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Supply Chain Risks in EU-South Korea Relations: Semiconductor Industries

by Sunkung Choi

ABSTRACT

Recent geopolitical crises and the Covid-19 pandemic have exposed weaknesses in global supply chains, leading to disruptions in the flow of goods and creating shortages. The semiconductor shortage crisis between 2020-2021 exacerbated these issues, particularly affecting industries reliant on chips. This crisis prompted governments and industries to prioritise resilience and independence in supply chains. This paper examines the causes, effects and implications of the supply chain crisis, focusing on the economic relations between the EU and South Korea. Both parties recognise the importance of addressing supply chain vulnerabilities and have initiated collaborative efforts to strengthen critical industries like batteries and semiconductors. Moving forward, strategic collaboration between the EU and South Korea will be crucial for effectively addressing the supply chain crisis. Measures such as enhancing supply chain resilience, investing in research and development and fostering technological cooperation are essential for ensuring economic stability and navigating future challenges.

South Korea | Bilateral trade | European Union | Germany | Semiconductors | Coronavirus

keywords

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by Sunkung Choi*

Introduction

The globalised world has enjoyed an extended period of economic stability, often referred to as the "Goldilocks economy".[1] This era has been characterised by moderate economic growth and low inflation, which emerged in the aftermath of the collapse of the Soviet Union and China's accession to the World Trade Organisation between 1991 and 2001. Throughout this period, advancements in technology and transportation played a pivotal role in fostering robust global connectivity, facilitating the seamless movement of goods, services and information across borders.[2] This heightened interconnectedness led to a surge in international trade and brought about a marked increase in the complexity of global supply chains, as businesses strived to meet the demands of an increasingly interconnected global marketplace.[3] This trend continued in the following years: it is worth noting that since 1990, trade has been instrumental in driving global economic growth, lifting incomes by 24 per cent globally and by an even more substantial 50 per cent for the poorest 40 per cent of the population. However, recent geopolitical tensions, such as Russia's war against Ukraine and the unprecedented disruption caused by the Covid-19 pandemic, have served as seismic shocks to the global economic system,

[1] Robert J. Gordon and James H. Stock, "Foundations of the Goldilocks Economy: Supply Shocks and the Time-Varying NAIRU", in *Brookings Papers on Economic Activity*, No. 2/1998, p. 297-346, https://www.brookings.edu/?p=180285; Sherle R. Schwenninger, "A Goldilocks World Economy?", in *World Policy Journal*, Vol. 23, No. 4 (Winter 2006/2007), p. 1-9, DOI 10.1162/wopj.2007.23.4.1.

[2] Jianyong Yue, *China's Rise in the Age of Globalization. Myth or Reality?*, Cham, Palgrave Macmillan, 2018.

[3] Tolga Demiryol, "Political Economy of Connectivity: China's Belt and Road Initiative", in *RAIS Conference Proceedings, 10-11 June 2019*, p. 168-180, https://doi.org/10.5281/zenodo.3267662.

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disrupting supply chains and causing widespread economic upheaval.[4]

The 2020-21 Covid-19 pandemic, in particular, exposed vulnerabilities in global supply chains, disrupting the flow of goods, creating shortages and leading to prolonged delays. Lockdown measures and travel restrictions imposed to curb the spread of the virus resulted in factory closures, transportation bottlenecks and labour shortages.[5] The supply of chips was no exception. It created more and more severe problems in industry and market as chips are not a final product for direct consumption but intermediate good for many modern goods. The production of chips itself also requires global supply chains of resources and technologies crossing borders of many countries. The shortage in chip supply alarmed governments and industries to realise that heavy reliance on global supply chain could cause severe trouble on daily life, economy, industry and overall growth of a country.[6]

This paper delves deeper into the underlying causes, discernible effects and far-reaching implications of this critical predicament, particularly within the context of the economic relations between the European Union and the Republic of Korea (ROK).

1. Chip supply chain risks: Causes and effects

1.1 Unexpected events vs. geopolitical intentions

It is important to explore the intricate dynamics of supply chain disruptions in detail before delving into chip supply chain risks in detail. Among various ways of identifying the supply chain risks, this paper identifies the causes of occurrence. One cause of occurrences is an unexpected event such as the Covid-19 pandemic, the most recent, impactful, yet unexpected event that caused supply chain crisis. This crisis served as a stark reminder that even the most robust supply chains can falter in the face of unforeseen crises.[7]

[4] Thomas Barnebeck Andersen, "How Much Did China's WTO Accession Increase Economic Growth in Resource-Rich Countries?", in *China Economic Review*, Vol. 30 (2014), p. 16-26, 10.1016/j.chieco.2014.05.001; Yeling Tan, "How the WTO Changed China", in *Foreign Affairs*, Vol. 100, No. 2 (March/April 2021), p. 90-102.

[5] Jarrah F. Al-Mansour and Sanad A. Al-Ajmi, "Coronavirus 'COVID-19'–Supply Chain Disruption and Implications for Strategy, Economy, and Management", in *The Journal of Asian Finance, Economics and Business*, Vol. 7, No. 9 (2020), p. 659-672, https://doi.org/10.13106/jafeb.2020.vol7.no9.659; I. Nyoman Pujawan and Alpha Umaru Bah, "Supply Chains Under COVID-19 Disruptions: Literature Review and Research Agenda", in *Supply Chain Forum: An International Journal*, Vol. 23, No. 1 (2022), p. 81-95, DOI 10.1080/16258312.2021.1932568.

[6] Kenechukwu Nwuka Ochonogor et al., "The COVID-19 Pandemic and Supply Chain Disruption: An Analysis of the Semiconductor Industry's Resilience", in *International Journal of Technical & Scientific Research Engineering*, Vol. 6, No. 1 (January-February 2023), p. 7-18, https://ijtsre.org/papers/2023/ev6c1/IJT-44712257.pdf.

[7] Kristin Scholten, Mark Stevenson and Dirk Pieter van Donk, "Dealing with the Unpredictable:

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The other cause is geopolitical competition between state actors. An example of geopolitical tensions impacting supply chains is the China-US trade war initiated by former President Donald Trump in 2018. Motivated by the desire to address the longstanding trade deficit and intellectual property protection against China, the United States imposed tariffs and trade barriers on Chinese goods.[8] The resulting disruptions, reduced trade volumes and economic uncertainty underscored how geopolitical tensions can override the benefits of free trade. This type of disruption is not inevitable but purely caused with a certain intention. Those type of crisis encompasses the clash over technology protection and data governance. Usually countries impose restrictions on cross-border data flows, affecting tech companies and supply chains. This fragmentation has resulted in reduced efficiency and stifled innovation, highlighting the delicate balance between security concerns and open trade. Another case argues that economic security in more important than the economic benefit from free trade. In this case, economic security, defined as ensuring consistent access to resources for a stable standard of living, is crucial for economic well-being and national security.[9] After experiencing the supply chain disruption related to the Covid-19 pandemic and witnessing the difficulties in economic security which is exposed to vulnerabilities, governments started to prioritise independence from the global supply chains.

1.2 Structure vulnerability of supply chain risks and chips industry

In the previous section, two causes of supply chain crisis were mentioned, namely unexpected events and geopolitically intended disruptions. The shock of supply chain crises on both industry and society is related to lean manufacturing trends, so called "just-in-time" production, a model that relies heavily on accurate demand forecasting. Throughout the years, as transportation and technology have been adapted to the model, companies have become effective in selecting price-competitive locations for the procurement of components. However, during the recent supply chain crisis, the "just-in-time" production model proved unable to adapt to unexpected shifts in demand.

The rigidity of "just-in-time" supply chains hindered the supply of chips to the world.[10] Due to the scarcity of chips essential for automobiles and electronics, the

Supply Chain Resilience", in *International Journal of Operations & Production Management*, Vol. 40, No. 1 (2020), p. 1-10, https://doi.org/10.1108/IJOPM-01-2020-789.

[8] Richard Baldwin and Rebecca Freeman, "Risks and Global Supply Chains: What We Know and What We Need to Know", in *Annual Review of Economics*, Vol. 14 (2022), p. 153-180, https://doi.org/10.1146/annurev-economics-051420-113737; Samuel Roscoe, "Redesigning Global Supply Chains During Compounding Geopolitical Disruptions: The Role of Supply Chain Logics", in *International Journal of Operations & Production Management*, Vol. 42, No. 9 (2022), p. 1407-1434, DOI 10.1108/IJOPM-12-2021-0777.

[9] Cheng-Chwee Kuik, "The Twin Chessboards of US-China Rivalry: Impact on the Geostrategic Supply and Demand in Post-Pandemic Asia", in *Asian Perspective*, Vol. 45, No.1 (Winter 2021), p. 157-176, DOI 10.1353/apr.0.0010.

[10] Shahana Althaf and Callie W. Babbitt, "Disruption Risks to Material Supply Chains in the Electronics Sector", in *Resources, Conservation and Recycling*, Vol. 167 (April 2021), Article 105248, DOI 10.1016/j.

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supply of overall goods and services faced delays. Consumers started to experience shortages in a range of products, from electronics and pharmaceuticals to household items (including infant formulas or tampons), leading to empty shelves, delayed deliveries and scarcity of everyday products – which in turn contributed to inflationary trends.

The chip industry is particularly vulnerable during supply chain crises due to several interconnected factors. The semiconductor manufacturing process involves a complex global supply chain with multiple stages, from raw materials to finished products. Components are sourced from various countries, making the industry susceptible to disruptions in any part of the chain. Moreover, the chip industry relies on specialised suppliers for critical components such as wafers, chemicals and equipment. These suppliers serve multiple industries, creating interdependencies. A disruption in one area can cascade through the entire supply chain.[11] Building semiconductor fabrication facilities, commonly known as "fabs" or expanding capacity takes years. Once established, lead times for production are long, ranging from months to years. These conditions make it difficult for the industry to adjust to sudden demand changes. At the same time, semiconductor manufacturing requires substantial capital investment, and companies hesitate to build excess capacity due to cost and market volatility. This lack of flexibility, in turn, exacerbates shortages during crises.

Geopolitical tensions impact trade relations and supply chains, leading to export restrictions, tariffs and sanctions that disrupt the flow of critical components. The chip industry is caught in the crossfire of global politics. As mentioned above, many companies adopt just-in-time inventory practices to minimise costs. While efficient, this approach leaves little buffer during supply disruptions, and a sudden surge in demand overwhelms existing stock. The increasing demand for chips from various sectors strains supply, while technological advancements require more advanced chips. Meeting these demands is challenging during crises.[12] Natural disasters such as earthquakes and floods disrupt production facilities, while the Covid-19 pandemic highlighted vulnerabilities in global supply chains, affecting production, logistics and workforce availability. Some critical components have limited suppliers, and if a major supplier faces disruptions such as fire or bankruptcy, the entire industry suffers. Furthermore, semiconductors are essential for defence, communication, transportation, healthcare and other critical sectors. Therefore, shortages impact economic growth, innovation and competitiveness. In short, the chip industry's vulnerability arises from its intricate supply chain,

resconrec.2020.105248.

[11] Benjamin Frieske and Sylvia Stieler, "The 'Semiconductor Crisis' as a Result of the COVID-19 Pandemic and Impacts on the Automotive Industry and Its Supply Chains", in *World Electric Vehicle Journal*, Vol. 13, No. 10 (2022), Article 189, https://doi.org/10.3390/wevj13100189; Vinay Ramani, Debabrata Ghosh and ManMohan S. Sodhi, "Understanding Systemic Disruption from the Covid-19-induced Semiconductor Shortage for the Auto Industry", in *Omega*, Vol. 113 (December 2022), Article 102720, DOI 10.1016/j.omega.2022.102720.

[12] Vinay Ramani, Debabrata Ghosh and ManMohan S. Sodhi, "Understanding Systemic Disruption", cit.

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specialisation, long lead times, geopolitical complexities and high stakes for global economies and security.

2. Connection toward the global supply chain: The EU and Korea cases

2.1 Economic cooperation between Korea-EU and supply chain issues

The EU and the ROK have developed strong economic ties over the years. Korea is the EU's 9th largest export destination for goods, while the EU is the ROK third largest export market. Since the entry into force of the EU-Korea free trade agreement on 1 July 2011, bilateral trade and investment have expanded remarkably. Total bilateral trade in goods amounted to 107.3 billion euros in 2021, representing a significant increase of 70.8 per cent since 2011. In 2020, EU-ROK trade in services was concentrated in specific sectors, including transport, royalties and license fees, and telecommunications, computer and information services. The ROK is one of the EU's ten strategic partners globally (and one of the four in Asia). Brussels sees Seoul as a partner with the political and economic influence to make a difference at the global and regional levels. The bilateral agreement,[13] which has been in force since 2014, sets the overall framework for cooperation, covering areas such as non-proliferation, human rights, counterterrorism, climate change, energy security, and development assistance. In short, the EU and the ROK have a robust economic relationship, with significant trade volumes and cooperation across various sectors, and a deepening political partnership.

Recently, Seoul and Brussels have decided to strengthen their collaboration on supply chains, focusing on advanced industries. Firstly, they plan to strengthen on battery supply chains.[14] The latter are critical for various applications, including electric vehicles, renewable energy storage and portable electronics. Because of the two sides' shared emphasis on carbon neutrality, the supply of batteries has a significant importance in their economy and political agendas.[15] Secondly, given

[13] On 10 May 2010 the two sides signed a Framework Agreement, which entered into force on 1 June 2014. It provides a basis for strengthened cooperation on major political and global issues such as human rights, non-proliferation of weapons of mass destruction, counterterrorism, climate change and energy security. European Union and South Korea, *Framework Agreement between the European Union and its Member States, on the one part, and the Republic of Korea, on the other part*, Brussels, 10 May 2020, https://eur-lex.europa.eu/legal-content/en/TXT/?uri=celex:22013A0123(01).

[14] Sae Won Chung and Jae-Seung Lee, "Building the Pillars of the EU-South Korea Strategic Partnership", in *Asia Europe Journal*, Vol. 17, No. 3 (September 2019), p. 327-340, DOI 10.1007/s10308-019-00557-z; Gabriel Felbermayr et al., "Quantifying the EU-Japan Economic Partnership Agreement", in *Journal of the Japanese and International Economies*, Vol. 51 (2019), p. 110-128, DOI 10.1016/j.jjie.2018.12.007.

[15] Frauke Bierau et al., "Opportunities for European SMEs in Global Electric Vehicle Supply Chains in Europe and Beyond", in Tim Schulze, Beate Müller and Gereon Meyer (eds), *Advanced Microsystems for Automotive Applications. Smart Systems for Green and Automated Driving*, Cham, Springer, 2016, p. 223-235; James Eddy, Alexander Pfeiffer and Jasper van de Staaij, "Recharging Economies: The EV-

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the global shortage of semiconductors, enhancing cooperation in this area is crucial. Semiconductors are essential components in electronic devices, ranging from smartphones and computers to industrial machinery and automobiles. Both batteries and semiconductors are highly relevant to the automotive industry. The transition to eco-friendly vehicles, such as electric and hydrogen-powered cars, requires robust supply chains. After all, the ROK is a major player in the automotive industry, and collaboration with the EU can strengthen these supply networks. Seoul and Brussels also aim to increase cooperation in the renewable energy sector as well, given its potential positive impact on improving supply chains efficiency for components such as turbines, generators and transmission equipment.[16]

By addressing these specific supply chain issues, the ROK and the EU aim to improve resilience, sustainability and competitiveness in critical industries. Their collaboration reflects a shared commitment to navigating global uncertainties and promoting economic growth.

2.2 Impact of supply chain crisis on Korean economy

During the Covid-19 pandemic, Seoul's economy both encountered adversities and showed resilience, particularly in trade. Initially, the country experienced a rapid deterioration in exports as global demand dwindled amidst lockdowns and disruptions. Notably, in April 2020, exports plummeted by 24.3 per cent, marking the most substantial decline in a single month since the global financial crisis in 2009. However, South Korea's response to the pandemic was characterised by a highly effective containment strategy, which included aggressive testing, contact tracing, mask-wearing and preventive measures. Unlike many other nations, the ROK never imposed a full lockdown, enabling the control of Covid-19 spread while minimising disruptions to economic activities. Despite the initial setbacks, South Korea's economy demonstrated resilience, outperforming many major economies. Following a contraction of 0.85 per cent in 2020, the country's gross domestic product (GDP) swiftly rebounded. In 2021, GDP surged by 4 per cent, reaching an 11-year high. This robust recovery was driven by strong exports and private consumption. South Korea's export-oriented economy showcased resilience, particularly in sectors such as semiconductors, electronics and automobiles. These industries played a pivotal role in sustaining the economy amidst the pandemic. Moreover, the country's comprehensive crisis management strategies helped mitigate the adverse effects of the pandemic on trade. Therefore, it is possible to say that, even though South Korea encountered initial challenges due to the pandemic, its effective containment measures and robust export performance contributed to a relatively swift economic recovery.

Battery Manufacturing Outlook for Europe", in *McKinsey Insights*, May 2019, https://www.mckinsey.com/industries/oil-and-gas/our-insights/recharging-economies-the-ev-battery-manufacturing-outlook-for-europe.

[16] Troy Stangarone, "South Korean Efforts to Transition to a Hydrogen Economy", in *Clean Technologies and Environmental Policy*, Vol. 23, No. 2 (March 2021), p. 509-516, https://doi.org/10.1007/s10098-020-01936-6.

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Even though the economic damage during the pandemic was limited, the trade war between the United States and China, the Russia-Ukraine war and post-pandemic inflation have all caused multiple challenges. The ROK's chip manufacturing industry is currently facing the worst crisis in a decade, with expected negative impacts on the national economy. In August 2022, South Korea experienced a decline in monthly chip exports for the first time in 26 months. This reduction in exports has affected the overall trade balance and economic growth. Additionally, the entry of Chinese companies like Yangtze Memory Technologies into the memory chip business has increased competition, threatening Korean memory chip giants like Samsung Electronics and SK Hynix. This heightened competition could lead to market share erosion, impacting revenue and profitability. Moreover, oversupply of memory chips and subsequent price cuts create financial pressure for Korean chip manufacturers, leading to potential shrinkage in profit margins and affecting overall industry profitability. There are also concerns about the long-term outlook for the chip industry crisis, with some experts believing it will persist for at least the next years.[17] A prolonged downturn could have severe consequences for the Korean economy. Intensifying global competition in the chip supply chain, coupled with the rapid growth of Chinese companies, leaves Korean chipmakers in a challenging time.

2.3 Impact of supply chain crisis in the EU: A focus with German economy

The supply chain crisis has left a profound impact on the EU, reverberating across various sectors and shaking economic stability. Disruptions in global supply chains have translated into shortages of critical components and raw materials, causing production delays and cost escalations particularly in industries such as automotive, electronics and pharmaceuticals. Consequently, reduced trade flows have cast a shadow on economic growth and competitiveness. A significant factor exacerbating the crisis is the EU's heavy reliance on imports for intermediate goods and components. Disruptions in countries like China and India have dealt a blow to EU manufacturers, exposing the vulnerability stemming from dependency on a limited number of suppliers. This dependency has intensified the EU's vulnerability to supply chain disruptions. Moreover, shortages have fuelled price volatility, triggering inflation as the costs of raw materials and transportation soar. Consumers have borne the brunt of these impacts, facing higher prices for goods and services across the board.

A case in point is Germany, a country that before the war was heavily reliant on energy imports from Russia, in particular natural gas from the Nord Stream 1

[17] KPMG's survey highlighted that while there is optimism about revenue growth, executives are cautious about workforce growth, R&D spending, and capital expenditures. KPMG and Global Semiconductor Alliance, *Semiconductor Outlook Buoyed by AI and Automotive. Global Semiconductor Industry Outlook for 2024*, 2024, https://kpmg.com/us/en/articles/2024/global-semiconductor-industry-outlook.html.

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pipeline. After the outbreak of the war, Germany swiftly reduced its dependence on Russian energy, diversifying sources and securing alternative supplies. However, the energy crisis has not been without its consequences. BASF, a prominent German chemicals company, announced up to 2,600 job cuts worldwide due to cost pressures. Most of these job losses will be in Germany, where energy-intensive production lines are being shut down. According to a paper published in 2020, Germany's central bank, Bundesbank, has indeed warned of the risk of recession in the country if the war escalates and the embargo on Russian coal, oil and gas restricts power providers and industries. A projected 2 per cent shrinkage in the German economy underscores the severity of the potential economic impact.[18] Indeed, Germany experienced -3.8 per cent of GDP growth in 2020 and -0.3 per cent in 2023.

The complex relationship between Germany's market dependency on China and the recent supply chain crisis also shows an example of dynamics of global trade and economic interdependence. In recent decades, China has emerged as Germany's most significant trading partner for goods, accounting for a substantial 9.5 per cent of the European country's total trade in goods in 2021. This rapid rise underscores the deepening economic ties between the two nations.

An analysis of value-added linkages along the supply chain further reveals in fact the critical role that China plays in Germany's economy. While China is not the sole dominant supplier or destination market for Germany, its significance cannot be overstated. The recent supply chain crisis has served as a stark reminder of the vulnerabilities inherent in global trade. Disruptions, shortages, and delays have prompted Germany to re-evaluate its reliance on specific partners and to seek ways to mitigate risks.[19] The recent reduction in export volume from Germany to China has raised concerns, particularly for a nation historically known for its robust export-oriented economy. Several factors have contributed to this decline, including tensions in international politics, supply chain disruptions and shifting economic dynamics.

Among the industries most affected by this reduction are machinery and automotive sectors, which have traditionally been key pillars of Germany's export prowess. Challenges faced by these industries include supply chain disruptions and reduced demand in the Chinese market. German machinery exports to China, for instance, have encountered obstacles due to disruptions in the supply chain, leading to diminished export volumes. Similarly, the automotive sector, heavily

[18] John Kampfner, "Russia and China in Germany", in *RUSI Occasional Papers*, July 2020, https://rusi.org/explore-our-research/publications/occasional-papers/russia-and-china-germany; Klaus C. Engelen, "Germany in Crisis", in *The International Economy*, Vol. 36, No. 4 (Fall 2022), p. 10-13, http://www.international-economy.com/TIE_F22_EngelenLetter.pdf.

[19] Sebastian Biba, "Germany's Relations with the United States and China from a Strategic Triangle Perspective", in *International Affairs*, Vol. 97, No. 6 (November 2021), p. 1905-1924, DOI 10.1093/ia/iiab170; Max J. Zenglein, "Mapping and Recalibrating Europe's Economic Interdependence with China", in *MERICS China Monitor*, 18 November 2020, https://merics.org/en/node/917.

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reliant on China as a significant market, has felt the impact of the decline in export volume. Furthermore, the chemicals and pharmaceutical sectors have also experienced decreased exports to China. These industries, which play a crucial role in Germany's export portfolio, have faced challenges in maintaining export levels amid changing market dynamics and supply chain disruptions.[20]

In response to these challenges, the EU has embarked on a strategic re-evaluation of its relationship with China, with efforts to reshore critical industries gaining momentum. Investments in domestic production and diversification have emerged as essential strategies to bolster resilience against future disruptions. The EU has also emphasised technological sovereignty, channelling investments into digital infrastructure, 5G networks, and semiconductor manufacturing to reduce dependency on non-EU suppliers.

3. Prospects for the future

3.1 Prospects for the EU

The EU has embarked on a comprehensive and strategic endeavour to tackle the semiconductor shortage crisis and fortify its resilience in the sector. At the forefront of these efforts is the European Chips Act, a landmark initiative unveiled in early 2022. This legislation is designed to bolster the EU's competitiveness and self-reliance in the semiconductor industry, which has emerged as a cornerstone of modern technological advancement. The European Chips Act encompasses a multifaceted approach aimed at addressing various facets of the semiconductor ecosystem. One of its primary objectives is to ramp up production capacity within the EU by incentivising domestic semiconductor manufacturing. By fostering an environment conducive to investment and innovation, the EU aims to cultivate a robust and self-sustaining semiconductor industry capable of meeting the continent's growing demand for chips.[21]

In addition to expanding production capacity, the Chips Act places a strong emphasis on research and development (R&D) to drive technological innovation across the semiconductor value chain. Through strategic investments in chip design, manufacturing processes and packaging techniques, the EU seeks to enhance the competitiveness of European semiconductor firms on the global

[20] Christine Arriola, Przemyslaw Kowalski and Frank van Tongeren, "The Impact of COVID-19 on Directions and Structure of International Trade", in *OECD Trade Policy Papers*, No. 252 (September 2021), https://doi.org/10.1787/0b8eaafe-en.

[21] Kathleen R. McNamara, "Transforming Europe? The EU's Industrial Policy and Geopolitical Turn", in *Journal of European Public Policy*, 6 July 2023, https://doi.org/10.1080/13501763.2023.2230247; Rajeswari Pillai Rajagopalan, "The U.S. Escalates Chips War with China", in *ORF Occasional Papers*, No. 397 (April 2023), https://www.orfonline.org/research/the-us-escalates-chips-war-with-china; Bernhard Dachs, "The European Chips Act", in *FIW Policy Briefs*, No. 58 (February 2023), https://www.fiw.ac.at/?p=2444.

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stage. By harnessing the power of cutting-edge technologies such as artificial intelligence, quantum computing and advanced materials, the EU aims to position itself at the forefront of semiconductor innovation. Furthermore, the Chips Act seeks to foster collaboration and cooperation among public and private entities within the semiconductor ecosystem. By forging strategic partnerships and facilitating knowledge-sharing initiatives, the EU aims to create a vibrant and interconnected semiconductor community capable of driving collective progress and innovation. This collaborative approach is essential for maximising the impact of EU investments in semiconductor research, development and manufacturing.

In parallel to legislative and policy measures, the EU has established the Chips Joint Undertaking – a dedicated investment platform aimed at supporting the growth of the semiconductor sector. This initiative serves as a vital catalyst for promoting EU leadership in semiconductor technology over the medium to long term. By providing financial support for research projects, infrastructure development, and talent acquisition, the Chips Joint Undertaking aims at nurturing a thriving semiconductor ecosystem that fosters innovation, competitiveness, and sustainability. Moreover, the EU is keenly aware of the critical role that skilled talent plays in driving semiconductor innovation and growth. Efforts are underway to address the skills shortage in the semiconductor field by attracting new talent, fostering a culture of lifelong learning, and providing targeted training and education programs. By investing in the development of a highly skilled workforce, Brussels wants to ensure that the union remains at the forefront of semiconductor innovation and manufacturing.

Additionally, the EU is actively engaging with industry stakeholders, research institutions, and member states to create a strategic framework for semiconductor development. Through collaborative partnerships and collective action, the EU seeks to leverage the collective expertise and resources of its member states to strengthen Europe's position in chip manufacturing and technology. By aligning policy objectives, coordinating research efforts, and sharing best practices, the EU aims to create an enabling environment for semiconductor innovation and growth. Importantly, the EU's efforts extend beyond immediate crisis management, encompassing a long-term vision for semiconductor development and competitiveness. By fostering a culture of innovation, investing in research and development, and promoting collaboration and cooperation, the EU aims to maintain its technological leadership and ensure the security of semiconductor supply chains in the years to come. In summary, the EU's political and industrial efforts are essential for strengthening semiconductor production, fostering innovation, and ensuring long-term competitiveness, thereby shaping Europe's digital future and economic resilience.

As one of the world's major chip producers, the ROK has been actively responding to the global supply chain crisis in the semiconductor industry. The South Korean government and private companies have indeed made notable efforts to address the challenges posed by the shortage of critical components.

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3.2 Prospects for the ROK

The ROK and the United States have elevated their cooperation in major industries, including semiconductors and lithium-ion batteries, to re-establish global supply chains. The goal is to mitigate challenges posed by China and potential shortages of critical components. The US-ROK techno-political alignment aims to strengthen and upgrade security cooperation, with semiconductors playing a central role. US President Joe Biden has emphasised the significance of semiconductors for national security and advocated for "friend-shoring," bringing production back to the United States and its allies. On the domestic front, Seoul has renewed its commitment to supporting the advanced semiconductor industry. Former ROK President Moon Jae-in initiated the formation of a "semiconductor belt" across Gyeonggi and Chungcheong provinces to enhance supply chain resilience, while the National Advanced Strategic Industry Act has enacted regulation of semiconductor exports to foreign companies. Following up, the current ROK President Yoon Suk-yeol has stated that his government aims to make the country a "semiconductor superpower" by expanding engineering education and training more specialists.[22]

ROK companies continue to invest in research, development, and innovation within the semiconductor sector. These efforts focus on enhancing production capabilities, improving chip designs, and staying at the forefront of technological advancements. Furthermore, ROK semiconductor manufacturers collaborate with global partners, including US companies, to strengthen supply chains and share expertise. Strategic partnerships help mitigate disruptions and ensure a stable flow of critical components.

During his recent state visit to the Netherlands, President Yoon engaged in significant diplomatic and economic activities aimed at strengthening bilateral relations and exploring mutual interests. This historic visit marked the first state visit by a South Korean president since the establishment of diplomatic ties between the two countries in 1961. President Yoon met with King Willem-Alexander, emphasising the importance of diplomatic ties and strategic collaboration. A significant highlight of President Yoon's visit was his tour of the headquarters of ASML, a Dutch semiconductor equipment manufacturer and global leader in lithography technology – a technology crucial for chips production. The visit aimed to strengthen cooperation and explore opportunities for investment and technological collaboration, given the common interests shared by the ROK and the Netherlands in the semiconductor sector.

[22] YangPaeng Kim, "Chips in Flux: The Outlook for the Global Semiconductor Market and Implications for the Korean Economy", in *KIET Monthly Industrial Economy*, 29 August 2023, https://www.kiet.re.kr/en/pub/economyDetailView?detail_no=2852; Chan-Yuan Wong and Christopher J. Russell, "A Search Dilemma for Market Niches: Korea and Taiwan in a Time of US-China High-Tech Decoupling", in *Global Policy*, Vol. 15, No. 2 (May 2024), p. 475-486, DOI 10.1111/1758-5899.13346.

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Both countries, indeed, recognise the strategic importance of semiconductors for their economies and national security, underscoring the commitment to fostering a strong semiconductor alliance. In 2022, the ROK and the Netherlands signed a strategic partnership treaty in Seoul, emphasising coordination between government and private sectors to protect and promote critical and emerging technologies, including semiconductors. ASML's role in the semiconductor supply chain is pivotal, with South Korea being its second-largest market by sales after Taiwan. President Yoon's visit, thus, aimed to ensure stability in semiconductor sales and explore avenues for collaboration, further reinforcing the strategic partnership between the two nations.

3.3 EU-ROK collaboration

Addressing the supply chain crisis requires strategic cooperation between the EU and the ROK. Here are some possible strategies for both parties.

First, they should diversify sources of critical components and raw materials. Identifying common sources of risk is crucial and both should work together to find alternative suppliers, especially for natural resources.

Second, they should invest in R&D. Joint investment in R&D for advanced technologies, including semiconductors, batteries and other critical industries will help both parties to address the current supply chain risks. Foster innovation and develop cutting-edge solutions will help them reducing the dependency on external suppliers.

Third, they should promote technological cooperation.[23] The EU and the ROK should facilitate knowledge exchange and collaboration in areas such as semiconductor manufacturing, lithography technology, and digital transformation.

Fourth, strategic alliances with like-minded countries, or supranational institutions such as the EU, are important to mitigate the supply chain crisis. Both Brussels and Seoul share similar values such as liberal democracy, peace, and human rights. Shared values, in turn, can contribute to strengthen cooperation with other like-minded countries to collectively address supply chain challenges and protect common interests.[24] Eventually, those collaboration can facilitate the policy coordination and common crisis response.

[23] Shawn Donnelly, "Semiconductor and ICT Industrial Policy in the US and EU: Geopolitical Threat Responses", in *Politics and Governance*, Vol. 11, No. 4 (2023), p. 129-139, https://doi.org/10.17645/pag.v11i4.7031; Heekwon Kyung and Jun Lee, "Changes in Geopolitics of Semiconductors and Directions for Korea", in *KIET Monthly Industrial Economy*, 29 July 2022, https://www.kiet.re.kr/en/pub/economyDetailView?detail_no=2715.

[24] Rajiv Kumar, "The US-China Chip War and Prospects for South Korea-India Semiconductor Cooperation", in *Journal of Indian and Asian Studies*, Vol. 4, No. 2 (July 2023), Article 2340004, https://doi.org/10.1142/S2717541323400041.

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Finally, the EU and the ROK should establish mechanisms for real-time information sharing during supply chain disruptions. This would enable the joint crisis response plans to mitigate the impact of future shocks. In short, Seoul and Brussels should work closely together, leveraging their technological expertise, shared values, and strategic interests to navigate the supply chain crisis effectively and ensure economic stability.

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