 2030**	**Not specified**	**2021 - 2025**	**2023 - 2029**	**2022 - 2031**	**2022 - 2025**
Estimated value of incentives (USD bn)	**USD 74bn** (USD 52bn; Incentives) (USD 22bn; Tax credit)	**USD 30 - 45bn**	**Up to USD 10bn in incentives** (Up to 50% government funding)	**Up to USD 150bn**	**USD 15 - 20bn** (25% tax credit for leading edge R&D; 5% for advanced manufacturing equipment)	**USD 55 - 65bn** (R&D tax credits up to 50%; up to 20% for new facility spend)	**Up to USD 7bn** (Mainly for leading edge production; up to 50% setup cost subsidy)

Source: RBC BlueBay Asset Management, UBS: "Is the technology industry heading towards deglobalization?", as at December 2022.
Note: estimated value of total incentives from 2014-2030.

Assessing the implications

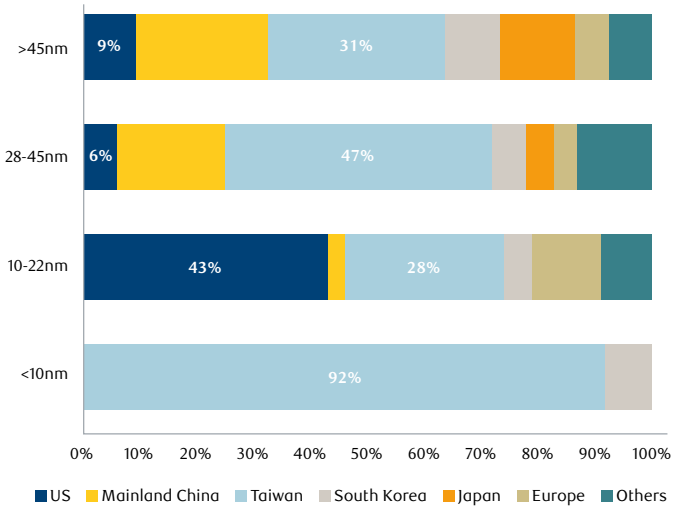
As a permanent trend, the U.S./China tech war is likely to have implications at both a macro and portfolio level. We summarise below our key conclusions, based on our research. At the same time, we acknowledge that this is an evolving area and will continue to closely monitor any developments.

From a macro perspective, we do not anticipate a material change to the global semiconductor manufacturing status quo in the next five, or even ten, years. As of 2022, 92% of leading logic production comes from Taiwan and 8% from South Korea (Exhibit 9). While we do not expect this picture to materially change, we do expect to see a marginal increase in U.S.-made chips, primarily from TSMC's investments in the U.S.. There are two key reasons why we believe the status quo will largely remain:

1. **The inability to recreate the current semiconductor ecosystem in the U.S.**
   The Act will, in our view, be unsuccessful at relocating the East Asia-centric semiconductor ecosystem and supply chain that has built up over the last 3-4 decades, within the next 5-10 years, because 1) the funding is simply not large enough to accommodate it, with the Act's entire allocation roughly equal to TSMC's annual CapEx spend; and 2) even if the U.S. subsidies were materially upsized and CapEx taken care of, it would be impossible to recreate the same level of productivity and cost structure in the U.S.. It would essentially require the entire Taiwan or Korea-based supply chains that have been growing and fine-tuned together gradually over decades, to relocate to the U.S..

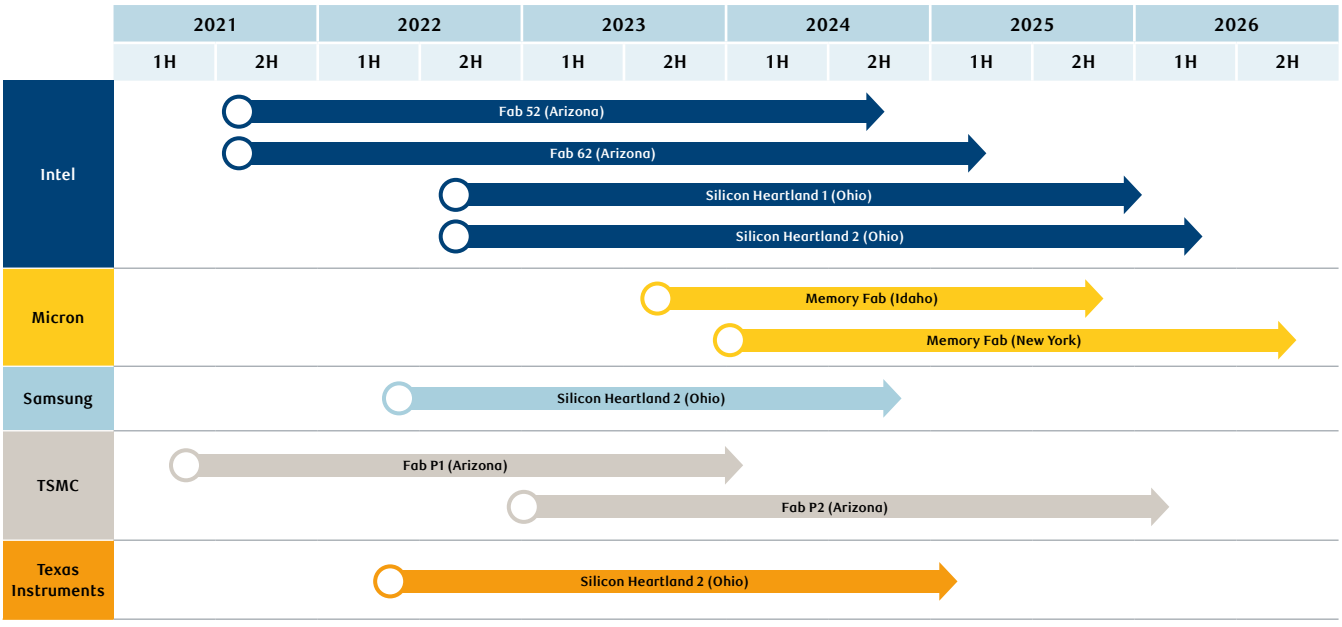
2. **The lack of credible U.S.-based competition**
   While funding is important to semiconductor development, it does not guarantee success, as the key factor is technological capability. Most of the Act's funds will be directed to Intel, which lacks the technology and the ecosystem on which TSMC has built its competitive position. Ultimately, subsidies make industries less competitive in the medium to long run because companies begin to rely on them. (Exhibit 10).

Exhibit 9: Breakdown of global processing capacity by region



Source: SIA, Goldman Sachs research, as at December 2022.

Exhibit 10: Timeline of U.S. Chips Act projects



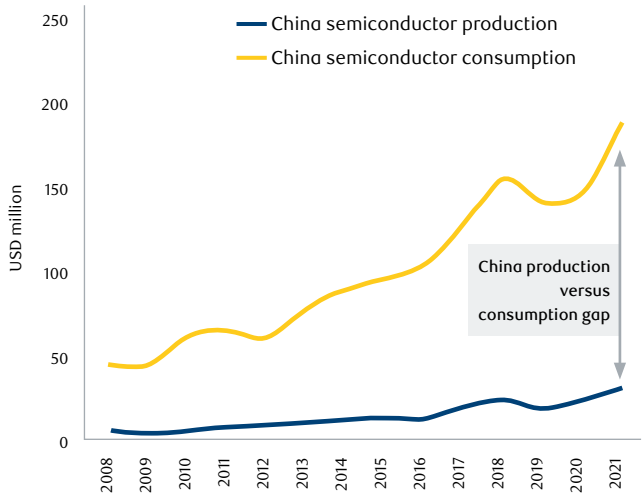
Source: RBC BlueBay Asset Management, UBS, as at December 2022. Note: only includes announced/confirmed projects.

[3] TSMC announces intention to build and operate an advanced semiconductor Fab in the US.

In terms of implications from a portfolio standpoint, there are several factors to consider:

- **Stock specific implications:**
  - **Returns:** returns for companies in the semiconductor industry could be potentially diluted by the lower return on investments outside of Taiwan and China. In our view, the impact will be marginal, as this CapEx and related capacity will be gradual and relatively small. To a large extent, this is already reflected in the current valuations for the industry.
  - **China-based assets:** if the U.S. expands its restrictions to include less advanced technology, semiconductor capacity in China may become difficult to maintain and service, and it could therefore lose value. This is not an issue at the moment, and it is unlikely to become one in the near to medium term.

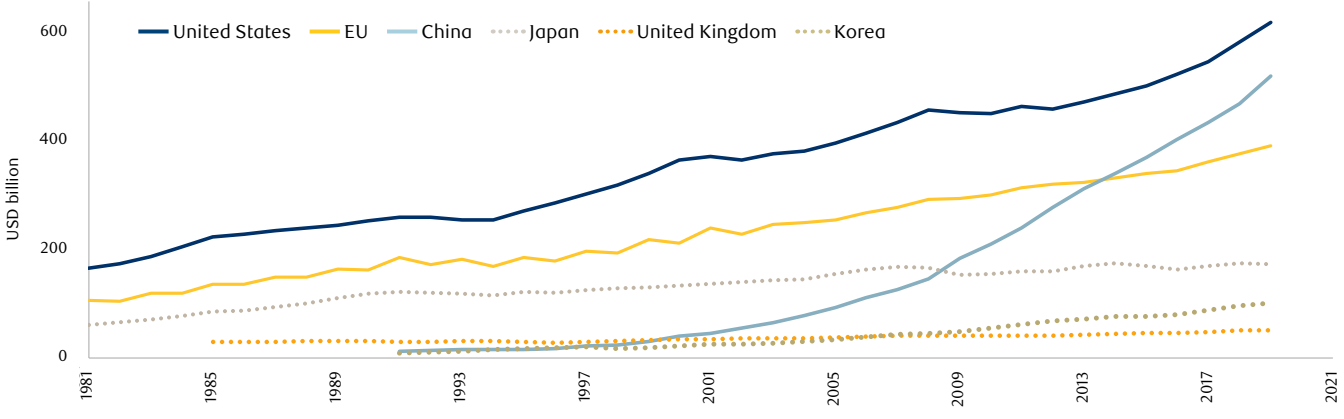
Exhibit 11: China is reliant on imports of semiconductors



Source: BofA Global Research estimates, SIA, IC Insights, as at May 2022

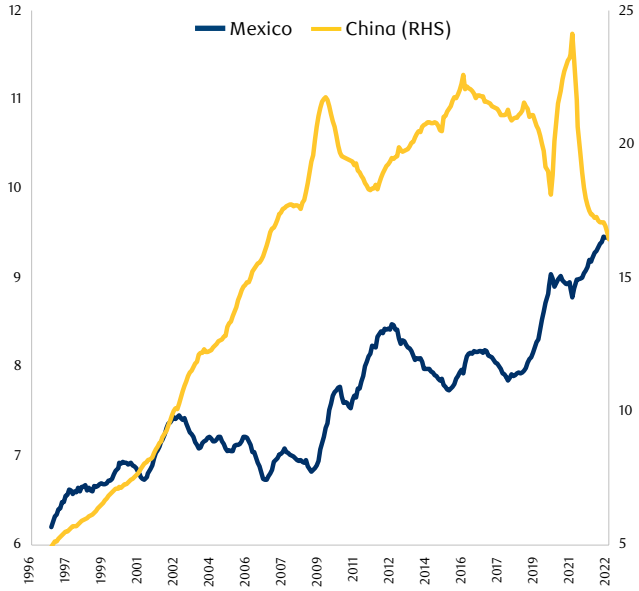
- **Sector implications:** we may see lower valuation multiples as headlines and noise on the topic continue to circulate and weigh on how investors perceive the sector. Lower returns could also weigh on valuations.
- **Country implications:** the rising tensions between the U.S. and China and the related tech restrictions are unlikely, in our view, to cause a reduction in global trade per se but rather a restructuring. While China is likely to continue to lose share in global trade, we expect other countries in emerging markets ("EM") to gain. The net result is likely to be a zero-sum game for emerging countries.
  - **Slower technological development and innovation in China:** the U.S.'s tech restrictions on China are likely to impact China's technological advancement in the medium term and hence also its productivity and growth, in relative terms. China is reliant on imports of semiconductor chips (Exhibit 11) and this is particularly the case for leading edge nodes. That said, China is investing heavily in R&D, and equally we cannot rule out the country's ability to limit the expected impact of U.S. restrictions (Exhibit 12).
  - **EM beneficiaries from changes to the global tech supply chain:** while China is expected to lose some competitiveness, there will also be beneficiaries in EM as CapEx moves out of China towards the Asean countries (Vietnam, Malaysia and Thailand), India and Mexico. In particular, we believe that nearshoring presents a distinct opportunity for Mexico to expand its economic role and to become the leading supplier to North America, while the U.S. government's plans for friendshoring should encourage further supply chain relocations into ASEAN, given the region's supportive policies, cost competitiveness and ties to existing manufacturing hubs (Exhibits 13 and 14).

Exhibit 12: Research and development spending



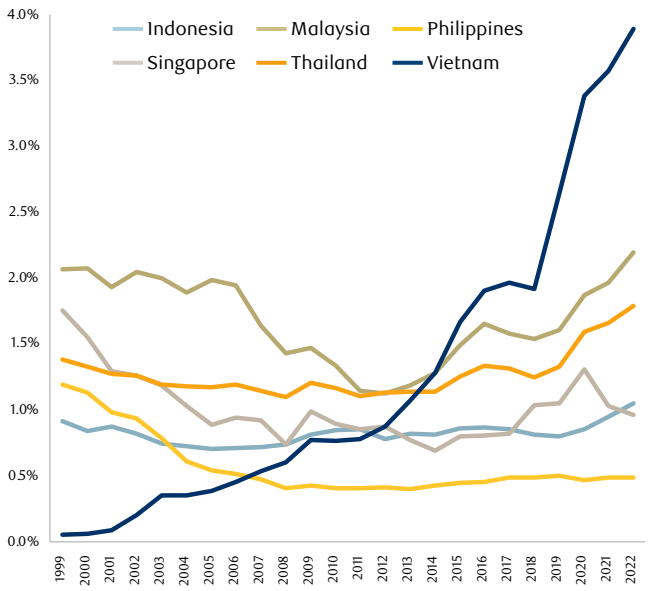
Source: OECD, RBC BlueBay Asset Management, as at January 2020.

Exhibit 13: Share in U.S. imports of manufactured goods (%, 12 mma) – Mexico to benefit from nearshoring



Source: J.P. Morgan, as at April 2023.

Exhibit 14: Country share of U.S. imports – Asean to benefit from friendshoring



Source: CEIC data, J.P. Morgan, as at December 2022.

Ongoing geopolitical events make our top-down, thematic research more important than ever. As long-term owners of the companies in which we invest, we seek to understand the broader implications of political and social change, and how these are likely to affect companies and supply chains across emerging markets.

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Guido is a portfolio manager on the Emerging Markets Equity team at RBC BlueBay (RBC Global Asset Management's business outside North America). Prior to joining the organization in 2010, Guido had worked as an emerging markets portfolio manager and also as an equities analyst at a U.K.-based asset management firm, specializing in global emerging market strategies. He had previously worked at a global asset management firm as a securities analyst, where he progressed to become a junior portfolio manager. Guido began his career in the investment industry in 1998 as an equity and derivatives trader in Italy. Guido holds an MBA from Boston College's Carroll Graduate School of Management and a Bachelor of Science in Economics from Universita' Cattolica Del Sacro Cuore.

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