Policy brief

Supply chains and geopolitical crisis

The semiconductor industry and case of Malaysia

By Jaideep Singh, Angeline Tan, Rishika Chauhan, Matthew Moran and Daniel Salisbury
Foreword by Datuk Prof Dr Mohd Faiz Abdullah

December 2025

Institute of Strategic & International Studies (ISIS) Malaysia

ISIS Malaysia

The Institute of Strategic & International Studies (ISIS) Malaysia was established on 8 April 1983 with a mandate to advance Malaysia's strategic interests. As an autonomous research organisation, we focus on foreign policy and security; economics and trade; social policy and nation-building; technology and cyber; and climate and energy.

We actively conduct Track 2 diplomacy, promoting the exchange of views and opinions at the national and international level. We also play a role in fostering closer regional integration and international cooperation through various forums, such as the Asia-Pacific Roundtable, ASEAN Institutes of Strategic & International Studies network, Council for Security Cooperation in the Asia-Pacific, Pacific Economic Cooperation Council, Network of East Asian Think-Tanks, Network of ASEAN-China Think-Tanks and ASEAN-Australia-New Zealand Dialogue.

King's College London

The Department of War Studies at King's College London is a world-leading academic department dedicated to the interdisciplinary study of conflict, security and international politics, with research and teaching spanning undergraduate to PhD levels. It is one of the few departments globally focused on understanding the complex realm of war, peace and security through integrated teaching, research and engagement. Cutting-edge research underpins a wide range of public engagement activities, including events, news features, podcasts and impact initiatives. The department facilitates interaction and knowledge exchange between the study and practice of security and foreign policy by providing expertise and insight to policymakers, parliamentarians and industry in Britain and beyond.

Contributors

Jaideep Singh is an analyst in the Economics, Trade and Regional Integration team at ISIS Malaysia. His research focuses on industrial and trade policies, including their interplay in geoeconomics. His work has been featured in The Diplomat, *Washington Post, South China Morning Post, Al Jazeera English* and Lowy Institute's The Interpreter. He served as a former special officer to the deputy investment, trade and industry minister and a former Overseas Development Institute fellow in Zanzibar, Tanzania.

Angeline Tan is an analyst in the Foreign Policy and Security Studies team at ISIS Malaysia. Her primary research looks into Chinese foreign policy, including the Belt and Road Initiative and South China Sea. She is also interested in Japan's strategic approaches to Southeast Asia and the impact of the US-China's tech rivalry on the region. In particular, she has been researching about the chip war and its implications in the Indo-Pacific.

Dr Rishika Chauhan is a Post-Doctoral Researcher and Sessional Lecturer based at the Department of War Studies at King's College London. She has held teaching and research positions at the University of Delhi, Observer Research Foundation, Indian Pugwash Society, Boston University and Yale-NUS College. She was also a member of the 2024 UK Sanctions Implementation and Strategy Taskforce, constituted by RUSI, London.

Dr Matthew Moran is Professor of International Security and head of the Department of War Studies at King's College London. His research spans a range of security-related issues and he has published on subjects ranging from the Iranian nuclear challenge to the coercive effects of sanctions. His latest book is *Coercing Syria on Chemical Weapons: A Case Study of Deterrence and Coercive Diplomacy* (Oxford University Press, 2025).

Dr Daniel Salisbury was a visiting research fellow at the Centre for Science & Security Studies (CSSS) within the Department of War Studies when this report was written. He is currently Senior Fellow for Nuclear Arms Control, Non-Proliferation and Disarmament at the International Institute for Strategic Studies (IISS) based in Singapore.

Table of contents

Foreword

A salient feature of international trade today is the strong presence of interlinked global supply chains in the manufacturing sector. In the pursuit of economic efficiency and cost effectiveness, business operations across many industries have become increasingly international, involving differentiated processes in different countries. Nowhere is this more evident than in the semiconductor industry.

Describing them as "the new oil" doesn't quite do justice to the fact that semiconductor devices or microchips are effectively the brain behind modern life towards civilian as well as military uses. Hence, it cannot be overstressed how critically important semiconductor supply chains are and how dependent they are on specialised hubs for design and production across North America, Europe and East Asia. As the world's sixth largest semiconductor exporter, Malaysia is an indispensable part of this ecosystem.

However, the global nature of semiconductor supply chains is inherently vulnerable and highly prone to disruption. Both man-made and natural crises, such as geopolitical competition and pandemics, threaten to upend the seamless movement of goods and capital needed to keep the industry and the world at large running. For Malaysia, the stakes are high, given the sector's substantial contribution to its economy.

This policy brief, produced in collaboration with the Centre for Science & Security Studies within the Department of War Studies at King's College London, explores the factors that contribute to supply chain vulnerability and proposes recommendations to enhance national resilience. A crucial angle in this analysis is our case study of Malaysia's semiconductor industry, which is the first in recent years to map the diverse profile of its semiconductor trade and investment across the supply chain.

This interdisciplinary work emphasises the need for countries to prioritise policies that build agility and promote economic security. As global economic and technological competition intensifies, Malaysia's relevance in the semiconductor landscape depends on its capacity to adapt to external shocks and address domestic challenges with clarity and purpose.

Datuk Prof Dr Mohd Faiz Abdullah
Chairman
Institute of Strategic & International Studies (ISIS) Malaysia

1 Introduction

1.1 Overview of supply chains

Over the past three decades, globalisation has created unprecedented opportunities for economic growth. The progressive integration of the world's economies, driven by new technologies and liberal trade policies, has created conditions that allow more of the global population to access more advanced consumer goods and services than ever before.

At the centre of this interconnected system are global supply chains. These are the international, interdependent networks of supply and production that support the journey from supplier to consumer. From the late 1990s onwards, considerable attention was devoted to the various ways that "cross-border production and supply chain arrangements ... could improve the efficiency of even the most complex manufacturing processes".[1] Today, these networks "have become the world economy's backbone and central nervous system".[2] Companies now depend on geographically dispersed "chains of specialised suppliers rather than a vertically integrated model of production, where one company performs most tasks".[3]

Supply chain arrangements bring enormous benefits in terms of efficiency, speed and flexibility. At the same time, increased interconnectivity and dependencies also raise risks. Global supply chains of growing length and complexity are now more prone to disruption than ever before. Simply put, "you are left vulnerable when you depend on a single supplier somewhere deep in your network for a crucial component or material".[4] And the drivers of disruption are many and varied, ranging from natural disasters to cyber-attacks, and from state conflict to public health emergencies.

1.2 Semiconductor supply chains: significance and significant

One specific area of vulnerability is found in semiconductor supply chains. Semiconductors, commonly known as integrated circuits or chips, have been described as the "essential building blocks of electronic devices, forming the foundation upon which modern technology is built".[5] They are present in technologies of all kinds, from refrigerators to missile guidance systems, and enable "the creation of increasingly powerful and energy-efficient systems that drive innovation".[6]

Given their importance and the widespread nature of their use, little surprise that semiconductors hold enormous strategic significance. Thadani and Allen argue that the "semiconductor industry and its supply chain increasingly rival oil and gas in terms of their importance to international relations, the attention they receive from senior leaders in government and business, and their use as a tool of foreign policy."[7]

This strategic dimension to semiconductors means that demand far exceeds supply and there is fierce competition over their acquisition. No single state has developed all the required technologies to produce advanced semiconductors. Production relies on a small number of firms in a handful of countries – mostly in the Indo-Pacific – some of which are at the epicentre of strategic competition between global powers. In short, supply chains involving semiconductors are inherently vulnerable.

With semiconductors, the risks are even more acute. Their centrality to technology means that even minor disruptions could have important consequences and large-scale disruption would be hugely consequential for economic, military and social activity. One industry source, for example, estimates that conflict disrupting and damaging key aspects of the semiconductor supply chain could set the global economy "back at least 20 years".[8]

1.3 Impact of geopolitical crisis on supply chains

Against this background, this report seeks to explore the intersection of geopolitical crisis and supply chain surety. It considers the potential for geopolitical crises to disrupt semiconductor supply chains. The analysis includes a typology of crises with geopolitical and supply chain implications. The report then considers how supply chain resilience might be enhanced. It draws on international best practice and newly emerging approaches, setting out recommendations for enhanced supply chain resilience.

This report uses Malaysia as a case study to explore the vulnerabilities and mitigation efforts of a medium-sized player in the semiconductor manufacturing sector. Over five decades, Malaysia has emerged as a critical node in global semiconductor supply chains. It is now the world's sixth largest semiconductor exporter, supplying major markets worldwide while attracting substantial foreign direct investment.[9] This deep integration, coupled with the industry's sizeable contribution to the national economy, makes Malaysia both indispensable and exposed to supply chain shifts. As a case study, Malaysia could help illuminate some of the key challenges and risks facing countries that are key players in the semiconductor space.

The report is structured in six parts. Building on the introduction, **Section 2** considers the concept of geopolitical crisis and associated risks. To aid discussion, it sets out a loose typology of crises, their likelihood and impact. Building on the crises and potential for disruption, **Section 3** moves to focus on supply chains and the vulnerabilities that make them susceptible to disruption. The key question underpinning this section is: what are the factors that contribute to supply chain vulnerability? **Section 4** considers the issue of resilience and how this can be developed in global supply chains. **Section 5** sets out the case study of Malaysia. The section explores Malaysia's emergence as a critical node in global semiconductor supply chains and considers some of its risks and vulnerabilities. It also highlights measures being considered or pursued by relevant authorities in Malaysia. **Section 6** concludes and presents some recommendations for measures that could enhance supply chain resilience, both in Malaysia and more broadly.

2 Geopolitical crisis and supply chain disruption

In the current international context, the prospect of geopolitical crisis is seen as the greatest threat to international markets and the global economy.[10] Broadly speaking, geopolitics describes the various ways that economic and political power is used to control networks, territory and physical features, as a means of generating or increasing influence.[11] Geopolitical crises can be generated directly by a political actor, as in Russia's invasion of Ukraine in 2022, or as a second-order effect, that is a by-product of unforeseen and possibly uncontrollable external events, such as in response to natural disasters.

From a business perspective, geopolitical crises can generate immense instability and could disrupt profoundly business operations, from operational challenges to financial stability, in unexpected ways. This is particularly the case with global supply chains, which form part of a delicate international ecosystem. With a distributed network model, crises on one side of the globe can have reverberations on the other side.

2.1 Typology of geopolitical crises

Table 1 provides a loose typology of crises to help frame the discussion of their nature and geopolitical effects. The typology is divided into two main parts by the origins of the crisis: the first part covers human crises, including conflict, other efforts to project political and economic power, and those resulting from isolated incidents or phenomena (Box 1 in Section 2.1.5). The second part includes crises with natural causes but that could have knock-on geopolitical effects or dimensions as governments and other actors seek to respond to them.

Each phenomenon is assessed by its likelihood of occurrence and potential impact, whether it is low (L), medium (M), high (H) or already occurring. Relevant examples of phenomena are also provided where applicable.

Table 1. Typology of geopolitical crises with supply chain implications

Origin	Phenomenon	Likelihood	Impact	Examples and remarks
Human (geopolitical effects)	Conflict (regional or global)	L	H	Potential clash between China, the United States and regional partners in Asia-Pacific
	Conflict (localised between regional actors)	L-M	M-H	Russian invasion of Ukraine (2022-present); Israel's Gaza War (2023-present)
	Grey-zone activity	Occurring	L-M	Russian covert action and sabotage efforts across Europe; competition over various territories and islands in South China Sea; cyber-attacks by state actors
	Terrorism	Occurring	L-M	Terrorist attacks on infrastructure and related government response

	Other violent non-state acts	Occurring	L-M	Somali piracy, Houthi missile attacks on shipping and related government response.
	Economic and technological competition	Occurring	L-M	Tariffs and export controls – as used in "chip war" (Box 3)
	Labour-related issues	Occurring	L-M	Labour shortages from bottlenecks in training and human resource development; industrial action in ports, logistics and/or manufacturing – e.g. US port worker strikes in late 2024 and early 2025
	Counterfeiting	Occurring	L-M	A growing threat to supply chain integrity, said to cost the US-based chip industry US$7.5 billion per year
	Wildcard events	Occurring	L-M	Smaller isolated incidents – largely at logistical and industrial nodes (Box 1)
Natural (second-order geopolitical effects)	Pandemic	L-M	H	Covid-19 – affected every country (Box 2)
	Epidemic	M-H	M	Avian flu caused an egg shortage in the US, causing prices to more than double
	Natural disaster with regional impacts	L-M	H	The 2004 Indian Ocean earthquake and tsunami destroyed critical infrastructure in affected areas, beyond the substantial loss of life
	Natural disaster with localised impacts	M-H	L	The Fukushima earthquake in 2011 had an impact on automotive and semiconductor supply chains

Source: KCL's analysis and tabulations
Note: L=Low, M=Medium, H=High

Regional and global conflicts

“Man-made” crises range from low-likelihood and high impact events, such as regional or global conflict, to events already occurring with lower to medium impacts. For example, war will inevitably have one of the greatest disruptive effects on global supply chains. Consider the conflict in Ukraine, which had a clear impact on supply chains into and out of Ukraine, including trade in grains. It also disrupted logistical networks, with commercial flights to and from the country suspended since 2022, and goods having to be moved by road or rail.[13]

This conflict also had second-order logistical effects. Many Western airlines, apart from avoiding Ukrainian airspace, have also been banned from Russian airspace in retaliation for Western sanctions, adding between two and four hours and associated fuel and personnel costs to routes from Europe or the US to Asia.[14]

With semiconductors in mind, the potential flashpoint that would have the greatest disruptive effect would be any conflict involving Taiwan, where 60% of the world’s semiconductors and more than 90% of the most advanced ones are produced. Conflict involving Taiwan, and disruption to the semiconductor manufacturing base, could cause an unprecedented global economic shock, potentially setting the world economy back decades.[15]

Other conflicts have also had knock-on effects on supply chains. The war in Gaza and tensions between the US and Iran saw the Houthi rebels in Yemen attack more than 60 vessels between October 2023 and March 2024 in the Red Sea, just below the southern end of the Suez Canal, disrupting shipping and raising costs. The Houthis have also previously targeted airports in Saudi Arabia with missiles.[16]

Sub-state and ‘grey-zone’ activities

Below the threshold of open conflict, grey-zone activities have also had an impact on supply chains. Russian efforts to wage hybrid warfare across Europe through covert action and sabotage have clear potential for disruption. For example, alleged Russian efforts to place an incendiary device in the cargo hold of commercial freight or passenger aircraft destined for the US could have huge ramifications for air cargo.[17] Russian efforts have also included sabotage of industrial facilities in Europe, including arson at manufacturing facilities in the UK and Poland.[18] Cyberattacks could also disrupt industrial operations.

Terrorist incidents have also been shown to impact on supply and logistical chains. The US government’s response to the 9/11 terror attacks, including delays at the Canadian and Mexican borders, caused extensive supply chain disruption.[19] Incidents can also cause significant disruption surrounding individual logistical nodes. For example, the crash of Metrojet Flight 9268, which exploded after leaving Sharm El Sheikh International Airport in Egypt in October 2015, was likely the work of a terrorist group. Flights were disrupted for several weeks after the incident while investigations were underway, stranding as many as 100,000 tourists.[20]

Other actions by sub-state actors can also create instability and disruption near to global logistical flows. For example, Somali pirates were linked to 1,068 attacks on ships resulting in 218 successful hijackings and the abduction of at least 3,741 crew members up to 2013. A World Bank study noted that in 2010 about US$1.6 trillion in global trade travelled along routes affected by piracy, and Somali piracy cost the global economy an estimated US$18 billion annually, including ransoms, insurance, security measures, rerouting and/or increased speed, or using other transportation modes.[21]

Economic and technological competition

Economic and technological competition has also disrupted supply chains. The US and other nations have in recent decades deployed sanctions and export controls. A particular focus in recent years has been high-performance semiconductors, a key component in the development of artificial intelligence (AI). The US has sought to prevent the transfer of these semiconductors and equipment for their manufacture to China. The struggle over this crucial technology has been described as a "chip war" (Section 3 and Box 4).

The second Trump administration has shown greater interest in using tariffs to reshape its international trading relationships, a tool also used and threatened the last time Trump was in office in 2017–2021 and later used by the Biden administration against China. The US imposing tariffs raises the costs of goods for US consumers, and sees industry scramble to renegotiate contracts, find alternative sources of supply, and related logistical routes. Following his entry into office in January 2025, tariffs have been imposed and lifted against most countries and a range of sectors, sometimes with hours' notice or for just several days before being lifted or paused. Tariffs and tit-for-tat responses have the potential to escalate into a broader trade war, as targeted economies respond in kind seeking to inflict economic pain to see the tariffs revoked.

Counterfeiting

Counterfeiting is a well-known and global issue that can undermine legitimate business, endanger consumers and create significant costs for governments. Counterfeits can infiltrate global supply chains through the production of seemingly high-quality components, which are sold through legitimate channels and passed off as genuine items. In the semiconductor sector, this might include, for example, unauthorised "cloned" microchips, created from stolen design information or the chemical washing of genuine chips and relabelling them as higher specification items.

This can have an impact on the supply chain in a number of ways, resulting in "high(er) costs, delays, lost sales, product recalls and even legal action."[22] Counterfeiting is also a highly dynamic phenomenon that can exacerbate the impact of other types of supply chain disruption, with counterfeiters looking to take advantage of opportunities where supply chain shortages are an issue. For example, the recent global semiconductor chip shortage, precipitated by the Covid-19 pandemic, led to counterfeiters flooding the market with chips.[23]

Countries may support counterfeiting operations in different ways. For example, in North Korea, counterfeiting is a state-directed enterprise, seen as a vital source of revenue, given its long-standing economic failings.[24] Other countries may support counterfeiting indirectly through their failure to establish laws that protect intellectual property (IP), lax labour market regulations and high levels of corruption.[25]

Wildcards

The category of "smaller isolated incidents or phenomena", essentially wildcards, is also included in Table 1 (Box 1 contains more information). These can have a huge impact if they occur at or near to logistical nodes. Ports can be dangerous places, with small errors in the movements of huge cargo ships being extremely damaging, as well as accidents hosting hazardous materials having disruptive effects. Also, terrorist attacks can trigger broader changes to processes, which can also impact supply chains that reverberate long after the attacks themselves.

Box 1. Wildcards: when small, and often isolated, incidents have enormous effects

A range of one-off incidents have had extensive impacts, affecting shipping, logistical hubs and industrial facilities.

- *Shipping disruptions*. In March 2021, the *Evergiven*, a 400m cargo ship capable of carrying 20,000 twenty-foot equivalent unit (TEU) containers, became lodged across the Suez Canal for six days. Almost 12% of global trade passes through the canal and the incident held up US$9.6 billion of trade each day.[26] Increasingly common lithium battery fires have also had disruptive effects, causing damage, diverting ships and affecting schedules. They are a major factor in the doubling of container ship fires in 2022 compared to 2021.[27]
- *Accidents at ports*. In August 2020, a large quantity of ammonium nitrate exploded at the Port of Beirut in Lebanon. The port, which typically processes 70% of the country's imports, was out of commission for several weeks.[28] In August 2024, a huge explosion on a container ship at the Port of Ningbo-Zhoushan in China, among the world's busiest, caused parts of the port to be closed for several days.[29]
- *Incidents at industrial facilities*. Fires and other incidents at factories can cause destruction, delays and knock-on effects.[30]

Source: KCL's analysis

Natural disasters

Crises derived from natural phenomena also can have geopolitical impacts and, by extension, impact on supply chains. The most extensive supply chain impact of a natural phenomenon in recent memory was the Covid-19 pandemic (Section 3 and Box 2), when many countries imposed lockdowns that curtailed economic activities. Changes in labour practices – as many workers moved to work remotely – heightened demand for certain products, including computers and IT equipment. The crisis had a geopolitical and geoeconomic dimension as different governments competed for personal protective equipment (PPE), vaccines and other goods to fight the pandemic.[31] In addition, countries expanded their use of non-tariff measures, such as export restrictions, ostensibly to safeguard domestic supply of medical products and equipment.[32]

Other natural disasters can also impact on supply chains, from huge regional events, such as the 2004 Indian Ocean earthquake and tsunami, which killed an estimated 230,000 people in 14 countries, to smaller more localised events. The 2011 Japanese earthquake and tsunami, which killed nearly 20,000 people, destroyed many industrial facilities, bringing effects on supply chains. For example, four large car manufacturers had plants in or near to the destruction zone, and the halt in production had knock-on effects for global auto markets.[33]

Extreme weather events, such as storms, flooding and droughts, exacerbated by climate change, may also adversely impact logistical hubs and manufacturing processes. For example, Taiwan has been suffering from severe drought since 2021, which has impacted wafer-fabrication facilities that require vast quantities of water to cool machinery and keep water sheets free of debris.[34] This has led to Taiwan adopting policies that restrict water use for agricultural purposes to ensure that its semiconductor industry has sufficient supply. [35]

2.2 Impacts of supply chain disruption

In sum, a wide range of crises, both fermented by geopolitical tensions and with potential geopolitical impacts, can disrupt global supply chains. The main impacts are as follows:

- *Time*. Disruption delays the speed at which goods can be moved through the supply chain. The reliance of many industries on just-in-time (JIT) business and manufacturing models, and the complexity of many goods, means the prospect for knock-on effects is extensive.
- *Product costs*. Disruption can lead to shortages in supply, and as demand rises, so can the costs of manufactured products.
- *Shipping costs*. Disruption, particularly when it affects logistical infrastructure or transport means, can also raise the demand for shipping capacity. For example, during Covid-19, shipping costs rose to US$15,000 per TEU from Europe to Asia in 2021, as compared to an average cost of US$1,200. Some retailers even paid as much as US$28,000 to move a TEU across the Pacific Ocean during the pandemic.[36] Other phenomena, such as the Houthi missile attacks on shipping, have also caused shipping costs to rise.
- *Insurance costs*. Relatedly, disruption, particularly involving potential damage to property or heightened risk of accidents, will raise insurance costs associated with shipping goods.[37]
- *Adaptation challenges and costs*. In cases where supply chains will not bounce-back, they will need to adapt, which can involve various costs and challenges.
- *Industrial output decline*. Broadly, disruption to supply chains decreases industrial output, resulting in a decline in revenue for affected companies and economies. It can also result in shortages of certain goods for consumers.[38]

3 Semiconductor supply chain vulnerabilities

Section 2 explored the nature of geopolitical crises and how these create risks and disruption for supply chains. Section 3 focuses on supply chains themselves and their vulnerabilities. Combining an understanding of geopolitical crises and their impacts with the vulnerabilities of supply chains allows for a more holistic approach to building supply chain resilience.

Since the early 2000s, research on supply chains has highlighted the negative impact of supply chain disruptions. These include "large financial losses, lost sales and … a negative impact on shareholder wealth and operating performance."[39] Considerable research has been devoted to analysing supply chain vulnerabilities – where vulnerability is defined as the "degree of fragility of a system"[40] – and how these should be managed, yet in practice, it seems that "the vulnerability of supply chains to disturbance or disruption has increased".[41] This statement dates from 2004, but remains relevant.

The problem here lies in the tension or indeed paradox at the core of global supply chains. Efforts to create efficiency have essentially also created vulnerabilities. A range of factors, from the drive to lower costs and increase efficiencies in production to the need for niche capabilities, have pushed companies to rely on:

1. actors and specialisms dispersed by geography;
2. actors and specialisms highly concentrated in certain regions;
3. a small number of highly specialised partners;
4. supply chains that are inherently and sometimes overly complex;
5. the timely or JIT despatch of goods;
6. industrial processes that take a long time to build and reconstitute.

The semiconductor industry provides clear examples of these vulnerabilities, being "inherently global, from the skills and economies of individual nations to the interwoven fabric of the businesses involved, to the distribution of natural resources."[42] This section explores six key characteristics of semiconductor supply chains that have led efficiency to foster vulnerability.

3.1 Geographical dispersal

To create efficiency, industrial capacity has often become dispersed around the world. Supply chains have seen specialised capacity become located in certain parts of the world and goods produced and moving between them.

For example, in the semiconductor supply chain, there is no single country or region that can undertake all the stages of the semiconductor manufacturing process to a high level. About 96% of electronic design automation (EDA) software is produced in the US. Much of the core IP is split between the US and Europe. The majority of wafer-production capacity is located in three East Asian countries. The US, Japan and Europe host most of the tool production. The bulk of fabrication capability is split between the US, Japan, South Korea and Taiwan.[43]

This means that different national-level and regional capabilities are dependent on the continued delivery and stability of aspects of the supply chain in different countries or parts of the world. Disruption to manufacturing activities in a single country or even at a single significant semiconductor company or manufacturing facility can cause knock-on effects down the supply chain. For example, semiconductor shortages during the Covid-19 pandemic (Box 2) were in part exacerbated by fires at two Japanese factories. In March 2021, fire at a Renesas production plant destroyed 5% of the clean room space. This is significant for a company responsible for 30% of the global market for microcontroller units used in vehicles.[44] Furthermore, the Renesas factory had been helping to relieve pressure on supply following an October 2020 fire at an Asahi Kasei Microdevices semiconductor plant, which paused output for at least a year.[45]

Box 2. Covid-19 and semiconductor shortages, 2020-2023

The pandemic caused unprecedented disruptions to supply chains worldwide. This was particularly visible in the semiconductor supply chains, with a global shortage beginning in late 2020 and lasting into 2023. The shortages were caused and exacerbated by a range of factors, including the surge in demand for IT equipment as many worked from home during the pandemic; developments in the US-China "chip war" competition (Box 3); growth of cryptocurrency mining activity; and the war in Ukraine.

Several "wildcard" events further squeezed supply. A drought in Taiwan reduced much-needed water used in manufacturing processes and two fires in prominent Japanese plants disrupted production extensively.[46] A winter storm in Texas shut down saw facilities for several months.[47]

At the centre of discussions of vulnerability and disruption, particularly related to the semiconductor supply chains, was JIT practices.[48] Driven by efforts to cut costs, these involve the purchase of goods with shorter lead times, seeing manufacturers keeping less inventory and incurring lower storage costs.

The pandemic exposed supply chain vulnerabilities and saw states and businesses work towards building further resilience. The uniqueness of the crisis made it hard to use previous learnings but the need for a proactive approach was felt across the industry.[49] For JIT practices, industry increased buffers by keeping larger inventory.[50] The need to foster resilience was acknowledged widely.

Source: KCL's analysis

The geographical dispersal of aspects of the supply chain and need to transfer raw materials, semi-finished products and finished products from one facility or country to another creates vulnerabilities. Many of the risks discussed in Section 2, particularly wildcard events, impacted on logistical routes and nodes. Avoiding disruption is key to the smooth operation of logistical nodes, and shipping and air transport.

3.2 High regional geographical concentration

The geographical location of key elements of the industry creates vulnerabilities. Many elements of the semiconductor supply chain are in the Asia-Pacific, an arena for high-technology as well as strategic competition between the US and China. The manufacturer of 60% of chips and 90% of the most capable is Taiwan and given cross-strait tensions under the one China policy, the risk of escalation and military action remains a concern.[51] The US and China, along with their allies and partners, have been indulging in a "chip war" for control over this critical technology (Box 3), which has affected many manufacturing states in the region. Other functions are also heavily concentrated in the region, such as wafer production, fabrication and tool production. Beyond geopolitical concerns, other natural risks are also high in the region, including major fault lines, creating the risk of earthquakes and tsunamis.

Box 3. 'Chip war': 21st century struggle over semiconductors

"Chip war" describes the geopolitical competition over the production of semiconductors and will be crucial to determining technological dominance and superpower status in this century. While states have competed over the technology as long as it has existed, the first signs of this new era of competition were seen in October 2022 when the Biden administration announced the implementation of export restrictions on advanced semiconductors and chip-manufacturing equipment. A year later, the US released a new set of rules that tightened the 2022 export control measures, combat loopholes that emerged and expanded the entity list. These restrictions were aimed at handicapping China's ability to produce advanced semiconductors that could threaten the American technological dominance.

Biden's export controls have had serious implications on the global semiconductor supply chain, creating disruptions and opportunities across the Indo-Pacific. Ironically, countries facing the most disruptions are US allies, such as Japan and Korea. Tokyo has consistently faced US pressures to follow suit by implementing restrictions on semiconductor-related exports to China,[52] while Japanese chip firms struggle to regain their global tech leadership in a highly competitive environment. South Korea has also faced a dilemma between its key security ally and China, its largest semiconductor trading partner.[53]

The most obviously impacted by the chip war's disruptions is China, which has responded with its own measures, including the Micron ban and export restrictions on critical minerals crucial to semiconductor production. Biden's export controls have prompted companies to pursue China Plus One strategies, whereby supply chains are diversified out of China to reduce risks and protect against shocks.[54] On the other hand, the chip war has created opportunities for some countries in the Indo-Pacific. The push for China Plus One has shifted investment flows into India, Vietnam and Malaysia,[55] which have less advanced semiconductor production capabilities and, therefore, thought to be less controversial bases in the context of the chip war.

Current US President Donald Trump aims to continue constraining China's position through export controls and tariffs. At the time of writing, the second Trump administration has both tightened and loosened export controls on chip exports, although no definitive measures have been announced amid ongoing US-China trade negotiations.

Source: ISIS Malaysia's analysis

3.3 Reliance on a handful of partners

Expertise and capability are also highly concentrated in a small number of countries and, in some cases, companies. The importance of Taiwan obviously creates vulnerabilities. More specifically, Taiwan Semiconductor Manufacturing Corporation (TSMC) is often cited as the manufacturer of 90% of the world's most advanced chips.[56]

The importance of a small number of firms (oligopolies) and, in some cases, one single firm (effective monopolies), also creates vulnerabilities. For example, the top five semiconductor manufacturers contribute around 75% of global value-added, giving them disproportionate power to affect the supply, and compounding the impacts of any disruption.[57]

ASML Holding in the Netherlands is the only manufacturer of extreme ultraviolet lithography (EUVL) photolithography machines used to manufacture the most advanced chips.[58] The machines are so specialised that only around 140 machines have been produced in the past decade, with each one retailing at US$200-300 million.

3.4 Complexity

The semiconductor supply chain is "remarkably complex".[59] The supply chain is constantly evolving and most entities within it have limited visibility of the supply chain and even less control over it. This creates vulnerabilities because it is challenging for states and businesses to understand the vulnerabilities and risks.

3.5 Reliance on just-in-time models

The widespread use of just-in-time (JIT) models also compounds the risks of disruption.[60] Efficiency is the objective, yet it places even more emphasis on smoothly functioning supply chains. The dispersion of specialised functions across different companies and countries complicates semiconductor supply chains, while exposing them to potential disruptions and increasing their vulnerability.

3.6 Time to reconstitute and bounce back

The nature of semiconductor technology creates supply chain vulnerabilities. Semiconductor technology is incredibly complex, has high barriers to entry, and capability takes huge financial investment and long-time scales to constitute. For example, semiconductor fabrication plants can take years to establish and cost billions. They also rely on high-end equipment subject to export controls. Skilled labour is hugely important and, in many countries, in short supply. This creates vulnerabilities because it makes backfilling for lost capacity more challenging and prevents states or companies from responding quickly to shocks and disruption.

4 How to build supply chain resilience

Given the wide array of geopolitical crises that can impact on semiconductor supply chains and their inherent vulnerability, it is important to consider how to reduce risks in this area. Here, the concept of resilience has risen to the fore, which in the context of supply chains can be defined as "preparedness for unexpected disruptions, which includes their ability to respond to, and recover promptly from prospective disruptions and return to their normal state or improved state." [61]

There are many different actions that states, governments and businesses can take, and are already taking, to enhance the resilience of their supply chains, such as devising new approaches and tools to navigate and manage crises, while reducing their vulnerabilities.

4.1 Supply chain resilience framework

A supply chain resilience framework, developed by the UK Department of Business and Trade, highlights five "options" for strengthening long-term resilience, recommending that multiple options, or indeed all, be pursued at once (Box 4). The UK's role in semiconductor supply chains is mostly related to R&D and intellectual property.

Box 4. UK Department for Business and Trade's supply chain resilience framework

1. **DIVERSIFICATION.** Identify alternate sources of supply to **create flexibility** in the supply chain.
2. **INTERNATIONAL PARTNERSHIPS.** Work with international partners to **identify common challenges** and strengthen the resilience of international supply chains and systems.
3. **STOCKPILING AND SURGE CAPACITY.** Identify where it may be beneficial to **hold stocks or strategic reserves** of components or goods which are vulnerable or at risk.
4. **ONSHORING.** Identify whether **increasing or expanding domestic capacity** might be helpful in reducing risks.
5. **DEMAND MANAGEMENT.** Identify whether it may be beneficial to **manage the demand** for a product considering substitutes and alternatives, innovation and circularity.

Source: Government of the United Kingdom (2022)

The US, which has substantial interests in most stages of the supply chain (besides wafer fabrication), takes a slightly broader view of resilience. As a Biden administration executive order (EO) dated June 2024, which at the time of writing remains in force under the Trump administration, notes:

> "More resilient supply chains are secure and diverse. Characteristics of resilient supply chains include greater domestic production; a diverse and agile supplier base; built-in redundancies; a reliable transportation system; secure critical infrastructure; adequate stockpiles; safe and secure data networks; reliable food systems; and a world-class, globally competitive American manufacturing base and workforce." [62]

The CHIPS and Science Act, passed in 2022 to incentivise domestic semiconductor manufacturing and retained under Trump, was formed as a centrepiece to counter China in the "chip war" (Box 3) alongside export controls on chips and related production equipment. It focuses on building resilience in the supply chain with billions of dollars of funding to boost R&D and manufacture of semiconductors in the US, effectively encouraging onshoring.[63]

Enacting these and other frameworks to strengthen resilience requires a shift from some of the historical tenets and thinking about semiconductor supply chain development, most notably the notions of adequate and unchallenged resources and cost-driven approaches.[64] Key stakeholders must now acknowledge that significant and prolonged supply chain disruptions may occur more regularly. As a result, future supply chains will need to be more dynamic and adaptable, with the ability to be reconfigured rapidly. Here, a delicate balance must be struck between efforts to increase resilience and the need for cost efficiency.[65] Achieving this will require the adoption of new supply chain management practices that provide deep real-time insights into supply chain risks and interdependencies.

4.2 Supply chain visibility

Accurate and timely information is essential in preparing and responding to a crisis. In the supply chain context, key information includes inventory levels, production processes, orders, purchasing plans and shipping status. The ability to track these elements at every tier is commonly referred to as supply chain visibility (SCV).[66] Developing capabilities in this area could improve the resilience of supply chains, through anticipating potential issues and bottlenecks, and supporting proactive mitigating actions.

However, this has proven to be a challenging task across all sectors, as highlighted by a McKinsey survey in 2021, which found that only 2% of companies had visibility of their supply chain below the second tier.[67] Without SCV up and down the supply chain, the impact of crises can be magnified, as demonstrated during the Covid-19 pandemic, which resulted in "insufficient visibility in supplier operations resulted in a major disruption in production at the buyers' end" in the semiconductor context.[68]

Efforts to improve SCV have accelerated in recent years, driven by a growing recognition of its importance following crises like Covid-19, as well as the availability of new technical tools and information systems that, if harnessed properly, have the potential to illuminate the extended supply chain. These include radio frequency devices (RFID), which are increasingly being used throughout the supply chain, to provide real-time data on raw materials and goods. Emerging technologies, such as AI and blockchain, could also be SCV game changers. The former can be used to extract and analyse vast quantities of data from a wide range of disparate data sources, while the latter can support the creation of a "trustworthy and tamper-proof audit trail".[69]

However, despite the promise of new technologies, for these to be effectively leveraged on, there needs to be increased information sharing both internally and externally up and down the supply chain. According to a recent Delphi study, there exist a few challenges, common to many sectors, that limit supply chain information sharing.[70] These include a lack of standardised systems and technical standards, concerns that sharing information might lead to a competitive disadvantage and organisational cultures that prioritise information protection.[71]

5 Semiconductor supply chains: the case of Malaysia

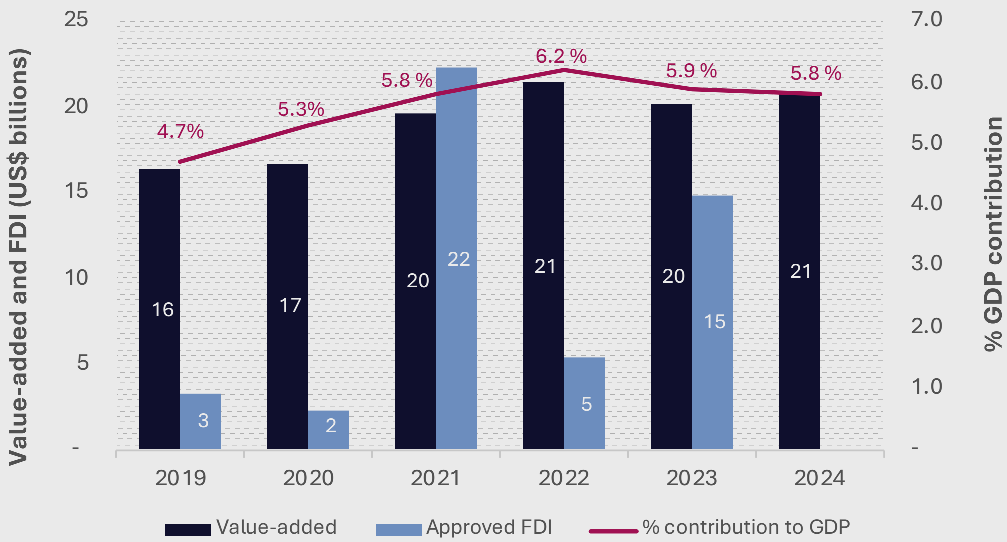
5.1 Overview of Malaysia's semiconductor industry and trade flows

The Malaysian case provides further insights into supply chain vulnerabilities and resilience in the context of semiconductor manufacturing. The country is a medium-sized player in the semiconductor industry yet has one of the highest intensities of semiconductor trade in the world, based on percentages of national trade flows. After providing some context on the Malaysian semiconductor industry, this section considers risks posed to resilience and risk-mitigation efforts.

The Malaysian semiconductor industry, established more than five decades ago, has emerged as both a major driver of the economy and a critical node in global semiconductor supply chains. In 2023-24, the sector contributed to almost 6% of GDP[72] and more than a third of approved foreign direct investment,[73] overseeing substantial growth compared with the pre-pandemic period (Fig. 1).

Fig. 1. The semiconductor industry contributes 6% to Malaysian GDP and more than a third of FDI flows

Total value-added and approved FDI inflows into the semiconductor industry (US$ billions, left) and industry contribution to annual GDP (%, right), 2019-24



Source: ISIS Malaysia's calculations based on Department of Statistics, Malaysia (2023 and 2025) and various Malaysian Investment Development Authority annual reports

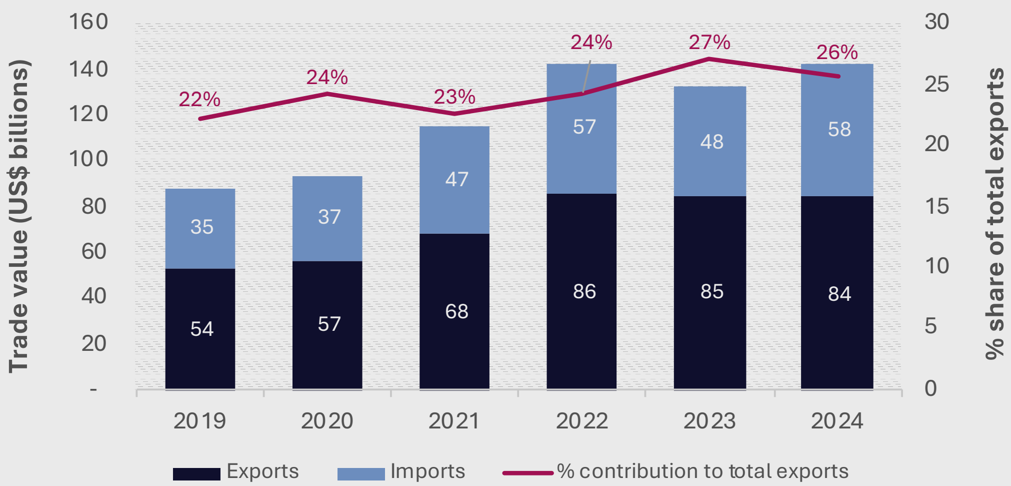
Note: Value-added figures represent the summation of two categories of goods as defined by DOSM, namely "electrical equipment" and "electronic components & boards, communication equipment and consumer electronics", which include the semiconductor industry and ancillary industries within the broader umbrella of electrical and electronic products. Approved FDI figures refer to "electronic components" alone, which are available only up to 2023 at the time of writing.

Since Malaysia's first free trade zone in Penang state in 1972,[74] Malaysia has established a foothold in the back-end segment of the semiconductor value chain. Today, the country has a strong global presence in semiconductor component manufacturing, as well as in assembly, testing and packaging (ATP) of microchips (Appendix A provides an overview of the semiconductor value chain), mainly in the northern Penang-Kulim cluster.[75]

Trade data reinforce Malaysia's criticality to the global semiconductor market. Semiconductor products constitute 27% of its total exports in 2024 (Fig. 2), a trading intensity that is unmatched in all but four countries (Appendix B). With almost US$85 billion in exports of semiconductor products, Malaysia ranks as the world's sixth largest semiconductor exporter, surpassing major economies like the European Union, Japan and the US in both absolute and relative trade flows.

Fig. 2. Malaysia's semiconductor exports total $85 billion, making it the sixth largest exporter

Semiconductor trade by value (US$ billions, left) and share of total exports (%, right)



Source: ISIS Malaysia's calculations based on UN COMTRADE (2025) Note: Henceforth, and unless otherwise stated, "semiconductors" refers to the sum of all products bearing the four-digit codes 8541 and 8542 in the World Customs Organisation's Harmonised System of tariff and trade classification in line with convention.

Malaysia's trading partners in semiconductor products are global, largely reflecting a combination of market size and proximity. Five key players – ASEAN, China, the US, the EU and Taiwan – account for about two-thirds of Malaysia's semiconductor exports (Fig. 3) and 80% of imports (Fig. 4). The other major East Asian economies – Hong Kong, Japan and South Korea – also feature in the top 10 across both exports and imports. This overall share has remained largely stable since the pre-pandemic period, though there have been shifts in individual economies' relative contributions in line with broader macroeconomic ebbs and flows.

It is important to note that neither of the two primary players in the chip war (Box 3), namely China and the US, ranks as Malaysia's largest semiconductor trading partner in exports or imports, underpinning its relative economic non-alignment in the major power rivalry. Instead, ASEAN is the largest destination for Malaysian semiconductor exports while Taiwan is the biggest source of imports, both of which have grown in importance since the pandemic. As it stands, Malaysia does not appear to be overdependent on any individual economy for semiconductor trade in the aggregate, which could provide a buffer in the event of an escalation in trade tensions.[76]

Fig. 3. ASEAN is Malaysia's top semiconductor export partner

Exports by key partners (% of total semiconductor exports), 2018-24

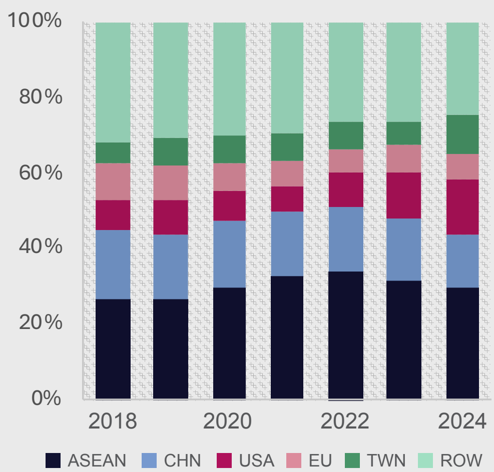
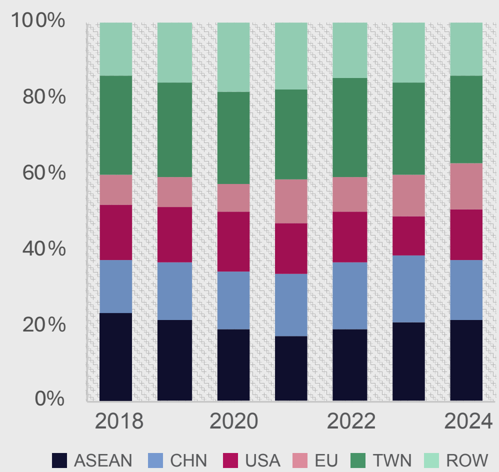


Fig. 4. Taiwan is Malaysia's largest source of semiconductor imports

Imports by key imports (% of total semiconductor imports), 2018-24



Source: ISIS Malaysia's calculations based on UN COMTRADE (2025)
Note: Henceforth, applicable jurisdiction names reflect ISO 3-digit or adjacent conventions. Figures for China refer to mainland China. ROW refers to the rest of the world.

Malaysia's criticality to semiconductor supply chains is further reinforced by its centrality to both American and Chinese trade in the sector. The US imports more semiconductor products from Malaysia than from any other trading partner, surpassing Taiwan and mainland China (Fig. 5). From China's perspective, Malaysia is its third largest importer and fourth largest trading partner in semiconductors (Fig. 6). It is, therefore, no coincidence that supply chain diversification since the start of the US-China trade war in 2018 has placed Malaysia on the radar as an alternative for companies looking for a viable China Plus One destination.[77]

Fig. 5. Malaysia is the US's largest trading partner in semiconductor products

Largest US semiconductor trading partners by export and import flows (US$ billions), 2024

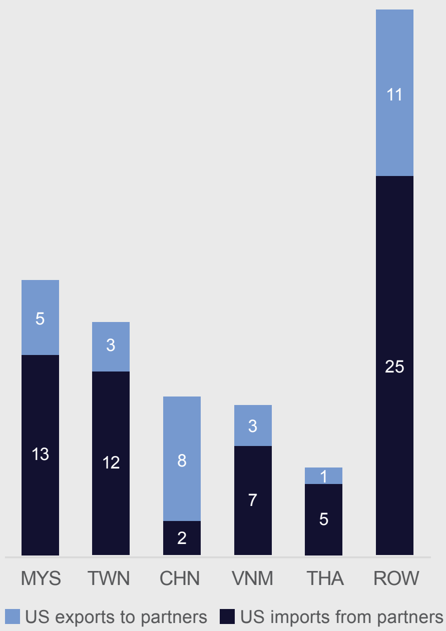
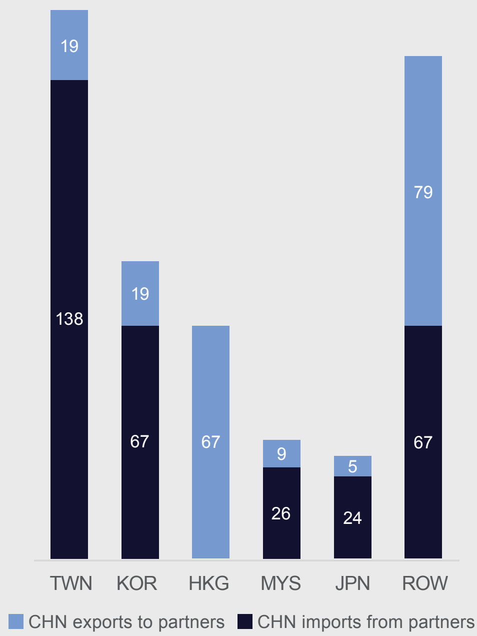


Fig. 6. Malaysia is China's 4th largest trading partner in semiconductor products

Largest China semiconductor trading partners by export and import flows (US$ billions), 2023

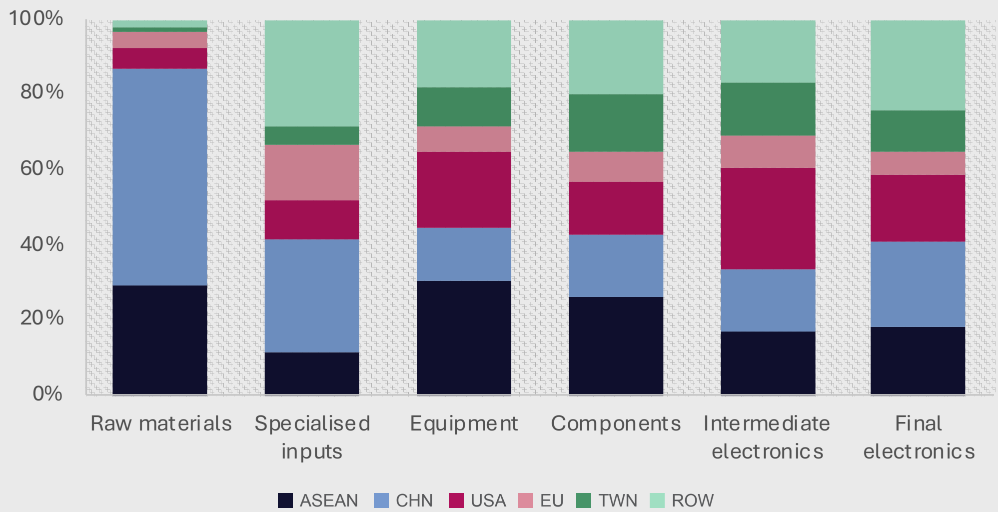


Source: ISIS Malaysia's calculations based on UN COMTRADE (2025)
Note: Reported American and Chinese imports from Malaysia may not be directly comparable to Malaysia's reported export figures in Fig. 3 and 4 due to methodological differences.[78]

Fig. 7 provides a disaggregated picture of Malaysia's semiconductor trade flows at every stage of the sectoral manufacturing supply chain (Appendix C breaks down the export and import decomposition). China is the dominant trading partner only in the acquisition of raw materials for semiconductor components – accounting for more than half of Malaysia's trade in silicon, germanium and gallium – a consequence of Chinese dominance in critical mineral production.[79]

Fig. 7. Malaysia has a diversified mix of semiconductor trading partners at most stages of the supply chain, except in raw materials

Composition of Malaysia's semiconductor trade by key partners at each stage of the supply chain (% share of total trade at every stage), 2024



Source: ISIS Malaysia's calculations based on UN COMTRADE (2025) Each stage of this supply chain consists of 6-digit HS codes adapted from mapping exercises by OECD (2019) and AMRO (2024).[80]

As the supply chain moves downstream, trade patterns become more diversified. In other words, beyond raw materials, no one country has more than a 50% share of Malaysia's exports or imports at any stage of the semiconductor supply chain. This is partly because specialised inputs and equipment for wafer and component production are sourced from a broader range of countries in line with the geographic concentration of the supply chain in specific processes.[81] The trend largely continues further down the supply chain, where ASEAN, China, the US, the EU and Taiwan are all notable partners in Malaysia's trade in intermediate semiconductor devices and final electronics.

From the perspective of investment, while approved FDI figures tend to fluctuate based on trends in the cyclical semiconductor industry, the post-pandemic years have seen an uptick in new projects and expansions from multinational corporations (MNCs). Table 2 provides a non-exhaustive list of MNC-backed semiconductor facilities that have opened in Malaysia since 2022, revealing a balanced portfolio of investment from the EU, the US, China and Taiwan, among others. Diversification also largely extends to domestic direct investment. Analysis by *The Edge* on the geographical exposure of Malaysian public semiconductor companies reveals that less than a third are reliant on just one market, whether it is China, Singapore, Taiwan or the US, for more than half of their revenue.[82]

Table 2. Many of the recent semiconductor facilities in Malaysia are set up by European and East Asian companies

List of major semiconductor facility openings in Malaysia since 2022

Year	Company	Country	Type of facility and location
2025	Neways	NLD	Manufacturing facility for advanced modules in Selangor
	JHT	CHN	Manufacturing facility for test handlers in Penang
	ASE Technology Holding	TWN	5th Penang plant for ATP activities, including advanced packaging
2024	Infineon	GER	Silicon carbide power fabrication plant in Kulim
	Benchmark	USA	4th Penang facility for semiconductor capital equipment
	Elna	TWN	2nd Penang plant to manufacture printed circuit boards
	Melexis	BEL	Wafer testing facility in Kuching
	AT&S	AUT	Facility in Kulim to produce substrates for chip packaging
	Ferrotec	JPN	Material fabrication for equipment in Kulim
2023	Bosch	GER	Automotive chip testing facility in Penang
	AEM	SIN	Semiconductor testing and handling facility in Perai
2022	Simmtech	KOR	Substrate and PCB manufacturing facility

Source: ISIS Malaysia's tabulations based on various news sources, adapted from Lee, J. (2024). *Southeast Asia and the Chip Wars: Navigating a Decoupling World*. Singapore: ISEAS-Yusof Ishak Institute. https://fulcrum.sg/southeast-asia-and-the-chip-wars-navigating-a-decoupling-world/

The Malaysian semiconductor industry is closely integrated into global supply and value chains, particularly through backward linkages whereby imported inputs are used to produce exported goods.[83] The country has established itself as a critical player in the semiconductor market, as evidenced by the scale and volume of its back-end manufacturing processes. Its diversified network of sectoral trading and investment partners provides a degree of resilience against supply chain disruptions. However, as a small and highly open economy,[84] Malaysia remains vulnerable to both external and internal risks that could challenge its resilience, as the next section explains.

5.2 Semiconductor supply chain risks and vulnerabilities in Malaysia

Building on the typology of crises outlined in Table 1, this section assesses key risks that could threaten the resilience of Malaysia's semiconductor industry. While multiple risks exist, the most immediate and consequential stem from intensifying economic and technological competition (Table 3). Malaysia also faces challenges related to geopolitical uncertainty, structural vulnerabilities and external disruptions that could impact on the industry's long-term stability.[85] Of course, wildcard events like those described in Box 1 could also occur but are no more likely to cause disruption to Malaysia than other elements of global supply chains.

Table 3. Assessment of the likelihood of crises and their impact on Malaysia's supply chain resilience

Crisis origins	Phenomenon	Likelihood	Impact	Examples and remarks
Human (geopolitical effects)	Conflict (regional or global)	L	M-H	The Ukraine war prompted raw material stockpiling and diversified procurement, which may have long-term implications on the industry[86]
	Conflict (between regional actors)	L-M	H	Escalation of tensions in the South China Sea or outbreak of conflict in the Taiwan Strait may disrupt shipping lanes
	Grey-zone activity	M	L	Potential harassment by Chinese vessels in the South China Sea may interfere with freedom of navigation and escalate tensions
	Terrorism	L	L	Low risk of terrorism, particularly those directly targeting supply chain infrastructure
	Economic and technological competition	Occurring	M-H	Expansion of Trump tariffs to Malaysia; major powers scrutinise Malaysia's foreign policies for risk aversion
	Labour-related issues	Occurring	L-M	Skilled labour shortages may cause disruption
	Wildcard events	L	L	Similar risks faced by facilities and infrastructure elsewhere in the world.

Crisis origins	Phenomenon	Likelihood	Impact	Examples and remarks
Natural (second order geopolitical effects)	Natural disaster with regional/ localised impacts	M-H	H	Sea level rise crippling Malaysia's port infrastructure

Source: ISIS Malaysia's analysis based on KCL's typology
Note: L=Low, M=Medium, H=High

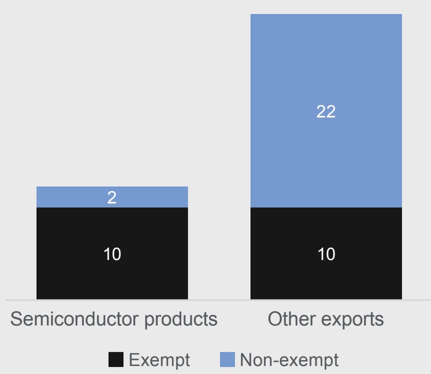
Escalating trade war and tariff risks

On 2 April 2025, the second Trump administration announced the introduction of "reciprocal" or country-specific tariffs on almost every nation, as well as a blanket 10% tariff on most US imports.[87] After a series of pauses and negotiations, Malaysia was assigned a tariff rate of 19%, which first came into force on 1 August[88] and was later formalised on 26 October in line with the Agreement on Reciprocal Trade (ART) between Washington and Putrajaya.[89]

At the time of writing, Washington's proposed tariffs notably exclude imports of selected semiconductor products and related electrical equipment. These exemptions amount to almost 81% of Malaysia's total semiconductor exports to the US and 45% of its total US-bound exports as of 2024 (Fig. 8), potentially muting the immediate impact on the sector's trade prospects. As of October 2025, the US trade-weighted tariff on Malaysia's semiconductors stands at 4.6%, rising from the pre-tariff effective rate of 0%.

Fig. 8. More than 80% of Malaysia's semiconductor exports exempted from Trump's 'reciprocal' tariffs as of October 2025

Value of Malaysia's semiconductor exports exempted from 'reciprocal' tariffs (US$ billions), 2024



Source: ISIS Malaysia's calculations based on UN COMTRADE (2025)

The medium-term impact of the White House's trade policy on Malaysia's semiconductor industry will depend on the extent to which the exemptions remain in place. At the time of writing, the Trump administration has indicated that separate product-specific tariffs will be introduced for semiconductors in line with Section 232 of the Trade Expansion Act, similar to those imposed on automobiles, steel products and pharmaceuticals.[90]

A full quantitative analysis of potential semiconductor tariffs is beyond this report's scope, given the uncertainty over the scope and depth of these tariffs.[91] However, Trump has floated the possibility of a 100% duty on semiconductor imports, with exemptions for companies with a manufacturing presence in the US.[92] The mechanics of exemptions for reshoring production to the US remain unclear, but given the significant presence of American multinational companies, such as Hewlett-Packard, Intel, Micron and Texas Instruments, operating in Malaysia's semiconductor ecosystem, the impact on the sector's trade and investment may be muted by such exemptions.[93]

At the same time, the US has highlighted that it may "positively consider" the ART with Malaysia, including "taking [it] into consideration" as part of its trade actions under Section 232.[94] This further suggests that at least some semiconductor exemptions may be preserved for Malaysia, thereby minimising any substantial negative substitution effect, in which Malaysian semiconductors become relatively less competitive than competing exports to the US from elsewhere.

Risk of supply chain bifurcation

Beyond tariffs, another risk factor is technological competition, specifically the potential bifurcation of semiconductor and adjacent supply chains. While the US and China have thus far primarily imposed export controls against each other,[95] it is increasingly likely that the two countries will attempt to limit third countries' ability to access key resources based on geopolitical considerations.[96]

As a China Plus One destination,[97] the push for diversification has so far benefitted Malaysia.[98] Accordingly, it has maintained a "neutral position" on these unilateral restrictions to date.[99] However, if the rivalry intensifies and begins to target third-party countries, bifurcation will put pressure on Malaysia's longstanding policy of nonalignment and force it to choose a side. As a major semiconductor exporter, this will inevitably pull Malaysia into the chip war, which will have significant implications on its industry and further pressure on its foreign policy.

Greater scrutiny over Malaysia's foreign policy

Malaysia's non-alignment makes it an appealing FDI destination, as it is conducive to a stable and low-risk business environment. Although Malaysia has long enjoyed a strong relationship with China, there have been speculations in recent years that it is aligning with Beijing.[100] This perception is fuelled by Malaysia's interest to join the BRICS grouping, which is often assumed to be China led.[101] Malaysia's bid for BRICS has also led to more high-level interactions with Russia in 2024, when Russia chaired the bloc. While an assessment of Malaysia's alignment is beyond the scope of this report, perceptions of its foreign policy orientation carry implications for investor confidence, particularly amid heightened geopolitical scrutiny of the semiconductor supply chain. Although these perceptions have not affected FDI to date, it may shape long-term strategic considerations. Before the chip war, Malaysia's foreign policy was rarely subject to such close scrutiny. This is especially delicate, given that the US is a major source of FDI, including in semiconductors.

Talent shortages as a structural vulnerability

According to industry stakeholders, Malaysia has a shortage of high-skilled talent to satisfy growing semiconductor industry demand. The government states that the sector needs 50,000 engineers annually in line with rising investments, yet local public universities produce only one-tenth of that figure.[102] A 2022 survey by the Malaysian Semiconductor Industry Association found that less than 1% of Malaysia's workforce in the sector had an advanced degree, with two-thirds of the talent and skill gap driven by insufficient industry-ready engineers.[103]

Related challenges include high turnover and brain drain of local engineers to countries perceived to have better employment prospects, such as Singapore.[104] These threaten the resilience and continuity of the local semiconductor industry by complicating efforts to attract investment and enhance Malaysia's positioning in more advanced segments of the value chain.

Maritime and logistical risks

As a maritime nation, Malaysia depends heavily on shipping routes to transport goods, with more than 90% of the freight volume[105] and 50% of its trade value taking place by sea, particularly through Port Klang.[106] As global supply chains become increasingly interlinked, even distant disruptions to freight flows can affect the seamless delivery of cargo. The Red Sea conflict in 2024, for instance, led to temporarily higher logistical costs because of cancellations and delays in deliveries.[107]

Additionally, climate change presents a threat to the continuity of Malaysia's port operations. Projections suggest that Port Klang, the town housing Malaysia's busiest port, is vulnerable to sea level rise in the coming decades,[108] which could affect both port and road infrastructure.[109]

5.3 Enhancing resilience

Several steps have been taken by the Malaysian government and industry to mitigate these risks and build resilience in the supply chain to the benefit of businesses and global supply chain surety.

Product diversification

Malaysia's recent industrial and investment policies emphasise the need to strengthen manufacturing resilience through activities that promote greater economic complexity and higher value addition. In semiconductors, this means expanding beyond the ATP segment by investing in front-end capabilities and advanced packaging[110] to reduce dependence on cyclicality in any individual segment.

The New Industrial Master Plan (NIMP) 2030 focuses on developing five local integrated circuit (IC) design companies in electric vehicles, renewable energy and artificial intelligence, and attracting global wafer fabrication companies.[111] The 2024 National Semiconductor Strategy (NSS) outlines further actions to create a "thriving" end-to-end semiconductor ecosystem, including training 60,000 engineers; earmarking funds for research, development, commercialisation and innovation; and securing US$110 billion in strategic investments.[112]

Although government fiscal support has been limited,[113] progress on these targets has materialised on a piecemeal basis, including through the 2024 opening of Malaysia's first IC design park in Selangor[114] and a March 2025 federal deal of US$250 million to acquire intellectual property from Arm Holdings, a British semiconductor design firm.[115]

Trade and investment diversification

While Malaysia has a globalised network of trading partners, the government has acknowledged the importance of continuing to diversify its economic partnerships, particularly as a safeguard against the escalation and expansion of the US-China trade war.[116] As the 2025 ASEAN chair, Malaysia has focused on boosting intra-ASEAN trade to build resilience and promote economic integration.[117] This includes efforts to develop an ASEAN Framework for Integrated Semiconductor Supply Chain (AFISS). [118]

In semiconductors, Malaysia has strengthened its collaboration with Brazil in IC design under their joint trade committee, overseeing new memoranda of understanding in 2024 between Malaysian and Brazilian research institutes as well as semiconductor industry associations.[119] Malaysia also elevated its relationship with India to a comprehensive strategic partnership, outlining greater commitment to science and technology collaboration, including in semiconductors, where there are substantial opportunities for policy alignment and R&D in line with their competitive advantages.[120]

As of October 2025, Malaysia ratified a free trade agreement (FTA) with the United Arab Emirates,[121] concluded negotiations on an FTA with South Korea[122] and resumed talks on an FTA with the EU.[123] Adding to Malaysia's 16 bilateral and regional FTAs, these arrangements could provide scope for deeper global semiconductor value chain integration through provisions on economic cooperation, the digital economy and capacity building.

Supply chain management

Malaysia's Ministry of Investment, Trade and Industry has announced preliminary plans to manage supply chain risk through a proposed traceability platform as part of broader supply chain mapping, though the status of this development is unclear at the time of writing.[124] At the regional level, AFISS was initiated during Malaysia's ASEAN chairmanship in 2025, but details remain brief at the time of writing. It envisions to promote regional coordination in semiconductor-related infrastructure, investment, innovation and talent development.[125]

Ultimately, Malaysia's semiconductor industry is well integrated into global supply chains and has largely benefitted from the shifting investment landscape driven by the chip war. Its diversified trade relationships and critical role in back-end semiconductor processes provide some resilience against shocks. However, risks from trade tensions, talent shortages and infrastructure vulnerabilities necessitate proactive mitigation strategies. Malaysia's non-aligned stance has served it well thus far, but intensifying geopolitical pressures may test the nation's ability to maintain this balance in the years ahead.

6 Conclusion and recommendations

Semiconductor supply chains are crucial to the functioning of technologies in the modern world, yet their vulnerability to geopolitical crises is clear. Building resilience is, therefore, hugely important to the future of global economic, social and military activity. This report has considered the range of crises that could potentially disrupt these supply chains, including those instigated by human activity and natural phenomena with geopolitical implications.

The report then highlighted a range of vulnerabilities specific to semiconductor supply chains. These include their dispersed nature, regional concentration, the importance of a small number of very specialised actors and high levels of complexity. The report has also discussed resilience as a concept to mitigate some of these risks.

The Malaysian case is used to explore the risks, vulnerabilities and resilience. Malaysia is a key semiconductor producing country and a mid-sized player in the broader semiconductor supply chain picture. The case study showcased Malaysia's interaction with a range of partners and investors. Neither the US nor China is the country's largest partners in the semiconductor business. The diversity of partners provides some resilience and Malaysia has largely managed to straddle the superpower rivalry rather than "take a side" at this point.

The country faces a range of risks, including many of those explored in Section 2, but these mostly surround economic and technological competition. The risks of tariffs and a potential trade war are perhaps major risks at this point, and Malaysia may be forced to pick a side in the "chip war". The case study also explored how the Malaysian government has sought to enhance resilience, including by diversifying its products and trade and investment, as well as undertaking supply chain risk management efforts.

Finally, this report seeks to highlight a range of recommendations to enhance supply chain resilience in the semiconductor industry, both in terms of broader recommendations as well as those stemming from the Malaysian case.

6.1 Broad recommendations

Build and share models of resilience. There is a limited understanding of the resilience concept, as well as its operationalisation, among government and industry. While some models have been presented (Section 4), they may need further tailoring to specific national contexts.

Supply chain mapping. The value of supply chain mapping and visualisation is increasingly recognised in the semiconductor industry and other sectors. For efforts in this area to lead to useful insights in support of enhanced resilience, there is a need to overcome barriers that limit the sharing of relevant information up and down the supply chain as well as the greater adoption of technologies, such as RFID, AI and blockchain.

Explore new technologies. New technologies may yield insights into supply chains, vulnerabilities and resilience. RFID, AI and blockchain could be used to undertake mapping of supply chains and powerful if used in combination. For example, RFID can be combined with blockchain to provide an auditable and immutable history of a product's journey, helping, for example, to reduce the risk from counterfeits by creating the ability to trace it back to its source.[126] AI tools can analyse vast quantities of RFID and other data to build up a real-time picture of an extended supply chain. This can then be stress tested through simulating different crisis scenarios and seeing how potential disruptions propagate through supply chains.

Red teaming. Red teaming exercises, or those where a group work to identify vulnerabilities, could help understand the vulnerabilities of supply chains and the potential impacts of various risk scenarios. They could also be used to raise awareness of the vulnerabilities and risks among officials and industry players.

Emergency preparedness and contingency planning. Many of the risks, particularly "wild cards" (Section 2), involve logistical nodes. Good emergency preparedness and contingency planning could help to prepare states and industry for disruption and allow them to bounce back and reconstitute quickly.

Public-private partnerships. The effective understanding of risks and vulnerabilities, as well as efforts to build resilience, relies on shared understanding between the government and the private sector. Building public-private partnerships is an important way to facilitate information sharing and discussion. Emphasis could be placed on building these at a national level, perhaps using a third party as a facilitator, such as a think-tank, trade association or university research centre.

6.2 Malaysian case specific recommendations

Strengthen diversification efforts to reduce dependence on a single partner. Policymakers may need to normalise the notion of operating in a "US plus one" world, at least while Washington's rhetoric remains rooted in isolationism and protectionism. This could, for example, take the form of continued regional cooperation in supply chains under the Indo-Pacific Economic Framework even without US buy-in, similar to the adoption of the Comprehensive and Progressive Agreement for Trans-Pacific Partnership (CPTPP) following American withdrawal in 2017.

Pursue a hedging strategy that minimises risk and maximises opportunities. Putrajaya should keep steadfast with a policy of non-alignment, maintaining strong relationships with all countries and maximising economic opportunities. This entails continued engagement with the US through government-to-government, government-to-business and business-to-business channels, even as Malaysia pursues opportunities to diversify into non-traditional markets. For instance, the government should ensure there is regular dialogue with the American Malaysian Chamber of Commerce to assure investors that Malaysia remains open to quality investment.

Formalise linkages between academia, government and industry. Tripartite cooperation under the triple helix model entails greater emphasis on research, development, commercialisation and innovation to upskill the workforce to meet industry demand and address industry talent shortage. Greater linkages must focus on strengthening data governance and sharing to support evidence-based decision-making. One practical way of promoting industry-government engagement is through regular ministry-led workshops involving crucial private sector stakeholders, such as the Malaysia Semiconductor Industry Association.

Solidify government's role as facilitator of industrial growth. In the short and medium term, the government should ramp up fiscal contributions for NSS and NIMP 2030 as indicated in these policy plans to signal state commitment in line with the mission-oriented model of innovation. Additionally, Malaysia could explore the possibility of increasing the national stake in semiconductor operations through joint ventures with foreign players, which might help mitigate risks of sudden or unilateral closures.

Maximise FTAs and related economic arrangements. Malaysia must work towards promoting the effective utilisation of its existing FTAs, with a focus on implementing provisions that call for capacity building and cooperation. Greater collaboration should be based on comparative advantage and policy complementarities across industrial strategies. For instance, the UK and Malaysia as parties to CPTPP could deepen semiconductor cooperation through efforts to encourage British fabless design companies to outsource segments of the semiconductor manufacturing process to Malaysia.

Appendix A: overview of the semiconductor value chain

The production of semiconductors begins with the **design of integrated circuits** (IC), a process that relies on electronic design automation software and dedicated intellectual property. This stage, which results in blueprints outlining the chip's specifications and requirements, represents about half of the semiconductor industry's total value-added.

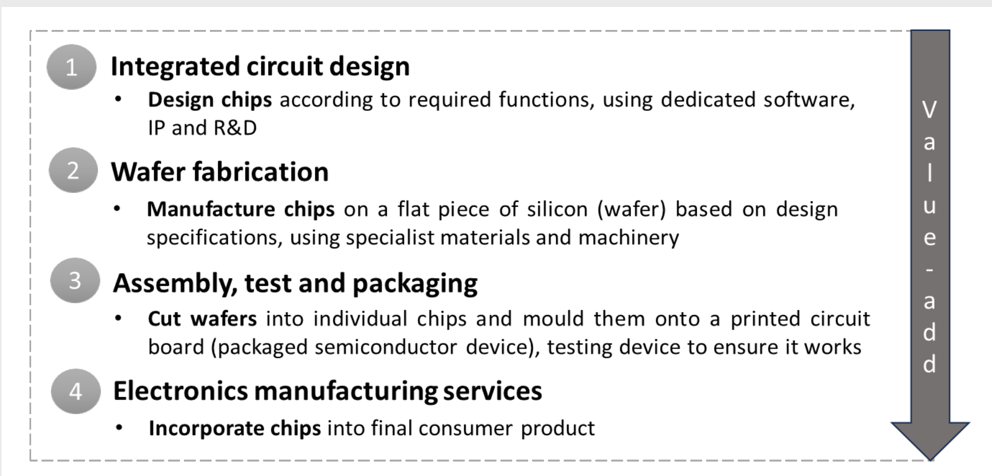
Next is **wafer fabrication,** the front-end of chip manufacturing. The designed IC is printed onto an 8-12-inch flat piece of silicon (called a wafer) using raw and processed materials and specialist machinery in a foundry. This stage accounts for about a quarter of total value-added.

The third stage is the back-end of chip manufacturing involving **assembly, testing and packaging.** Wafers are cut into individual chips, moulded and packaged onto a printed circuit board (PCB), which are then tested for performance and functionality. This stage contributes about 5% of industry value-added.

Finally, **electronics manufacturing services** incorporate the packaged PCBs into final consumer electronic products.

Fig. A1: The semiconductor value chain consists of four major steps from design to the final consumer product, decreasing in average value-addition along the way

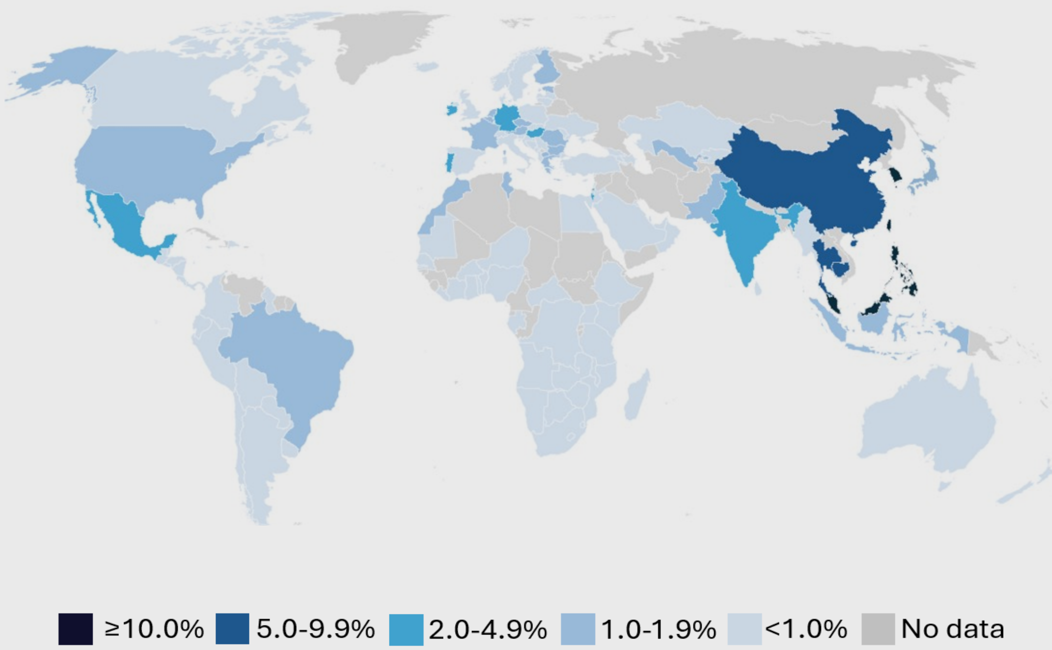
Stages of the semiconductor value chain



Appendix B: intensity of semiconductor trade by country

Fig. B1. Malaysia has the world's fifth highest intensity of semiconductor trade

Share of semiconductor trade to total trade flows by country, 2023

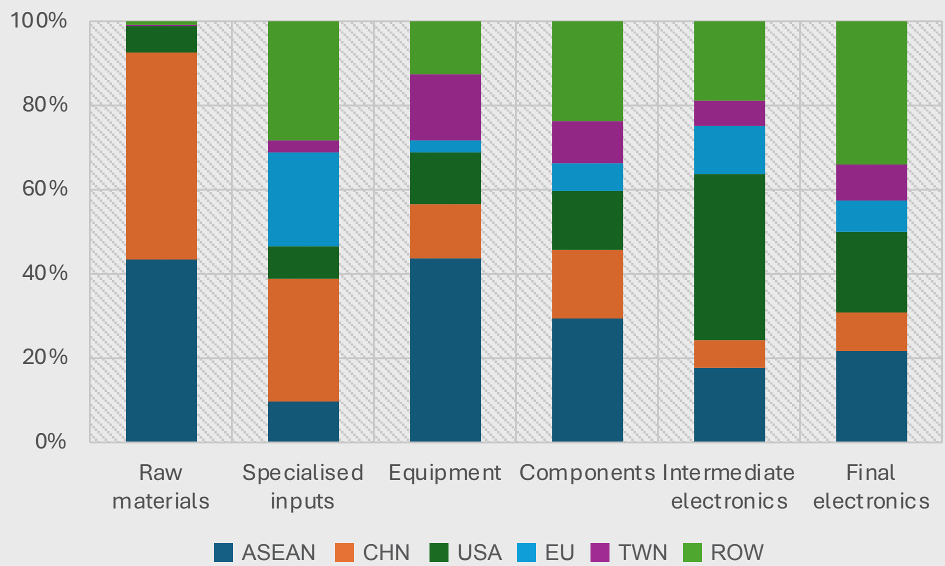


Source: ISIS Malaysia's calculations based on UN COMTRADE (2025)

Appendix C: Malaysia's largest export and import partners across the semiconductor supply chain

Fig. C1. China is Malaysia's largest export partner in upstream segments while ASEAN and the US are the top export destinations in the midstream and downstream

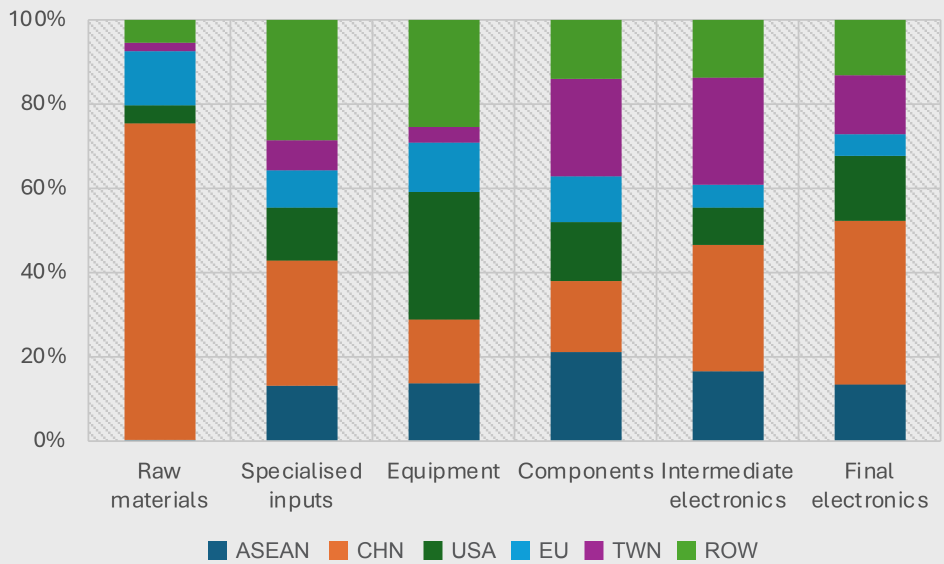
Composition of semiconductor exports by key partners at each stage of the supply chain (% of total semiconductor exports), 2024



Source: ISIS Malaysia's calculations based on UN COMTRADE (2025)

Fig. C2. China is Malaysia's dominant import partner in the upstream and downstream while midstream products are sourced from a more balanced mix of countries

Composition of semiconductor imports by key partners at each stage of the supply chain (% of total semiconductor imports), 2024



Source: ISIS Malaysia's calculations based on UN COMTRADE (2025)

Notes and references

1 Alfaro, L. and Chor, D. (2023). Global supply chains: The looming "great reallocation" (Working Paper No. 31661). National Bureau of Economic Research. https://www.nber.org/system/files/working_papers/w31661/w31661.pdf

2 Cattaneo, O., Gereffi, G. and Staritz, C. (2010). Global value chains in a postcrisis world: Resilience, consolidation, and shifting end markets. In O. Cattaneo, G. Gereffi, & C. Staritz (Eds.), *Global value chains in a postcrisis world: A development perspective* (p. 7). Washington, D.C.: World Bank

3 Lewis, J. A. (2022). *Supply Chain Sovereignty and Globalization*. Washington, D.C.: Center for Strategic and International Studies. https://www.csis.org/analysis/supply-chain-sovereignty-and-globalization

4 Shih, W. C. (2020). *Global Supply Chains in a Post-Pandemic World*. *Brighton,* MA: Harvard Business Review. https://hbr.org/2020/09/global-supply-chains-in-a-post-pandemic-world

5 Shamaei, A (2024). *Role of Semiconductors in AI, Analytics and Edge Computing*. https://ashamaei.medium.com/role-of-semiconductors-in-ai-analytics-and-edge-computing-f1b81282abfe

6 Ibid

7 Thadani, A. and Allen, G. C. (2023). *Mapping the Semiconductor Supply Chain: The Critical Role of the Indo-Pacific Region"*. Washington, D.C.: Center for Strategic and International Studies. https://www.csis.org/analysis/mapping-semiconductor-supply-chain-critical-role-indo-pacific-region

8 Engel, R., Gardiner, C. Jett, J. and Smith, A. (2023). "Why war with China over Taiwan could ruin the global economy". *NBC News,* 29 June. https://www.nbcnews.com/news/world/taiwan-war-china-us-ruin-global-economy-semiconductors-chips-rcna91321

9 ISIS Malaysia's calculations based on UN COMTRADE (2025) database. See Section 3

10 For example, according to a January 2024 client survey conducted by Goldman Sachs, 54% of respondents identified geopolitics as the top risk to markets and the global economy. Gledhill, A. (2024). "Goldman Client Survey Shows Geopolitics Is Biggest Risk in 2024". *Bloomberg,* 16 January. https://www.bloomberg.com/news/articles/2024-01-16/goldman-client-survey-shows-geopolitics-is-biggest-risk-in-2024?embedded-checkout=true.

11 Adapted from Flint, C. (2024). *Everyone is Talking About It, but What is Geopolitics?* https://www.e-ir.info/2024/07/07/everyone-is-talking-about-it-but-what-is-geopolitics/

12 Semiconductor Industry Association (2018). *Detecting and Removing Counterfeit Semiconductors in the U.S. Supply Chain*. https://www.semiconductors.org/wp-content/uploads/2018/06/ACTF-Whitepaper-Counterfeit-One-Pager-Final.pdf. The SIA is a trade association based in the US.

13 Kyiv Independent (2024). "Ukraine '95% ready' to resume flights but needs adequate air defenses, minister says". *Kyiv Independent,* 21 November. https://kyivindependent.com/ukraine-flights/

14 Hughes, R. A. (2024). "Here's how restrictions on flying over Russia are making flights longer and more expensive". *Euronews,* 30 July. https://www.euronews.com/travel/2024/07/30/heres-how-restrictions-on-flying-over-russia-are-making-flights-longer-and-more-expensive

15 Engel et al. (2023)

16 Nada Altaher and Bianca Britton, "Missile hits arrivals hall of Saudi Arabia airport, injuring 26, official says", *CNN,* 12 June 2019, https://www.cnn.com/2019/06/12/middleeast/saudi-airport-houthi-missile-intl/index.html

17 Pancevski, B. (2024). "Russia Suspected of Plotting to Send Incendiary Devices on U.S.-Bound Planes". *Wall Street Journal,* 4 November. https://www.wsj.com/world/russia-plot-us-planes-incendiary-devices-de3b8c0a

18 AP News (2024). "US intelligence warns defense companies of Russian sabotage threat". *AP News,* 21 November. https://apnews.com/article/sabotage-russia-germany-putin-ukraine-058ee53d79af97bc9a499ccc10a5e35a

19 Sheffi, Y. (2001). Supply Chain Management under the Threat of International Terrorism. *International Journal of Logistics Management,* 12(2).

20 DW (2015). "Moscow: Terrorist attack could be behind the Sinai crash". *DW,* 11 September. https://www.dw.com/en/moscow-terrorist-attack-could-be-behind-the-sinai-crash/a-18837717

21 World Bank (2013). *The Pirates of Somalia: Ending the Threat, Rebuilding a Nation*. Washington, D.C.: World Bank. https://openknowledge.worldbank.org/entities/publication/6b9570fe-2f52-546f-af4b-605e4ebf04e6

22 Ghadge, A., Duck, A., Er, M. and Caldwell, N. (2021). Deceptive counterfeit risk in global supply chains. *Supply Chain Forum: An International Journal,* 22(2), p. 87.

23 Yang, S. (2021) "What's Worse Than a Chip Shortage? Buying Fake Ones". *The Wall Street Journal,* 15 July. https://www.wsj.com/articles/chip-shortage-has-spawned-a-surplus-of-fraudsters-and-fake-parts-11626255002.

24 OECD (2024). *Illicit Trade and the Korean Economy.* Paris: OECD. https://doi.org/10.1787/bc0bdd4a-en.

25 OECD and EUIPO (2018). *Why Do Countries Export Fakes? The Role of Governance Frameworks, Enforcement and Socio-economic Factors".* Paris and Alicante: OECD and EUIPO. https://www.oecd.org/gov/why-do-countries-export-fakes-9789264302464-en.htm.

26 Harper, J. (2021). "Suez blockage is holding up USD 9.6bn of goods a day". *BBC News,* 26 March. https://www.bbc.com/news/business-56533250. On a smaller scale, in March 2024, the *MV Dali* hit the Francis Scott Key Bridge in Baltimore, causing the bridge to collapse and preventing cargo ships from accessing the Port of Baltimore for 11 days, costing an estimated US$15 million a day.

27 Tirschwell, P. (2024). "Ocean carriers playing catch up in reducing risk of lithium-ion fires on ships". *S&P Global,* 8 January. https://www.spglobal.com/market-intelligence/en/news-insights/research/ocean-carriers-playing-catch-up-in-reducing-risk-of-lithiumion

28 Ibrahim, A. (2020). "How Tripoli's port 'stepped in' after 'apocalyptic' Beirut blast". *Al Jazeera,* 28 August. https://www.aljazeera.com/economy/2020/8/28/how-tripolis-port-stepped-in-after-apocalyptic-beirut-blast

29 Global Maritime Hub (2024). "Ningbo Port resumes operations after recent incident". *Global Maritime Hub,* 13 August. https://globalmaritimehub.com/essential-measures-for-minimizing-disruption-amid-ningbo-port-closure.html

30 Lampert, A. and Hepher, T. (2025). "Exclusive: Aerospace industry scrambles to deal with fallout from huge US factory fire". *Reuters,* 27 February. https://www.reuters.com/business/aerospace-defense/aerospace-industry-scrambles-deal-with-fallout-huge-us-factory-fire-2025-02-27/

31 Bradley, J. (2020). "In Scramble for Coronavirus Supplies, Rich Countries Push Poor Aside". *New York Times,* 9 April. https://www.nytimes.com/2020/04/09/world/coronavirus-equipment-rich-poor.html

32 Lee, S. and Prabhakar, D. (2021). *COVID-19 Non-Tariff Measures: The Good and the Bad, through a Sustainable Development Lens.* Geneva: United Nations Conference on Trade and Development. https://unctad.org/system/files/official-document/ser-rp-2021d3_en.pdf

33 Ramsay, M. and Wheatley, M. (2011). "After the disaster in Japan". *Automotive Logistics,* 1 July. https://www.automotivelogistics.media/after-the-disaster-in-japan/7408.article

34 Lepawsky, J. (2024). "Climate change puts global semiconductor manufacturing at risk. Can the industry cope?". *The Conversation,* 26 March. https://theconversation.com/climate-change-puts-global-semiconductor-manufacturing-at-risk-can-the-industry-cope-225879

35 Zhang, K. (2024). "How Water Scarcity Threatens Taiwan's Semiconductor Industry". *The Diplomat,* 19 September. https://thediplomat.com/2024/09/how-water-scarcity-threatens-taiwans-semiconductor-industry/

36 Goodman, P. S. (2024). "'It's All Happening Again.' The Supply Chain Is Under Strain". *New York Times,* 24 June. https://www.nytimes.com/2024/06/24/business/global-shipping-rates.html

37 Saul, J. and Cohn, C. (2024). "Red Sea insurance costs soar as Houthi shipping threats loom, sources say", *Reuters,* 19 September. https://www.reuters.com/world/middle-east/red-sea-insurance-costs-soar-houthi-shipping-threats-loom-sources-say-2024-09-19/

38 Moore, S. (2023). "How and When the Chip Shortage Will End, in 4 Charts". *IEEE Spectrum,* 28 March. https://spectrum.ieee.org/chip-shortage

39 Macdonald, J. R. and Corsi, T. M. (2013). "Supply Chain Disruption Management: Severe Events, Recovery, and Performance". *Journal of Business Logistics* 34(4), p.270.

40 Elleuch, H., Dafaoui, E., Elhmaedi, a. and Chabchoub, H. (2016). "Resilience and Vulnerability in Supply Chain: Literature Review", *IFAC-PapersOnLine,* 49(12), p.1449.

41 Christopher, M. and Lee, H. (2004). "Mitigating Supply Chain Risk Through Improved Confidence". *International Journal of Physical Distribution and Logistics Management,* 34(5), p.388.

42 Lippett, M. (2023). "The 'Golden Screw' in the Semiconductor Supply Chain". *Forbes,* 10 April. https://www.forbes.com/councils/forbestechcouncil/2023/08/10/the-golden-screw-in-the-semiconductor-supply-chain/

43 Khan, S. M. (2021). *Securing Semiconductor Supply Chains.* Washington, D.C.: Center for Security and Emerging Technology. https://doi.org/10.51593/20190017

44 Reuters (2021). "Fire damage at fab worse than first thought". *Reuters,* 29 March. https://www.reuters.com/article/business/renesas-says-damage-from-fire-at-chip-factory-worse-than-first-thought-idUSKBN2BL0LV/

45 Hiroi, Y. (2021). "Japan's Renesas steps in to ease automotive chip shortage". *Nikkei Asia,* 27 January. https://asia.nikkei.com/Business/Tech/Semiconductors/Japan-s-Renesas-steps-in-to-ease-automotive-chip-shortage

46 De Chant, T. (2021). "Fab fires and drought threaten to make chip shortages worse". *Ars Technica,* 24 March. https://arstechnica.com/tech-policy/2021/03/taiwan-drought-japanese-fab-fires-snarl-semiconductor-supply-chain/

47 Patel, N. (2021). "Why the global chip shortage is making it so hard to buy a PS5". *The Verge,* 31 August. https://www.theverge.com/2021/8/31/22648372/willy-shih-chip-shortage-tsmc-samsung-ps5-decoder-interview

48 Masters, B. and Edgecliff-Johnson, A. (2021). "Supply Chains: Companies Shift from 'Just in Time' to 'Just in Case'". *Financial Times,* 19 December. https://www.ft.com/content/8a7cdc0d-99aa-4ef6-ba9a-fd1a1180dc82

49 Bauer, H., Burkacky, O., Kenevan, P., Mahindroo, A. and Patel, M. (2020). *Coronavirus: Implications for the semiconductor industry.* McKinsey & Company. https://www.mckinsey.com/~/media/McKinsey/Industries/Semiconductors/Our%20Insights/Coronavirus%20Implications%20for%20the%20semiconductor%20industry/Coronavirus-Implications-for-the-semiconductor-industry.pdf

50 Choi, T. Y., Netland, T. H., Sanders, N., Sodhi, M. S. and Wagner, S. M. Just-in-time for supply chains in turbulent times. *Production and Operations Management,* p. 2336.

51 Sarkar, A. R. (2025). "Xi Jinping says no one can stop China's reunification with Taiwan as they are one family". *The Independent,* 1 January, https://www.independent.co.uk/asia/china/taiwan-reunification-xi-jinping-military-b2672304.html

52 Tobita, R. (2024). "U.S. urges Japan and Netherlands to tighten China chip tech curbs". *Nikkei Asia,* 9 March. https://asia.nikkei.com/Business/Tech/Semiconductors/U.S.-urges-Japan-and-Netherlands-to-tighten-China-chip-tech-curbs

53 The US has granted South Korean semiconductor giants Samsung and SK Hynix an indefinite waiver to supply its China-based factories with certain US chip-making equipment. This comes after consideration of Samsung and SK Hynix's significant scale of operations in China, which would cause disruptions to the global semiconductor supply chain if the US export controls were in full effect. The two companies account for nearly 70% of the global DRAM market and 50% of the NAND flash market before the export controls were announced. Lee, J. (2023). "South Korean firms get indefinite waiver on US chip gear supplies to China". *Reuters,* 10 October. https://edition.cnn.com/2023/10/09/tech/south-korea-samsung-hynix-chips-waiver-hnk-intl/index.html

54 Companies and countries are considering strategies such as decoupling, derisking and China Plus One as ways to reduce supply chain risk. Benson, E. and Sicilia, G. (2023). *A Closer Look at De-risking.* Washington, D.C.: Center for Strategic and International Studies. https://www.csis.org/analysis/closer-look-de-risking

55 Tan, A. (2025) *Driving factors of China Plus One.* Kuala Lumpur: Institute of Strategic & International Studies (ISIS) Malaysia. https://www.isis.org.my/wp-content/uploads/2025/05/Driving-factors-of-China-Plus-One.pdf

56 Cheung, E. (2024). "Everyone wants the latest chips. That's causing a huge headache for the world's biggest supplier". *CNN,* 22 March. https://www.cnn.com/2024/03/22/tech/taiwan-tsmc-talent-shortage-training-center-intl-hnk/index.html

57 While some observations in the paper are made for value chains, they also extend to supply chains. Haramboure, A., Lalanne, G., Schwellnus, C. and Guilhoto, J. *Vulnerabilities in the semiconductor supply chain.* Paris: OECD. www.oecd.org/content/dam/oecd/en/publications/reports/2023/06/vulnerabilities-in-the-semiconductor-supply-chain_f4de7491/6bed616f-en.pdf-

58 Tarasov, K. "ASML is the only company making the $200 million machines needed to print every advanced microchip. Here's an inside look". *CNBC,* 23 March. https://www.cnbc.com/2022/03/23/inside-asml-the-company-advanced-chipmakers-use-for-euv-lithography.html

59 Thadani and Allen (2023)

60 Burkacky, O., Deichmann, J., Pfingstag, P. and Werra, J. (2022). *Semiconductor shortage: How the automotive industry can succeed*. McKinsey & Company. https://www.mckinsey.com/industries/semiconductors/our-insights/semiconductor-shortage-how-the-automotive-industry-can-succeed

61 Rahman, T., Paul, S. K., Shukla, N., Agarwal, R. and Taghikhah, F. (2022). Supply chain resilience initiatives and strategies: A systematic review. *Computers & Industrial Engineering,* 170, https://www.sciencedirect.com/science/article/pii/S0360835222003734

62 The White House, Government of the United States of America (2024). *White House Council on Supply Chain Resilience* (Executive Order 14123). https://www.federalregister.gov/documents/2024/06/21/2024-13810/white-house-council-on-supply-chain-resilience

63 At the time of writing, the CHIPS and Science Act remains active and in force under the Trump administration. For an update on the policy as of July 2025, see Moore, S. K. (2025). *What the CHIPS Act Looks Like Now.* https://spectrum.ieee.org/chips-act-map.

64 Xiong, W., Wu, D. D. and Yeung, J. H. Y. (2024). Semiconductor supply chain resilience and disruption: insights, mitigation, and future directions. *International Journal of Production Research*. https://doi.org/10.1080/00207543.2024.2387074.

65 Ivanov, D. (2021). Supply Chain Viability and the COVID-19 pandemic: a conceptual and formal generalisation of four major adaptation strategies. *International Journal of Production Research,* 59(12), p.3541. https://doi.org/10.1080/00207543.2021.1890852.

66 Agrawal, T. K., Kalaiarasan, R., Olhager, J. and Wiktorsson, M. (2024). Supply chain visibility: A Delphi study on managerial perspectives and priorities. *International Journal of Production Research,* 68(8), p.2937. https://doi.org/10.1080/00207543.2022.2098873.

67 Alicke, K., Barriball, E. and Trautwein, V. (2021). *How COVID-19 is reshaping supply chains*. McKinsey & Company. https://www.mckinsey.com/capabilities/operations/our-insights/howcovid-19-is-reshaping-supply-chains.

68 Agrawal et al. (2024), p. 2937

69 Gaur, V. and Gaiha, A. (2020). *Building a Transparent Supply Chain Blockchain can enhance trust, efficiency, and speed*. Brighton, MA: Harvard Business Review. https://hbr.org/2020/05/building-a-transparent-supply-chain.

70 Agrawal et al. (2024), pp. 2927-2942

71 Ibid. p. 2935

72 ISIS Malaysia's calculations based on Department of Statistics, Malaysia (2024). *Gross Domestic Product Fourth Quarter 2024*. https://www.dosm.gov.my/portal-main/release-content/gross-domestic-product-fourth-quarter-2024. Note that this figure includes the value-added contribution of adjacent sectors, such as electrical equipment, industrial electronics and consumer products, and therefore likely overstates the direct economic contribution of the semiconductor industry. Note further that several sources since 2023 have erroneously claimed that the sector makes up 25% of Malaysia's GDP, possibly due to a misquotation. See, for example, International Trade Administration (2024). Malaysia *Semiconductors*. https://www.trade.gov/market-intelligence/malaysia-semiconductors

73 Author's calculations based on Malaysian Investment Development Authority (2024a). Malaysia *Investment Performance Report 2024*. https://www.mida.gov.my/wp-content/uploads/2025/02/MIDA_IPR-2024_SP_Screen.pdf

74 In the early 1970s, the first cohort of electronics companies set up factories in Penang's free trade zone. Known collectively as the "Eight Samurai", this cohort consisted of eight multinational corporations, namely Intel, AMD, Hewlett-Packard, Clarion, National Semiconductor, Hitachi, Osram and Bosh. For a historical overview, see Malaysian Investment Development Authority (2020). *Malaysia's E&E Industry.* https://www.mida.gov.my/wp-content/uploads/2020/12/EE-SIB-2022-2023-1.pdf.

75 Ministry of Investment, Trade and Industry, Malaysia (2023). *New Industrial Master Plan 2030: Electrical and Electronics Industry.* https://www.nimp2030.gov.my/nimp2030/modules_resources/bookshelf/e-03-Sectoral_NIMP-Electrical_Electronics_Industry/e-03-Sectoral_NIMP-Electrical_Electronics_Industry.pdf.

It has been claimed in various news reports and press releases that Malaysia holds 13% of the global market share in the ATP segment, but the original source of this data cannot be ascertained (see, for example, Azhar, D. (2024). "Malaysia targets over $100 bln in semiconductor industry investment". *Reuters,* 28 May. https://www.reuters.com/world/asia-pacific/malaysia-pm-says-targeting-over-100-bln-investment-semiconductor-chips-2024-05-28/). Nevertheless, there are over 400 local and foreign companies operating across Malaysia's electrical and electronic products (E&E) industry, suggestive of its size and significance.

76 For further reading that debunks the notion of Malaysia's perceived economic overdependence on China in particular, see Singh, J. (2024). "Debunking the Myth of Malaysia's Economic Overdependence on China". *The Diplomat,* 8 November. https://thediplomat.com/2024/11/debunking-the-myth-of-malaysias-economic-overdependence-on-china/.

77 The analysis considers only final exports and imports (excluding re-exports and re-imports) in line with UN COMTRADE nomenclature. Due to data constraints, it does not account for trade in value-added (TiVA) – i.e. the share of exports derived from domestic versus foreign inputs – which would likely suggest a smaller Malaysian contribution to American and Chinese semiconductor trade. The latest available TiVA data (collected by the OECD) extends only to 2022 and lacks industry-level granularity for this analysis.

78 Fig. 5 and 6 show semiconductor trading patterns from the perspective of the US and China respectively as reporting entities. These figures are not intended for comparison against Fig. 3 and 4, which present semiconductor trade from Malaysia's perspective as the reporting entity. US- and China-reported imports from Malaysia in Fig. 5 and 6 may not tally with Malaysia's reported exports in Fig. 3 due to differences in data classification. See World Bank (2010). *Imports, Exports and Mirror Data with UN COMTRADE.* https://wits.worldbank.org/wits/wits/witshelp/Content/Data_Retrieval/T/Intro/B2.Imports_Exports_and_Mirror.htm

79 For further reading on the role of critical minerals from China in semiconductor supply chains, see Berg, R. C., Ziemer, H. and Anaya, E. P. *Mineral Demands for Resilient Semiconductor Supply Chains.* Washington, D.C.: Center for Strategic and International Studies. https://www.csis.org/analysis/mineral-demands-resilient-semiconductor-supply-chains

80 The HS codes corresponding to each stage are as follows: (i) Raw materials – 280461, 284920, 282560; (ii) specialised and processed inputs – 370130, 370199, 370790, 900120, 900190, 900219, 900220, 900290; (iii) equipment to fabricate wafers and semiconductors – 841459, 841950, 842129, 842139, 842199, 848610, 848620; (iv) semiconductor components – 381800, 852351, 852352, 852359, 853290, 8533, 8534, 8540, 854110, 854231, 854232, 854233, 854239, 854290; (v) intermediate electronics (including apparatus and instruments) – 8473, 851190, 851761, 851762, 851769, 851890, 852290, 852729, 852990, 854430, 901490, 902490, 902790, 902890, 902990, 903090, 903190, 903290, 903300; (vi) final electronics (including consumer electronics) – 8470, 8471, 8472, 851713, 851718, 851771, 851779, 852581, 852582, 8526, 8528, 9006, 9022, 9027, 9030, 950430, 950450. See OECD (2019). *Measuring distortions in international markets: The semiconductor value chain.* Paris: OECD. https://doi.org/10.1787/8fe4491d-en, and Koh, W. C. (2024). *NIMP 2030 and Semiconductors.* Singapore: ASEAN+3 Macroeconomic Research Office. https://amro-asia.org/wp-content/uploads/2024/10/Selected-Issue-3_NIMP-2030-and-Semiconductors.pdf

81 For instance, Japan is a key producer of microlithography tools while the Netherlands is the primary provider of photolithography machines needed for the wafer fabrication segment

82 Liew, J. T. (2025). "Cover Story: Is Malaysia's chip sector prepared for the storm?". *The Edge* Malaysia, 30 January. https://theedgemalaysia.com/node/741796. Note that this excludes companies whose revenue is derived primarily from within Malaysian borders

83 Lim, M. T. and Tng, B. H. (2017). *Global Value Chains and the Drivers of Exports in Malaysia*. Kuala Lumpur: Bank Negara Malaysia. https://www.bnm.gov.my/documents/20124/826874/Global+Value+Chains.pdf

84 Malaysia's trade to GDP ratio is 132% as of 2023, more than double the global average. World Bank (2025). *Trade (% of GDP) – Malaysia*. https://data.worldbank.org/indicator/NE.TRD.GNFS.ZS?locations=MY&most_recent_value_desc=true

85 Another source of vulnerability is the cyclical nature of the semiconductor industry, particularly in the market for memory chips (as opposed to the more robust logic chips), where Malaysia's ATP activities are primarily concentrated. Downturns in the memory chip market due to fluctuating consumer demand can, and do, influence annual sectoral trade, investment and industry revenue flows. For further reading, see Kim, S., King, I. and Zhu, L. (2023). "'Everybody was wrong': The $160B memory-chip sector is suffering one of its worst routs ever despite vows to escape the boom-and-bust cycle". *Fortune,* 29 January. https://fortune.com/2023/01/29/memory-chip-sector-suffering-rout-despite-vows-to-escape-boom-bust-cycle/

86 In this case, Malaysia was not impacted as its materials and equipment are mainly sourced from the US, Japan, South Korea, Singapore and locally, as Figure 6 and Appendix B suggest. See also Kelly, T. and Blanchard, B. (2022). "Chipmakers see limited impact for now, as Russia invades Ukraine". *Reuters,* 24 February. https://www.reuters.com/technology/limited-impact-chips-yet-russia-invades-ukraine-future-uncertain-2022-02-24/

87 For an up-to-date timeline, see Bown, C. P. (2025). *Trump's trade war timeline 2.0: An up-to-date guide*. Washington, D.C.: Peterson Institute for International Economics. https://www.piie.com/blogs/realtime-economics/2025/trumps-trade-war-timeline-20-date-guide

88 For further reading on the impact of Trump's tariffs on Malaysia as of mid-2025, see Singh, J. and Cheng, C. (2025). *Trump, trade and tariffs: impact on Malaysia*. Kuala Lumpur: Institute of Strategic and International Studies (ISIS) Malaysia. https://www.isis.org.my/2025/06/06/trump-trade-and-tariffs-impact-on-malaysia/

89 For more information on the agreement, see Ministry of Investment, Trade and Industry (2025). *Agreement on Reciprocal Trade (ART)*. https://www.miti.gov.my/ART

90 A semiconductor tariff will likely be based on the outcome of Washington's ongoing investigation into the national security implications of semiconductor imports. In mid-2025, the US Department of Commerce initiated an investigation into the imports of semiconductors and associated manufacturing equipment under Section 232 of the Trade Expansion Act of 1962. This act empowers the president to restrict imports, through tariffs or otherwise, found to "threaten or impair the national security".

91 Should the semiconductor tariffs come into full effect, the immediate direct impact would be a reduction in US demand for all semiconductor imports (a negative income effect). In any case, we expect Malaysia's welfare losses – i.e. loss of export revenue – to be less than proportionate to the increase in tariffs, given its indispensability to the ATP segment of the semiconductor value chain and the high costs of indigenising these activities within American borders. Meanwhile, a negative substitution effect, where Malaysian semiconductors become relatively less competitive than competing exports to the US from elsewhere, would arise only if the latter targeted Malaysian product imports with higher tariffs, which is unlikely.

92 Shalal, A., Shepardson, D. and Bajwa, A. (2025). "Trump says US to levy 100% tariff on imported chips, but some firms exempt". *Reuters,* 8 August. https://www.reuters.com/world/china/trump-says-us-levy-100-tariff-imported-chips-some-firms-exempt-2025-08-07/

93 Some estimates indicate that about two-thirds of Malaysia's semiconductor exports come from US-based companies. See Isamudin, D. (2025). "Less punitive than feared, says expert on impact of US' planned tariff on Malaysia's semiconductor exports". *New Straits Times,* 7 August. https://www.nst.com.my/business/economy/2025/08/1256940/less-punitive-feared-says-expert-impact-us-planned-tariff

94 The White House, Government of the United States of America (2025). *Joint Statement on United States-Malaysia Agreement on Reciprocal Trade*. https://www.whitehouse.gov/briefings-statements/2025/10/joint-statement-on-united-states-malaysia-agreement-on-reciprocal-trade/

95 In recent times, Washington has blocked Chinese access to chipmaking equipment and Beijing has begun restricting American access to selected Chinese critical minerals. Baskaran, G. and Schwartz, M. (2024). *China Imposes Its Most Stringent Critical Minerals Export Restrictions Yet Amidst Escalating U.S.-China Tech War*. Washington, D.C.: Center for Strategic and International Studies. https://www.csis.org/analysis/china-imposes-its-most-stringent-critical-minerals-export-restrictions-yet-amidst

96 One such measure is the proposed Framework for Artificial Intelligence Diffusion announced in the final days of the Biden administration on January 15, 2025, which attempts to regulate global access to AI chips by classifying countries into three tiers with varying restrictions to access. As of late May 2025, the Trump administration has rescinded the rule, though export controls on AI chips may take a different form in the months to come. See Villasenor, J. (2025). *The new AI diffusion export control rule will undermine US AI leadership*. Washington, D.C.: Brookings Institution. https://www.brookings.edu/articles/the-new-ai-diffusion-export-control-rule-will-undermine-us-ai-leadership/

97 For further reading on the China Plus One strategy, see Tan, A. (2025). *Driving factors of China Plus One*. Kuala Lumpur: Institute of Strategic and International Studies (ISIS) Malaysia. https://www.isis.org.my/2025/05/22/driving-factors-of-china-plus-one/

98 During Trump's first term, Malaysia emerged largely unscathed from Washington's protectionist trade measures, which mainly targeted Chinese imports. Southeast Asia enjoyed a "bystander effect" marked by a diversion of trade towards countries like Malaysia and Vietnam, seen as being suitable, nonaligned alternatives to China. For most of the Biden administration, the US maintained its stance on China but also attempted to court Southeast Asia through the Indo-Pacific Economic Framework for supply chain cooperation, which Malaysia signed in 2022. Practically speaking, throughout this period, Malaysia's desirability as a destination for E&E investment was fuelled by its position as among the most competitive and mature "non-China, non-Taiwan" (and by extension geopolitically stable) markets for the ATP segment, according to ISIS Malaysia's interactions with semiconductor players in Penang.

For further reading on the situation before the second Trump administration, see Fajgelbaum, P., Goldberg, P., Kennedy, P., Khandelwal, A. and Taglioni, D. (2023). *The 'bystander effect' of the US-China trade war.* London: Centre for Economic Policy Research. https://cepr.org/voxeu/columns/bystander-effect-us-china-trade-war; and Menon, J. (2023). *What Can Malaysia Expect from IPEF?* Singapore: ISEAS-Yusof Ishak Institute. https://www.iseas.edu.sg/wp-content/uploads/2023/06/ISEAS_Perspective_2023_64.pdf

99 Ministry of Investment, Trade and Industry, Malaysia (2025). *MALAYSIA CONTINUES TO WORK CLOSELY WITH THE US AND SINGAPORE ON TRADE INVOLVING US-SANCTIONED CHIPS*. https://www.miti.gov.my/miti/resources/Media%20Release/MITI_STATEMENT_ON_EXPORT_OF_SANCTIONED_CHIPS_2025-03-04.pdf

100 Crabtree, J. and Chang, B. (2023). *Anwar's trip to China and the direction of Malaysia's foreign policy*. London: International Institute for Strategic Studies. https://www.iiss.org/sv/online-analysis/online-analysis/2023/05/anwars-trip-to-china-and-the-direction-of-malaysias-foreign-policy/

101 Siow, M. (2024). "As Brics lures Malaysia and Thailand while world order 'crumbles all around', is Asean ok?" *South China Morning Post,* 29 June. https://www.scmp.com/week-asia/politics/article/3268486/brics-lures-malaysia-and-thailand-crumbling-world-order-asean-ok

102 Ikram, I. and Qi, H. E. (2024). "Miti mulls proposal enabling foreign graduates to work in Malaysia amid talent deficit". *The Edge Malaysia,* 29 January. https://theedgemalaysia.com/node/698971.

Note that the figure excludes the number of graduates from private universities and vocational institutions, but the shortage still stands. See further Abu Rahim, M. A. R. and Sivashanmugam, L. (2024). Getting the Numbers Right: Graduates in Electricity & Electronics. Kuala Lumpur: Khazanah Research Institute. https://www.krinstitute.org/assets/contentMS/img/template/editor/20240322%20-%20EE%20Views%20GTS%202024_v4.pdf

103 Malaysia Semiconductor Industry Association (2023). *MSIA 2022 E&E Survey*. https://msia.org.my/folder_upload/pdf_file/e-Booklet_MSIA%202022%20E&E%20Survey.pdf

104 Min, Y., Min, Q., and Wei, H. (2024). "In Depth: Chasing Chip Talent to Keep the Boom Alive". *Caixin Global,* 11 December. https://www.caixinglobal.com/2024-12-11/in-depth-chasing-chip-talent-to-keep-the-boom-alive-102266993.html

105 Ministry of Transport, Malaysia (2024). 2023 *Malaysia Transportation Statistics*. https://www.mot.gov.my/en/Statistik%20Tahunan%20Pengangkutan/Transport%20Statistics%20Malaysia%202023.pdf

106 Department of Statistics, Malaysia (2024). *Monthly External Trade Statistics,* December 2024. https://www.dosm.gov.my/portal-main/release-content/monthly-external-trade-statistics-december-2024

107 Kang, S. L. (2024). "Short-lived relief for shippers as shipping costs surge amid Red Sea crisis". *The Edge Malaysia,* 19 June. https://theedgemalaysia.com/node/714828

108 National Water Research Institute of Malaysia (2022). *Impact of Sea Level Rise Due to Climate Change*.

https://mycoast.nahrim.gov.my/admin/uploads/publications/20221014014715.pdf

109 Tan, Z. Y. (2023). "Cover Story: Ready or not, here comes climate change". *The Edge Malaysia,* 23 February. https://theedgemalaysia.com/node/655548

110 Advanced packaging is a capital and technologically intensive set of techniques within the packaging segment that combines multiple categories of semiconductor devices onto a single device to increase efficiency and computation speed while reducing power consumption. For more information, see Shivakumar, S. and Borges, C. (2023). *Advanced Packaging and the Future of Moore's Law*. Washington, D.C.: Center for Strategic and International Studies. https://www.csis.org/analysis/advanced-packaging-and-future-moores-law

111 Ministry of Investment, Trade and Industry, Malaysia (2023)

112 Ministry of Investment, Trade and Industry, Malaysia (2024). *National Semiconductor Strategy*. https://crest.my/wp-content/uploads/FINAL_NSS_141024_2_compressed.pdf

113 Cheng, C., Chong, H., Ijlal, F., Singh, J., Kassim, Q., Zaikariah, Z, Pillai, G., and Farhan, A. (2025). *Budget 2026 Insights*. Kuala Lumpur: Institute of Strategic & International Studies (ISIS) Malaysia. https://www.isis.org.my/wp-content/uploads/2025/10/BUDGET-2026-_V3.pdf, and Cheng, C., Chong, H., Singh., J., Kassim, Q., Afandi, A., Markandu, D. R., Nair, K. L. and Zaikariah, Z. (2024). *Policy insights into Budget 2025: fiscal reforms, social protection, energy and climate action*. Kuala Lumpur: Institute of Strategic & International Studies (ISIS) Malaysia. https://www.isis.org.my/wp-content/uploads/2024/10/Research-note-budget-2025.pdf

114 Hazim, A. (2024). "Selangor eyes another chip design park as Puchong site fully occupied". The *Edge Malaysia,* 6 August. https://theedgemalaysia.com/node/721850

115 Azmi, H. (2025). "Malaysia seeks to become chip powerhouse with US$250 million investment in UK's Arm". *South China Morning Post,* 5 March. https://www.scmp.com/week-asia/economics/article/3301127/malaysia-seeks-become-chip-powerhouse-us250-million-investment-uks-arm

116 Annuar, A. (2025). "Malaysia preparing for possible US tariffs by building trade relations with others: Anwar". *The Straits Times,* 4 February. https://www.straitstimes.com/asia/se-asia/malaysia-preparing-for-possible-us-tariffs-by-building-trade-relations-with-others-anwar

117 Ministry of Foreign Affairs, Malaysia (2025). *ASEAN Malaysia 2025*. https://myasean2025.my/wp-content/uploads/2025/01/Brochure-ASEAN-2025.pdf

118 ASEAN Secretariat (2025). ASEAN strengthens global value chain agenda at 3rd FG-GVC Meeting. *https://asean.org/asean-strengthens-global-value-chain-agenda-at-3rd-fg-gvc-meeting/*

119 Malaysian Investment Development Authority (2025). "Brazil-Malaysia to set up joint development on IC design in 2025". *BERNAMA,* 1 December. https://www.mida.gov.my/mida-news/brazil-malaysia-to-set-up-joint-development-on-ic-design-in-2025/

120 Louis, Y. M. and Singh, J. (2024). *Making the Malaysia-India Comprehensive Strategic Partnership Work*. Kuala Lumpur: Institute of Strategic & International Studies (ISIS) Malaysia. https://www.isis.org.my/wp-content/uploads/2025/01/Making-the-Malaysia-India-Comprehensive-Strategic-Partnership-work.pdf

121 United Arab Emirates Ministry of Environment and Tourism (2025). *UAE-Malaysia Comprehensive Economic Partnership Agreement*. https://www.moet.gov.ae/en/uae-malaysia-comprehensive-economic-partnership-agreement

122 Ikram, I. (2025). "Malaysia and South Korea complete talks on free trade agreement". *The Edge,* 27 October. https://theedgemalaysia.com/node/775546

123 European Commission (2025). *Towards an EU-Malaysia Free Trade Agreement*. https://policy.trade.ec.europa.eu/eu-trade-relationships-country-and-region/countries-and-regions/malaysia/eu-malaysia-agreement_en

124 Malaysian Investment Development Authority (2024b). "MITI unveils initiatives for stronger industrial supply chain". *BERNAMA,* 14 August. https://www.mida.gov.my/mida-news/miti-unveils-initiatives-for-stronger-industrial-supply-chain/

125 Weno, R., Suhartono, H., Heryanto, T., Kiantara, R. and Adinda, C. (2025). *Strengthening ASEAN's Semiconductor Future: Building a Resilient Regional Supply Chain*. https://asean-bac.org/news-and-press-releases/strengthening-asean-s-semiconductor-future-building-a-resilient-regional-supply-chain

126 Zamani, E. D., Smyth, C., Gupta, S. and Dennehy, D. (2023). Artificial intelligence and big data analytics for supply chain resilience: a systematic literature review. *Annals of Operations Research,* 327, p.624. https://doi.org/10.1007/s10479-022-04983-y

INSTITUTE OF STRATEGIC &
INTERNATIONAL STUDIES
(ISIS) MALAYSIA

Address 1, Persiaran Sultan Salahuddin,
50480 Kuala Lumpur, Malaysia
Phone 603 2693 9366
E-mail info@isis.org.my

www.isis.org.my | ISIS_MY

ISISMalaysia | isis-malaysia

isis_malaysia