

Taiwan's Shifting Role in the Global Supply Chain in the U.S.- China Trade War

Jinji Chen, Hong-yu Lin, and Yi-ting Lien

The U.S.-China trade war and the pandemic have had a profound impact on cross-border supply chains. In the past few years of U.S.-China tensions, China has been accused of engaging in unfair competition by abusing its national power, from trade and technology to COVID-19 responses. Amid such accusations, some countries have been stepping back from cooperating with China due to national security concerns. As the lockdowns have further disrupted value chains and highlighted the vulnerability of global supply chains, enhancing supply chain resilience has now become a national imperative for the U.S., Japan, and other countries, with an emphasis on strengthening their production capabilities in the semiconductor and medical care industries.

After entering the WTO in 2001, China has developed a rapidly growing trade surplus. Its exports to the U.S. increased apace and hit the \$500 billion mark in 2017. As the trade imbalance widened, a rising trade deficit drew the U.S. government's attention and eventually led the Trump administration's decision to prioritize this matter. While there were high hopes that WTO accession terms would lead to market liberalization in China, the People's Republic has violated trade rules by continuing to subsidize state-owned enterprises, infringing on intellectual property rights, forcing technology transfers, and manipulating its currency. All these unfair trading practices have dramatically reconfigured value chains and negatively impacted worldwide economic activities.

According to the World Bank's 2019 Global Value Chain (GVC) Development Report,¹ GVCs were traditionally centered on three hubs—the U.S., Japan, and Germany in the Americas, Asia, and Europe, respectively. Connections were established based on adjacency. However, China's entry into the WTO has reshaped this order by restructuring the lineup of supply centers. By 2017, China had replaced Japan as the regional supply hub in the GVC networks. Its connections also extend to the Americas and Europe. China has become an important producer and trading center across GVC networks.

Globalization has spread the division of work in the GVC networks to a global scale. Cross-border investments have narrowed the technological gaps between countries and taken on an added importance of the differentiation in production costs. Therefore, vertical collaboration apportions value chain activities to different countries based on their location advantage. Taiwan has been heavily involved in the complex technological ecosystem between Japan and the U.S., and has benefitted from the two countries' research and design (R&D) capacities and key technologies. Embedded in this ecosystem, Taiwan emerged as a leading manufacturer in the semiconductor industry with policy support.

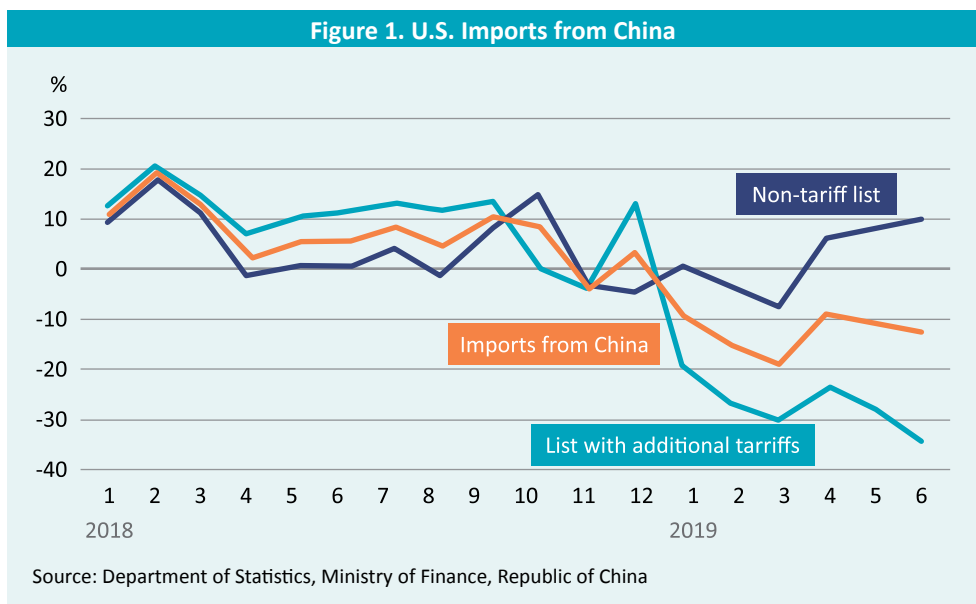
Years of gradually rising wages have eroded China's once-overwhelming cost advantage, which accelerated changes within the regional supply chain. The U.S.-China trade war has furthered these shifts. Companies from Taiwan, Japan, South Korea, ASEAN, Europe, and the U.S. are all reshaping the cross-border supply chains in the region. High-end manufacturing is reshoring to Taiwan, Japan, Europe, and the U.S., while labor-intensive sectors have been relocating to ASEAN and South Asia, where seemingly inexhaustible pools of relatively low-wage workers are available. On the cusp of its economic transformation, Taiwan is faced with challenges such as slow recovery of the global economy, reindustrialization of developed countries, and the emergence of China's red supply chain.² Past success in production and manufacturing is unlikely to be achieved again, given that the current economic model has encountered development bottlenecks. New growth catalysts are required to revive industrial development and boost economic growth.

In 2016, Taiwan launched a new model for economic development that focuses on strengthening industrial advantages of critical industries. After the COVID-19 outbreak in 2020, Taiwan has begun to adjust its economic structure, with a view to diversifying supply chain risks to avoid large-scale production suspension and disruption. Such efforts include boosting industrial upgrades and transformation, encouraging Taiwanese businesses to reshore, spearheading the development of cutting-edge industries, and developing high-end R&D and managerial talent. Taiwan has been closely following the Biden administration’s policy in technology and trade with China, stepping up cooperation with developed countries in R&D and technology, and relocating production to nations targeted by the New Southbound Policy.³ Adjusting industrial structure and deepening collaboration with the U.S., Japan, Europe, as well as the targeted countries of the New Southbound Policy will help Taiwan secure its vital role amid the reshuffling of international supply chains.

Economic Impact of U.S.-China Trade War on Taiwan and the Rest of the World

Impact of U.S.-China Trade War on Exports from Different Countries

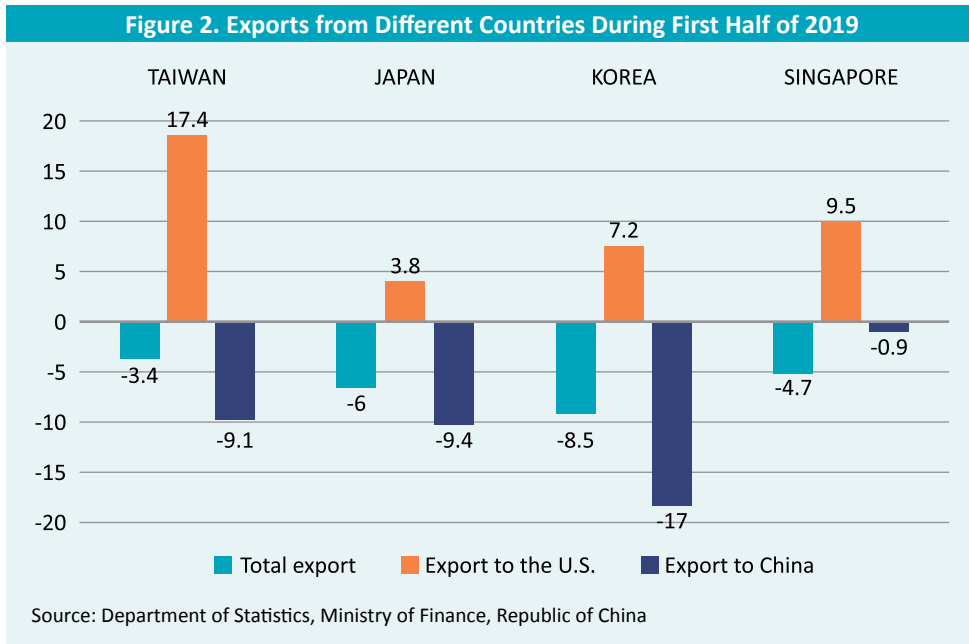
According to a report by Taiwan’s Ministry of Finance,⁴ U.S. imports from China grew at 6.8 percent in 2018—items with additional tariffs were up by 9.9 percent and non-tariff ones up by 4.2 percent. Since January 2019, the situation has changed (See Figure 1). Imports with additional tariffs decreased consecutively for 6 months, with a reduction of 27 percent from January to June, while non-tariff list imports remained stable with an annual growth rate of 2.4 percent. Total imports from China decreased by 12.4 percent.



The U.S.-China trade war has reduced China’s exports, particularly to the U.S. Consequently, China’s demand for components from other countries dropped, despite its dominant role as a part of the “Asian factory,” where a large number of components are assembled into final products. This was intertwined with the decline in other countries’ exports to China during the first half of 2019—Taiwan saw a drop of 9.1 percent, Japan of 9.4 percent, South Korea of 17 percent, and Singapore of 0.9 percent.

The U.S.-China trade war has triggered a restructuring of the global supply chain, with various countries directly selling more to the U.S. During the first half of 2019, Taiwan, Japan, South Korea, and Singapore all witnessed an increase in exports to the U.S. Taiwan benefited from orders transferred from China and enjoyed a growth of 17.4 percent year-over-year in its exports to the U.S., higher than 3.8 percent for Japan, 7.2 percent for South Korea, and 9.5 percent for Singapore. In sum, Taiwan’s exports sailed through the storm of trade war, with only a 2.3 percent decline in exports during the first half of 2019, a lower rate compared to South Korea, Japan, and Singapore (See Figure 2).

In response to the U.S. tariffs, the Chinese government expanded export rebates in order to prevent a drastic decrease of Chinese exports.⁵ The action indirectly relaxed the pass-through effect of U.S. tariffs on U.S. consumers and reduced the pressure of imported inflation.



Impact of U.S.-China Trade War on Taiwan's Imports/Exports

In 2018, Taiwan's total exports were \$334 billion, up 5.9 percent from a year earlier. Meanwhile, Taiwan's imports totalled \$284.79 billion, up 10.7 percent. Its overall imports increased slightly by 0.3 percent. Exports to China went up by 6 percent and exports to the U.S. increased by 7.4 percent. Because of the continuation of the trade war, in the first half of 2019, Taiwan's exports declined by 3.4 percent from the same period in 2018. Its total exports to China dropped by 4 percent. Its exports to the U.S., however, grew by 17.1 percent during the first half of 2019.⁶ This may undermine existing networks in supply chains and lead to a reshuffling effect on cross-border collaboration models—creating a new division of work in global supply chain networks.

As Taiwan and China's roles in supply chains continued to evolve, the collaboration and division of labor between the two are also gradually changing. In the past, countries have relied on the interconnectivity of global supply chains to improve margins. Taiwan carried out R&D and shipped semi-finished goods to China for processing, and China exported to the U.S. on a large scale to meet the demand there. This triangular trade involves orders accepted by Taiwan, production in China, and consumption in the U.S. The triangular trade model has also impacted Taiwan's investment, production layout, and actual trade operations following the U.S.-China trade war. In this reshuffling of global supply chains, some Taiwanese companies have benefited from the orders shifted from China. Some of the examples are networking and communication equipment, low-to-mid-end bicycle parts, and components.

Impact on Collaboration in Supply Chains

China has been ramping up its efforts to foster its own red supply chain by supporting its domestic industries with considerable government subsidies after Taiwan became an integral part of its supply model. The supply cooperation between Taiwan and China has changed from a complementary vertical division of upstream to downstream to a competitive relationship in the same horizontal level in recent years. The comparative advantage of Taiwan's collaboration in the global supply chain is therefore being challenged by the emergence of the red supply chain.

While a vertical division of labor from upstream to downstream is still the primary practice across global supply chain networks, mass production, which is often part of such operations, can no longer accommodate consumers' needs because of the rapidly changing trade preferences and tech landscape. Product tailoring and differentiation are of crucial importance in this context and were therefore incorporated into the existing horizontal division of labor model. Specifically, while countries that produce at the same level of this labor division model might build the same product and thus are seemingly without the need for exchange between them, they might still trade with each other as their respective products are differentiated. In order to gain the agility to respond quickly to shifting market preference, this practice, called "intra-industry trade," (IIT)⁷ is necessary. IIT is relatively common in an incomplete market.

The global scale of intra-industry trade has been expanding constantly, indicating the growing importance of product differentiation in the horizontal division of labor. The Asia-Pacific region follows this model to seek technology transfers and investments from developed countries. Based on a vertical division of labor in goods, Taiwan is exploring differentiable products by developing flexible production flows. Through mutually beneficial investments, exchange of talent, and technological connections, Taiwan has been establishing industrial cooperation ties with developed countries to stay on top of the trends for horizontal collaboration and respond to changes in the international economy. This shift from a vertical international specialization in division of labor towards differentiation based on a horizontal collaboration adds to the challenges from the U.S.-China trade war and new consumer behavior post-pandemic faced by Taiwan in the adjustment of its industrial structure.

Regionalization and Shortening Global Supply Chains

The most obvious change in the global value chains is the shift from high-volume manufacturing to customization for the consumer market. In addition, driven by digitalization, consumers have started to demand customized products.⁸ The traditional system of specialization and division of labor cannot accommodate such demand in a timely manner. Thus, companies have become proactive in the planning of global production activities. Suppliers must construct a value chain system to quickly respond to consumers' needs to enhance competitiveness and achieve product differentiation. This has triggered relocation of the supply chain towards specific regions or countries. This change has been accelerating amid the COVID-19 outbreak, which delivered an economic headwind to consumer markets in the U.S. and Europe, where retailers suffering heavy losses. Orders with contracted manufacturers in Asia were therefore cancelled, leading to massive layoffs and unemployment in the Asian countries.

This trend is irreversible, and it will most likely continue even in the post-pandemic era. European and U.S. brands believe that they have been over-reliant on cost efficiency and outsourcing production to Asia and ignorant of the risks associated with production concentration.⁹ Going forward, they will pursue local production by setting up supply chains in their own region. For instance, supplies to the European market will be shifted to nearby countries such as Turkey, Eastern Europe, and North Africa. The production lines for the U.S. market will be relocated to adjacent countries in the Americas. The combination of supply chain reshuffling and regionalization will come as a shock to Asian countries, which are highly reliant on profits brought by outsourced manufacturing in inter-regional trade.

Diversion from China and Shortening Global Supply Chains

China has undoubtedly become a major global player in trade as a supplier and as a market. Given the transformation towards regionalization and "desinicization"¹⁰ in supply chains networks, the U.S. and European countries will turn to trusted strategic partners in specific industries or subject matters (e.g., R&D of key materials, national security) by moving their supply chains to those countries. This will speed up the exodus of the global supply chain out of China. Companies will have to rethink the prior focus on cost reduction and mass production, as these approaches had resulted in overreliance on China as the singular manufacturing base. Such reliance has made heavy losses in the event of crises inevitable throughout the supply chains given that the networks are highly specialized and

interdependency from upstream to downstream around the world is immense. To avoid overreliance on the “Made in China” program or to prevent more losses due to chain disruption, Japan,¹¹ Europe,¹² and the U.S.,¹³ are all encouraging their companies to move out of China via different policies or laws or prohibiting China’s targeted corporate shopping sprees during the pandemic. For instance, Japan allocated a budget of approximately 243.5 billion yen to assist Japanese companies to relocate manufacturing from China.¹⁴ Its policy also aims to encourage high-value-added manufacturing to reshore to Japan and to relocate labor-intensive production lines to Southeast Asia. As these G7 member countries grow wary of China, both governments and corporations in these countries have expressed their intention to accelerate desinicization in their global supply chains.

The resilience of supply chains has become a critical concern in the wake of the pandemic. The combined impact of the U.S.-China trade war and this new focus on building resilient supply chains is reshaping the network design. Characteristics and structures of industry would be key considerations for supply chain optimization. The pandemic has prompted companies to strengthen their strategies on risk diversification in both investment and trade, with a focus on tightening information security as well as searching for alternative production bases. Companies will urgently accelerate their digitization to allow more flexibility for production flow control, manpower allocations, and distribution logistics. This will also involve facilitating the diversification of supply chains to spread risks and reduce risk impact. The logic of risk diversification will greatly affect facility location determination in the post-pandemic future. Except for China, the rest of Asia will most likely usher in a new round of investment as companies gravitate to Asian end-markets when redesigning their supply chain layout. While cost reduction used to be a dominant consideration for production planning, the disruption from the pandemic has shown that a multi-core supply network calibrated to minimize risk exposure is strategically more important. In this light, we predict that an intricate production network formed by shorter and more regionalized supply chains in Asia will slowly emerge.

The Implications for Taiwan’s Semiconductor Industry

After the tit-for-tat tariff game between the U.S. and China, the U.S. government started to sanction Chinese tech companies in 2020. In May, the U.S. Department of Commerce tightened the export rules by stipulating that permits are required for supplies to Huawei and other companies on the Entity List of foreign companies who use any semiconductor technology and equipment from the U.S. In August, the U.S. extended restrictions on Huawei access to technology by prohibiting third-party foreign companies that have been developed or produced with U.S. software or technology to supply Huawei without US permission. In December, the Department of Defense further designated Semiconductor Manufacturing International Corporation (SMIC) as owned and controlled by the Chinese military. Consequently, SMIC was banned from using American technology, and a gap in foundry capacity therefore emerged.¹⁵ Meanwhile, the demands of remote schooling and working amid the COVID-19 pandemic have pushed the market for personal computers,¹⁶ gaming devices,¹⁷ and smartphones¹⁸ to its strongest growth in recent years. This is the same for the semiconductor market— demand soared to the point where production could not keep pace with it, causing a global chip shortage.¹⁹

The shortage hit the auto industry particularly hard. In early 2020, carmakers had to curtail production of vehicles and cut back on orders for chips accordingly. While the demand for cars revived in October 2020, carmakers are still feeling the pain of a global chip shortage as semiconductor supply chain capacity has been fully booked by manufacturers of electronic or computer devices, who tend to be more lucrative customers than automakers are. The automobile industry requires a large variety of semiconductor chips, from parking sensors to ones used for emission reduction.²⁰ Toyota, Ford, and Volkswagen suspended production due to the silicon shortage.²¹ Leading car manufacturing countries worldwide have consequently realized that the negative impact of this shortage on the recovery of their auto industries as well as overall economy is alarming. The importance of the semiconductor industry in Taiwan therefore stood out to Japan, the U.S., and Germany, with the governments approaching semiconductor companies in Taiwan to ask for increased supply.²² U.S. President Joe Biden also ordered a comprehensive security review on the supply chain of key products to address problems brought by the lack of supply chain resilience, seeking cooperation with trusted allies to develop responsive strategies.²³

Governments around the world have all learned a lesson from U.S.-China tensions, the auto industry's pleas, and the disruption that led to severe chip shortages—building their own semiconductor industry in order to strengthen supply chain resilience has become a priority on the policy agenda. Given the capital-intensive nature of the chip industry, companies in Europe have been cutting back on capital expenditures required for new production lines and outsourced manufacturing to semiconductor foundry companies in Asia since 2000.²⁴ Now, 80 percent of the world's chips are produced and supplied in Asia. Europe and the U.S., instead, focus on the design and development of cutting-edge semiconductor and state-of-the-art chipsets.²⁵ This was the backdrop of the existing division of work and cooperation in the global semiconductor supply chain networks.

Countries worldwide now consider the semiconductor industry an essential part of national strategy. Europe and the U.S. are seeking to build their own chip arsenals and, for the purpose of national security, encouraging semiconductor giants to invest in the U.S. This indicates a coming change in the division of labor in this industry, which transformed from the highly efficient model of vertical international specialization to the development of a new horizontal division of labor via technological cooperation within strategic alliances.

The battle between the United States and China over tech supremacy, the shortage of automobile chips, and the impact of the COVID-19 pandemic all have exposed Taiwan's key role in the chip industry's complex ecosystem. The supply constraint has increased the bargaining power of major Taiwanese semiconductor companies. As the pandemic fueled demand for advanced chips to power electric devices, Taiwan's semiconductor industry is expected to be continuously boosted by considerable orders from around the world.

Advantages for Taiwan in Shifting Global Supply Chains

Leveraging the unique opportunity of adjustments to global supply chains and the reshaping of the international economic order, industries in Taiwan are working to strengthen their relations with producers and suppliers to solidify their status and influence across global supply chains. TSMC's mid-to-downstream customers continue to deepen cooperation

with TSMC because of its highly competitive advanced processes. Likewise, the U.S., Europe, and Japan all expressed an interest in collaboration with TSMC as such connections with the semiconductor titan are expected to boost technological competitiveness. For the U.S., this could further enhance its chance of winning the battle for leadership in core technologies with China.

Taiwan has developed one of the most comprehensive semiconductor ecosystems in the world. It is highly competitive in advanced processes, testing and packaging, and chip design. Science-based industrial parks also play an important role in the pursuit of cluster effects and integration. As electrification, automation, and artificial intelligence are driving the development of the automotive industry, the demand for auto semiconductors and electronics is set to rise significantly. The commercialization of 5G will create a case for connected cars. In addition to outsourcing orders from international auto semiconductor makers, Taiwan's semiconductor manufacturers of foundry, fabless, integrated circuit design, and testing and packaging are also gaining traction in the auto segment, striving to stay on top of future development and business opportunities.

The tension between the U.S. and China, the impact of COVID-19, and the explosive demand from technological advancement such as the Internet-of-Things and 5G, have shown that semiconductors are not merely electronic components. Instead, it is a strategically valuable industry that countries worldwide are racing to build. The policy focus, which previously centered around vertical international specialization in division of labor and production efficiency, has now turned to national security concerns as well as economic and political stability. This shift is reshaping the landscape of the global semiconductor industry. TSMC in 2020 announced it would set up leading-edge production in the U.S. by building a 12-inch plant in Phoenix, Arizona, which is scheduled to ramp up 5nm production in the first half of 2024.²⁶ This is an important step that marks the advancement of Taiwanese semiconductor industry's global roadmap. TSMC's decision is also beneficial to supply chain cooperation between the U.S. and Taiwan.

Taiwan's Supply Chains in the New International Collaboration

With strong support from the government's foreign trade policies in the 1980s, Taiwan successfully achieved spectacular growth through economic liberalization and integration into the international trade order. Harnessing abundant capital to develop capital- and technology-intensive industries such as electronics, information, and machinery, Taiwan enjoyed rapid growth in the information and communications technology (ICT) industry, which has been a driving force of Taiwan's economic development. In the context of academic theories, Taiwan was one of the main beneficiaries of the international division of labor in the Heckscher–Ohlin model.²⁷

The cross-border mobility and vertical specialization in the ICT industry were further amplified by globalization and international trade. This sped up the effect of international factor price equalization,²⁸ and some of the related occupations consequently declined in developed countries. This refined international system of division of labor also diminished the past advantage in production cost for some companies, increasing the likelihood for them to be replaced as competitiveness diminishes. Even countries playing pivotal roles in

supply chain networks may suffer a tech exodus involving the loss of key technologies, R&D activities, and profits, as low-cost labor pools in distant countries may be a better choice for building production sites based on the logic of international division of labor.

The U.S. is among the most affected countries by this trend. To maintain its advantage in the international production chain, former U.S. president Obama in 2012 sought to revive manufacturing by encouraging companies to reshore to the US.²⁹ His successor, President Trump, further initiated a trade war to challenge China's unfair trade practices. The rivalry has continued under the Biden presidency—the administration has announced that it will not immediately remove tariffs on imports from China, and it seeks to unite like-minded countries to curb Chinese influence.³⁰ Meanwhile, China is gradually transforming from its role as the world's factory to a domestic-consumption driven economy with import substitution policies.³¹ China's increasingly sophisticated supply chains have also achieved economies of scale.

With the U.S. and China continuing to compete for dominance in international trade, Taiwan's role and profitability in the legacy system of vertical collaboration will gradually shrink. This is a deep concern for industries in Taiwan, making it necessary to keep up with key trends in the new global collaboration system across supply chains by: 1) diversifying its supply chain footprints to reduce risk; and 2) speeding up digital transformation and smart manufacturing.

Both Taiwan and China's roles in supply chain networks will change in the foreseeable future. The long-standing mechanism of labor division between the two, where Taiwan takes orders, China produces, and the U.S. consumes, will most likely decline. On the other hand, the growing interconnectivity and complexity of global supply chain networks have increased the vulnerability of countries worldwide. As a result, supply chain resilience is now at the top of the task list for everyone in the post pandemic era.

Acceleration of International Supply Chain Reshuffling and Diversification of Risks

The virus outbreak, which originated in Wuhan, shut manufacturing facilities for an extended period.³² China's dominant role as the "world's factory" means that any major disruption puts global supply chains at risk. Countries that used to rely on enormous imports from China suffered the most from such disruption. Therefore, the trend of "desinicization," as an element of efforts to diversify supply chains, has accelerated. The U.S.-China trade war has also triggered global supply chain transformation. After the U.S. and China reached the first-stage trade agreement, some Taiwanese companies also adjusted their product roadmap and planning. There's a sizeable exodus among Taiwanese businesses in China, with some of them reshoring to Taiwan for manufacturing high-end tech products and advanced bicycles. Traditional industries are also adjusting production lines—many moved to emerging markets outside of China. In sum, forward-looking strategies are required for the development and transformation of industries in Taiwan post COVID-19.

Faster Digital Transformation and Marching Towards Smart Manufacturing

In general, most companies have taken preliminary steps to apply new technologies to precisely control production, inventory, and shipments in order to improve operations and boost efficiency. However, this is still in an early stage in digitalization. COVID-19 has prompted companies to speed up digital transformation, changing the long-term planning of industrial structure in Taiwan. Remote working, video conferencing and staggered patterns have been implemented on a large scale to prevent the spread of the virus. This has boosted the demand for notebooks, monitors, networking and computer equipment (e.g., webcams), video surveillance systems, etc. Business operations and work models are expected to be more flexible post-pandemic. The growing penetration of new technologies, such as cloud computing, video conferences, and file sharing, will enable companies to reduce operational costs and to boost employee productivity and work flexibility.

Roadmap for the Future of Industrial Development in Taiwan

New Connections, New Opportunities

Companies that produce in China have started to rethink their manufacturing strategy following the slowdown of Chinese domestic consumption and the U.S.-China trade war. The longstanding “triangular trade relationship” between Taiwan, the U.S., and China could therefore break down gradually. Instead, there are signs that Taiwan’s direct exports to the U.S. as the end market have been growing rapidly. Going forward, Taiwan should strive to play a more integral role in the supply chain network that connects developed countries and focus on value-added economic activities. This will ensure that Taiwan plays a vital role in the new Asian-Pacific value chain order. Through R&D, talent, investments, industrial cooperation, and international exchange with developed economies, Taiwan will be able to boost its competitiveness and anchor a key position in international value chains. In addition, Taiwan should reinforce its connections with Southeast Asian markets by moving production out of China and into other parts of Asia.

New Business Opportunities for Restructuring Supply Chains

Digital economy, technology innovation, and export of innovative services have become the source of export competitiveness. Faced with the challenge of the global supply chain reshaping, Taiwan should seize business opportunities associated with new supply chains through digital transformation and technological innovation. This encompasses new production models, new consumer products, and new supply systems. Taiwan can secure a key position in cross-border value chains for its export industries by leveraging its advantage in ICT hardware manufacturing. This will drive innovation throughout the value chain and upgrade the division of labor. Industries in Taiwan will be able to export the integration of hardware, software, and systems to enable smart technology applied in different domains (e.g., smart medicine, smart energy, smart homes, and smart transportation). The creation of innovative platforms will enable duplication of successful applications and experience from Taiwan’s domestic market to foreign markets through building demonstration sites to share the Taiwan model.

Supply Chain Security Against the Backdrop of Digital Transformation

Given that the interdependence within supply chain networks could potentially create an attack surface for adversaries to probe, there has been growing concerns over international cooperation and threats it may pose to national security among developed countries. In this light, products from Taiwan should have clear segmentations in quality, technology, and sales across different supply chains, particularly when it comes to ICT and national defense. On top of that, as the omnipresence of digital transformation is poised to reshape the way all organizations operate, Taiwan should tap into its strong capacity in manufacturing high-end ICT key components to develop its information security industry. These efforts would strengthen Taiwan's technological leadership in the area of cloud computing, mobilization, Big Data, and artificial intelligence and become critical to networking and information security.

Conclusion

Amid the global reshuffling of supply chains, triggered by the pandemic and the U.S.-China trade war, companies should seek to diversify supply chains to avoid long-run risks such as production disruptions caused by public health crises. Taiwan should seize the opportunity to adjust its economic structure, accelerate industrial transformation, encourage its businesses to reshore, create blueprints for forward-looking industries, and develop high-caliber R&D and managerial talent. In terms of the supply chain, Taiwan should actively seek collaboration with developed countries in different levels of technological production, particularly in the R&D area. It should also expedite the relocation of production sites to the targeted countries of the New Southbound policy and build better connections with these countries in order to speed up Taiwan's industrial structure upgrade.

Endnotes

¹ "Global Value Chain Development Report 2019: Technological Innovation, Supply Chain Trade, and Workers in a Globalized World," (Washington, D.C.: World Bank Group, 2019), <http://documents.worldbank.org/curated/en/384161555079173489/Global-Value-Chain-Development-Report-2019-Technological-Innovation-Supply-Chain-Trade-and-Workers-in-a-Globalized-World>.

² China has been reforming its economic structure since 2011, aiming to reach a "rebalance" for its economy. Specifically, the Chinese government upgraded its manufacturing industry and increased the magnitude of import substitution. Chief among these policy goals is the "2025 Made in China" proposal, which aims to boost R&D capabilities in technologies and to form a "red supply chain," where local Chinese tech firms with apparent government support can increasingly take on the work of manufacturing products for global tech firms. Such a strategy has attracted Taiwanese talents and companies in high-tech industry to consider moving to China for better profit.

³ New Southbound Policy, "New Southbound Policy Portal - Ministry of Foreign Affairs, Republic of China (Taiwan)," https://nspp.mofa.gov.tw/nsppe/nspp.mofa.gov.tw/nsppe/index_source.php [Accessed July 2, 2021].

- ⁴ “Analysis on the Impact of the US’s Recent Additional Tariffs Levied on Chinese Goods,” Department of Statistics, Ministry of Finance, Republic of China, August 21, 2019, <https://www.mof.gov.tw/download/4a9a925348114782a56ac99067dbd35b>.
- ⁵ The State Council of the People’s Republic of China, “Govt to improve tax refund for exports,” October 8, 2018, http://english.www.gov.cn/premier/news/2018/10/08/content_281476336717074.htm [Accessed July 6, 2021].
- ⁶ Anshuk Gandhi, Carmen Magear, and Roger Roberts, “How Technology Can Drive the Next Wave of Mass Customization,” McKinsey & Company, McKinsey on Business Technology no. 32, Winter 2013, https://www.mckinsey.com/~media/mckinsey/dotcom/client_service/bto/pdf/mobt32_02-09_masscustom_r4.ashx.
- ⁷ OECD, “Intra-Industry Trade,” October 19, 2010, 201–11, <https://doi.org/10.1787/9789264084360-85-en>.
- ⁸ Erin Sweeney, “The Growing Trend of Customized Products Offers Joy & Connection For Consumers,” DMS Insights, December 16, 2020, <https://insights.digitalmediasolutions.com/articles/customization-brands-cpg>.
- ⁹ Johanna Andersson, Achim Berg, Saskia Hedrich, Patricio Ibanez, Jonatan Janmark, and Karl-Hendrik Magnus, “Is apparel manufacturing coming home? Nearshoring, automation, and sustainability – establishing a demand-focused apparel value chain,” McKinsey & Company, October 2018, https://www.mckinsey.com/~media/mckinsey/industries/retail/our%20insights/is%20apparel%20manufacturing%20coming%20home/is-apparel-manufacturing-coming-home_vf.pdf.
- ¹⁰ Smith Brain Trust, “De-Sinicization’ and Manufacturing in China,” University of Maryland, Robert H. Smith School of Business, July 28, 2020, <https://www.rhsmith.umd.edu/research/de-sinicization-and-manufacturing-china> [Accessed July 3, 2021].
- ¹¹ Simon Denyer, “Japan Helps 87 Companies to Break from China after Pandemic Exposed Overreliance,” *Washington Post*, July 21, 2020, https://www.washingtonpost.com/world/asia_pacific/japan-helps-87-companies-to-exit-china-after-pandemic-exposed-overreliance/2020/07/21/4889abd2-cb2f-11ea-99b0-8426e26d203b_story.html.
- ¹² “Post Covid-19, Can Emerging Markets Capitalise on a Shift in Manufacturing Away from China?” Oxford Business Group, May 14, 2020, <https://oxfordbusinessgroup.com/news/post-covid-19-can-emerging-markets-capitalise-shift-manufacturing-away-china>.
- ¹³ J.R. Reed, “President Trump ordered US firms to ditch China, but Many Already Have and More Are on the Way,” CNBC, September 4, 2019, <https://www.cNBC.com/2019/09/01/trump-ordered-us-firms-to-ditch-china-but-many-already-have.html>.
- ¹⁴ Isabel Reynolds and Emi Urabe, “Japan to Fund Firms to Shift Production Out of China,” *Bloomberg*, April 8, 2020, <https://www.bloomberg.com/news/articles/2020-04-08/japan-to-fund-firms-to-shift-production-out-of-china>.
- ¹⁵ Sean Keane, “Huawei Ban Timeline: Chinese Company’s Android Rival is Coming to Phones and Tablets,” *CNET*, June 2, 2021, <https://www.cnet.com/news/huawei-ban-timeline-chinese-company-android-rival-coming-phones-tablets/>.
- ¹⁶ Maria Armental, “PC Demand During Pandemic Fuels Strongest U.S. Market Growth in a Decade,” *Wall Street Journal*, December 20, 2020, <https://www.wsj.com/articles/pc-demand-during-pandemic-drives-strongest-u-s-market-growth-in-a-decade-11602537956>.

- ¹⁷ Yvonne Lau, “Nintendo Won the Pandemic. How will the Gamemaker Confront COVID’s End?” *Fortune*, May 7, 2021, <https://fortune.com/2021/05/07/nintendo-switch-games-earnings-pandemic-sales/>.
- ¹⁸ Irina Ivanova, “Apple profits more than double on pandemic-fueled iPhone sales,” *CBS News*, April 28, 2021, <https://www.cbsnews.com/news/apple-reaches-record-profits-in-first-quarter-of-2021/>.
- ¹⁹ “The Global Chip Shortage is Here for Some Time,” *Economist*, May 20, 2021, <https://www.economist.com/finance-and-economics/2021/05/20/the-global-chip-shortage-is-here-for-some-time>.
- ²⁰ Sam Shead, “Carmakers Have Been Hit Hard by a Global Chip Shortage — Here’s Why,” *CNBC*, February 8, 2019, <https://www.cnbc.com/2021/02/08/carmakers-have-been-hit-hard-by-a-global-chip-shortage-heres-why.html>.
- ²¹ William Boston, Asa Fitch, Mike Colias, and Ben Foldy, “How Car Makers Collided With a Global Chip Shortage,” *Wall Street Journal*, February 12, 2021, <https://www.wsj.com/articles/car-chip-shortage-ford-vw-gm-11613152294>.
- ²² Saloni Meghnani, “Germany Pushes Taiwan to Alleviate Chip Shortage,” *Taiwan News*, January 25, 2021, <https://www.taiwannews.com.tw/en/news/4111377>.
- ²³ The White House, “Executive Order on America’s Supply Chains,” February 24, 2021, <https://www.whitehouse.gov/briefing-room/presidential-actions/2021/02/24/executive-order-on-americas-supply-chains/>.
- ²⁴ Emma Dandy, “Infineon warns chip downturn will push it into the red in Q3,” *Independent*, March 24, 2014, <https://www.independent.co.uk/news/business/news/infineon-warns-chip-downturn-will-push-it-red-q3-9211618.html>.
- ²⁵ Leo Kelion, “Intel chief Pat Gelsinger: Too many chips made in Asia.” *BBC News*, March 24, 2021, <https://www.bbc.com/news/technology-56512430>.
- ²⁶ Taiwan Semiconductor Manufacturing Company Limited, “TSMC Announces Intention to Build and Operate an Advanced Semiconductor Fab in the United States,” May 15, 2020, <https://pr.tsmc.com/english/news/2033> [Accessed July 3, 2021].
- ²⁷ The Heckscher–Ohlin model (H–O model) is a general equilibrium mathematical model of international trade, developed by Eli Heckscher (1919) and Bertil Ohlin (in 1933).
- ²⁸ Factor price equalization is an economic theory, by Paul A. Samuelson (1948), which states that the prices of identical factors of production, such as the wage rate or the rent of capital, will be equalized across countries as a result of international trade in commodities.
- ²⁹ The White House, “FACT SHEET: President Obama’s Blueprint to Support U.S. Manufacturing Jobs, Discourage Outsourcing, and Encourage Insourcing,” January 25, 2012, <https://obamawhitehouse.archives.gov/the-press-office/2012/01/25/fact-sheet-president-obama-s-blueprint-support-us-manufacturing-jobs-dis>.

- ³⁰ Henry Olsen, "Joe Biden hasn't lifted Trump's tariffs on China. Good," *Washington Post*, March 30, 2021, <https://www.washingtonpost.com/opinions/2021/03/29/joe-biden-hasnt-lifted-trumps-tariffs-china-good/>.
- ³¹ Nis Grünberg and Vincent Brussee, "China's 14th Five-Year Plan – Strengthening the Domestic Base to Become a Superpower," Mercator Institute for China Studies (MERICS), April 9, 2021, <https://merics.org/en/short-analysis/chinas-14th-five-year-plan-strengthening-domestic-base-become-superpower>.
- ³² "Coronavirus: Much of 'the World's Factory' Still Shut," BBC News, February 10, 2021, <https://www.bbc.com/news/business-51439400>.