

Analysis of the Semiconductor Sector



Overview:

The semiconductor sector, also known as microchips or simply "chips," is regarded as the "brain" behind technological innovations ranging from consumer products, including televisions, laptops, and mobile phones, to more sophisticated equipment used in aerospace, business operations, and national defense. This industry made a substantial contribution to the global economy, accounting for 20% of the global GDP growth from 1995 to 2015, equivalent to a contribution of \$11 trillion. Despite the prominent global shortage of semiconductors, the industry is projected to maintain a Compound Annual Growth Rate (CAGR) of 6.3% until the year 2027, increasing from \$613.1 billion to \$736.4 billion (Figure 1).

Functions of Major Players- An interesting aspect is that the market features varying degrees of specialization around the world: while East Asia exhibits exponential growth in cutting-edge development, North America serves as a hub of innovation and leadership, Asia-Pacific specializes in large-scale production, and Western Europe focuses on precision manufacturing. However, during the COVID-19 pandemic, the global chip supply chain began to experience new dynamics.

Impacts of the Pandemic- The chip shortage was exacerbated by the pandemic, which affected production and the global supply chain, but recovery is underway, facilitated by innovative internationalization strategies. For instance, Intel's strategic decision to expand its chip production to Vietnam reflects a broader trend among U.S. tech companies, driven by the need to manage large volumes of data and improve operational efficiency with reduced risk. With an initial investment of \$300 million yielding a return of \$1 billion, Intel demonstrates confidence in the viability and growth potential in the Asian market. This move, highlighted by researcher Kawamata from Nagasaki University, is significant for the U.S. as it seeks new expertise in the internationalization of compact chips in East Asia (Figure 2). The company benefits from fiscal incentives, including a corporate tax exemption for four years and a reduced rate for the following nine years.

New specializations- Semiconductors are commonly recognized for their nanometric capacity, referred to as scales. The Gate-All-Around (GAA) scale represents the most advanced class of transistors (<7nm) and offers a 25% improvement in energy efficiency, along with a 12% increase in performance, while reducing the chip area by 5%. This has led to higher market demand (Figure 3). In contrast, the older Planar-FET and Fin-FET technologies, with Fin-FET representing an advancement over Planar-FET by enabling 3D scaling to enhance performance and energy efficiency, do not achieve the same advancements as GAA.

Japan- The new dynamics of internationalization, focusing on the Japanese market with a lower degree of risk, are expected to result in an annual Compound Annual Growth Rate (CAGR) increase of 2.6% until 2027. Furthermore, the Japanese semiconductor industry has increasingly concentrated on high-tech niches that are less sensitive to price fluctuations, indicating a lower price elasticity of demand. Demand for these products tends to be more inelastic, meaning that price variations have less impact on the quantity demanded. On the other hand, income elasticity of demand remains significant, as a rise in global income can stimulate demand for advanced technologies in which Japan specializes.

Drivers:
Semiconductor revitalization- Atsuyoshi Koike, president of Rapidus, asserts that it has been several decades since Japanese companies last stood out in the process of manufacturing cutting-edge semiconductor chips. By 2027, the new semiconductor consortium, supported by the Japanese government and major conglomerates, plans to surpass several generations. A thorough market study of compact semiconductors in Japan revealed that Sony Semiconductor Solutions, Mitsubishi Electric, and Renesas are distinguished as leaders in terms of innovation and efficiency (Figure 4). Data analysis indicates that these companies not only meet but also exceed the standards required to be recognized as innovators in the development of cutting-edge semiconductors, making them highly recommended for investment.

Fiscal environment- The tax laws provided by the Japanese government play a vital role in reducing research and development costs for semiconductor companies. This stimulates continuous innovation, a crucial factor in such a rapidly evolving sector. However, the overall tax burden, including the consumption tax, can affect the cost structure of companies, thereby influencing final prices and competitiveness in both domestic and international markets. The impact of these fiscal regulations on Japan's semiconductor industry is twofold. While tax incentives help promote innovation and global competitiveness, the complex tax structure and high tax rates can pose significant challenges, especially for smaller or newer companies in the sector.

Degree of political fragmentation- Despite recent political challenges, such as the assassination of Shinzō Abe and the intensification of technological competition between the USA and China, Japan maintains its economic resilience. The enactment of an economic security law in 2022 reflects the Japanese government's response to these challenges, aimed at strengthening supply chains and infrastructure security. The solid industrial base and ongoing commitment to innovation and technological development mitigate the impacts of political instability, minimizing the risk for investments. Despite political fragmentation, Japan continues to be a safe and attractive environment for foreign investments.

Risks:

Macroeconomic- Although inflation can impact operational costs and input prices, Japan's strategy of specialization and its focus on high-tech segments of the semiconductor industry provide a degree of protection against these pressures.

Operations- Companies must ensure that their products comply with Japanese standards of quality and safety. These regulations affect both the supply chain and the increase in operational costs.

Regulatory- Complying with stringent regulations can be challenging, particularly for smaller companies, which may struggle to adapt to the demands of safety and environmental protection.

Infrastructure- For instance, the 2011 earthquake and tsunami in Japan affected 25% of the global production of silicon wafers, a crucial component in semiconductor manufacturing. This disruption in the wafer supply led to significant production delays in the country.

FIGURE 1 – SEMICONDUCTOR MARKET

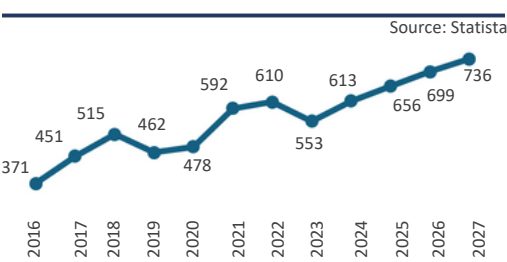


FIGURE 2 – KEY PLAYERS IN <5NM CHIPS IN 2023

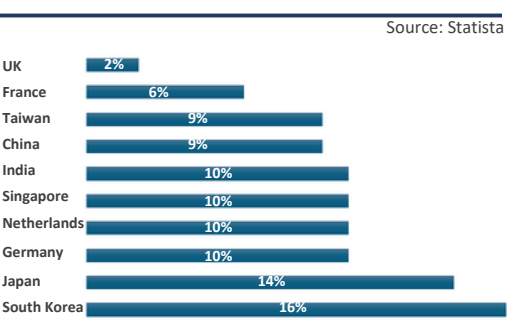


FIGURE 3 – DEMAND FOR ADVANCED CHIPS

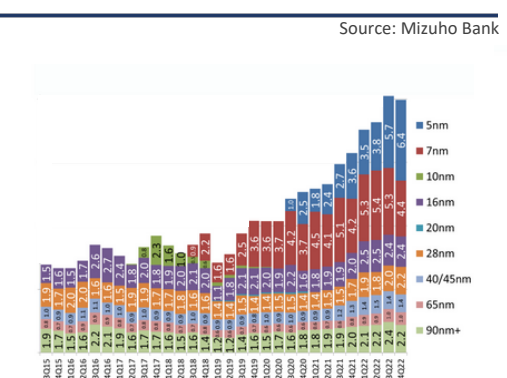


FIGURE 4 – STRATEGIC CHIP CONSORTIUM

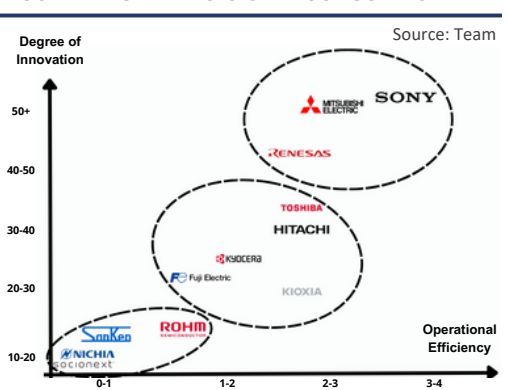


FIGURE 5 – RISK MATRIX

