



Japan's Economic Security and the Semiconductor Industry

The Validity of the Revitalization Strategy

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About the Author

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Summary

Japan's semiconductor industry, once globally dominant in DRAM during the 1980s, declined through the 1990s and 2000s due to trade friction with the United States, the rise of Korean competitors, and a failure to adapt to the fabless/foundry model. Today, Japan's logic IC process technology lags at the 40nm node.

The 2020 global semiconductor shortage prompted Japan to launch two major revitalization projects under the banner of economic security: TSMC Kumamoto, a joint venture producing 12–28nm logic ICs for Japan's automotive, industrial, and consumer electronics sectors; and Rapidus, an ambitious startup targeting 2nm logic IC manufacturing by 2027.

The paper argues that while TSMC Kumamoto meaningfully strengthens Japan's domestic supply chain — connecting Japanese equipment and materials suppliers with downstream industries — Rapidus tells a different story. Because Japan has virtually no domestic industrial base currently using 2nm chips, Rapidus's primary market will likely be the United States. Rather than enhancing Japan's supply chain resilience, Rapidus effectively inserts Japan into a global advanced logic IC supply chain running from the Netherlands through Japan to the United States. Unless Japan develops industries using these chips, the Rapidus project will not directly address Japan's economic security strategy.

Japan's Economic Security and the Semiconductor Industry

The Validity of the Revitalization Strategy

Economic security is a concept that has existed for over a century. Its importance, which has been renewed in the twenty-first century, stems from economic growth and technological progress becoming inextricably linked to national security.

Furthermore, while the global economy has become increasingly interconnected since the end of the Cold War, recent events—such as U.S.-China trade friction, the pandemic, and Russia's invasion of Ukraine—have occurred in rapid succession, exposing the vulnerabilities of global supply chains. In particular, the semiconductor shortage that emerged in 2020 spurred nations to rethink how they procure strategic materials amid growing geopolitical instability. Major nations are actively strengthening their semiconductor manufacturing bases under the banner of economic security. Japan is also advancing large-scale projects backed by substantial national budgets.

This paper clarifies the essence of economic security and examines the validity of Japan's ongoing semiconductor industry revitalization strategy, informed by the history of Japan's semiconductor sector.

Economic Security in Japan

Economic security became a serious concern in Japan during the oil crises of the 1970s.¹ These disruptions exposed the vulnerability of energy supplies and demonstrated how easily a nation's economic foundation could be shaken by external factors. However, discussions at the time were limited to resource acquisition and energy policy, lacking a sufficient perspective on economic security as a national strategy.

1 Japan experienced two major oil crises in 1973 and 1979, both of which had profound economic consequences.

Subsequently, with the end of the Cold War, the global economy deepened the international division of labor under a U.S.-dominated system. Notably, China joined the WTO in 2001, attracting significant foreign investment and further strengthening its position as the world's factory. Overall, the global economy of the 2000s saw nations increase their mutual dependence on each other for manufacturing bases and parts procurement, based on the principle of comparative advantage.

However, these mutual economic ties are vulnerable to exogenous shocks. The 2008 Lehman Shock demonstrated that a financial crisis originating in the United States could directly impact the global economy (Krugman 2009). Furthermore, China's suspension of rare-earth exports following the 2010 Senkaku Islands (Chinese: *Diaoyutai*) fishing boat collision incident led Japan to recognize that trade could be used as diplomatic leverage. This incident demonstrated how reliance on specific countries for critical materials undermines national autonomy, underscoring the importance of policy responses such as diversifying critical material sources and developing alternative technologies.

Entering the late 2010s, the intensification of the U.S.-China rivalry accelerated instability in the international order, decisively impacting Japan's economic security policy. In particular, the U.S.-China trade war, initiated under the first Trump administration, evolved beyond mere trade friction into a contest for hegemony over cutting-edge technologies such as semiconductors, communications, and artificial intelligence (AI) (Allison 2017). Furthermore, as these technologies possess dual-use capabilities, with the boundary between military and civilian applications hazy, an international consensus emerged that technology leakage can directly threaten national security.

The Essence of Economic Security

In light of recent geopolitical shifts, Japan's Liberal Democratic Party (LDP) proposed the concepts of "strategic autonomy" and "strategic indispensability" to clarify the nation's economic security strategy (LDP 2020). Strategic autonomy means maintaining and safeguarding essential economic functions even under external pressure or unforeseen circumstances. This autonomy does not imply complete self-sufficiency but rather conveys the ability to manage interdependence within an international framework, ensuring that dependencies are not exploited as vulnerabilities (Baldwin 1980). Strategic indispensability, on the other hand, refers to Japan's recognition as an "irreplaceable presence" within the international community. This concept posits that by becoming an indispensable partner to other nations through advanced technology, vital industries, intellectual property, and influence in shaping international rules,

Japan can enhance its diplomatic and economic influence as well as its security deterrence. For example, the competitive advantage of Japanese companies in semiconductor manufacturing equipment and materials is cited as an example of indispensability. Ultimately, strategic autonomy is a “defensive” concept, while strategic indispensability is an “offensive” one. For Japan to survive in an uncertain international environment, it is crucial to enhance both fronts simultaneously (LDP 2020).

The modern global economy features multilayered global supply chains, making it impossible for any single country to operate in complete economic isolation. Therefore, rather than severing interdependence, it is critically important to design strategically interdependent structures to minimize the risk of excessive reliance on specific countries or supply disruptions—in other words, “supply chain resilience.” Furthermore, economic security encompasses multiple policy domains, including preventing technology leakage, protecting critical infrastructure, and strengthening R&D foundations. Because of the dual-use characteristics of advanced technologies, protecting and nurturing technology directly impacts both national competitiveness and security (Mazzucato 2013). Therefore, the essence of economic security lies in securing strategic autonomy and indispensability through strengthening supply chains, protecting and nurturing technological foundations, and ensuring the safety of critical infrastructure.

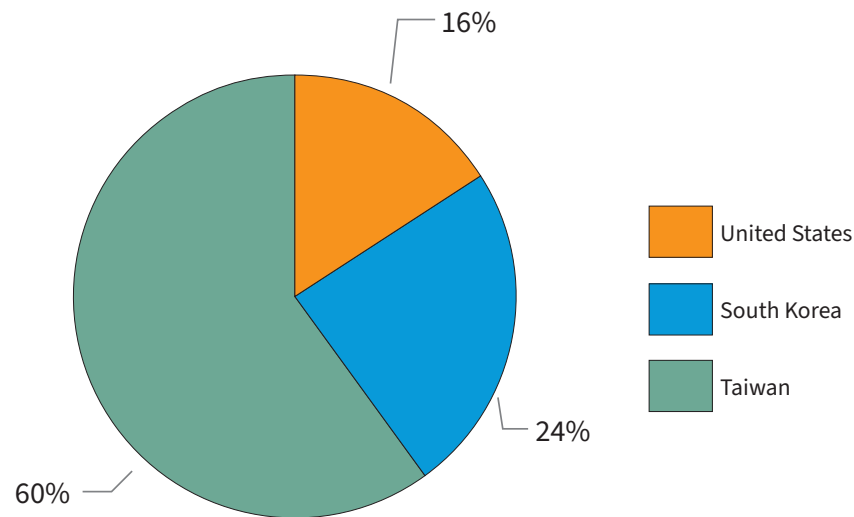
Against this backdrop, the Japanese government has established an institutional framework explicitly positioning economic security as a national strategy. The Economic Security Promotion Act, enacted in May 2022 under the Kishida administration, symbolizes this framework. This law comprises four pillars: ensuring stable supplies of critical materials, securing the safety of critical infrastructure, supporting the development of advanced critical technologies, and establishing a patent non-disclosure system. It provides a legal foundation for the government to collaborate with companies and research institutions to advance supply chain resilience and technology protection (Cabinet Office 2022).

Why Have Semiconductors Been Designated as Strategic Materials?

Semiconductors now play an indispensable role in corporate activities and people’s social lives. From automobiles, communication devices, and medical equipment to energy management systems and even military equipment, semiconductors are critical components of electronic devices used everywhere. If their supply were to be disrupted, the entire national economy could suffer significant damage. The 2020 global semiconductor shortage highlighted the vulnerabilities of this dependency structure.

Second, while the semiconductor industry's supply chain has a global reach, manufacturing capacity for advanced logic integrated circuits (ICs) in particular has become geographically concentrated. As shown in figure 1, the production of advanced ICs below 10nm is especially concentrated in Taiwan and South Korea. Amid heightened tensions across the Taiwan Strait, the risk of supply disruption has become a recognized real threat. While Japan possesses strengths in materials and equipment, its logic IC processing has stagnated at the 40nm node, equivalent to around 2010 standards. Given Japan's current lack of self-sufficiency in advanced semiconductors, the view has spread that supply chain instability could have severe repercussions for Japanese industry and society.

FIGURE 1 Market shares of Advanced Logic IC Manufacturing Countries, 2023



Note: Market share is for ICs 10nm and below.

Source: Ministry of Economy, Trade and Industry (2023).

Third, semiconductors are at the center of the global competition for technological supremacy. Cutting-edge fields like AI, quantum technology, and 5G/6G communications all rely on high-performance semiconductors. Superior semiconductor technology forms the foundation of a nation's military, economic, and information capabilities (Segal 2021). Within the U.S.-China rivalry, semiconductor technology has become subject to export and investment controls precisely because it is recognized not merely as an industrial product, but also as a material at the core of national strategy. Accordingly, policymakers should consider actions to mitigate vulnerabilities and enhance the resilience of the semiconductor value chain (OECD 2025).

In Japan, too, projects to strengthen the domestic semiconductor manufacturing base have been launched, driven by the growing importance of economic security and semiconductor shortages. TSMC Kumamoto and Rapidus Corporation are the two pillars of this project, backed by substantial national budget allocations. TSMC Kumamoto aims to bring the manufacturing technology of TSMC, one of the world's largest foundries, to Japan and strengthen industrial clusters centered on Kyushu. Rapidus, on the other hand, is a company tasked with manufacturing the world's most advanced 2nm logic ICs, aiming to rapidly catch up with TSMC and Samsung.

The purpose of this paper is to examine the validity of these two projects from the perspective of Japan's economic security. However, before doing so, I will first review the history of Japan's semiconductor industry. During the 1980s, the Japanese semiconductor industry was highly competitive. But by the late 1990s, it had lost its competitive edge and reached its current state following a restructuring process in the 2000s. To evaluate the validity of TSMC Kumamoto and Rapidus as pillars of this national project, it is essential to first understand the industry's rise and fall.

The Development Process of Japan's Semiconductor Industry

1950s–1970s: The Dawn Period

The dawn period for Japan's semiconductor industry began during the nation's postwar recovery. In the 1950s, Bell Laboratories in the United States released transistor technology, which Japanese companies actively adopted. Subsequently, various firms began the prototyping and domestic production of transistors. Among them, Sony achieved a breakthrough by launching Japan's first transistor radio in 1955 (Osanai 2024).

Entering the 1960s, semiconductor technology shifted from transistors to ICs. Japanese companies also advanced their in-house development of both analog and logic ICs. A defining feature of this period was the simultaneous domestic production of upstream industries, such as manufacturing equipment and materials. Japan's semiconductor industry formed a comprehensive domestic supply chain that encompassed equipment and materials from an early stage (Negrine et al. 2025).

In the 1970s, competition intensified in the development of large-scale integration (LSI)¹ and very large-scale integration (VLSI) technologies, driven by increasing integration levels and advances in process scaling techniques. In 1976, the Japanese government, led by the Ministry

of International Trade and Industry, launched the VLSI Project through the VLSI Technology Research Association. Private sector participants, including NEC, Hitachi, Fujitsu, Mitsubishi Electric, and Toshiba, advanced foundational technology development in areas such as micro-processing and design. A defining feature of the VLSI Project was its dual approach of cooperation and competition: industry, academia, and government jointly developed common foundational technologies, while individual companies competed in the final product stage. This project is credited with elevating the technological foundation of Japan's semiconductor industry and fostering the formation of a human resource network (Brown and Linden 2010; Nakamura Y. 2025).

1980s: The Golden Age

The 1980s marked a period when Japan's semiconductor industry established a significant presence in the global market, with Japanese companies enjoying overwhelming dominance, particularly in dynamic random-access memory (DRAM). The primary factors behind this success were manufacturing technologies that enabled high yields and the total quality control (TQC) process. Furthermore, the vertically integrated model underpinned the competitiveness of Japanese companies. These companies, known as integrated device manufacturers (IDMs), built an integrated system encompassing design, manufacturing, packaging, testing, and final product integration. IDMs enabled close coordination between manufacturing process improvements and product design optimization, achieving both speed and quality in product development.

By the mid-1980s, Japanese companies held approximately 50 percent of the DRAM market share. However, this situation became a point of contention in the United States, leading to the Japan-U.S. semiconductor friction of the late 1980s. U.S. companies claimed Japanese firms were engaging in "predatory pricing" and "market-closing practices." The U.S. government demanded that Japan open its market and correct prices. Yielding to U.S. government pressure, the Japan-U.S. Semiconductor Agreement was signed in 1986. The agreement mandated expanding the share of foreign-made semiconductors in the Japanese market and requiring transparency in Japanese companies' pricing to prevent sales at below-fair-market-value (FMV) prices. It also introduced a mechanism for the U.S. government to monitor the pricing actions of Japanese companies. Consequently, their pricing strategies became constrained, contributing to a decline in their competitiveness in the DRAM market (Tomoshige 2022; Choi 2024).

Furthermore, the 1991 revised agreement explicitly set a target of at least 20 percent market share for foreign-made semiconductors in Japan. This significantly constrained Japanese companies' market strategies. South Korea's semiconductor industry gained competitiveness by

exploiting loopholes in the Japan-U.S. Semiconductor Agreement. Korean companies, exempt from FMV requirements, profited from the agreement (Nakamura Y. 2025).

While pressure from the United States intensified, structural challenges also emerged within Japanese companies. In the late 1980s, as process scaling technology advanced and manufacturing equipment became more sophisticated, capital investment costs surged. This led to financial problems for IDMs, as the investment burden fell entirely on a single company. Furthermore, amid shortening product lifecycles and increasing market diversification, IDMs began to reveal their lack of flexibility.

1990s: The Period of Decline

The 1990s marked a period when Japan's semiconductor industry lost its competitiveness. Multiple factors contributed to this decline, including the economic downturn following the collapse of the bubble economy, the rigidity of the nation's industrial structure, and delays in adapting to technological paradigm shifts. In particular, the stagnation of investment after the bubble burst and the slow response to the rise of the international division of labor model eroded the competitiveness of Japanese companies². Furthermore, changes in the industrial structure significantly contributed to the decline in Japanese companies' competitiveness.

Until the 1980s, the semiconductor industry was dominated by IDMs, which handled everything from design to manufacturing, assembly, and testing. However, when TSMC, founded in Taiwan in 1987, introduced the foundry model specializing in contract manufacturing, the fabless/foundry model—separating design from manufacturing—rapidly gained traction starting in the 1990s. Specialized foundry companies like TSMC gained economies of scale by receiving manufacturing orders from fabless companies worldwide, enabling them to continuously invest in further process scaling.

In contrast, Japanese companies, reluctant to utilize external foundries or separate their design departments, clung to the IDM model. Because Japanese firms had long emphasized the “integration of manufacturing and design” as a strength, transitioning to the fabless/foundry model proved difficult both organizationally and institutionally (Brown and Linden 2010). Consequently, Japanese companies were left behind in the increasingly specialized and segmented global semiconductor supply chain.

2 Negrine et al. (2025) point out that Japanese companies' failure to continue investing in micro processes during the 1990s led to their falling behind in technological competition.

By the late 1990s, the decline in Japanese competitiveness in the DRAM market became pronounced, with Korean firms rising to prominence instead. Samsung, backed by aggressive capital investment and government support, rapidly advanced its process scaling, overwhelming Japanese competitors. Additionally, during this period, personal computers (PCs) proliferated rapidly alongside the development of the internet, and Korean-made DRAM dominated the market share for general-purpose PC DRAM. Japan lagged as it shifted away from supplying high-quality DRAM for mainframes. The inability to respond quickly to the demand for PC DRAM was a major factor in the decline of Japan's semiconductor industry (Yoshioka 2010; Nakamura Y. 2025; Koyanagi 2025).

2000s–2010s: The Restructuring Period

The 2000s to 2010s saw the restructuring of Japanese semiconductor manufacturers. The manufacturing equipment and materials industry maintained its international competitiveness, shifting Japan's semiconductor industry's focus from manufacturing to equipment, materials, and specialized devices (Tomoshige 2022).

The symbolic events of this period were the establishment of Elpida Memory and Renesas. Elpida Memory, formed in 1999, integrated the DRAM divisions of NEC, Hitachi, and Mitsubishi Electric, and was seen as the “last bastion” of Japan's DRAM industry. Renesas was formed by merging the LSI divisions of Hitachi and Mitsubishi Electric, joined by NEC Electronics in 2010. Thus, new Japanese semiconductor companies emerged in both the memory and the logic IC sectors.

Elpida established a state-of-the-art 300mm wafer fab in Hiroshima and achieved a listing on the Tokyo Stock Exchange's First Section in November 2004. It also planned the Taiwan Memory Initiative with companies responsible for memory production in Taiwan. However, its excessive focus on general-purpose DRAM, combined with deteriorating external conditions like post-Lehman Shock demand contraction and yen appreciation, led it to file under the Corporate Reorganization Act of Japan in February 2012. It was ultimately sold to U.S.-based Micron Technology for ¥60 billion.

Renesas is a manufacturing company that produces system LSIs, including automotive semiconductors, power semiconductors, and microcontrollers. It suffered prolonged losses for many years. In 2013, it was placed under the umbrella of the Innovation Network Corporation of Japan (INCJ) and temporarily nationalized. However, the Japanese government and the parent companies of Renesas—Hitachi, Mitsubishi Electric, and NEC—continued to support the

company, sustaining it to this day. Unlike Elpida, Renesas has maintained government support. This is due to its status as Japan's sole domestic semiconductor company following Elpida's collapse, coupled with its supply of automotive semiconductors to Japan's strong automotive industry (Koyanagi 2025). However, Renesas's process scaling level remains at 40nm³. For IC manufacturing below 40nm, it apparently outsources the work to external foundries.

Other Japanese semiconductor companies that have maintained competitiveness since the 2000s include Kioxia (formerly Toshiba Memory), which produces NAND flash memory, and Sony, which manufactures image sensor semiconductors. However, regarding logic IC process scaling technology, Japanese companies lag significantly behind their U.S., South Korean, and Taiwanese counterparts (see table 1).

3 The most advanced logic IC process technology in Japan is the 32nm process established by Panasonic in 2010 at its Toyama Prefecture facility. However, this plant was sold to an Israeli company in 2014 (Koyanagi 2025).

TABLE 1 The evolution of logic IC process scaling technology and mass production companies, 90nm and below

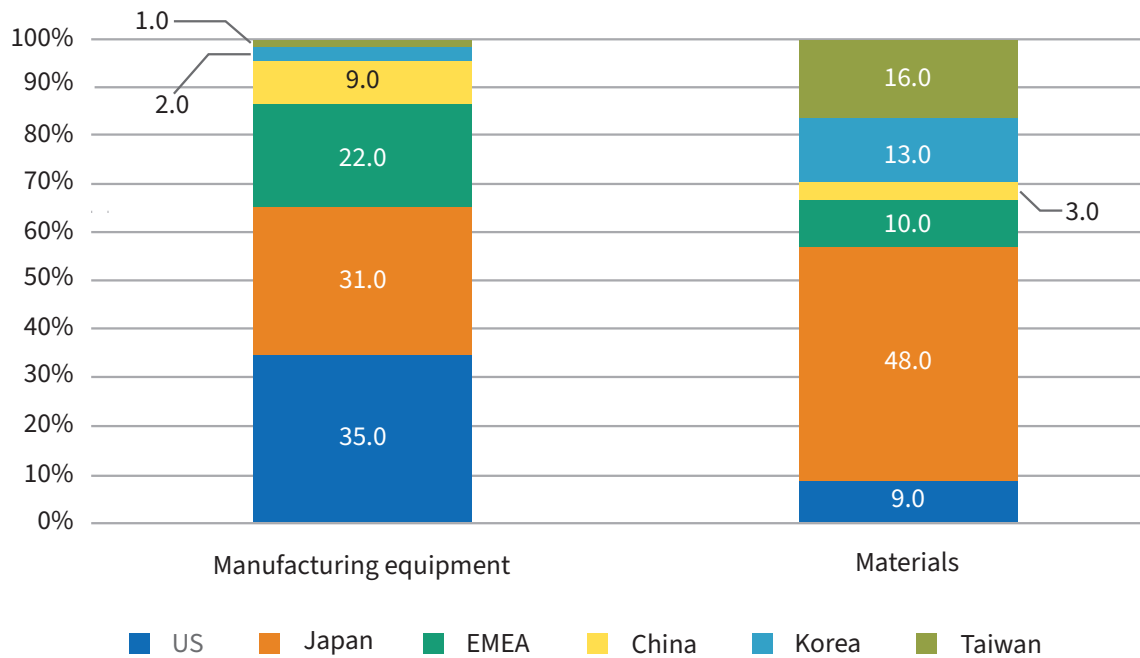
Country	90nm 2003	65nm 2005	45/40nm 2007	32/28nm 2010	22/20nm 2012	16/14nm 2015	10nm 2016	7nm 2018	5/4nm 2020	3nm 2023	2nm 2025
United States	Advanced Micro Devices			Global Foundries							
	Intel										
	IBM										
	Texas Instruments										
	CS										
	MOT										
Europe	IT										
	ST Micro										
Japan	Fujitsu										
	Matsushita		Panasonic								
	Renesas										
	Toshiba										
	Sharp										
	Sony										
Korea	Samsung										
China	SMIC										
Taiwan	UMC										
	TSMC										

Note: CS = Cypress Semiconductor; MOT = Motorola; IT = Infineon Technologies.

Source: Modified from Koyanagi (2025).

Japan has maintained its international competitiveness in the semiconductor manufacturing equipment and materials sector since the 2000s. Figure 2 shows the market share by country of origin for semiconductor equipment and materials. Japanese companies hold over 30 percent of the semiconductor equipment market and approximately 50 percent of the materials market.

FIGURE 2 Market share in manufacturing equipment and materials, by country, 2021



Note: EMEA=Europe, the Middle East, and Africa.

Source: METI 2023.

The Validity of the Semiconductor Industry Revitalization Strategy

As shown in the timeline review above, Japan's semiconductor industry achieved a high market share in the DRAM sector during the 1980s. However, beginning in the 1990s, it lagged behind South Korean, Taiwanese, and U.S. companies and began withdrawing from the DRAM market. Japan's advancement in logic-IC process scaling stalled around the 40nm level, reflecting 2010-era technology standards. While maintaining high shares in the equipment and materials sectors, Japan's share of the overall semiconductor industry revenue stood at only 9 percent as of 2022 (Shivakumar et al. 2023). Against this backdrop, the global semiconductor shortage in 2020 highlighted the urgent need to strengthen semiconductor supply chains.

Evaluating its semiconductor industry against the LDP's criteria of "strategic autonomy" and "strategic indispensability" (LDP 2020), Japan lacks strategic autonomy in the design and manufacturing of logic ICs beyond the 40nm node. Conversely, regarding equipment and materials, while there are variations by type and field, Japan generally possesses strategic indispensability. TSMC Kumamoto, which handles the manufacturing of 12–28nm logic ICs, and Rapidus, which

aims to manufacture advanced 2nm logic ICs, can be construed as projects aimed to securing strategic autonomy for Japan's semiconductor industry in the logic IC field.

Overview of the Two Projects

Around 2020, the global semiconductor shortage intensified, and supply risks became apparent within Japan as well. In response, the Japanese government prioritized the strengthening of domestic semiconductor manufacturing capabilities as a key policy and is believed to have begun full-scale negotiations with TSMC. In May 2021, TSMC announced it would establish an R&D base in Japan. That October, it announced plans to build a new factory in Kikuyo Town, Kumamoto Prefecture, in a joint venture with the Sony Group. The factory's operating company was named Japan Advanced Semiconductor Manufacturing (JASM). TSMC, Sony, and Denso invested in it, with Toyota later joining as a shareholder. Construction began in April 2022, and the facility was completed in February 2024. Since late 2024, it has been producing 22/28nm and 12/16nm logic ICs for automotive, industrial equipment, and consumer electronics appliances. Plans for a second factory adjacent to the operational site were also announced. This second facility is slated to produce advanced 3/4nm logic ICs in 2027.

Rapidus, on the other hand, is a foundry aiming to manufacture 2nm logic ICs using cutting-edge process technology licensed from IBM. The initiative began when Tetsuro Higashi, former chairman of Tokyo Electron, received a phone call from IBM in the summer of 2020 proposing the 2nm manufacturing project (Kataoka 2023). Higashi consulted with Atsuyoshi Koike, then-president of Western Digital Japan, and the two presented the Rapidus concept to the Ministry of Economy, Trade and Industry. Rapidus was born when it was selected as a recipient of a research and development project with a ¥ 70 billion budget.⁴ Rapidus aims to develop and manufacture high-performance logic ICs domestically for smartphones, AI servers, data centers, and high-performance computing (HPC). With a target of starting mass production in 2027, preparations for a pilot line in Chitose City, Hokkaido, and the introduction of extreme ultraviolet (EUV) equipment are currently underway. Leveraging Japan's unique strengths in small-volume, high-value-added, and short-lead-time production, the company is building an integrated system that covers everything from design to back-end processes.

The Japanese government is providing subsidies to TSMC Kumamoto and Rapidus. For TSMC Kumamoto's first plant, ¥476 billion was spent, followed by ¥732 billion for the second plant

4 The award came from the New Energy and Industrial Technology Development Organization (NEDO), a Japanese national research and development corporation and the core institution promoting research and development in energy, environmental, and industrial technology.

(Koyanagi 2025). Meanwhile, for Rapidus, subsidies totaling ¥1.722 trillion have been disbursed from 2022 to 2025, based solely on amounts approved by the Ministry of Economy, Trade and Industry (METI n.d.).

Criticism of the Two Projects

Given the massive amounts of tax funds invested, these two projects have faced significant criticism and skepticism. For example, JASM, the operating company for TSMC Kumamoto, is effectively a foreign-owned enterprise since TSMC holds over 80 percent of its capital, leading to criticism of the Japanese government's decision to subsidize it. Furthermore, even if TSMC Kumamoto is established, critics have said that it will not lead to a more resilient supply chain because front-end mask design and manufacturing, as well as back-end processes, will continue to be conducted in Taiwan (Yunokami 2023).

Rapidus likewise faces numerous questions and criticism regarding its technology and business model. For example, Hayashi (2025) notes that Rapidus lacks the technological resources a startup should have. Choi (2024) highlights Rapidus' recklessness in immediately tackling cutting-edge technology and expresses concern that its strategy of specializing in advanced logic ICs may prevent it from achieving economies of scale comparable to TSMC.⁵ Furthermore, Koyanagi (2025) and Osanai (2024) criticize Rapidus for lacking clear target customers and for deliberately avoiding a volume-driven strategy, despite operating in the equipment industry. Additionally, Wakabayashi (2022) and Osanai (2024) express concern that TSMC Kumamoto and Rapidus, despite being the two major projects under Japan's semiconductor industry revitalization strategy, are progressing independently of each other. The geographical separation of the two companies' factories is also highlighted as problematic. For example, Todo (2025) critically notes that while TSMC Kumamoto is located in Kyushu, a semiconductor industry hub, Rapidus established its factory in Hokkaido, an area with little semiconductor industry concentration.

The above discussion outlines the main criticisms and questions regarding the two projects.⁶ However, no research has yet examined these projects from the perspective of Japan's economic security. Therefore, the following section examines both projects from this viewpoint.

5 TSMC manufactures ICs at all technology levels, including legacy technologies, not just the advanced 2nm logic ICs.

6 I was only able to find one prior study that has viewed the Rapidus case positively. Nakamura Fumio et al. (2025) evaluate Rapidus as a case where institutional entrepreneurs contribute to strengthening the semiconductor supply chain.

Framework for Analysis

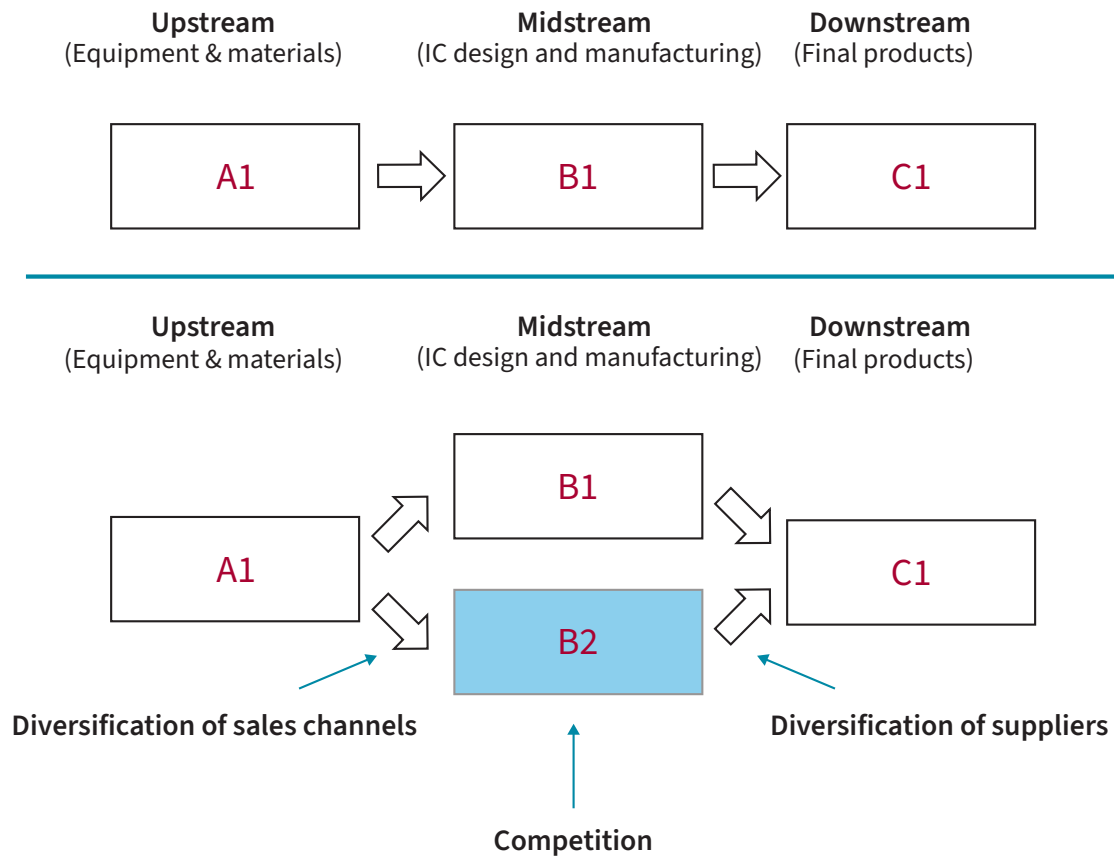
As stated above, the key elements of economic security encompass diverse factors such as supply chain resilience, the protection and cultivation of technological foundations, and the level of safety of critical infrastructure. However, for Japan—which lags behind Taiwan, South Korea, and the United States in the technological capabilities of its semiconductor industry, particularly in logic ICs—supply chain resilience should be paramount. Therefore, this paper will primarily examine the validity of the two projects from a supply chain perspective.

Figure 3 conceptualizes the logic IC supply chain. Upstream involves equipment and materials, midstream encompasses design and manufacturing, and downstream includes the final product industries that incorporate ICs. The semiconductor industry, as commonly referred to, comprises the upstream and midstream segments. Furthermore, while the midstream segment may need to be further subdivided today due to the evolution of fabless and foundry models, it is grouped together here for simplicity of explanation.

As shown in the upper half of figure 3, if only one company operates in each of the upstream, midstream, and downstream segments, the supply chain becomes vulnerable. This is because the cessation of operations at any single company would cause the supply chain to collapse. Furthermore, from the perspective of a nation’s economic security, it is desirable for companies responsible for each segment to be located domestically. This is because geopolitical instability carries the risk of disrupting overseas supply.

Both TSMC Kumamoto and Rapidus are foundries. The direct benefit of having more companies manufacturing IC chips extends to upstream equipment and materials companies and downstream final product manufacturers. This is because equipment and materials companies gain more diverse customers, while final product manufacturers gain more diverse sources for IC chip procurement. On the other hand, an increase in the number of midstream manufacturing companies will lead to competition (see the lower half of figure 3).

FIGURE 3 Logic IC supply chain



Source: Author.

Analysis

Based on the analytical framework presented in figure 3, let us examine the significance of TSMC Kumamoto and Rapidus.

First, TSMC Kumamoto will produce 12–28nm logic ICs, primarily targeting automotive, industrial equipment, and consumer electronics. For Japan, where process scaling technology has stalled at 40nm, this 12–28nm range represents advanced technology. However, globally, this is a mature (stable) technology level comparable to what was considered “advanced” in the early 2010s. Although Japan’s technology stalled at 40nm, with TSMC’s guidance, the 12–28nm node is considered a technology level that Japanese engineers can handle. Furthermore, TSMC Kumamoto will benefit Japan’s upstream equipment and materials industries as well as its downstream final product industries. In particular, downstream final product industries

that suffered from semiconductor shortages in the 2020s are expected to see semiconductor procurement stabilize.⁷

Rapidus aims to begin mass production of cutting-edge 2nm logic ICs by 2027, but has not disclosed specific target customers. Downstream industries using 2nm logic ICs include smartphones, data centers, communications infrastructure, AI servers, and HPC. However, the United States is strongly competitive in these sectors, while Japan has virtually no industrial base. Furthermore, Rapidus established a marketing subsidiary, Rapidus Design Solutions LLC, in California in April 2024. This suggests that the primary sales market for its 2nm ICs will be the United States. In other words, the decisive difference between Rapidus and TSMC Kumamoto is that Rapidus's IC chips will be sold in the United States, not Japan. Regarding equipment and materials, Japanese-made products can be utilized even in Rapidus's advanced IC manufacturing. However, EUV lithography equipment is essential for 2nm IC production, and only ASML⁸ in the Netherlands can supply this equipment. This equipment is extremely expensive, reportedly costing between ¥20 billion and ¥30 billion per unit. Furthermore, mastering the equipment requires advanced know-how, prompting ASML to establish training centers in Taiwan and South Korea, where its user companies are located.

Based on the above analysis, the feasibility of TSMC Kumamoto and Rapidus can be summarized as follows. TSMC Kumamoto will benefit both Japan's equipment and materials industries and sectors like automobiles, industrial machinery, and consumer electronics. Furthermore, locating it in Kumamoto Prefecture, Kyushu—an area with significant industrial concentration—will likely provide TSMC Kumamoto with a degree of operational stability. Consequently, the goal of strengthening supply chains (strategic autonomy for Japan's semiconductor industry), a key pillar of economic security, is expected to be largely achievable (see figure 4).

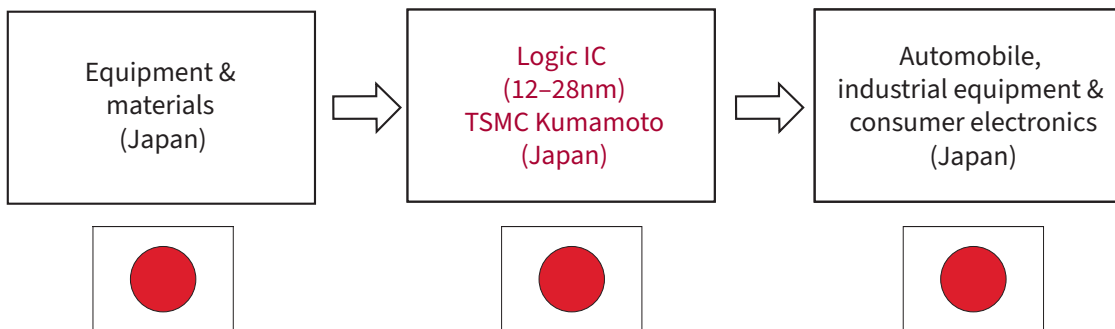
In contrast, Rapidus's primary market is the United States. The emergence of Rapidus provides U.S. companies like Apple and NVIDIA with more suppliers for advanced logic ICs. However, the benefits for Japan, where few companies currently use such advanced logic ICs, are minimal. Additionally, while benefits may accrue to Japan's strong equipment and materials sectors, Japan cannot produce the EUV lithography equipment essential for 2nm process fabrication.

7 For example, Sony built its own image sensor factory adjacent to TSMC Kumamoto. Furthermore, Kyushu hosts numerous automobile assembly plants and parts factories, and TSMC Kumamoto's presence will strengthen the procurement of automotive semiconductors.

8 Formerly known as Advanced Semiconductor Materials Lithography and based in the Netherlands, ASML supplies 83 percent of worldwide sales of lithography machines.

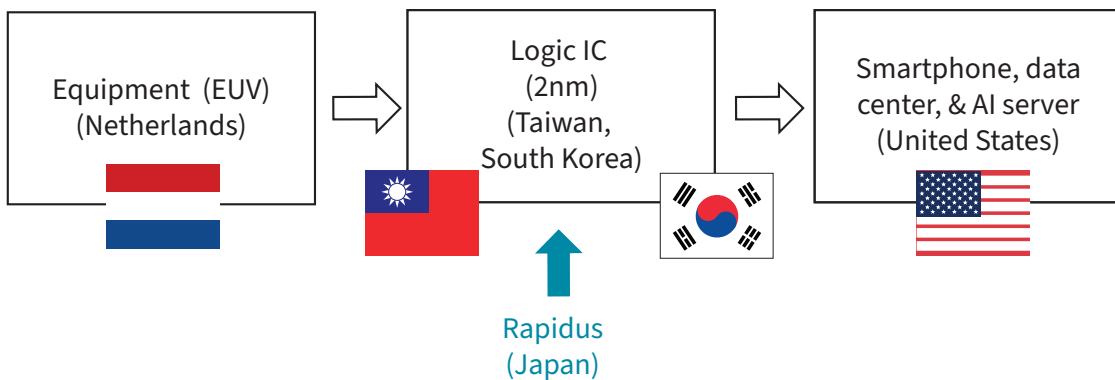
Dutch company ASML holds strategic indispensability in EUV, and Rapidus will compete with TSMC and Samsung for EUV procurement from ASML. Summarizing the above points, Rapidus's role clearly indicates Japan's new participation in the middle of the advanced logic IC supply chain, which flows from the Netherlands to Taiwan/South Korea and then to the United States (see figure 5). While the economic and business significance of this chain cannot be outright dismissed, it must be acknowledged that it is quite distinct from the "strengthening of supply chain resilience" which is central to Japan's economic security.

FIGURE 4 TSMC Kumamoto's role in strengthening Japan's supply chain resilience



Source: Author.

FIGURE 5 Japan's insertion of Rapidus into the advanced logic IC supply chain



Source: Author.

Conclusion

This paper has examined the background behind the recent emphasis on economic security, considered the history of Japan's semiconductor industry, and assessed the validity of Japan's ongoing semiconductor industry revitalization strategy. Economic security gained prominence

globally starting in the late 2010s, as the U.S.–China economic rivalry became apparent, prompting related legislative developments. Furthermore, the semiconductor shortage that emerged in 2020 affected production and social activities globally, positioning semiconductors as strategic materials. Under the banner of economic security, nations are now working to strengthen their semiconductor industry supply chains. In Japan, two projects are currently underway: TSMC Kumamoto and Rapidus.

Japan's semiconductor industry held a high market share in the DRAM sector during the 1980s. However, it lost competitiveness in the 1990s due to misjudgment of market trends and changes in the external environment, such as Japan–U.S. trade friction and yen appreciation. Its logic IC process scaling technology stalled at 40nm in the 2010s. The semiconductor shortage that emerged in 2020 caused the Japanese government to recognize the need to revitalize its semiconductor industry, leading to the launch of the two major projects: TSMC Kumamoto and Rapidus.

However, a comparative analysis of the two projects reveals significantly different outcomes regarding supply chain resilience—a core element of economic security. In the case of TSMC Kumamoto, linkages with Japan's equipment and materials industries, as well as its automotive, industrial machinery, and consumer electronics sectors, were strengthened. This fosters expectations that TSMC Kumamoto will enhance Japan's domestic supply chain resilience. In contrast, Rapidus seems to indicate that Japan is joining the global supply chain for the advanced logic ICs—an area Japan had previously not been involved in—rather than primarily focusing on strengthening Japan's domestic supply chain.

Future research should focus on how Rapidus can be best operated. Previous studies have directed various criticisms at Rapidus. However, since the project is already underway, it is more constructive to focus on operational improvements rather than merely criticize it. The biggest problem with Rapidus is that there are virtually no industries currently using 2nm logic ICs in Japan. However, looking ahead over the next decade, demand for 2nm technology is expected to emerge in Japan. A particularly promising potential customer is the automotive sector, which is developing autonomous driving technology. Since the automotive industry remains a field where Japan still holds competitiveness, having Rapidus specializing in dedicated logic ICs for autonomous driving could also help strengthen the domestic supply chain. I will aim to validate this hypothesis by adding it to my next research agenda.

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