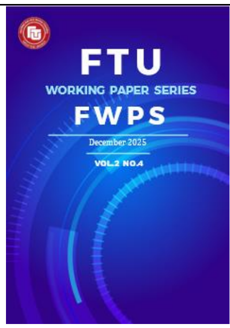

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XÂY DỰNG KHẢ NĂNG PHỤC HỒI CỦA CHUỖI CUNG ỨNG TRONG NGÀNH CÔNG NGHIỆP BÁN DẪN VIỆT NAM TRONG BỐI CẢNH CHIẾN TRANH THƯƠNG MẠI MỸ-TRUNG: CƠ HỘI VÀ THÁCH THỨC

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Tóm tắt

Bài nghiên cứu phân tích cách cuộc chiến thương mại Mỹ - Trung đã ảnh hưởng lên chuỗi cung ứng bán dẫn toàn cầu và ngành công nghiệp bán dẫn của Việt Nam. Tác giả áp dụng phương pháp định tính dựa trên dữ liệu thứ cấp và bốn trụ cột của khả năng chống chịu chuỗi cung ứng, bao gồm lập kế hoạch dự phòng, tính linh hoạt, khả năng hiển thị và sự hợp tác, để đánh giá phản ứng của Việt Nam ở cả cấp độ chính phủ và doanh nghiệp. Dựa trên đánh giá này, bài nghiên cứu tiếp tục phân tích các cơ hội và thách thức chính đối với Việt Nam trong việc nâng cao vị thế trong chuỗi giá trị chất bán dẫn toàn cầu. Mặc dù Việt Nam đang nổi lên như một điểm đến hấp dẫn cho đầu tư nước ngoài, đặc biệt trong các khâu lắp ráp, kiểm định và đóng gói (OSAT), nhưng vẫn còn tồn tại nhiều hạn chế như cơ sở hạ tầng chưa phát triển, năng lực nội địa còn yếu và thiếu hụt lao động có tay nghề cao. Do đó, bài viết đề xuất các hàm ý chính sách thực tiễn để Việt Nam xây dựng khả năng chống chịu chuỗi cung ứng và từng bước chuyển mình khỏi các phân khúc có giá trị gia tăng thấp, hướng đến trở thành trung tâm bán dẫn của khu vực.

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Từ khóa: chất bán dẫn, khả năng phục hồi của chuỗi cung ứng, Việt Nam, chiến tranh thương mại Mỹ-Trung

BUILDING SUPPLY CHAIN RESILIENCE IN VIETNAM'S SEMICONDUCTOR INDUSTRY IN THE CONTEXT OF THE US-CHINA TRADE WAR: OPPORTUNITIES AND CHALLENGES

Abstract

This study aims to analyze how the US-China trade war has reshaped the global semiconductor supply chain and affected Vietnam's semiconductor industry. The author applied a qualitative approach based on secondary data and the four pillars of supply chain resilience including contingency planning, flexibility, visibility, and collaboration to evaluate Vietnam's governmental and enterprise level responses. Based on this assessment, the paper evaluates the key opportunities and challenges for Vietnam in enhancing its position within the global semiconductor value chain. While Vietnam is emerging as a promising destination for foreign investment, particularly in assembly, testing, and packaging (OSAT), it continues to face significant limitations such as underdeveloped infrastructure, limited domestic capabilities, and a shortage of high-skilled labor. Therefore, the paper suggests practical policy implications for Vietnam to build supply chain resilience and move beyond low value-added production toward becoming a regional semiconductor hub.

Keywords: semiconductor, supply chain resilience, Vietnam, US–China trade war

1. Introduction

It is undeniable that the semiconductor industry plays an increasingly important role in the development of almost every sector from automotive and telecommunications to healthcare and renewable energy. The ongoing US-China trade war has posed persistent and strategic challenges and significantly disrupted the established semiconductor supply chains. These disruptions have forced firms to reassess their supply chain dependencies and search for alternative, more resilient production bases. In this context, building semiconductor supply chain resilience is not only a response to short-term disruptions but a strategic requirement to adapt to the evolving dynamics of global trade and technology competition.

As a result of escalating geopolitical tensions, companies seeking to diversify their supply chains away from China have begun considering Vietnam as an alternative due to its strategic location, competitive labor costs, and favorable trade conditions. This shift has presented several opportunities for Vietnam to develop its semiconductor industry. For example, industry leaders such as Hana Micron Vina, Amkor Group, and Samsung have expanded their operations in Vietnam particularly in assembly, testing, and packaging facilities (Hong Phuc, 2024). At the same time, Vietnam's semiconductor industry faces significant challenges, including a heavy reliance on external inputs, infrastructure deficiencies, and a shortage of skilled labor. These issues highlight the urgent need for Vietnam to not only seize the emerging opportunities but also implement strategic reforms to address existing limitations and strengthen its role in the global semiconductor supply chain.

Therefore, this report aims to analyze how the US-China trade war is reshaping the global semiconductor industry and affecting the semiconductor industry of Vietnam to propose implications for Vietnam to build a resilient semiconductor supply chain.

2. Theoretical basis

2.1. Supply chain resilience

2.1.1. Definition

In the context of supply chain management, the notion of resilience began to take clear shape in the early 2000s. Christopher and Peck (2004) defined it as "the ability of a system to return to its original state or move to a new, more desirable state after being disturbed", which underscores the dual capacity of a supply chain not only to recover from disruption but also to improve through transformation.

Following this foundation, Ponomarov and Holcomb (2009) emphasized that Supply Chain Resilience (SCRes) is a critical component of Supply Chain Risk Management (SCRM). They argued that to fully understand SCRes, researchers must draw from multiple theoretical streams, particularly those that explore vulnerability, adaptability, and system dynamics under uncertainty. This approach established SCRes as an emerging theory in its own right, offering a more comprehensive and interdisciplinary lens.

Tukamuhabwa et al. (2015) later built on these earlier definitions by framing SCRes as "the adaptive capability of a supply chain to prepare for and/or respond to disruptions, to make a timely and cost-effective recovery, and therefore progress to a post-disruption state of operations ideally, a better state than prior to the disruption." This definition places greater emphasis on the proactive and forward-looking aspects of resilience, highlighting not just recovery but evolution and improvement.

More recently, Wieland and Durach (2021) have advanced the theoretical understanding of supply chain resilience by identifying two distinct yet complementary paradigms: engineering resilience, which focuses on stability and rapid recovery, and social-ecological resilience, which emphasizes adaptability, learning, and transformation amid systemic changes.

Overall, SCRes has evolved from a reactive capability to a strategic, adaptive, and transformative process, which becomes significantly vita, especially in the context of the semiconductor industry operating in highly globalized and technologically intensive value chains.

2.1.2. Pillars of Supply Chain Resilience

A resilient supply chain is underpinned by four foundational capabilities: contingency planning, flexibility, visibility, and collaboration. According to Pavlov (2019), contingency planning is a recovery strategy developed before disruptions and implemented afterward. It involves designing backup systems such as redundant suppliers, buffer inventories, alternative transport routes, and flexible production—to reduce downtime and maintain operations under adverse conditions. Central to this approach is risk assessment, which identifies vulnerabilities like supplier unreliability or logistics delays and prioritizes responses accordingly (Leadvent Group, 2025). The shift from "just-in-time" to "just-in-case" highlights the growing need for flexibility through supply diversification and technological tools like real-time tracking and predictive analytics. Additionally, effective contingency planning includes strong communication protocols, financial safeguards, and continuous updates to adapt to evolving risks. These measures collectively enhance business resilience and competitiveness in a volatile global environment (Kuehne & Nagel, n.d.).

According to Kamalahmadi and Parast (2016), flexibility refers to the ability of supply chains to take adaptive positions in response to abnormal situations and rapidly adjust to significant changes. Key components of flexibility include the adoption of dual or multi-sourcing strategies, increasing inventory buffers across different stages and expanding capacity buffers in production, logistics, and distribution. Additionally, flexibility is enhanced through the use of local or near-shore suppliers, outsourcing non-core or non-scalable operations, and shortening supply chain cycle times (Deloitte, 2022)

Visibility refers to the real-time ability to access and monitor data across the entire supply chain (Ivanov & Dolgui, 2020). This capability enhances early risk detection, supports rapid decision-making, and mitigates vulnerabilities to external shocks, particularly relevant in globally interconnected industries such as semiconductors. Key components of visibility include the digitization of supply chain operations to enable transparency and automation, improved insight into multi-tier supplier landscapes, and enhanced understanding of customer demand trends and fluctuations. Furthermore, embedding risk management practices throughout the end-to-end supply chain, implementing the control tower concept for centralized oversight, and strengthening demand planning and forecasting are all essential for enabling agile and informed responses to disruptions (Deloitte, 2022).

Collaboration, defined by the ability to forge symbiotic and trust-based relationships with key internal and external stakeholders, has evolved into a critical pillar of supply chain resilience. Historically, supply chain managers often sought to minimize partner numbers to reduce operational complexity. However, contemporary strategies favor partner diversification. This shift mitigates dependency on any single supplier and its resources, thereby enhancing stability and flexibility in the face of market disruptions. Furthermore, leveraging technologies that promote transparency and efficient communication and information sharing significantly strengthens the collaborative capacities within the supply chain (Longeagne, 2024). Key components include fostering cross-functional teamwork, strengthening external partnerships, promoting a resilience-oriented mindset across the organization, and establishing dedicated resilience task forces (Deloitte, 2022).

2.2. Semiconductor value chain

The semiconductor value chain is one of the least understood yet most crucial aspects of the global economy, powering everything from smartphones to supercomputers. It is a complex, highly specialized, and globally distributed system encompassing three primary stages: chip design, fabrication, and assembly. Each stage depends on critical inputs from specialized suppliers, leading to a value chain characterized by high division of labor, market concentration, and deep interdependencies.

In the design phase, firms, especially fabless companies, and IDMs, rely heavily on electronic design automation tools and intellectual property blocks, dominated by US-based companies such as Synopsys, Cadence, and Mentor, making it highly vulnerable to geopolitical disruptions. Leading nations in chip design include the United States, Taiwan, and China.Fabrication, the most capital and knowledge-intensive stage, involves etching chip designs onto silicon wafers using sophisticated manufacturing equipment. It is dominated by foundries like TSMC (Taiwan) and Samsung (South Korea), the only two firms currently capable of producing chips at nodes below 7nm. The stage depends on advanced equipment from a few global suppliers, such as ASML (Netherlands) for EUV lithography, and US firms like Applied Materials and Lam Research for deposition and etching. Finally, the assembly and testing phase, often performed by OSAT companies, requires further specialized tools and chemicals. No single country controls the entire semiconductor supply chain; instead, it spans regions across the world including the U.S., Taiwan, South Korea, Japan, Europe, and China. While this maximizes efficiency and innovation, it remains geopolitically fragile and non-resilient, with critical bottlenecks in EDA software, IP licensing, and advanced manufacturing equipment (Kleinhans and Baisakova, 2020).

3. Impact of US-China trade war on the global semiconductor industry

3.1. Overview of the trade war

3.1.1. Historical context

The US-China trade relationship began in 1979 under President Jimmy Carter, who believed integrating China into global trade would benefit the US economy through increased investment and exports. By 2007, China had become a major economic power, accounting for one-quarter of global fixed asset investment, which was 40 percent higher than that of the United States, leading to rising competition and pressure between the two nations (Eduardovna, 2024). Tensions intensified during the 2016 US presidential election, when Donald Trump accused China of unfair trade practices and proposed a 45 percent tariff on Chinese goods (Suisheng and Guo, 2019). In 2018, the US imposed tariffs on 50 billion dollars' worth of Chinese products, or 0.37 percent of China's GDP, sparking a trade war. China responded with its own tariffs. The dispute was fueled by rivalry in areas such as information technology and artificial intelligence and continued despite the 2019 Phase One Agreement (Eduardovna, 2024).

3.1.2. Current situations

China is currently the United States' third-largest trading partner; however, tensions rose sharply in 2025. In February, President Donald Trump signed an executive order imposing a 10 percent tariff on all Chinese imports, citing the fentanyl crisis. Tariffs increased to 20 percent, 34 percent, and up to 145 percent by April. China responded with tariffs up to 125 percent and non-tariff measures, including rare earth export restrictions and antitrust probes against US firms (Bown, 2025). China later announced it would not retaliate further. A temporary agreement in May reduced tariffs for 90 days, but core issues remain unresolved.

3.2. The impact of trade war on global semiconductor industry

3.2.1. Increased production cost and supply chain disruption

The semiconductor supply chain is one of the most globally interconnected industries, involving multiple countries and specialized firms across production stages. However, the US export restrictions disrupt the semiconductor supply chain by limiting China's access to essential components and machinery, affecting production capacities in China and global companies relying on Chinese facilities. In response, China began implementing its own countermeasures through export controls on critical raw materials, including gallium, germanium, and silicon, all of which are essential for chip manufacturing and areas where China holds a dominant global position (Jia et al., 2022). These moves have intensified supply chain vulnerabilities, especially for the US and EU, which depend heavily on affordable and stable imports. While alternative sources such as the Democratic Republic of Congo and Russia exist, they present substantial risks related political instability and international sanctions (Hamdani and Belfencha, 2024).

These actions by the two major players in the global semiconductor industry have reduced the supply chain's absorptive capacity, as firms face material shortages and rising costs. This has forced companies to reassess manufacturing and sourcing strategies, potentially increasing production costs. Recently, Advanced Micro Devices projected a $1.5 billion loss in revenue and an 11 percentage point reduction in its expected gross margin for 2025 due to new U.S. rules requiring licenses for exporting advanced AI chips to China (Bajwa and Cherney, 2025). Nvidia also warned of significant losses from losing access to China's AI market (Cao, 2025).

3.2.2. Global Strategic Realignment

Instead of spreading production globally as before, companies now focus on regionalization, organizing production and supply activities within the same geographic area or among neighboring countries to enhance resilience and reduce exposure to the trade war. Many countries have introduced industrial policies to protect and strengthen their strategic positions in the semiconductor industry. For example, the introduction of South Korea's K-Chips Act and European Chips Act reflect attempts to decrease reliance on vulnerable global supply chains and illustrate the growing wave of regionalization and technological self-sufficiency amid the trade war.

In addition to regionalization, companies are diversifying their supplier base by sourcing components from countries unaffected by US-China tensions to maintain stable production. Southeast Asia rises to play an increasingly vital role, especially for firms seeking to reduce dependence on China (Source of Asia, 2025). This diversification enhances supply chain flexibility by spreading risk geographically and avoiding tariffs and regulatory challenges tied to trade restrictions.

The trade war forces chip designers and producers in Taiwan, Japan, and South Korea to balance compliance with US policies while maintaining trade with China. This situation has led to a split in the global semiconductor market, with one side aligned with the United States and its allies and the other with China, potentially resulting in distinct technological standards and supply chains. The push for regionalization and friend-shoring, where production shifts to countries politically aligned with the US, further deepens this divide.

4. Vietnam's key responses to the shifts in global semiconductor supply chain

4.1. At the government level

4.1.1. Contingency planning

The Vietnamese government has adopted contingency planning as a strategic tool to build semiconductor supply chain resilience. A key initiative is the development of the country's first semiconductor fabrication plant by 2030, supported by a 12.8 trillion VND budget and investment incentives such as tax breaks and fast-tracked land access. Additionally, the government is enhancing digital infrastructure through real-time monitoring systems and predictive analytics to improve disruption response capabilities. This marks a clear transition from "just-in-time" to "just-in-case" strategies, positioning Vietnam as a lower-cost, stable alternative in the global semiconductor landscape.

4.1.2. Flexibility

Taking advantage of the China+1 strategy, the government introduced generous tax incentives, including corporate income tax exemptions and reductions, preferential tax rates for high-tech projects, and import duty exemptions for essential equipment and materials. These measures aim to offset increased production costs and attract diversified investment away from China, reflecting the multi-sourcing and near-shoring principles of supply chain flexibility (Kamalahmadi & Parast, 2016). Furthermore, the development of industrial zones and high-tech parks with ready-built infrastructure supports regional diversification and reduces exposure to geopolitical tensions.

Moreover, while both the US and China are key input and output markets for Vietnam's semiconductor industry, the Vietnamese government has taken prompt action to ensure supply chain continuity. As a result, efforts have been made to diversify both export markets and sourcing channels. Specifically, Vietnam has not only continued exporting semiconductor components to the US but also actively expanded to other promising markets such as South Korea, Japan, and the European Union. At the same time, for sourcing raw materials and machinery, Vietnam has reduced its dependence on China by seeking alternative suppliers from various countries, thereby enhancing its resilience against external shocks(General Statistics Office of Vietnam, 2024). Such efforts help to enhance the country's ability to rapidly adapt to supply chain shocks by strengthening local capacity, reducing lead times, and supporting diversified production, which are core components of a flexible and resilient supply chain.

4.1.3. Visibility

In response to rising production costs and heightened trade uncertainties caused by the US–China trade war, the Vietnamese government has accelerated digitization initiatives to strengthen supply chain visibility. Tools such as Enterprise Resource Planning (ERP) and Manufacturing Execution Systems (MES) have been promoted under national digital transformation programs to enhance cost control, production efficiency, and responsiveness, which provides transparency and automation in supply chain visibility (VCCI, 2025).

Moreover, to address customs-related supply chain delays, particularly those resulting from Chinese export restrictions on semiconductor inputs, he VNACCS/VCIS electronic customs system enables real-time tracking and process transparency, allowing firms to proactively adjust operations. Additionally, Vietnam's pursuit of FTAs like the CPTPP and EVFTA supports strategic diversification beyond US and Chinese markets. Compliance with these agreements requires robust traceability and supplier data sharing, further embedding visibility and risk management into the national supply chain structure (Nguyen, 2024)

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4.1.4. Collaboration

In response to the geopolitical realignment triggered by the US–China trade war, Vietnam has prioritized strengthening collaborative ties with strategic partners to reduce overdependence on Chinese suppliers. Notably, through the Indo-Pacific Technology and Security Initiative and recent bilateral agreements with the United States, Vietnam has committed to expanding cooperation in semiconductor workforce training, R&D, and infrastructure development (Mai, Poling and Quitzon, 2024). These actions reflect a shift toward trust-based, diversified partnerships. Domestically, the government's Human Resource Development Scheme for 2024–2030 aims to cultivate a skilled workforce of over 50,000 engineers by upgrading laboratories, reforming university curricula, and partnering with global tech leaders (Ministry of Planning and Information, 2024). Such initiatives foster cross-functional capacity and promote a resilience-oriented mindset, preparing Vietnam's semiconductor industry to integrate more deeply into global value chains and adapt swiftly to external shocks

4.2. At enterprises level

4.2.1. Contingency Planning

Vietnamese semiconductor firms have aligned with the government's contingency planning efforts by adopting niche strategies to minimize exposure to high-risk segments. Instead of competing directly in advanced chip manufacturing, companies have focused on stable-demand segments such as automotive and telecom chips . This targeted approach reduces vulnerability to technological shocks and global market volatility. Moreover, firms like FPT Semiconductor and VN Chip have actively supported workforce development by collaborating with universities and training programs, helping to ensure long-term operational continuity (FPT Corporation, 2024). These enterprise-level actions reflect contingency planning's emphasis on risk assessment, capacity building, and maintaining supply chain functionality during disruptions intensified by the US–China trade conflict.

4.2.2. Flexibility

In response to US–China trade tensions and associated supply chain disruptions, firms in Vietnam's semiconductor sector have adopted adaptive strategies aligned with key flexibility components. Foreign-invested companies like Intel and Samsung have increased their capital investment, each exceeding USD 1 billion to expand chip testing and packaging capacity in Vietnam (Duc Thien, 2025, Ha Van, 2024). These moves reflect efforts to reduce dependency on China (multi-sourcing), build capacity buffers, and shorten cycle times. Domestically**,** FPT launched Vietnam's first locally designed chip in 2022, marking an important step in localizing design capabilities and enhancing autonomy (Lam Thao, 2025). Similarly, Viettel High Tech has developed processors for military and civilian applications, which strengthens Vietnam's resilience by reducing reliance on imported chips and establishing local supply alternatives (Minh Thi, 2023). These actions collectively support regional diversification, supply continuity, and responsiveness, which are core aspects of a flexible and resilient supply chain.

4.2.3. Visibility

Leading technology firms such as Viettel High Tech and FPT Semiconductor have implemented ERP systems integrated with IoT sensors, enabling real-time monitoring of production lines, inventory levels, and delivery schedules (Duy Quang, 2024). This reflects the digitization and automation components of supply chain visibility and transparency enhancement across operations. These technologies support rapid decision-making and early bottleneck detection, especially when facing delays in importing equipment, thus embedding risk management and improving demand planning in response to supply chain disruptions. Besides, due to geopolitical tensions, many companies have shifted their sourcing away from China to alternative suppliers in Japan, South Korea, and the EU. To ensure quality and reliability, real-time traceability and supplier performance monitoring tools are widely adopted, demonstrating improved insight into the multi-tier supplier landscape and the application of the control tower concept. Furthermore, foreign-invested enterprises such as Samsung and Intel require local partners in Vietnam to integrate into centralized data platforms, supporting shared visibility and internal-external data integration (Hai Yen, 2024).

4.2.4. Collaboration

In response to the risks posed by the US–China trade war, Vietnamese semiconductor firms have increasingly turned to global diversification through strategic, trust-based partnerships. FPT's alliances with Siemens (Germany) and GigaX (South Korea) exemplify this trend, enabling knowledge transfer and greater supply chain agility across Europe and Asia (FPT Corporation, 2024). At the same time, cross-functional collaboration and training in resilience are advancing through academic–industry partnerships. Intel Vietnam, for instance, collaborates with top universities to co-develop curricula and laboratories in chip design and testing, building a skilled, flexible workforce aligned with Deloitte's (2022) concept of a cross-functional resilience task force. Additionally, foreign-invested enterprises like Samsung and Amkor are transitioning from transactional procurement to long-term supplier development programs, supporting local firms through joint training and audits. These efforts foster a collaborative ecosystem, reduce geopolitical dependency, and reinforce Vietnam's strategic role in the global semiconductor supply chain realignment.

5. Opportunities and challenges for Vietnam

5.1. Opportunities

5.1.1. Strengthening Vietnam's position in the regional supply chain

As global supply chains are being restructured to reduce dependence on China due to geopolitical risks and high tariffs exposure, Vietnam stands out as a pivotal node in Southeast Asia's semiconductor ecosystem with strategic location at the crossroads of major maritime and overland trade routes, a stable political environment, and highly competitive labor costs. In 2020, Vietnam ranked 12th globally, up from 47th in 2001 and 3rd in ASEAN for electronics exports. As multinational investors reallocate capital, Vietnam is poised to become the “second center” of electronics manufacturing after China.

Major technology players such as Apple, Intel, and Samsung have already begun diversifying their supply chains away from mainland China in response to ongoing US–China tensions. While Vietnam does not yet host wafer fabrication facilities or lead in advanced chip design, it is rapidly expanding its role in the downstream segments of the value chain-most notably in packaging (OSAT), testing, and even certain aspects of electronic design automation (EDA). These activities once considered low-value add, now command increasing strategic importance as manufacturers prioritize resilience and flexibility over sheer scale. Vietnam’s first-ever national pavilion at SEMICON Southeast Asia 2025 underscores its commitment to growing the semiconductor sector and attracting investment (VietnamPlus, 2025).

5.1.2. Increasing FDI inflows into high-tech sectors

Vietnam's strategic embrace of the “China +1” approach has boosted its appeal foreign direct investment (FDI), particularly in high-tech sectors like semiconductors. International integration is accelerating Vietnam’s convergence with global markets and capital sources. According to the International Labour Organization, 99 of the top 100 electronics firms in Vietnam are FDI-related (ILO, 2016). High-tech industries, including semiconductors, have seen steady capital inflows (Khe, 2025).

Vietnam’s Minister of Information and Communications, Nguyen Manh Hung, projects the semiconductor industry will generate about USD 18.23 billion in revenue in 2024, an 11.5% increase from 2023. Foreign-invested enterprises account for a significant share, with approximately USD 11.6 billion invested in the sector. This investment trend is expected to continue growing (Hong Phuc, 2025). The Ministry of Planning and Investment forecasts FDI inflows exceeding USD 40 billion in 2025, driven largely by high-tech and digital services projects (Ministry of Planning and Investment, 2024).

Global firms such as Hana Micron (South Korea), Amkor Technology, Intel (USA), Samsung Electronics (South Korea) and may more have expanded packaging, testing, and R&D operations in Vietnam. Hana Micron plans to invest about USD 930 million by 2026 to upgrade its chip packaging, while Amkor Technology is investing USD 1.6 billion in an advanced packaging plant using equipment relocated from China. Intel operates its largest back-end chip factory in Vietnam, significantly contributing to local semiconductor capacity (Guarascio, 2024; Hong Phuc, 2025). These investments are transforming Vietnam from a low-cost assembly base into a sophisticated hub for assembly, testing, and emerging design within the global semiconductor value chain.

5.1.3. Developing supporting industries and enhancing technological capabilities

FDI expansion in Vietnam not only brings capital but also improves technological capacity and workforce quality in the semiconductor industry. Companies like Intel, Samsung, Infineon, and Amkor have established manufacturing plants and R&D centers, implementing technical training, technology transfers, and advanced production processes for Vietnamese engineers and technicians. These efforts have raised professional skill levels and fostered supporting industries. Through collaborative training, technology transfer, and infrastructure development, Vietnam is gradually building a sustainable semiconductor ecosystem. This supports enhanced global competitiveness and deeper integration into global value chains.

5.2. Challenges

5.2.1. Intrinsic challenges in developing a domestic supply chain

Vietnam faces several intrinsic challenges in developing a resilient domestic semiconductor supply chain. A major issue is the severe shortage of high-quality human resources, with only around 5,000 semiconductor engineers available, less than 20% of current demand while training capacity remains limited and brain drain persists. Additionally, the industry suffers from a fragmented and underdeveloped ecosystem lacking local suppliers, R&D capacity, and fabrication facilities, making Vietnam heavily reliant on foreign partners and vulnerable to supply disruptions. Infrastructure gapsincluding unstable energy, inadequate logistics, and insufficient clean water further constrain the country's ability to attract large-scale semiconductor investment. Lastly, a weak domestic market and limited local enterprise participation, with only a few active players like Viettel and FPT, hinder Vietnam's efforts to build internal capacity and integrate more deeply into global value chains (Khe, 2025).

5.2.2. Intense external competitive pressure

Vietnam faces fierce competition regionally and globally to attract semiconductor investment. Within Southeast Asia, countries like Malaysia, Indonesia, and Singapore already possess more advanced semiconductor ecosystems and are actively attracting investment in key stages like chip assembly, testing, and manufacturing (Source of Asia, 2025). These nations are emerging as viable alternatives to China, pushing Vietnam to compete in terms of infrastructure, operational costs, and investment incentives. Globally, Taiwan, South Korea, China, and India present even greater competitive pressure, given their established technological capabilities, long-standing experience, and well-developed supply chains (Khe, 2025).

Furthermore, while Vietnam possesses an advantage in rare earth reserves, the country still lacks the capacity to process and supply key strategic materials independently. This forces Vietnam to rely heavily on external suppliers for essential inputs. However, the global semiconductor supply chain is dominated by a few countries, notably the U.S., Taiwan, South Korea, Japan, and especially China, which supplies strategic materials namely germanium and gallium arsenide (Kleinhans and Baisakova, 2020, Jia et al., 2022). Vietnam's geographic proximity to China and other sensitive regions, political tensions, export restrictions, or sanctions affecting China could disrupt material flows and seriously undermine Vietnam's efforts to build a resilient semiconductor industry.

5.2.3. Risks arising from the US-China trade tensions and policy volatility

Vietnam benefits from the “China+1” strategy as companies diversify supply chains away from China. However, this also puts Vietnam in a sensitive position within the semiconductor sector. The US is increasing control over the semiconductor supply chain and imposing stricter export restrictions on technology destined for China. Vietnam risks being caught in the crossfire if suspected of allowing Chinese goods to bypass US sanctions by routing through Vietnam, which could lead to tariffs or stricter regulations.

Additionally, the US Department of Commerce has initiated a national investigation into imported semiconductors to assess their national security impact and explore possible export restrictionsfpt. This reflects Washington’s use of semiconductor supply chain controls as a strategic tool. For Vietnam, these geopolitical maneuvers create new risks and highlight the need for transparency, compliance, and careful positioning within global supply chains to avoid unintended consequences of the US-China rivalry.

6. Implications for Vietnam to enhance its semiconductor industry

6.1. Government

To build a flexible and resilient semiconductor supply chain, the Ministry of Finance and the Ministry of Science and Technology should spearhead the development of detailed policy roadmaps. These should outline benchmarks for integrated circuit (IC) design output, quotas for public R&D investment, and measurable workforce development targets. These instruments would enhance contingency planning by allowing for regular performance tracking and adaptive resource allocation. In parallel, these ministries alongside the Ministry of Planning and Investment—should establish semiconductor-specific funding mechanisms, such as competitive research grants, targeted tax incentives, and matching funds. These financial tools not only lower innovation risks but also promote deeper public-private collaboration, which is essential for long-term adaptive capacity.

Furthermore, the Ministry of Construction, in coordination with provincial People’s Committees, should prioritize upgrading infrastructure in existing high-tech zones like Saigon Hi-Tech Park and Hoa Lac Hi-Tech Park. Upgrades to logistics systems, utility networks, and permitting processes will significantly improve infrastructure flexibility and responsiveness to evolving industry needs. Lastly, the Ministry of Industry and Trade and the Ministry of Foreign Affairs must adopt a proactive trade policy. By leveraging trade agreements such as the CPTPP, EVFTA, and RCEP, Vietnam can diversify export markets and reduce vulnerability to geopolitical shocks. These ministries should also establish an early warning system to monitor global trade disruptions and ensure that both domestic and FDI firms are represented in international semiconductor dialogues to safeguard Vietnam’s strategic interests.

6.2. Industry and Business Associations

Industry associations such as the Vietnam Association for Supporting Industries (VASI) and the Vietnam Chamber of Commerce and Industry (VCCI) should take the lead in strengthening domestic supply chain capabilities. By developing national supplier directories, hosting sourcing events, and implementing vendor certification programs, these organizations can help reduce Vietnam's dependence on foreign inputs and expand its local supplier base. Semiconductor firms themselves should also engage more actively in shared R&D labs and technical support units located in high-tech parks. This collaboration would facilitate technology transfer and build a more innovative and resilient ecosystem.

Moreover, companies are encouraged to strengthen their linkages with academia by offering internships, contributing to curriculum development, and serving as adjunct instructors. These collaborations are vital to developing a skilled workforce and enhancing operational flexibility. To ensure policy alignment and amplify the industry's voice, firms should also participate in a Semiconductor Trade and Policy Forum coordinated by VCCI to help synchronize private sector needs with government priorities and position Vietnam in global semiconductor standards-setting discussions.

6.3. Academia and Training Institutions

To address workforce constraints, the Ministry of Education and Training should revise accreditation requirements to allow universities to offer semiconductor-related programs even without full-time faculty. Recognizing qualified industry professionals as adjunct instructors would ensure program continuity and industry relevance. In addition, the National Innovation Center (NIC) should play a brokerage role by connecting universities with leading semiconductor firms to launch cooperative education programs that combine classroom instruction with hands-on factory experience—vital for producing job-ready graduates.

Academic institutions should also enhance their student outreach by promoting semiconductor career paths through company-led campus events, marketing campaigns, and targeted scholarship programs. These efforts will help increase enrollment in technical disciplines aligned with industry demand. Finally, the Ministry of Home Affairs should fund and coordinate regional training centers that focus on practical skills like chip packaging, inspection, and quality control. These centers will support localized contingency planning while ensuring alignment with industry needs

6.4. Development Partners and International Cooperation

Vietnam's resilience strategy must also be supported by strong international partnerships. The Ministry of Industry and Trade and the Ministry of Foreign Affairs should work to establish targeted technology cooperation agreements with strategic partners such as Japan, South Korea, Taiwan, and the European Union. These agreements should prioritize access to advanced materials, fabrication tools, and technical training, all of which are critical to supply chain diversification and contingency preparedness.

In addition, Vietnam should collaborate with key development partners like JICA, USAID, and the World Bank to fund research in alternative semiconductor materials, refurbished equipment usage, and circular economy practices. Such initiatives not only bolster sustainability goals but also strengthen the country's capacity to withstand external shocks and ensure long-term supply chain resilience.

7. Conclusion

The US-China trade war has been creating profound changes to the global semiconductor supply chain due to export controls, tariff barriers and escalating geopolitical tensions. In this context, building supply chain resilience has become a strategic imperative for both countries and businesses involved in the industry. For Vietnam, this shift presents both opportunities and challenges. The relocation of supply chains from China has opened doors for Vietnam to attract major technology firms such as Intel, Samsung, and Amkor, especially in assembly, testing, and packaging. With a favorable location, competitive labor costs, and a growing electronics sector, Vietnam is gradually gaining a foothold in the regional semiconductor landscape. However, key challenges remain, including dependence on Chinese materials and equipment, limited high-tech production capacity, uneven infrastructure, and a shortage of skilled human resources. To address these, Vietnam should implement practical policies, upgrade high-tech parks, expand talent training, diversify supply sources through global partnerships, and strengthen trade policies to enhance semiconductor resilience and transform into a leading semiconductor hub in Southeast Asia.

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