

Asia's Critical Role in the Semiconductor Value Chain

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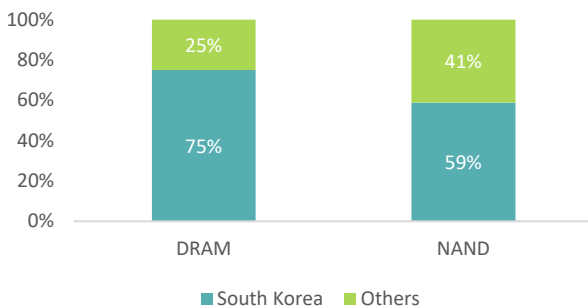
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- Although the Q2 earnings release of chip companies and the slowdown of the US economy have created uncertainty about whether the Artificial Intelligence frenzy could last, Asia can potentially offer a diversified source of growth for investors who believe in the long-term structural growth of the semiconductor industry.
- Opportunities to invest in the semiconductor value chain in Asia go well beyond the foundry industry in Taiwan and the memory industry in South Korea. Japan leads in raw material and semiconductor manufacturing equipment production, while Taiwan and China dominate the assembly, testing, and packaging of chips.
- Empirically, leading semiconductor companies in Asia appear to exhibit a lower equity return correlation with their counterparts in the US and Europe, which could lead to diversification benefits.

Since the world's biggest chip maker reported impressive Q2 results but provided relatively conservative guidance for Q3, investors have been doubting whether the Artificial Intelligence (AI) frenzy could last. In addition, slowing labor market momentum in the US signals a slowdown in the global economy. As a result, we witnessed a rotation from growth to value stocks over the last two weeks. The Bloomberg World Semiconductor Index has gone down by 14.2% (as of September 9, 2024) from historical high in July. However, for investors who believe in the long-term structural growth of the industry, Asia can potentially offer a diversified source of growth.

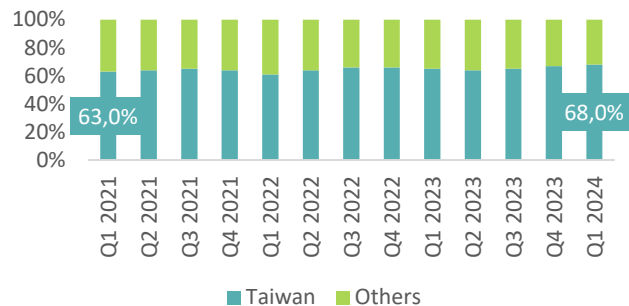
While the majority of fabless design technology is held by US technology giants, Asia plays a critical role in the global semiconductor supply chain. The semiconductor memory industry is an oligopolistic market led by South Korean companies. Their technological advantages in developing DDR5 dynamic random access memory (DRAM) and high-bandwidth memory (HBM) for high-performance computing are unparalleled globally. The same is true for the foundry industry in Taiwan. Specialization as pure-play foundries allows Taiwanese companies to focus on investing in cutting-edge manufacturing processes and technology nodes to sustain their competitive advantage. The competitiveness of Korean memory makers and Taiwanese foundries is evident in their leading and rising global market share. A change in the competitive landscape is highly unlikely.

Chart 1: Market Share of South Korean Companies in the Semiconductor Memory Market



Source: TrendForce, as of Q1, 2024.

Chart 2: Market Share of Taiwanese Companies in the Foundry Industry



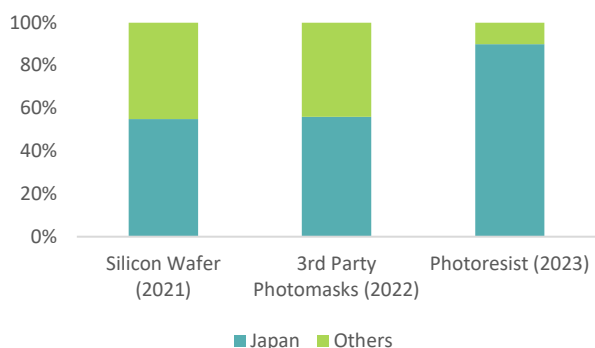
Source: TrendForce, as of Q1, 2024

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Beyond the well-appreciated foundry in Taiwan and the memory industry in South Korea, Japan holds a significant advantage in producing semiconductor raw materials and semiconductor assembly and test equipment due to its legacy. Japanese companies held more than 50% of the global market share in producing silicon wafers and third-party photomasks, and over 90% in producing photoresist (Chart 3). In the semiconductor manufacturing equipment market, 5 out of the top 10 largest companies were Japanese firms as of H1 2023, according to CINNO Research, mainly focusing on manufacturing assembly and testing equipment for chips. These are industries with profoundly high technological barriers to entry, and the technology gap is difficult to overcome by cost advantage. Hence, despite the significant investment China has put in to build its domestic semiconductor value chain onshore, Chinese companies are so far less relevant for the global supply chain.

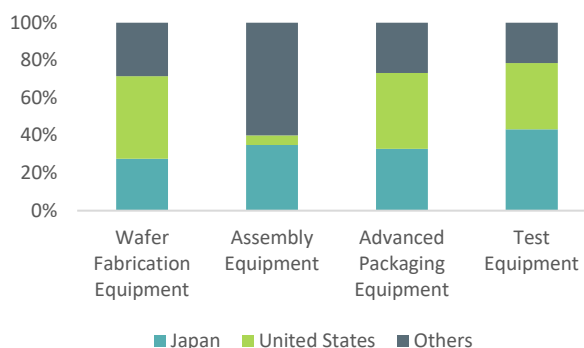
The increased demand for high-performance chips for AI computation warrants an upgrade across the entire value chain. For example, advanced packaging (e.g., hybrid bonding) that improves the performance and efficiency of chips would require twice as many silicon wafers as 2D packaging and specialized equipment to handle the stacking of multiple layers efficiently. The manufacturing process and the chips themselves have to adapt to cater to the advanced packaging process. Therefore, sustained revenue growth is expected for existing leading companies in Korea, Taiwan and Japan with technology advantages. However, it is also critical to recognize that the expansion of production capacity of these industries requires significant investments and could be relatively slow to convert the demand to the bottom line on their balance sheets.

Chart 3: Market Share of Japanese Companies in Selected Segments of the Global Semiconductor Raw Material Supply Chain



Source: HDIN Research, as of December 2021. CICC, as of December 2022. Nomura Securities, as of December 2023.

Chart 4: Semiconductor Manufacturing Market Share by Company Headquarters 2021

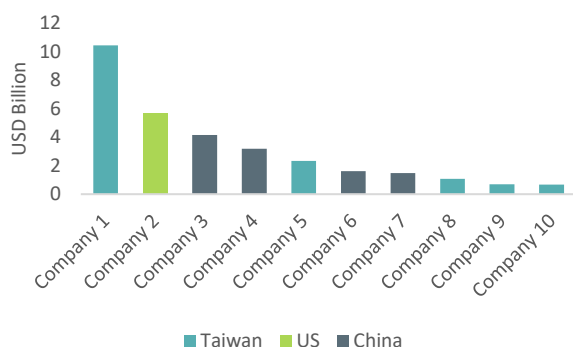


Source: CSIS, TechInsights, as of 2021

In addition to its well-known foundry industry, Taiwan, along with China, excels in the assembly, testing, and packaging (ATP) segment of the semiconductor supply chain. Among the top 10 outsourced semiconductor assembly and testing (OSAT) companies, five are Taiwanese firms and four are Chinese companies (Chart 5). This segment of the supply chain typically involves fewer complex processes and is therefore more labor-intensive than the rest of the supply chain. Affordable labor costs in Taiwan and China have helped maintain their competitiveness. However, with heightened geopolitical tension in the region, this part of the supply chain could gradually shift to Southeast Asian countries such as Malaysia and Vietnam, which are less vulnerable to geopolitical risks, offer a similar level of labor cost, and more importantly, have a relatively mature electrical and electronic (E&E) industry. These factors could make Southeast Asia more attractive than other emerging markets like India if such a supply chain shift happens.

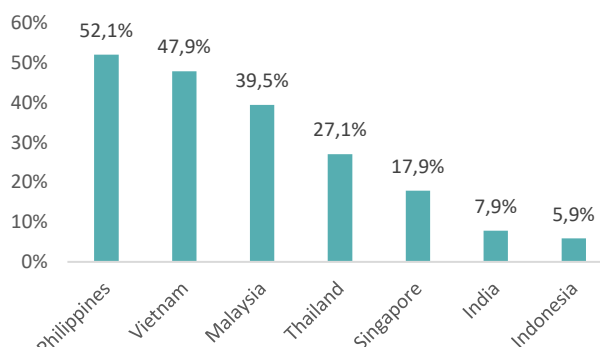
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Chart 5: Top 10 OSAT Players by Revenue



Source: ChipInsights, as of December 31, 2023

Chart 6: Electronic / Electric Product Export as Percentage of Total Export



Source: Philippine Statistics Authority, as of July 2024. General Statistics Office, Vietnam, as of March 2024. Malaysia External Trade Development Corporation, as of July 2024. Department of Statistics Singapore, as of July 2024. Thailand's Trade Statistics, as of July 2024. India Ministry of Commerce and Industry, as of August 2024. BPS-Statistics Indonesia, as of July 2024.

Asia plays a critical role in the upper and lower streams of the global semiconductor value chain. Indeed, these segments may not offer the most lucrative opportunities in the value chain. They also may not exhibit skyrocketing earnings growth because these companies would require a significant amount of time and investment to scale up their production to meet the increased demand. Yet, they are some of the key beneficiaries of the global semiconductor arms race. Empirically, the leading semiconductor companies in Asia tend to exhibit earnings growth with a lag of one quarter compared with the companies in other regions. In addition, they also appear to exhibit a lower equity return correlation with their counterparts in the US and Europe, possibly because many of them are not pure-play companies. Although correlation can change over time, empirical evidence seems to suggest Asia could potentially offer benefits for investors who wish to enjoy diversified growth in the semiconductor industry.

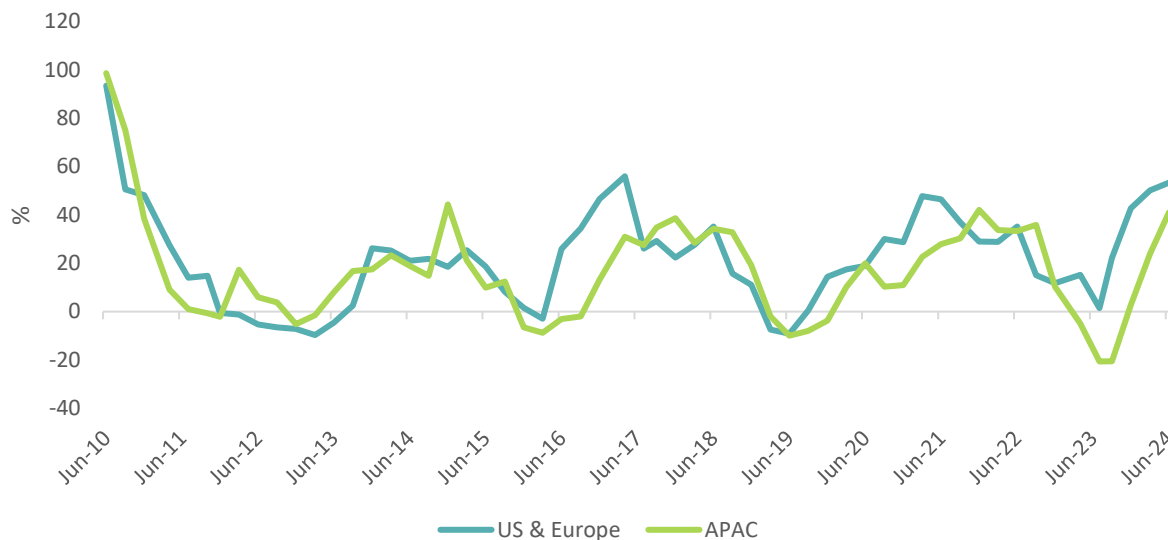
Chart 7: Correlation Matrix of Selected Leading Companies across the Semiconductor Value Chain

	US CPU	US GPU	US ASIC	US SME	US EDA	Europe SME	Taiwan Foundry	Korea Memory	Japan Raw Material	Japan SME	Japan SME	Taiwan OSAT
US CPU	1.00											
US GPU	0.71	1.00										
US ASIC	0.55	0.66	1.00									
US SME	0.67	0.71	0.68	1.00								
US EDA	0.61	0.70	0.63	0.66	1.00							
Europe SME	0.60	0.66	0.56	0.76	0.69	1.00						
Taiwan Foundry	0.46	0.47	0.43	0.51	0.44	0.53	1.00					
Korea Memory	0.30	0.42	0.43	0.45	0.35	0.36	0.57	1.00				
Japan Raw Material	0.39	0.42	0.45	0.43	0.38	0.42	0.50	0.40	1.00			
Japan SME	0.54	0.59	0.54	0.68	0.54	0.60	0.63	0.56	0.66	1.00		
Japan SME	0.49	0.54	0.51	0.55	0.48	0.46	0.53	0.46	0.59	0.76	1.00	
Taiwan OSAT	0.34	0.40	0.28	0.43	0.37	0.48	0.71	0.43	0.36	0.49	0.42	1.00

Source: Bloomberg, DWS Investment GmbH, as of August 30, 2024. Based on weekly return from January 1, 2021 to August 30, 2024. Headers present selected companies in the respective value chain. CPU = Central Processing Unit. GPU = Graphic Processing Unit. ASIC = Application-Specific Integrated Circuit. SME = Semiconductor Manufacturing Equipment. EDA = Electronic Design Automation. OSAT = Outsourced Semiconductor Assembly and Testing.

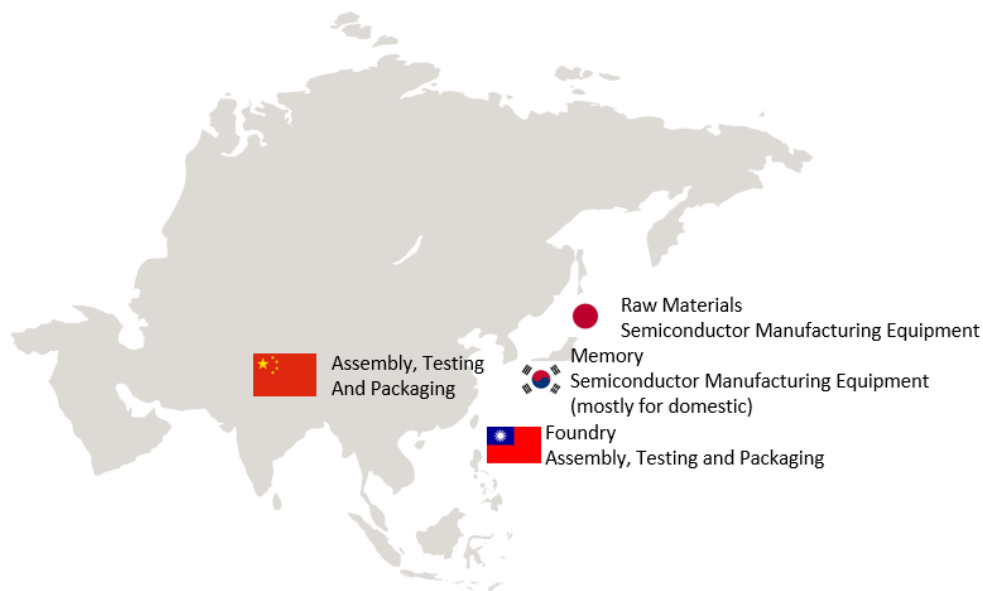
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Chart 8: Simple Average Revenue Growth of Selected Semiconductor Companies



Source: Bloomberg, DWS Investment GmbH, as of August 30, 2024. The same set of companies in Chart 6 is used for analysis.

Chart 9: Mapping the Semiconductor Value Chain in Asia



Source: DWS Investment GmbH, as of September 6, 2024.

Glossary

DDR5 DRAM is a type of synchronous dynamic random-access memory (DRAM). Compared to its predecessor DDR4 SDRAM, DDR5 was planned to reduce power consumption, while doubling bandwidth.

Correlation is a measure of how closely two variables move together over time.

Fabless chipmakers design and market semiconductors for smartphones, computers, medical devices, and many other electronic devices.

An **oligopoly** is a market in which control over an industry lies in the hands of a few large sellers who own a dominant share of the market.

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