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Technology Runs Through Asia

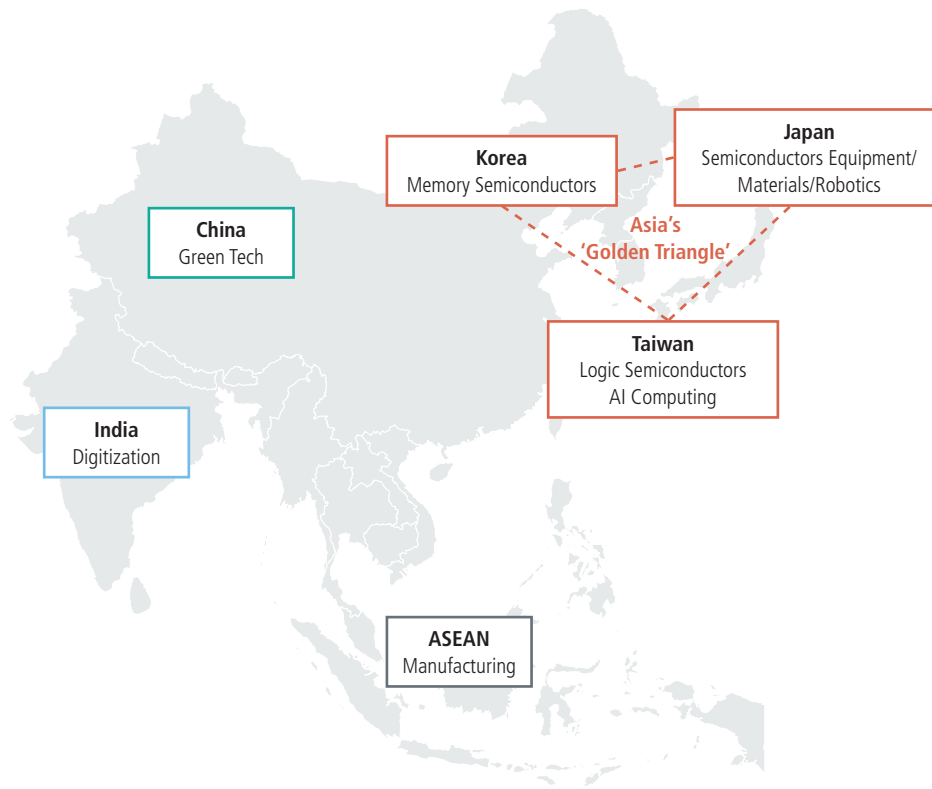
Across the “Golden Triangle” and beyond, Asian companies are forming a foundation for global technological growth and development.

Global investors continue to have faith in the long-term potential of the artificial intelligence revolution and its ability to change how we work and live. And nowhere in the world is more integral to achieving that future than Asia, in light of its central role in semiconductors and other core technologies. Recently, we connected with three Neuberger Berman investors with a front-row seat to these developments: Yan Taw (YT) Boon, Head of Thematic – Asia, Sebastian Hou, Senior Investment Analyst – Taiwan, and Zui Shiromoto, Portfolio Manager, Japan Equities. In this Q&A, they weigh in on broad trends in the technology sector across Asia and where they see opportunities and challenges.

When it comes to technology, why think about Asia specifically rather than globally?

YT: If you consider the U.S. Magnificent Seven companies, all rely upon Asian companies in what we call the new Golden Triangle: Taiwan, Japan and South Korea. In our view, without these three major economies and the expertise and manufacturing they provide, you wouldn’t have Apple, Microsoft, Amazon, Meta or Google, or any other tech giants that currently dominate our lives.

ASIA'S LONG-ESTABLISHED STRENGTH HELPS FUEL THE GLOBAL ECONOMY



Source: Neuberger Berman.

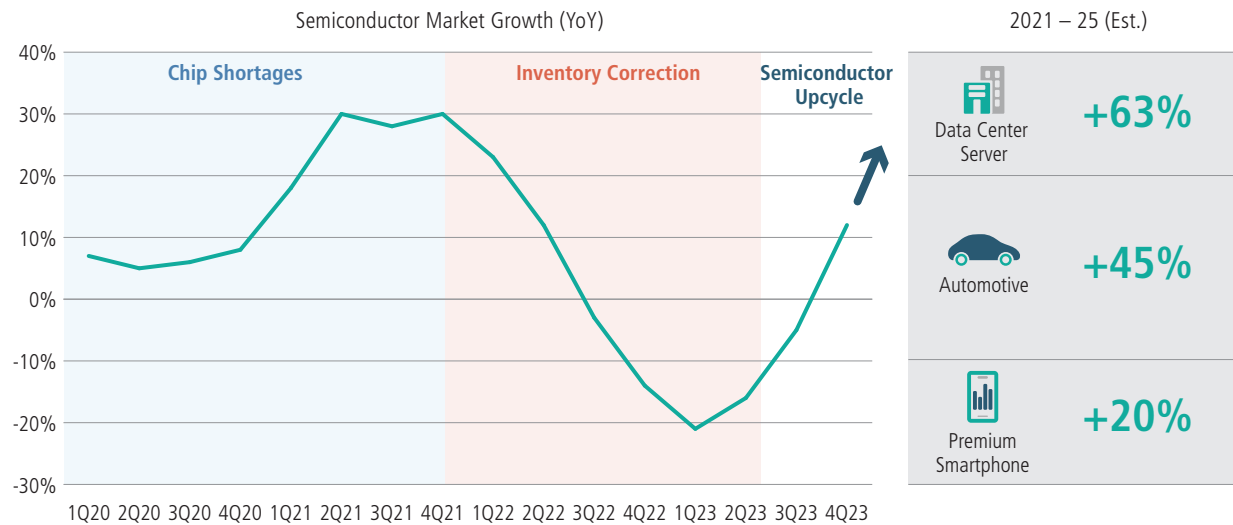
How has this phenomenon developed, and why is Asia becoming a greater focal point for investors interested in technology?

Sebastian: In part, it is the legacy of how the technology and semiconductor supply chains have evolved over the past 40 years. Western global tech companies have tended to dominate branding and applications, but increasingly have outsourced manufacturing to Asia.

We believe the reason Asia is getting more attention than 10 years ago is the increased interest in semiconductors, tied to COVID-related shortages, the growth of artificial intelligence and geopolitics. Much of the world's tech manufacturing takes place in Asia, making investors more conscious of the opportunities here.

And those opportunities are significant, particularly in AI. Chip prices for the new AI technology are much higher than for traditional silicon chips—potentially up into the millions of dollars each in the new-generation AI servers—because of the amount of computing that needs to take place, often in parallel processing. This implicates all elements of the ecosystem around semiconductors—from equipment and materials to storage and thermal cooling to power management.

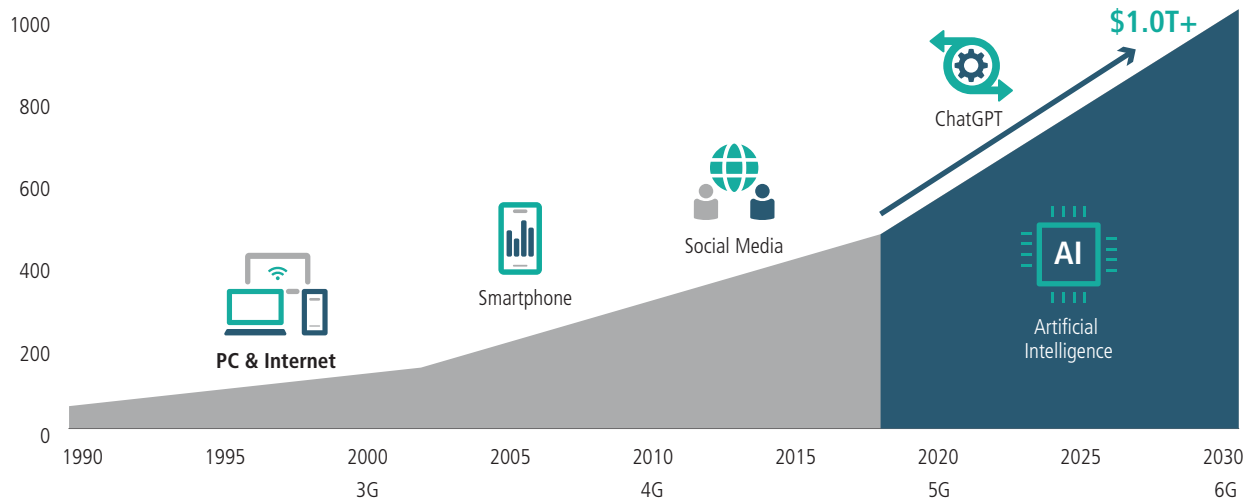
SEMICONDUCTORS REMAIN IN A CYCLICAL UPSWING



Source: Neuberger Berman estimates, WSTS, Gartner, UBS. Nothing herein constitutes a prediction or projection of future events or future market behavior. Historical trends do not imply, forecast or guarantee future results. Due to a variety of factors, actual events or market behavior may differ significantly from any views expressed or any historical results. Investing entails risks, including possible loss of principal. **Past performance is no guarantee of future results.**

THE GLOBAL SEMICONDUCTOR MARKET IS EXPECTED TO REACH \$1 TRILLION BY 2030

Global Semiconductor Industry Revenue (\$ Billions)



Source: BofA Research, SIA, Gartner. Nothing herein constitutes a prediction or projection of future events or future market behavior. Historical trends do not imply, forecast or guarantee future results. Due to a variety of factors, actual events or market behavior may differ significantly from any views expressed or any historical results. Investing entails risks, including possible loss of principal. **Past performance is no guarantee of future results.**

How has geopolitics played a role in the rejuvenation of the Asian technology sector?

YT: Given the geopolitical tensions between the western world and countries like Russia and China, new attention is being paid to supply chain diversification—most notably in companies’ China-plus-one strategies.

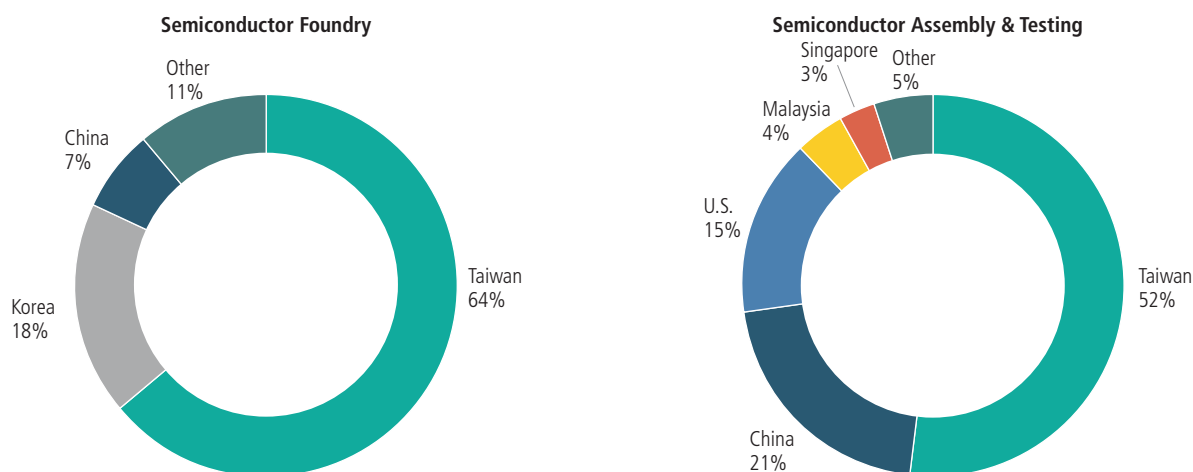
Historically, China was the “factory for the world,” but increasingly, the new Golden Triangle countries are taking over that role for high value-add technology products while South and Southeast Asia—India, Malaysia, Thailand and Vietnam—are stepping in for lower-end manufacturing due to cheap labor costs. It’s a long-term process, and a sometimes painful one, given that China remains price-competitive in many areas, in part due to overcapacity as they seek to overcome economic stagnation.

Tell us a bit about Taiwan’s role in the tech supply chain.

Sebastian: When you talk about manufacturing and key components for semiconductors and AI, Taiwan plays a crucial role, with a complete ecosystem from up- to mid- to downstream manufacturing. Upstream includes designing and building semiconductors, midstream involves creating components for devices, and downstream refers to assembly—where just a handful of companies account for more than 50% of global PCs, smartphones and servers. Taiwan is a one-stop shop, and with the advent of AI, its role has expanded. For example, Nvidia has a close relationship with TSMC, the leading Taiwan semiconductor manufacturer, while the liquid cooling needed for AI chips, along with final server assembly, are conducted by Taiwanese companies at manufacturing sites in Taiwan and Southeast Asia.

TAIWAN: A ONE-STOP SHOP

Market Share



Source: TrendForce, SIA, IC Insights, Yole, CSET estimates.

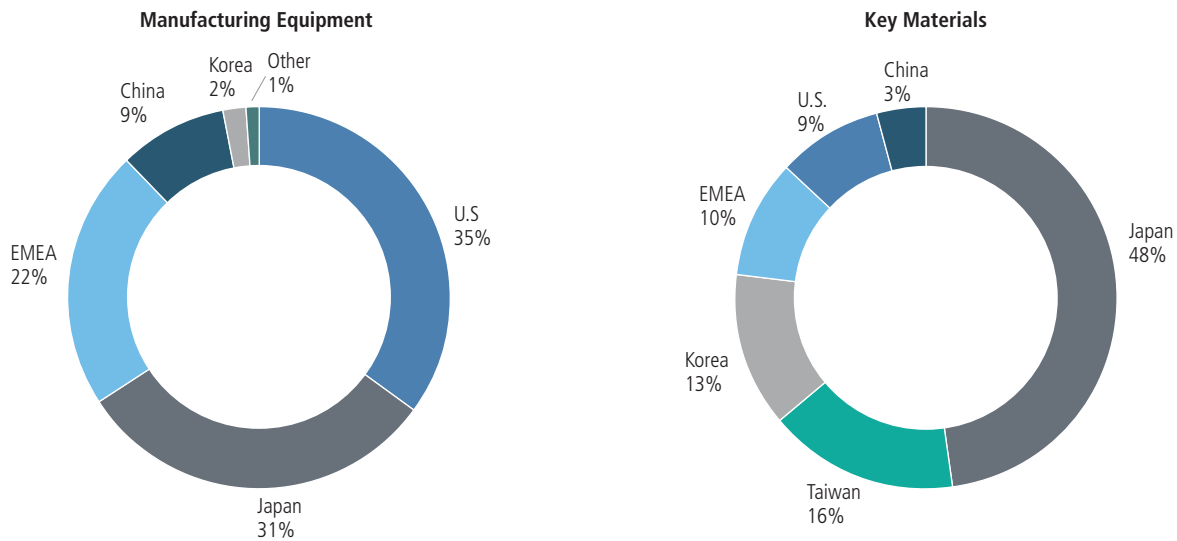
What about Japan, which for so long was a bit of a sleeping giant?

Zui: Japan continues to have broad technological capabilities and, today, holds a third of the global market in semiconductor equipment and half of the global market for semiconductor materials. In our view, if you want to make something, chances are you’ll find the resources to do so in Japan.

Although long-dormant, Japan’s tech industry has been regaining traction quickly, largely as a result of reshoring. In 2021, TSMC announced a plan to build a factory in Kyushu, Japan, and the Japanese government then started to give out subsidies for the project. The government expanded its support, such as by allocating \$13 billion in its 2023 budget to boost the domestic semiconductor ecosystem. Among the new projects is a factory in the Hokkaido region, called Rapidus, formed by major Japanese companies, whose goal is to increase domestic production capacity for cutting-edge semiconductor components. For reference, Kyushu and Hokkaido together are roughly the size of New York State, so this is a meaningful commitment.

JAPAN: EDGE IN SEMICONDUCTOR EQUIPMENT AND MATERIALS

Market Share



Source: Japan Ministry of Economy, Trade and Industry. Key materials include wafers, photoresists, CMP slurries, photomasks, sputtering targets and bonding wires.

Let's explore Korea and Southeast Asia, and their part in all this.

YT: We've talked about Taiwan as a semiconductor manufacturing hub and Japan's strength in upstream equipment and materials. Korea is somewhat different as a leader in manufacturing memory chips and displays. Without Korea, I wouldn't have my iPad because it wouldn't have a screen or memory storage. In Southeast Asia, I'd highlight Thailand, Malaysia and Vietnam. These are the three main Southeast Asian countries that are now benefiting from China-plus-one as manufacturers shift some operations elsewhere. Malaysia is capturing a meaningful chunk of the semiconductor market; for example, Intel's largest non-U.S. design and packaging facilities are in Malaysia. Thailand and Vietnam are more focused on lower-end manufacturing and assembly, given their competitive labor costs.

Data centers are a key part of the Asia tech trend. Can you flesh this out?

YT: For AI data centers, a central issue is consumption of power. Whether in the U.S. or Asia, you have to make strategic investments to make sure that power is available. Malaysia has very affordable energy because of local oil and gas production, as well as hydropower and solar—which is abundant; so, data center growth has been accelerating. Japan's wind power provides similar advantages.

Location is important as well. Malaysia is situated next to Singapore, a key financial hub. And Japan's data network connection with Asia flows naturally through Hawaii and the U.S.

Zui: Government support also matters. Japanese authorities are pushing for data centers, in part because digital penetration is still very low, and many tasks are done on paper! Moreover, there's a desire to protect information—something that's harder in overseas locations. So, data centers are a growth area for the country, which is giving new opportunities to IT service providers.

How is Japan dealing with growing energy needs, and do you see any beneficiaries?

Zui: There is a meaningful government drive toward renewable energy. A lot of wind and solar power projects are being built in Japan. There is also increased debate about nuclear power use due to the emergence of data centers and new semiconductor factories.

In terms of beneficiaries, while utility companies may see a demand increase, we also have found that specialized construction companies that help build such facilities are well positioned. Historically, these companies have struggled with low profitability due to the difficulty of raising contract prices. However, the trend is changing. On the one hand, the demand to build and improve such facilities is increasing, while on the other hand, the working capacity of these specialized builders remains limited. This demand-supply gap enables them to better increase order prices and improve profitability on new projects.

Are there bottlenecks in Taiwan as well?

Sebastian: Because of geopolitics, major U.S. internet companies, chip designers and others have doubled down on their investments in Taiwan, adding to R&D centers and data centers. This has caused some stresses on the system, with higher inflation and property prices. But we believe the crucial bottleneck is people and talent. Taiwan is a small island, and there are already a lot of semiconductor technology companies here, so any fresh graduates are already being hired. Like many others, Taiwan has low birthrate, which it's trying to correct, but obviously that will take a long time.

Electricity is also an issue, given data centers' intense power usage. Taiwan is generally anti-nuclear, so it has been promoting other renewables, which aren't keeping up with demand. Grid investment has increased over the last two years, and that will likely continue.

YT: It's worth noting that pressures on the electrical grid are happening globally as countries contend with the same data-related power demand as in Asia. A lot of Japanese, Taiwanese and Korean electric power transformer and equipment suppliers are benefiting from this—in terms of upgrades in the power grid, renewable energy and transportation infrastructure—across the market-cap spectrum.

China remains subject to multiple U.S. sanctions. How is this affecting the Asian technology sector?

Zui: Broadly speaking, it limits the sale of high-end semiconductors, but maintains access to many other lower-end products, semiconductor production equipment and services, with assembly being especially important when it comes to Japan. That said, we are watching closely how the situation develops.

Are you concerned about whether U.S. policy could shift after the upcoming election?

YT: Regardless of whether Donald Trump or Kamala Harris is elected president, it's pretty clear that China will face challenges in getting access to leading-edge technology. That's part of what has been driving stock market volatility this year in the technology sector. However, if you think about the long term, the strategic value of Asia, particularly in semiconductors and manufacturing, is likely to remain unchanged.

For now, the geopolitical situation is actually helping Asian tech. A few years ago, China was largely focused on acquiring things like global luxury brands. Now, those yuan have turned to semiconductor equipment, with China purchases sometimes accounting for 50% of company sales. People would be really concerned if at some point they were told, "no more tech sales at all to China." But to me that seems a pretty remote possibility.

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