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GLOBAL VALUE CHAINS IN AN ERA OF STRATEGIC UNCERTAINTY:

PROSPECTS FOR US-ROK COOPERATION

Dr. Miyeon Oh
Dr. Robert Dohner
Dr. Trey Herr

Scowcroft Center for Strategy and Security

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EXECUTIVE SUMMARY:
THE CHALLENGES OF A NEW ERA

The global COVID-19 pandemic brought the challenges of disruption to global value chains (GVC) into sharp focus for the policy community. While the pandemic is not alone in driving growing calls to realign the GVCs of major industries to mitigate risk of future disruptions, the virus has brought renewed importance to a set of key questions for firms and the policy community during an era of strategic uncertainty in the global economy. Stakeholder assumptions about what threats GVCs face, and how to manage this risk, are changing dramatically. Industry and government must confront these challenges and seek innovative solutions.

Strategic uncertainty is placing new pressures on value chains for industries crucial to both economic competitiveness and national security. This uncertainty is driven principally by new risks of US-China decoupling, trade and supply-chain protectionism, and unexpected shocks like COVID-19. Given this changing risk landscape, how can firms manage short- and long-term risks to balance national security requirements and commercial interests? What role should government play, and to what extent can, or should, governments require firms to operate more in line with national security priorities? As the race for global leadership on strategic emerging technologies heats up, how can the United States and its likeminded allies and partners, including the Republic of Korea (ROK), adapt to these new risks and effectively guarantee national security at acceptable economic cost?

The answer is to maximize effective cooperation between these allies and industry in the decades ahead. This report explores the key drivers of this new era of strategic uncertainty and the evolving landscape of risk it has produced for GVCs. The report examines how rising skepticism of globalization and trade expansion, convergence of commercial technology and national security, and intensifying competition and signs of decoupling between the United States and China are driving four threats to GVCs, including: protectionist pressures and aggressive trade policy; political risks; supply-chain security risks; and vulnerability to unexpected shocks. It illustrates these threats via two real-world case studies: the ROK-Japan trade dispute and its impact on semiconductor value chains, and the worldwide supply-chain disruption caused by the COVID-19 pandemic. Drawing on these cases, the report offers a roadmap for enhanced public and private sector cooperation, and a description of areas of future research critical for both governments and firms to overcome these new challenges.

FACTORS DRIVING STRATEGIC UNCERTAINTY

Rising skepticism of globalization and trade expansion stemming from a wave of populist anti-globalist sentiment in response to loss of manufacturing jobs and stagnant wage growth in the United States, among many other advanced economies, following the post-World War II liberalization of trade and reduction of trade barriers worldwide.

Convergence of commercial technology and national security, which has made governments, organizations, and individuals keenly aware of the vulnerabilities in technologies that are increasingly capable of collecting, analyzing, and making predictions based on networking and massive amounts of data.

Intensifying competition and signs of decoupling between the United States and China as the United States increasingly views its relations with China through the lens of strategic competition, as a rising China adopts a more assertive economic, military, and diplomatic posture on the world stage.

INCREASING STRESSES AND SHIFTING RISKS

Protectionist pressures and aggressive trade policy, exemplified by the Donald Trump administration's actions to raise, or threaten to raise, tariff rates on a variety of US imports from both competitors and allies on grounds of national security, such as tariffs on steel and aluminum imports.

Political risks, seen in China's willingness to use economic sanctions to signal displeasure and punish countries that it sees as going against its national interests, including targeting imports, such as Philippine bananas, Norwegian salmon, or Australian wheat.

Supply-chain security risks from malign actors compromising GVCs for Internet and communications technology (ICT) and other products and services, and from policy responses through measures such as the US use of export controls under the Department of Commerce's Entity List.

Unexpected shocks, such as the COVID-19 pandemic, which has interrupted GVCs, particularly in China, and has accelerated calls for national and multilateral efforts to reduce supply-chain concentration in China and localize production of critical supplies.

STRATEGIC UNCERTAINTY IN ACTION: TWO CASE STUDIES

The ROK-Japan Trade Dispute and Its Impact On Semiconductor Value Chains

The ROK-Japan trade dispute over semiconductor-manufacturing materials presents a stark example of how political disputes increasingly spill over into economic disputes, with potentially profound geopolitical and geoeconomic implications for those involved. As sanctions and export-control measures disrupt supply-chain links previously taken for granted, economies around the world dependent on foundational technologies like semiconductors are grappling with both the short- and long-term repercussions of the uncertainty this and similar disputes create.

The COVID-19 Pandemic and Global Supply-Chain Disruptions

The ongoing pandemic crisis, coupled with the deterioration of US-China relations, trade conflict, and new signs of decoupling, presents private firms and governments with a complex set of challenges as they seek to balance efficiency and resilience of their GVCs. The pandemic has reenergized calls to reshore or diversify value chains away from China, while underscoring the many difficulties of doing so. As the world seeks a speedy recovery for the global economy, the complex and expensive task of altering supply chains continues to complicate desires for a straightforward solution for future GVCs.

RECOMMENDATIONS FOR AN UNCERTAIN WORLD

In light of this report's analysis, the United States and Republic of Korea should adopt a number of measures to enhance cooperation in order to combat uncertainty, leading to more resilient GVCs, and, as a result, national economies for a new era. Recommendations explained in detail at the conclusion of this report include the need for the United State and/or Republic of Korea to:

- step up efforts to work with allies and partners, in order to develop sufficient supply in trusted global value chains;
- reevaluate the benefits, costs, and collateral effects of trade policy measures, particularly the use of export controls;
- define clear strategic objectives, and equally clear messaging to allies and partners, across the full range of international economic policies;
- have the government commit to limit its own supply-chain interventions to narrowly targeted, time-limited actions, and avoid systemic interventions in the ICT supply chain that have effects on all hardware or software users;
- reduce vulnerability to supply-chain disruptions by diversifying away from single-point-of-failure firms or sole-source vendors wherever possible;
- work together to map supply-chain networks of national significance, including for semiconductors and associated high-technology industries; and
- create sector-specific, government-private-sector steering committees across a number of high-technology industries including semiconductors, artificial intelligence, 5G, quantum computing, and autonomous vehicles.

1. INTRODUCTION

The study of global value chains, where the production of individual goods (and sometimes services) is distributed throughout the world, is increasingly discussed in the policy community, as are the associated risks of this dispersion.[1] The reliance of high-tech industries, like semiconductor development and personal computing, on low-cost but high-precision manufacturing in East and Southeast Asia has enabled nearly three decades of phenomenally powerful and low-cost customer electronics. This has, in turn, provided the digital platform for dominance by giants like Samsung, Google, Sony, and Facebook. The widespread adoption of once-exquisite technologies that are key to the modern global economy—like streaming video, high-bandwidth radio links, and automated image recognition—is built on consumer access to mobile phones, laptops, and wearables produced and distributed through these GVCs. The capability of these technologies and their wide availability have also supported a generation of low-cost commercial off-the-shelf (COTS) procurement by Western militaries, technologies like the Global Positioning System (GPS), and increasing reliance on full-motion overhead video.

Today, more than two thirds of economic activity occurs as part of a GVC.[2] The international nature of these production lines and vendor relationships creates desire in the business community for stability and predictability. As these linkages have developed and individual production segments have become more specialized, GVCs have grown more costly to alter, and ever more vulnerable to disruption along national boundaries. The strategic uncertainty engendered by a rising China—including economic espionage and substantial subsidies to national champions, along with intensifying US-China competition—threatens the free flow of commerce and the institutional underpinnings of the global free-trade regime under the Breton Woods system established after World War II. These global value chains are under threat.

As the rise of China and competition with the United States continue to reshape strategic dynamics in the Indo-Pacific, shifting economic, political, and security trends place new pressures on long-established value chains of high-technology industries. These changes not only influence how companies manage short-term risks to established GVCs, but also shape long-term strategies for growth, business partnerships, and profitability in an intensely competitive market. Recent political instability challenges assumptions about production and investment decisions, as well as choices of business partners, making long-term optimization and specialization more costly and uncertain.

Intensifying competition between the United States and China, as well as uncertainty about US commitments in Asia, have led to a substantial change in both the conception and scope of risks to these global value chains. In particular, certain high-technology industries face new constraints on capital-intensive investment decisions and rising domestic political pressures, on top of existing cutthroat commercial competition. As firms grapple with national security risks, they have to make choices driven by more than pure

1 Stephen Ezell, "Understanding the South Korea-Japan Trade Dispute and Its Impacts on US Foreign Policy," Information Technology & Innovation Foundation, January 16, 2020, https://itif.org/publications/2020/01/16/understanding-south-korea-japan-trade-dispute-and-its-impacts-us-foreign.
Samuel M. Goodman, Dan Kim, and John VerWey, "The South Korea-Japan Trade Dispute in Context: Semiconductor Manufacturing, Chemicals, and Concentrated Supply Chains," Office of Industries Working Paper ID-062, October 2019, 4–5, https://usitc.gov/publications/332/working_papers/the_south_korea-japan_trade_dispute_in_context_semiconductor_manufacturing_chemicals_and_concentrated_supply_chains.pdf

2 "Global Value Chain Development Report 2019: Technological Innovation, Supply Chain Trade, and Workers in a Globalized World," World Trade Organization, 2019, https://www.wto.org/english/res_e/booksp_e/gvc_dev_report_2019_e.pdf.

business risk about the GVCs they manage, and upon which they depend. Many firms are being asked to align with home governments that have a strong national security interest in domestically producing high-technology components and equipment. These firms are also dealing with uncertainty about how the United States will balance increasing national security concerns with historical commitment to international economic engagement through a network of multilateral institutions. Firms' decision-making processes are becoming more complex and uncertain, sometimes requiring them to sacrifice economic efficiencies in the name of national security.

To understand the rising strategic uncertainty and novel threats to these GVCs, this paper explores three principal drivers of their new risk profile: rising skepticism about globalization and trade expansion; convergence of commercial technology and national security; and intensifying competition and signs of decoupling between the United States and China.

Perfect security of global value chains is impossible, but participants can drive a material improvement in their exposure to risk, especially political instability. This report explains the risks facing global value chains in a period of strategic uncertainty driven by the three factors mentioned above. The report also offers policy recommendations for how the United States and its allies and partners should work together to mitigate these risks and support the continued development and stability of GVCs, especially in high-technology sectors. In particular, this report focuses on the prospects for cooperation between the United States and the Republic of Korea (hereafter, ROK or South Korea) using two case studies that underscore why global value-chain risk matters to the United States and its close allies and partners.

2. STRATEGIC UNCERTAINTY AND SHIFTING GVC RISKS

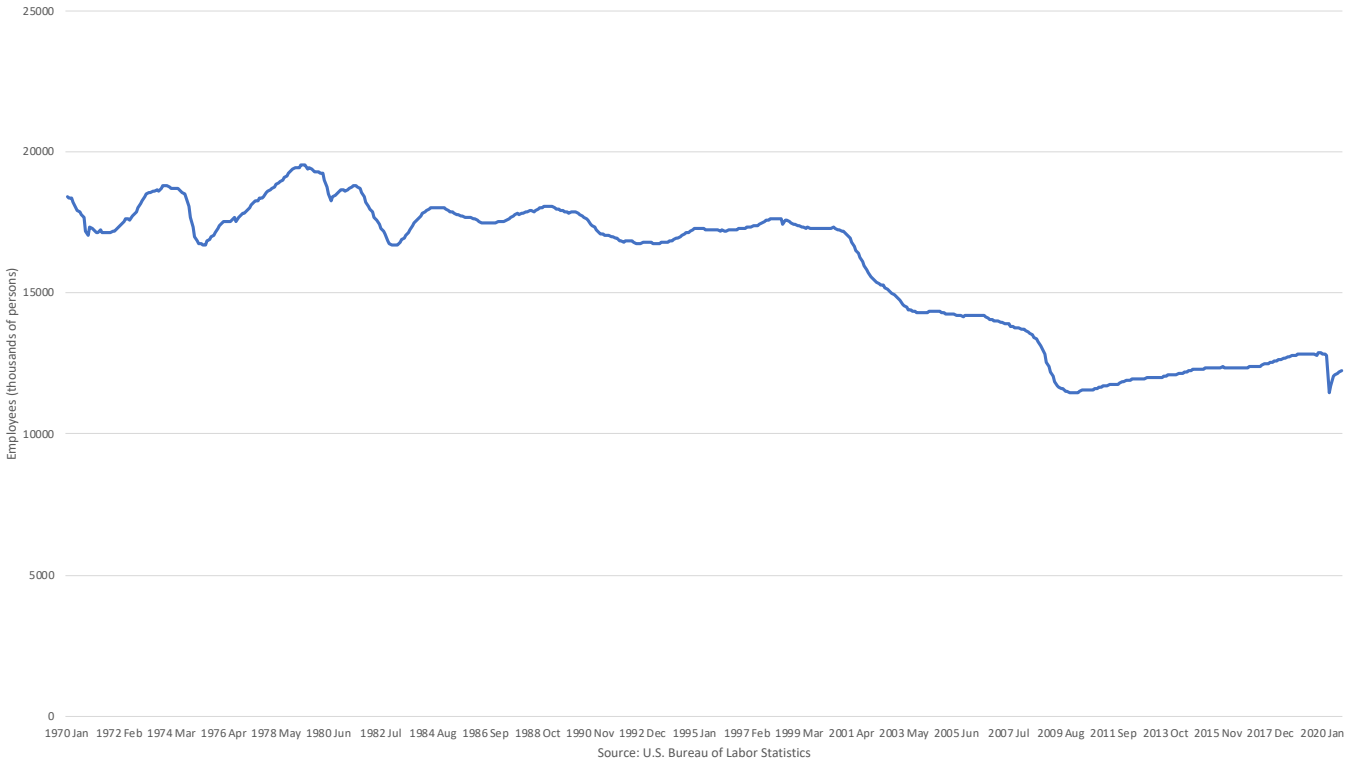
This report defines strategic uncertainty and shifting risks to GVCs as being driven mainly by three elements: rising skepticism of globalization and trade expansion; convergence of commercial technology and national security; and intensifying competition and signs of decoupling between the United States and China. The development of strategic uncertainty has changed the conception and scope of global value chains and their associated risks. These risks can be broken down into four categories: protectionist pressures and aggressive trade policies by major economies; political actions by nation states; disruptive new supply-chain security policies for key technologies; and vulnerability to unexpected shocks such as the COVID-19 pandemic. This section assesses the elements of strategic uncertainty, as well as major categories of GVC risks.

Sources of Strategic Uncertainty

The first dimension of strategic uncertainty is rising skepticism about the benefits of globalization and trade expansion. The post-WWII liberalization of trade and reduction of trade barriers, adopted in the last few decades by the most successful Indo-Pacific emerging markets, has led to a huge expansion of trade and widespread globalization of production through GVCs. This trend toward globalization has produced a wave of populist anti-globalist sentiment responding to the loss of manufacturing jobs and stagnant wage growth in many advanced economies, especially the United States.

The second element of strategic uncertainty is the convergence of commercial technology and national security. Technological advancements driving this convergence include:

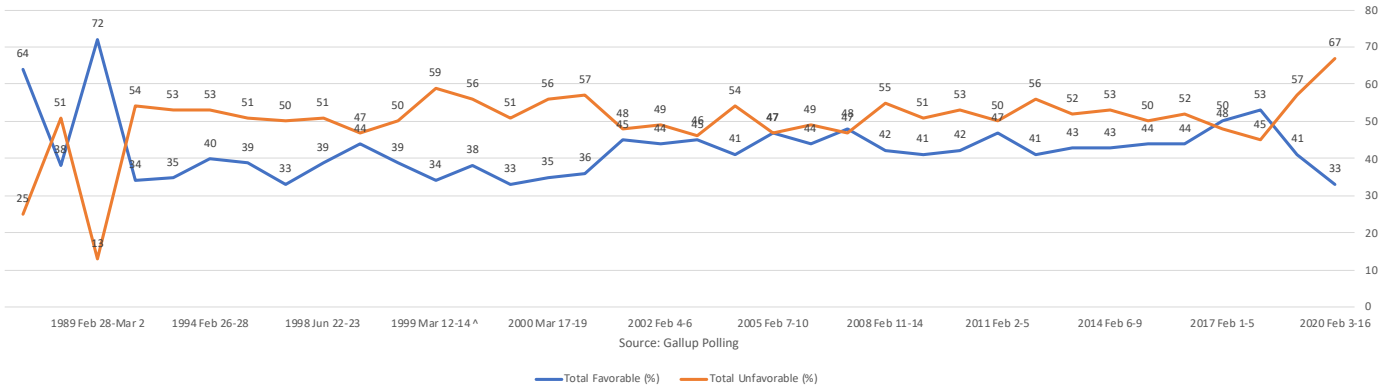
Figure 1: US Manufacturing Employment, 1970–2020.



The loss of manufacturing jobs since the peak in the late 1970s has led to growing skepticism about the benefits of globalization and trade liberalization in the United States.[1]

1 See, for instance, Robert E. Scott, "Manufacturing Job Loss: Trade, Not Productivity, Is the Culprit," *Economic Policy Institute*, August 11, 2015, https://www.epi.org/publication/manufacturing-job-loss-trade-not-productivity-is-the-culprit/.

Figure 2: Gallup Polling on US Public Opinion of China.



Polling data suggest that opinion of the People's Republic of China in the United States is at its lowest point since the two countries established formal diplomatic relations, even worse than after the Tiananmen Square massacre.[1]

1 "China," Gallup, 2020, https://news.gallup.com/poll/1627/china.aspx.

the development of increasingly powerful and inexpensive computers; the rapid spread of interconnected networks, both geographically and to a wider range of devices; the miniaturization and sharp fall in cost of a variety of sensors; and the ability to collect, analyze, and make predictions based on massive data collection from individuals and physical processes. While these developments have been ongoing since the early 1990s, China's rise and recurring Russian and Chinese efforts to exploit vulnerabilities in these technologies have made the public and politicians more keenly aware of the risks they create.

The third element of strategic uncertainty is increasing tensions and pressures for decoupling between the United States and China. China has rapidly grown its economy and military power in the Indo-Pacific over the last twenty years. While China has greatly increased its funding of domestic technological development, it has also pursued technology transfer from foreign holders through both legal and illegal means. This has shifted the prevailing Western view of China from a rapidly growing market opportunity to a commercial and strategic rival.[3] As an example, China is deeply integrated into the semiconductor global value chain, accounting for 29 percent of all single-country sales of semiconductors in 2014.[4] In particular, China has dominated the global manufacturing of mobile handsets; it accounted for three quarters of total production in 2016, and remains the top destination for top firms excluding South Korea's Samsung and LG.[5] The Chinese mobile giant Huawei has also set up mobile networks in fifty-four countries by 2019, and is operating various businesses in more than one hundred and seventy countries.[6] Despite this dominance in end products, however, China largely buys semiconductors made by other countries for assembling these smartphones, computers, and televisions. China's own semiconductor production capability is limited, and less technically advanced than international leaders like Samsung, Intel, and TSMC.[7]

Increased US-China tensions are likely to have consequences for all participants in Indo-Pacific global value chains, exacerbated further by ongoing disruptions and the political repercussions of the COVID-19 pandemic. As a major participant in value chains for semiconductors and advanced materials, a global leader in the development of cutting-edge technology, and a country heavily dependent on both Chinese market access and US security guarantees, South Korea is highly exposed to the stresses and risks to global supply chains described below. US-ROK cooperation is essential for both countries, and will provide a groundwork for other US allies and partners that face challenges from ongoing US-

3 "EU-China—A Strategic Outlook," European Commission, March 12, 2019, https://ec.europa.eu/commission/sites/beta-political/files/communication-eu-china-a-strategic-outlook.pdf.

4 Chinese sources put Chinese consumption of semiconductors at almost 60 percent of the global total. See "Beyond Borders: The Global Semiconductor Value Chain," Nathan Associates for Semiconductor Industry Association, May 2016, 18.

5 "Global Value Chain Development Report 2019: Technological Innovation, Supply Chain Trade, and Workers in a Globalized World."

6 Emily Feng and Amy Cheng, "China's Tech Giant Huawei Spans Much of the Globe Despite US Efforts To Ban It, , October 24, 2019, https://www.npr.org/2019/10/24/759902041/chinas-tech-giant-huawei-spans-much-of-the-globe-despite-u-s-efforts-to-ban-it.

7 John VerWey, "Chinese Semiconductor Industrial Policy: Past and Present," *Journal of International Commerce and Economics*, July 2019, https://www.usitc.gov/publications/332/journals/chinese_semiconductor_industrial_policy_past_and_present_jice_july_2019.pdf.

China tensions. For South Korea, cooperation with the United States is essential to ensure continued security and economic growth, and for the United States, close cooperation with South Korea and other allies and partners is essential to implementing US policies in the Indo-Pacific, such as its efforts to realign global supply chains and enhance their resilience from any disruptions.

Shifting Risks to Global Value Chains

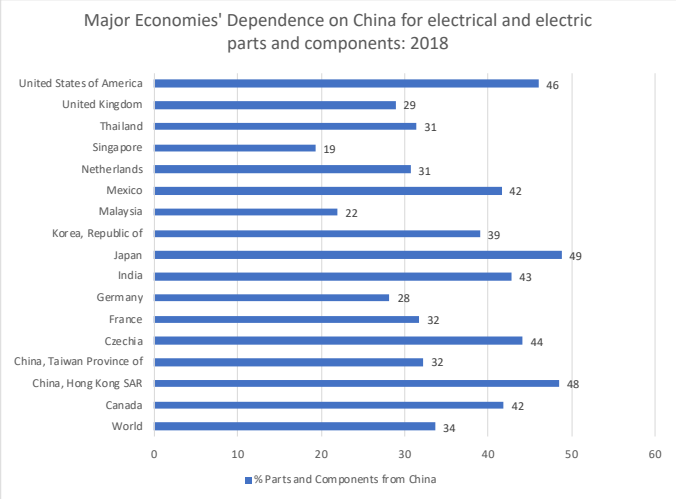
This section describes how sources of strategic uncertainty are increasing stresses and shifting risks to global value chains.

Protectionist Pressures and Aggressive Trade Policy

The first source of stress and increased risk is the trend of more aggressive trade measures and the reversal of the process of tariff reduction, particularly in the United States. The Donald Trump administration has taken a number of actions that raise, or threaten to raise, tariff rates on a wide range of US imports, including in industries most dependent on global value chains. The United States raised import tariffs on washing machines and solar panels from China, South Korea, and several other countries in January 2018, and used national security as a justification to impose 25-percent tariffs on steel and 10-percent tariffs on aluminum imports in March 2018 under Section 232 of the Trade Expansion Act of 1962.[8] But, the bulk of US tariff increases has been applied, in stages, to US imports from China. By the end of November 2019, the United States had raised tariffs on two thirds of it imports from China. In a departure from past tariff sanctions, the US tariff increases were heavily concentrated on intermediate goods and industrial goods, sparing duty increases on finished consumer goods.[9]

The United States and China signed a Phase I trade agreement on December 15, 2019.[10] The agreement prevented the imposition of US tariffs on a remaining tranche of imports in return for China increasing purchases of US goods and services by at least $200 billion. Despite the deterioration of relations since then, the United States and China have managed to maintain the Phase I deal on a separate track, with China steadily increasing its purchases of US goods, although well short of the level needed to meet the 2020 targets.[11] On August 24, the United States and China reconfirmed their commitment to the Phase I deal.[12] Even after Phase I, however, it remains a fact that the United States maintains tariffs on almost two thirds of total imports from China, and the average US tariff rate on Chinese imports is still at 19.3 percent, compared to 3 percent at the beginning of 2018.[13] China and other countries facing US tariffs have also retaliated by raising tariffs of their own. Currently applied Chinese tariffs on imports from the United States are 20.9 percent, up from 8 percent in early 2018.[14] Although the Trump administration sharply altered US tariffs, public sentiment toward China has

Figure 3: Percent Parts and Components for Electrical and Electronic Goods Imported from China in 2018.[1]



1 Valentina Romei, "Coronavirus Sends Ripples through Global Economy," *Financial Times*, February 12, 2020, https://www.ft.com/content/e9fbbb78-4901-11ea-aeb3-955839e06441.

8 Chad P. Bown and Melina Kolb, "Trump's Trade War Timeline: An Up-to-Date Guide," *Peterson Institute of International Economics*, August 6, 2020, https://www.piie.com/blogs/trade-investment-policy-watch/trump-trade-war-china-date-guide.

9 Eighty-two percent of parts and supplies that US-based businesses buy from China were subject to tariffs before September 2019, while only 29 percent of final consumer goods were similarly taxed. See Chad P. Bown, "Trump's Fall 2019 China Tariff Plan: Five Things You Need to Know," *Peterson Institute of International Economics*, August 14, 2019, https://www.piie.com/blogs/trade-and-investment-policy-watch/trumps-fall-2019-china-tariff-plan-five-things-you-need-know#:~:text=The%20September%201%2C%202019%20tariffs,affected%20by%20Trump's%20extra%20tariffs.

10 "Economic and Trade Agreement Between the Government of the United States of America and the Government of the People's Republic of China," Office of the United States Trade Representative, https://ustr.gov/countries-regions/china-mongolia-taiwan/peoples-republic-china/phase-one-trade-agreement/text.

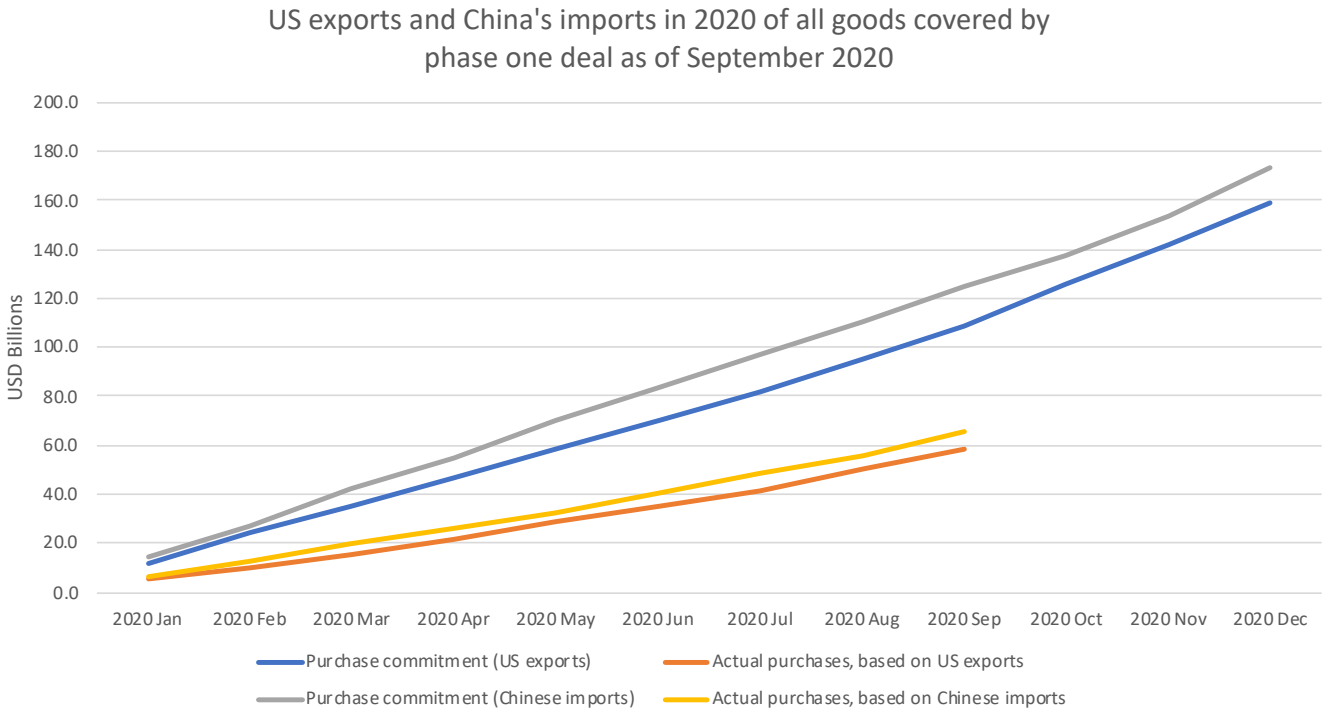
11 Mark Weinraub, "China Books Record U.S. Corn Purchase, Also Buys Soybeans," Reuters, July 14, 2020, https://www.reuters.com/article/us-usa-china-exports/china-books-record-u-s-corn-purchase-also-buys-soybeans-idUSKCN24F1TZ; Peyton Forte and Michael Hirtzer, "China Buys Most U.S. Corn Since 1994, Edging Toward WTO Quotas," Bloomberg, July 10, 2020, https://www.bloomberg.com/news/articles/2020-07-10/china-buys-most-american-corn-since-1994-with-new-permits-issued; Michael Hirtzer and Isis Almeida, "China Books Record Deal for U.S. Corn, Stepping Up Buying," Bloomberg, July 14, 2020, https://www.bloomberg.com/news/articles/2020-07-14/china-books-record-deal-for-u-s-corn-stepping-up-buying-spree.

12 Bob Davis and Lingling Wei, "Senior U.S., Chinese Officials Say They Are Committed to Phase-One Trade Deal," *Wall Street Journal,* August 24, 2020, https://www.wsj.com/articles/senior-u-s-chinese-officials-say-they-are-committed-to-phase-one-trade-deal-11598322056.

13 Chad P. Bown, "Phase One China Deal: Steep Tariffs Are the New Normal," *Peterson Institute of International Economics*, December 19, 2019, https://www.piie.com/blogs/trade-and-investment-policy-watch/phase-one-china-deal-steep-tariffs-are-new-normal.

14 Ibid.

Figure 4: Progress on Commitments from US-China Phase I Trade Deal.



Although the deal is still intact, projections indicate that China is unlikely to fulfill its purchase commitment of US goods.[1]

1 Chad P. Bown, "US-China Phase One Tracker: China's Purchases of US Goods," Peterson Institute for International Economics, August 25, 2020, https://www.piie.com/research/piie-charts/us-china-phase-one-tracker-chinas-purchases-us-goods.

shifted sharply within the United States, and higher tariffs are likely to remain no matter who wins the November US presidential election.[15]

Rising tariff rates are particularly disruptive to global value chains because they apply to the total value of the good, and not to the value added at the last stage. Thus, the effect of a tariff on value added at the stage where the tariff is applied can be a multiple of its percentage amount, and tariffs accumulate along production stages. While US trade policy attention has been focused on China and the revised North American Free Trade Agreement (NAFTA) with Canada and Mexico, the United States has continued to raise disputes with other trading partners. The threat of increased US tariffs on autos and auto parts remains and would affect the European Union (EU), Japan, and possibly South Korea, despite the revised US-ROK free-trade agreement (FTA).[16] At the same time as the United States has been raising or threatening to raise tariffs, the EU, Japan, South Korea, and others have continued negotiating free-trade agreements. China has also lowered its tariffs on imports from other countries while, at the same time, raising tariffs on imports from the United States. As a result, the geographies of economically efficient global value chains are likely to be skewed in significant, but still uncertain, ways in the next few years.

Political Risks

In addition to diverging trade and tariff policies among major economies, the last few years have witnessed a breakdown in the long-standing separation of economic and political issues, with political disputes increasingly played out through economic sanctions and trade measures. China has used economic sanctions, most of them temporary, to signal its displeasure and punish countries that have gone against its

15 "While Mr. [Joe] Biden has criticized the Trump trade war as self-destructive, the campaign has refused to pledge removing the levies, saying only they would be re-evaluated. Democrats in Congress say they would pressure him to keep some tariffs in place to protect American workers." Jacob Schlesinger, "What's Biden's New China Policy? It Looks a Lot Like Trump's," *Wall Street Journal*, September 10, 2020, https://www.wsj.com/articles/whats-bidens-china-policy-it-looks-a-lot-like-trumps-11599759286; David Lawder and Trevor Hunnicutt, "Pulled in Many Directions, Biden May Keep Trump's China Tariffs in Place," Reuters, September 8, 2020, https://www.reuters.com/article/us-usa-election-biden-trade-analysis/pulled-in-many-directions-biden-may-keep-trumps-china-tariffs-in-place-idUSKBN25Z1VH; Gavin Bade, "Biden Won't Rule Out New Tariffs, Adviser Says," *Politico*, September 22, 2020, https://www.politico.com/news/2020/09/22/biden-tariffs-adviser-420096.

16 Troy Stangarone, "KORUS FTA Doesn't Protect South Korea From Section 232 Investigations," *The Diplomat*, August 9, 2018, https://thediplomat.com/2018/08/korus-fta-doesnt-protect-south-korea-from-section-232-investigations/.

perceived national interest and security. Examples include prohibiting imports of Philippine bananas (over the South China Sea dispute), Norwegian salmon (over the Nobel Prize award to Liu Xiaobo), and Australian wheat (over Australia's call for a COVID-19 investigation), as well as the sanctions against ROK firms in China and limits on tourists going to South Korea after the Terminal High Altitude Area Defense (THAAD) deployment there in 2016.[17] As discussed in the case study below, Japan required export licenses for sales of three advanced material inputs for South Korean semiconductor production and removed South Korea from its whitelist for automatic export approvals as part of a dispute over liability of Japanese corporations regarding forced labor during Japan's occupation of Korea in WWII.[18] In April 2019, President Trump threatened to impose additional tariffs of 5 percent on all imports from Mexico unless the country took steps to limit illegal immigration to the United States.[19] The Trump administration reportedly threatened to impose auto tariffs on France, Germany, and the United Kingdom (UK) if they did not put pressure on Iran to adhere to the requirements of the Iran nuclear agreement.[20]

In addition, US financial and economic sanctions are an example of policy that has expanded from the political realm to include economic and strategic motivations. Originally, US sanctions had been used to directly constrain North Korea, Iran, and other rogue states, and to punish firms that violated UN resolutions and US sanctions policy. In recent years, the motivations have expanded to include concerns about Chinese intellectual-property theft, espionage, and supply-chain security, as well as industrial policy and technological competition, including issues discussed below. In short, firms with global value chains now have the additional risk of facing unexpected collateral damage from political disputes involving major countries.

Although China and the United States are the principal disputants, other countries in the Indo-Pacific region that participate in GVCs are also vulnerable to policy actions that disrupt supply chains. South Korea is particularly vulnerable, as it is heavily dependent on global value chains. Ninety percent of ROK exports are intermediate goods destined for further processing, often in China.[21] ROK exports are more than 40 percent of gross domestic product (GDP), one of the highest in the Organisation for Economic Co-operation and Development (OECD).[22] Persistent current-account surpluses reflect weak domestic demand and a high dependence on exports for South Korean growth. Although South Korea is closely aligned with the United States in terms of security, it is highly dependent on exports and the Chinese market for growth. More than a quarter of its exports (around $160 billion in 2018) go to China.[23] Among the OECD, only Australia has a higher share of its exports going to China—35.5 percent ($87.9 billion) in 2018.[24]

Supply-Chain Security

Firms are also encountering risk stemming from the character and integrity of the GVC process itself, better known as "supply-chain security."[25] Countries are growing increasingly wary of vulnerabilities arising from their links to the Internet, their citizens' devices, government computers, and more. These risks are not limited to information and communications technology—they have confronted nuclear-weapons systems, nuclear power plants, and military goods production for

17 Kesha West, "Banana Crisis Blamed on Philippines-China Dispute," Australia Network News, June 28, 2012, https://www.abc.net.au/news/2012-06-29/an-banana-exporters-caught-in-philippines-china-dispute/4100422; Echo Huang and Isabella Steger, "Norway Wants China to Forget about the Human Rights Thing and Eat Salmon Instead," *Quartz*, June 14, 2017, https://qz.com/1000541/norway-wants-china-to-forget-about-the-human-rights-thing-and-eat-salmon-instead/; Jethro Mullen, "China's 'Unofficial' Sanctions Rattle South Korea," CNN Business, March 3, 2017, https://money.cnn.com/2017/03/03/news/economy/china-south-korea-thaad-tourism-trade-sanctions/.

18 See Samuel M. Goodman, Dan Kim, and John VerWey, "The South Korea-Japan Trade Dispute in Context: Semiconductor Manufacturing, Chemicals, and Concentrated Supply Chains," Office of Industries Working Paper ID-062, October 2019, 4–5, https://usitc.gov/publications/332/working_papers/the_south_korea-japan_trade_dispute_in_context_semiconductor_manufacturing_chemicals_and_concentrated_supply_chains.pdf.

19 "Statement from the President Regarding Emergency Measures to Address the Border Crisis," White House, May 30, 2019, https://www.whitehouse.gov/briefings-statements/statement-president-regarding-emergency-measures-address-border-crisis/.

20 John Hudson and Souad Mekhennet, "Days before Europeans Warned Iran of Nuclear Deal Violations, Trump Secretly Threatened to Impose 25% Tariff on European Autos if They Didn't," *Washington Post,* January 15, 2020, https://www.washingtonpost.com/world/national-security/days-before-europeans-warned-iran-of-nuclear-deal-violations-trump-secretly-threatened-to-impose-25percent-tariff-on-european-autos-if-they-didnt/2020/01/15/0a3ea8ce-37a9-11ea-a01d-b7cc8ec1a85d_story.html.

21 Mike Bird, "Korea's Coronavirus Spread Puts an Export Hub at Risk," *Wall Street Journal*, February 25, 2020, https://www.wsj.com/articles/koreas-coronavirus-spread-puts-an-export-hub-at-risk-11582537118.

22 "Exports of Goods and Services (% of GDP)—Korea, Rep.," World Bank, https://data.worldbank.org/indicator/NE.EXP.GNFS.ZS?locations=KR.

23 "South Korea," Observatory of Economic Complexity, last modified June 2020, https://oec.world/en/profile/country/kor.

24 "Australia," Observatory of Economic Complexity, last modified 2018, https://oec.world/en/profile/country/aus.

25 Edna Conway and Michael Krigsman, "Cisco CSO: Enterprise Security and the Global Value Chain," CxO Talk #356 (podcast), May 24, 2019, https://www.cxotalk.com/episode/cisco-cso-enterprise-security-global-value-chain.

some time, and more recently have been of concern to the pharmaceutical and food industries.[26] However, the new elements of strategic uncertainty, described above, have had a pronounced impact on semiconductor and technology industries, and, as a result, have impacted a variety of industrial-equipment industries.

These information and communications technology (ICT) products are, by and large, produced through GVCs in which products are assembled from individual components made by numerous, and often geographically dispersed, producers. Rapid technological advantage in the sector, and the standardization of many ICT components, meant the ability to specialize in particular components at large scale and to tap low-cost labor for many operations, including final assembly. This, in turn, led to rapid reduction of costs and ICT product prices, spurring demand and fueling a virtuous cycle of further specialization and cost reduction.

Technological developments, including the growth of pervasive networking, remote sensing, and embedding computer control for myriad uses—from industrial processes, to vehicle navigation and control, to household items such as doorbells, televisions, and voice-activated speakers and appliances—continue to increase the importance of supply-chain security. These vulnerabilities may grow by an order of magnitude as technologies such as autonomous vehicles, the Internet of Things (IoT), and fifth-generation (5G) technology are increasingly adopted around the world. In this environment of heightened strategic uncertainty, the ICT and semiconductor industries face risk across the broad range of segments of the ICT lifecycle, including design, production, distribution, maintenance, and upgrading.[27]

These supply-chain security risks are not theoretical. In addition to widely reported breaches of confidential online data, there have been reports of compromised firmware for cell phones, infected flash-memory components, and counterfeit integrated circuits.[28] The UK's Huawei Cyber Security Evaluation Centre has found a multitude of vulnerabilities in poorly maintained code from the Chinese giant, supporting concerns that telecommunications equipment, 5G and otherwise, from the firm may be easily or intentionally undermined.[29]

Besides the immediate risk of technical flaws, ICT firms must grapple with inconsistencies in demand for exceptional law-enforcement access, still-formative national policies on supply-chain security, and considerable uncertainty as to their ultimate breadth, character, and restrictiveness.[30] The description of the evolving US supply-chain security policy below illustrates the nature of this challenge.

1 Governmental policy efforts on supply-chain security

US supply-chain security efforts reach back almost fifteen years. The George W. Bush administration's 2008 Comprehensive National Cybersecurity Initiative featured supply-chain security measures, including a joint Department of Homeland Security and Department of Defense (DHS/DoD) program to measure and mitigate supply-chain risk, with specific policies for the federal government.[31] The National Institute of Standards and Technology issued its first white paper on supply-chain risk-management practices in the private sector in 2011, and has convened a supply-chain security conference several times per year for more than a decade.[32]

Recent US policy has been a driving force in supply-chain security, although there have been initiatives in the United Kingdom and other countries.[33] The instantiation of "Team Telecom" under the Barack Obama administration involved more than one hundred and twenty companies signing network-security agreements as a condition of licensing from the US Federal Communications Commission. These

26 See "Appendix 1: Supply Chain Security: The Analogy to Counterfeit Pharmaceuticals" in Ariel Levite, "ICT Supply Chain Integrity: Principles for Governmental and Corporate Policies," Carnegie Endowment for International Peace, November 2019, 41–44.

27 See Levite, "ICT Supply Chain Integrity," p. 6 for a particularly useful graphic illustrating this process.

28 "Supply Chain Risks for Information and Communication Technology," United States Cybersecurity and Infrastructure Security Agency, December 2018, https://www.cisa.gov/sites/default/files/publications/19_0424_cisa_nrmc_supply-chain-risks-for-information-and-communication-technology.pdf.

29 Natasha Lomas, "UK Report Blasts Huawei for Network Security Incompetence," *TechCrunch*, March 28, 2019, https://techcrunch.com/2019/03/28/uk-report-blasts-huawei-for-network-security-incompetence/; "Dutch Spy Agency Investigating Alleged Huawei 'Backdoor': Volkskrant," Reuters, May 16, 2019, https://www.reuters.com/article/us-netherlands-huawei-tech/dutch-spy-agency-investigating-alleged-huawei-backdoor-volkskrant-idUSKCN1SM0UY; Kate O'Keeffe and Dustin Volz, "Huawei Telecom Gear Much More Vulnerable to Hackers Than Rivals' Equipment, Report Says," *Wall Street Journal*, June 25, 2019, https://www.wsj.com/articles/huawei-telecom-gear-much-more-vulnerable-to-hackers-than-rivals-equipment-report-says-11561501573.

30 The Russian hacking and sabotage of the Ukrainian electrical grid in December 2015 is one example. See David E. Sanger, *The Perfect Weapon: War, Fear, and Sabotage in the Cyber Age* (New York: Crown Publishing Group, 2018) 1-4; Aliya Sternstein, "China's Defense of Huawei? U.S. tech companies spy too," Nextgov, October 10, 2012, https://www.nextgov.com/cybersecurity/2012/10/chinas-defense-huawei-us-tech-companies-spy-too/58680/.

31 "Cybersecurity: Progress Made but Challenges Remain in Defining and Coordinating the Comprehensive National Initiative," US Government Accountability Office, March 5, 2010, https://www.gao.gov/assets/310/301464.html.

32 "Cyber Supply Chain Risk Management," Computer Security Resource Center, https://csrc.nist.gov/Projects/cyber-supply-chain-risk-management/publications; "Software and Supply Chain Assurance Forum," Computer Security Resource Center, https://csrc.nist.gov/Projects/cyber-supply-chain-risk-management/ssca.

33 Amid the outbreak of the COVID-19 pandemic, the UK is making plans to end its reliance on China for vital medical supplies and other strategic imports under the codename "Project Defend." See Kanishka Singh, "UK PM Johnson Orders for Plans to End Reliance on Chinese Imports: *The Times*," Reuters, May 21, 2020, https://www.reuters.com/article/us-health-coronavirus-britain-china/uk-pm-johnson-orders-for-plans-to-end-reliance-on-chinese-imports-the-times-idUSKBN22X2WA.

contracts provided for rights of audit, oversight, and site visits, as well as constraining business decisions and the location of assets.[34] The Department of Defense has developed a contentious Cyber Maturity Model Certification program to help drive better visibility and adherence to supply-chain risk-management best practices by major DoD contractors and their vendors.[35] The US Department of Homeland Security set up an Information and Communications Technology Supply Chain Risk Management Task Force in 2018 to evaluate supply-chain risks and pursue potentially limiting approaches, such as qualified-bidder lists, though this group has not yet produced a final report.[36]

In 2019, the White House directed the Commerce Department to identify ICT product and services transactions that pose national security risks, including those involving information and communications technology and services designed, developed, manufactured, or supplied by entities owned by, or subject to, the jurisdiction or direction of a foreign adversary.[37] While the Commerce Department has not yet precisely identified these adversaries, China and Huawei are oft-mentioned candidates. These reviews would be determined case by case, without the ability for preclearance, with narrow time windows for response.[38] Corporate criticism has been intense and, given the extent of business reaction, the final proposal is likely to change considerably.[39]

Export controls can be a tool for unpredictable executive action, and the United States has broadened their use in the past few years.[40] The two most important changes have been the revision of export-control regulations in the Export Control Reform Act (ECRA) in 2018, and the increased use of the Commerce Department Entity List to block transactions with listed firms, including many within China and foreign joint ventures of US firms.[41] The Export Control Reform Act codified existing US practices, but also required the Commerce Department, working with other US agencies, to develop a list of "emerging and foundational technologies" that are essential to US national security, and incorporate them into US export-administration regulations.[42] As of this writing, the list is still being developed.

The Entity List is a group of individuals, firms, or organizations that are subject to US export control, requiring a license from the Bureau of Industry and Security (BIS) of the Department of Commerce.[43] Over the past several years, the Entity List has become a powerful tool for responding to violations of US sanctions, theft of intellectual property, or other US policy

34 Megan Brown, Nova Daly, and Brandon Moss, "Companies Will Feel the Weight of Team Telecom Oversight," *Law360*, June 4, 2018, https://www.wiley.law/assets/htmldocuments/Companies%20Will%20Feel%20The%20Weight%20Of%20Team%20Telecom%20Oversight.pdf.

35 "DoD's Cybersecurity Maturity Model Certification (CMMC) Initiative," US Department of Defense, https://resources.infosecinstitute.com/dods-cybersecurity-maturity-model-certification-cmmc-initiative/.

36 "Information and Communications Technology Supply Chain Risk Management Task Force: Interim Report: Status Update on Activities and Objectives of the Task Force," United States Department of Homeland Security, Cybersecurity and Infrastructure Security Agency (CISA), September 2019, 13–15, https://www.cisa.gov/sites/default/files/publications/ICT%20Supply%20Chain%20Risk%20Management%20Task%20Force%20Interim%20Report%20%28FINAL%29_508.pdf.

37 "Securing the Information and Communications Technology and Services Supply Chain," Federal Register Notice 65316, November 27, 2019, https://www.federalregister.gov/documents/2019/11/27/2019-25554/securing-the-information-and-communications-technology-and-services-supply-chain.

38 Tamer A. Soliman, et al., "US Commerce Department Proposes Sweeping New Rules for National Security Review of US Information and Communications Technology or Services Transactions," Mayer Brown, December 2, 2019, https://www.mayerbrown.com/en/perspectives-events/publications/2019/12/us-department-of-commerce-proposes-rule-for-securing-the-nations-information-and-communications-technology-and-services-supply-chain.

39 See, for example, Nihal Krishan, "'Enormous Power Grab': Business Groups Bash Commerce Department Supply-Chain Security Proposal," *Washington Examiner*, January 16, 2020, https://www.washingtonexaminer.com/policy/economy/enormous-power-grab-business-groups-bash-commerce-department-supply-chain-security-proposal. IBM's comment, in a January 10, 2020, letter, was that "the Proposed Rule would not achieve [its] objectives. It is massively overbroad, and...would harm the US economy, fail to enhance US security, and violate due process."

40 For a general description of US export controls, see, "US Export Controls," United States Department of Commerce, International Trade Administration, https://www.trade.gov/us-export-controls.

41 "Supplement No. 4 to Part 744 Entity List," United States Department of Commerce, Bureau of Industry and Security, August 17, 2020, https://www.bis.doc.gov/index.php/documents/regulations-docs/2326-supplement-no-4-to-part-744-entity-list-4/file; Michael E. Leiter, "Tightened Restrictions on Technology Transfer Under the Export Control Reform Act," Skadden, September 11, 2018, https://www.skadden.com/insights/publications/2018/10/tightened-restrictions-on-technology-transfer.

42 The list included advanced computing; advanced materials; advanced surveillance; artificial intelligence; biotechnology; brain-computer interfaces; data analytics; hypersonics; logistics; microprocessors; position, navigation, and timing (PNT); quantum information and sensing; and robotics. See "The Export Control Reform Act of 2018 and Possible New Controls on Emerging and Foundational Technologies," International Trade Alert, September 12, 2018, https://www.akingump.com/a/web/97168/aokrg/international-trade-alert-09-12-2018-the-export-control-refo.pdf.

43 See "Entity List," United States Department of Commerce, Bureau of Industry and Security, https://www.bis.doc.gov/index.php/policy-guidance/lists-of-parties-of-concern/entity-list.

interests.[44] In April 2019, the Trump administration added Huawei and its affiliates to the Entity List, blocking the export of products and software containing US technology, although later exemptions for non-sensitive products and technology were added.

In May 2020, BIS amended the foreign-produced direct product (FDP) rule specifically to target Huawei's acquisition of semiconductors that are the direct product of certain US software and technology made domestically.[45] In August, BIS further restricted access by Huawei and its non-US affiliates on the Entity List, extending the restriction to items made outside the United States.[46] BIS also added another thirty-eight Huawei affiliates to the Entity List, which imposes a license requirement for all items subject to the Export Administration Regulations (EAR), and modified four existing Huawei Entity List entries. According to the Department of Commerce, "these actions prevent Huawei's attempts to circumvent US export controls to obtain electronic components developed or produced using US technology."[47]

Thus, US export-control regulations have considerable extraterritorial reach, exemplified by UK semiconductor design company ARM cutting significant business ties with Huawei and crippling Huawei's ability to manufacture most of its top-of-the-line mobile phones without a new source of chips.[48] One of the obstacles to supply-chain security is the reluctance of governments to give up their discretion to intervene in, or compromise, supply chains for their own national security or intelligence goals. Even if governments are unwilling to give up all attempts to compromise supply chains or intercept communications, they could improve ICT security for all users by committing to limitations. One suggested approach is the development of a set of international commitments—limiting interventions to those that are directly targeted, with a time limit, and containing a failsafe to shut down the intervention.[49] These commitments could be useful even without an enforcement mechanism, both in pressuring governments to make commitments in public and because interventions often come to light—particularly when they are systemic and affect all users. And, a breached commitment can have a powerful effect on both national reputation and credibility.[50]

2 Private Efforts on GVC Security

Early efforts to enhance supply-chain security developed after the attacks on New York's World Trade Center in 2001. They were initially focused on goods transport, before broadening to encompass supply chains through the Customs Trade Partnership Against Terrorism (CTPAT).[51] The International Standards Organization issued ISO 28000 (Specification for security management systems for the supply chain) in 2007, which was focused on developing internal supply-chain policies and management systems, along with developing internal compliance systems and compliance with external best practices.[52]

Major ICT firms across the global value chains have also responded to supply-chain security issues through their own initiatives. One of the most prominent examples is the Open Group, a global consortium to share best practices and develop technology standards.[53] The group's Open Trusted Technology Provider Standard (O-TTPS) certification program provides a set of guidelines, recommendations, and requirements that helps assure customers of the integrity of

44 The most notable example is the addition of Huawei to the Entity List in July 2019. Prior to that, in October 2018, the Commerce Department added the Chinese memory chip firm Fujian Jinhua to the Entity List as a result of complaints about intellectual-property (IP) theft from Micron Technology, effectively forcing the company to halt production early in 2019. "Addition of Fujian Jinhua Integrated Circuit Company, Ltd (Jinhua) to the Entity List," US Department of Commerce, October 29, 2018. In the ZTE case, the Commerce Department added the company to the Denied List, which barred all US transactions with the company, denying the firm essential components and threatening to put ZTE out of business. "Secretary Ross Announces Activation of ZTE Denial Order in Response to Repeated False Statements to the US Government," US Department of Commerce, April 16, 2018. See also, Raymond Zhong, "Chinese Tech Giant on Brink of Collapse in New U.S. Cold War," *New York Times*, May 9, 2018, https://www.nytimes.com/2018/05/09/technology/zte-china-us-trade-war.html.

45 "Commerce Department Further Restricts Huawei Access to U.S. Technology and Adds Another 38 Affiliates to the Entity List," US Department of Commerce, press release, August 17, 2020, https://www.commerce.gov/news/press-releases/2020/08/commerce-department-further-restricts-huawei-access-us-technology-and.

46 Ibid.

47 Ibid.

48 Ryan Whitwam, "US Sanctions Forcing Huawei to End ARM Chip Production," *ExtremeTech*, August 10, 2020, https://www.extremetech.com/mobile/313608-us-sanctions-forcing-huawei-to-end-arm-chip-production.

49 Levite, "ICT Supply Chain Integrity."

50 An example is the commitment made by the Chinese government in 2015 in the Strategic and Economic Dialogue with the United States to refrain from state-sponsored cyber hacking to acquire commercial technology and trade secrets. The resumption of this activity soon after the agreement was one of the most important factors sowing distrust of dialogue with the Chinese government, not just in the incoming Trump administration, but across both parties in Congress and across US officials.

51 "CTPAT: Customs Trade Partnership Against Terrorism," US Customs and Border Protection, https://www.cbp.gov/border-security/ports-entry/cargo-security/ctpat.

52 "Specification for Security Management Systems for the Supply Chain: ISO 28000:2007," International Standards Organization, https://www.iso.org/standard/44641.html. https://en.wikipedia.org/wiki/ISO_28000.

53 The Open Group has more than six hundred and twenty-five organization members, and defines its activity as "leading the development of open, vendor-neutral technology standards and certifications." See: "About Us—What We Do," Open Group, https://www.opengroup.org/about-us/what-we-do.

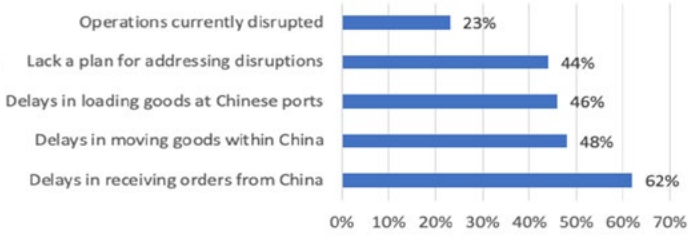
commercial off-the-shelf (COTS) information and ICT products worldwide, and safeguard global supply chains against security attacks.[54] The O-TTPS program has a voluntary self-assessed or third-party-assessed certification process, which is still relatively limited in its application.[55] None of these private-sector efforts clearly address national jurisdiction as a source of risk, which has featured prominently in recent US and Chinese policy moves.

Unexpected Shocks and the COVID-19 Pandemic

A final area of shifting risk to global value chains emerged as a direct result of the COVID-19 pandemic. The global crisis underscores many firms' remarkable dependence on, and concomitant vulnerability from, Chinese value chains. This was especially true in the early days of the crisis, when major firms such as Mazda, Hyundai, Chrysler, and Ford were forced to halt production as a result of shutdowns within China and sought costly workarounds.[56] Mazda spent $5 million to relocate production of a component used in exterior trim of certain models to Mexico—further amplifying the economic damage caused by the initial production stoppage.[57]

Beyond the initial economic disruptions, the pandemic accelerated calls for national and multilateral efforts to reshore production and diversify GVCs away from China. Japan received major media attention for earmarking funds in its economic stimulus to assist firms willing to return production to Japan (about $2 billion USD) or diversify to Southeast Asia (about $220 million USD).[58] Similarly, India is reportedly offering land twice the size of Luxembourg to companies seeking to move production to India.[59] Most notably, the United States has responded by launching the so-called "Economic Prosperity Network," a multilateral effort to remove supply chains from China, which is "comprised of countries, companies, and civil society organizations that are anchored in trust and that operate by a set of trust principles."[60] Japan, India, and Australia are also reportedly working to jointly launch a "supply chain resilience initiative."[61] These examples highlight the extent to which national governments are taking the deeper GVC risks revealed by the pandemic seriously. However, the extent to which they match private-sector realities, and are likely to produce meaningful, long-term reorientation of GVCs, requires deeper examination as a second case study in the following section.

Figure 5: Survey of Early Impact of COVID-19 on North American Companies.[1] (February 22 - March 5, 2020)



1 "Coronavirus Outbreak in China: Impact to Supply Chain," Institute for Supply Management, February 22–March 5, 2020, https://www.ismworld.org/supply-management-news-and-reports/reports/covid-19-resource-center/infographic/.

54 See: "O-TTPS Certification Program," Open Group, https://ottps-cert.opengroup.org/.

55 As of March 2020, there were six third-party-assessed and twenty-five self-assessed certifications. See: "O-TTPS Certification Register," Open Group, https://certification.opengroup.org/register/ottps-certification.

56 Emi Okada, "Mazda Delays Restart of Chinese Factories Amid Coronavirus Threat," *Nikkei Asian Review*, February 12, 2020, https://asia.nikkei.com/Spotlight/Coronavirus/Mazda-delays-restart-of-Chinese-factories-amid-coronavirus-threat; Jack Ewing, Neal E. Boudette, and Geneva Abdul, "Virus Exposes Cracks in Carmakers' Chinese Supply Chains," *New York Times*, February 4, 2020, https://www.nytimes.com/2020/02/04/business/hyundai-south-korea-coronavirus.html; Kalea Hall and Breana Noble, "Coronavirus Expected to Hit Automakers' Bottom Lines," *Detroit News*, February 10, 2020, https://www.detroitnews.com/story/business/autos/2020/02/10/china-auto-plants-shutdowns-coronavirus/4694320002/.

57 Naomi Tajitsu and Maki Shiraki, "Now Made in Mexico: Japan Auto Suppliers Shift China Production After Coronavirus," Reuters, March 16, 2020, https://www.reuters.com/article/health-coronavirus-japan-autos/now-made-in-mexico-japan-auto-suppliers-shift-china-production-after-coronavirus-idUSL5N2AR0HF.

58 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.

59 Nikhil Inamdar, "Coronavirus: Can India Replace China as World's Factory?" BBC News, May 18, 2020, https://www.bbc.com/news/world-asia-india-52672510.

60 "Special Briefing with Keith Krach, Under Secretary of State for Economic Growth, Energy, and the Environment; Cordell Hull, Acting Under Secretary of Commerce for Industry and Security; Dr. Christopher Ford, Assistant Secretary of State for International Security and Nonproliferation; and Ian Steff, Assistant Secretary of Commerce for Global Markets," US Department of State, May 20, 2020, https://www.state.gov/special-briefing-with-keith-krach-under-secretary-of-state-for-economic-growth-energy-and-the-environment-cordell-hull-acting-under-secretary-of-commerce-for-industry-and-security-dr-christophe/.

61 Shruti Srivastava and Isabel Reynolds, "Japan, India and Australia Eye 'Supply Chain Pact' to Counter China," *Japan Times*, August 23, 2020, https://www.japantimes.co.jp/news/2020/08/23/business/economy-business/japan-india-australia-supply-chain-china/#.X0arb8hKg2w.

3. CASE STUDIES

This report presents two case studies to illustrate how global value chains face increasing risks in a period of strategic uncertainty, and to explore the less-studied question of how firms can navigate goals of national security and economic efficiency at the same time. The first case study reviews the 2019 trade dispute between South Korea and Japan, and its impact on supply chains for semiconductor manufacturing and prospects for localization efforts. Like other export-control measures, the ROK-Japan trade dispute, driven by an underlying political dispute, provided an opportunity for firms to explore options for restructuring global values chains for semiconductors to mitigate potential risks from major disruptions, as well as for the South Korean government to seek private-sector cooperation to reshore supply chains.

The second case study analyzes the impact of the ongoing COVID-19 global pandemic crisis on global value-chain disruptions and efforts to restructure existing supply chains to increase resilience. The global pandemic and worsening US-China tensions have accelerated existing efforts to diversify and reshore global value chains, particularly as some companies revisit the benefits of de-risking their business by reshoring or diversifying their production in line with governments' national security interests.

TIMELINE OF KOREA-JAPAN DISPUTE 2019–2020[1]

JULY 2019	AUGUST 2019	SEPTEMBER 2019	NOVEMBER 2019	DECEMBER 2019	JULY 2020
The Japanese government imposes export controls on three chemical materials critical to semiconductor production in South Korea. Korean and Japanese officials meet twice to discuss the deteriorating diplomatic relations, but fail to resolve the issue.	The Japanese government removes South Korea from a "white list" of countries that enjoy preferential treatment for export licensing. The ROK announces that it will scrap the annual military information-sharing pact with Japan, the General Security of Military Information Agreement (GSOMIA).	ROK's Ministry of Trade, Industry, and Energy (MOTIE) initiates a World Trade Organization (WTO) dispute complaint against Japanese export measures.	The ROK government suspends its decision to terminate GSOMIA	The Japanese government partially eases export regulations on one of the chemicals—photoresists—by removing it from the list of export commodities that require special license to export, but South Korea remains off the "white list."	The WTO creates a dispute panel to rule on South Korea's complaint. The Dispute Settlement Committee favors the ROK's appeal, despite Japanese claims that the export controls were necessary for Japanese national security.

1 "Timeline of Japan-South Korea Relations," Center for Strategic and International Studies, http://japankorea.csis.org/; "Timeline: How the Japan-South Korea Trade Dispute Escalated," DHL, December 15, 2019, https://lot.dhl.com/timeline-how-the-japan-south-korea-trade-dispute-escalated/, with added information and sources.

A. ROK-Japan Trade Dispute and its Impact on Semiconductor Supply Chains

The case of the recent ROK-Japan trade dispute over semiconductor-materials exports illustrates the increasing trend of political disputes spilling over into the economic sphere in the form of sanctions and export-control measures.[62] While forecasting the trajectory of the current historical and political dispute is beyond the scope of this report, the supply-chain risks that were introduced by the trade dispute between the two countries, as well as the long-term implications of such risks, merit further examination.

On July 4, 2019, the Japanese government stopped referential treatment for shipments of three chemical materials critical to semiconductor production in South Korea—fluorinated polyimides, photoresists, and hydrogen fluoride. This meant that Japanese firms exporting these products had to seek governmental permission each time they wanted to ship them to South Korea, and the decision could officially take up to ninety days.[63] Effectively, whether or not South Korean semiconductor firms could receive shipments of these chemical materials was placed under the discretion of the Japanese government. Then, on August 28, 2019, the Japanese government went a step further by removing South Korea from its "white list" of countries enjoying preferential treatment for export licensing. This expanded the new regulation imposed on the three chemical materials to cover all products and materials classified as "strategic" by the Japanese government. (See Table 1 for a chronological list of developments in the ROK-Japan dispute.)[64]

After altering the procedures for export licensing, the Japanese government selectively granted special permission to Japanese firms exporting these materials. It granted permission to export photoresist, hydrogen-fluoride gas (etching gas), and fluorinated polyimide several times throughout the summer and fall of 2019. However, applications to export liquid hydrogen fluoride—which is different from its gas variant and is widely used to remove impurities during the etching of silicon wafer chips—were rejected several times, and were only accepted on November 16, 2019.[65]

Since Japan announced export controls on the three components mentioned above, there has been widespread concern that these export-restriction measures are likely to disrupt the existing global value chains for semiconductor-related industries in both the short and long term. When it comes to semiconductor value chains, Japan is a highly competitive supplier of semiconductor-manufacturing equipment and materials, whereas South Korea is a highly competitive producer of semiconductors.[66] The ROK's Samsung Electronics and SK Hynix collectively produce approximately 70 percent of dynamic random-access-memory semiconductors (DRAM) and 40 percent of NAND flash memory used worldwide—components critical to producing smartphones and modern electronics. Semiconductor-related industries have consolidated significantly in the past three decades, mainly due to increasingly high fixed costs and specialization. Combined with the trend of globalization, more concentrated groups of upstream suppliers (equipment and materials) have been selling to more concentrated groups of customers (chip producers), making it very hard for South Korea to find alternative suppliers.[67] As semiconductor firms cannot easily replace suppliers in the short term, the recent trade tensions between the two countries pose critical business risks, and may drive new national security risks. Disruptions of semiconductor supply undermine the digital economy, threatening everything from laptops and mobiles phones to the high-order computer demands of artificial-intelligence (AI) technologies.[68]

The trade diversion between Japan and South Korea will likely incur higher costs, lower revenues, and a reduced

62 Experts have pointed to the Korean Supreme Court's decision ordering Japanese firms to compensate colonial-era forced Korean laborers as a major driver of Japan's decision to impose export controls. Others have suggested that restrictions might be intended, in part, to protect Japan's own semiconductor industry. It is important to note, however, that the Japanese government maintains, "The purpose of the amended trade regulations are to improve South Korea's export control system" in the interest of national security, independent of historical disputes between the two countries. See: "South Korea Removes Japan from Fast-Track Trade 'White List,'" Reuters, September 17, 2019, https://www.reuters.com/article/us-southkorea-japan-whitelist/south-korea-removes-japan-from-fast-track-trade-white-list-idUSKBN1W21T2.

63 Makiko Yamazaki, Heekyong Yang, and Ju-min Park, "The High-Tech Trade Dispute Rooted in Japan's Wartime History," Reuters, July 8, 2020, https://www.reuters.com/article/us-southkorea-japan-laborers-explainer/the-high-tech-trade-dispute-rooted-in-japans-wartime-history-idUSKCN1U31D1; "Guide on Japan's Export Control Measures," Korea Strategic Trade Institute, 2019, https://japan.kosti.or.kr/user/Co/CoUser040L.do?CURRENT_MENU_CODE=MENU0016&TOP_MENU_CODE=MENU0002.

64 Ibid; "Ilbon Gyujae Baro Algi (Understanding Japan's Export Control Measures)," Korea Strategic Trade Institute, https://japan.kosti.or.kr/user/Co/CoUser040L.do?CURRENT_MENU_CODE=MENU0016&TOP_MENU_CODE=MENU0002.

65 Kim Eun-Hyoung, "Japan Approves Exports of Liquid Hydrogen Fluoride," *Hankyoreh*, November 18, 2019, http://english.hani.co.kr/arti/english_edition/e_international/917459.html.

66 Goodman, et al., "The South Korea-Japan Trade Dispute in Context."

67 Ibid.; Stephen Ezell, "Understanding the South Korea-Japan Trade Dispute and Its Impacts on US Foreign Policy," Information Technology & Innovation Foundation, January 16, 2020, https://itif.org/publications/2020/01/16/understanding-south-korea-japan-trade-dispute-and-its-impacts-us-foreign.

68 Damien Ma, Houze Song, and Neil Thomas, "Supply Chain Jigsaw: Piecing Together the Future Global Economy," MacroPolo, April 2020, https://macropolo.org/wp-content/uploads/2020/04/Supply-Chain.pdf; June Park, "Semiconductor Tech War Underlies the Japan–South Korea Trade Dispute," East Asia Forum, September 24, 2019, https://www.eastasiaforum.org/2019/09/24/semiconductor-tech-war-underlies-the-japan-south-korea-trade-dispute/.

return on capital for companies in both countries in the medium-to-long term, according to S&P Global.[69] As others have noted, "Japanese firms with clear competitiveness in the manufacturing of these [three] chemicals risk losing customers in a market where there are currently no obvious alternative buyers. Korean firms with clear competitiveness in semiconductor manufacturing may be forced to invest in or source from alternate sources that are inferior to current sources."[70]

The measures taken by the Japanese government generated severe uncertainty over semiconductor supply chains for relevant stakeholders—including ROK semiconductor producers and the South Korean government—for two main reasons. First, South Korean semiconductor firms rely almost entirely on Japan for these key chemical materials, as Japanese firms dominate their production. Japan has accounted for 90 percent of South Korea's fluorinated-polyimide and photoresists imports, and 44 percent of its hydrogen fluoride-imports.[71] Moreover, because Japanese firms account for 90 percent of the world's supply of fluorinated polyimide and photoresists, and 70 percent of global hydrogen-fluoride production, it was difficult for South Korean firms to find alternative suppliers.[72]

For the ROK government, the uncertainty over semiconductor supply chains was just as concerning because the semiconductor industry is foundational to the South Korean economy. South Korea has been an export-led economy—the world's fifth-most export intensive—and semiconductors accounted for almost one third of its exports and 92 percent of its export growth in 2018.[73] Semiconductor chips and smartphones produced by Samsung Electronics alone accounted for one fifth of South Korea's national exports in the first half of 2019.[74] Disruptions to semiconductor production also had the potential to affect other ROK industries. Major automakers like Hyundai and Kia increasingly depend on domestically produced semiconductors, as digital and electronic components have become more important to auto manufacturing. According to one market analyst, if the Japanese government had escalated by fully restricting exports of the chemical materials for semiconductors, it could potentially have reduced the South Korean GDP by as much as 2.6 percent in 2020.[75] In short, any deterioration in the ROK-Japan dispute posed a direct threat to the ROK economy, which also likely has a spillover effect on other economies whose supply chains are interlinked with those of South Korea.

While analysts remain cautious of South Korea's ability to quickly replace Japanese parts given the technological gap, there has been a strong push for localization.[76] Within a year of Japan's imposition of export controls, the ROK government, together with the South Korean semiconductor industry, made significant progress in onshoring and diversifying the supply of semiconductor input materials (see Table 2). Immediately after Japan's export controls were rolled out in August 2019, Seoul announced plans to invest about $6.48 billion in research and development (R&D) for semiconductor materials, parts, and equipment.[77] This was followed by a range of other supportive measures to spur domestic production of semiconductor chemical materials. This included easing testing standards of related chemical materials, and shortening the time for granting permission for building chemical-materials production facilities from seventy-five to thirty days. It also made available 100 billion won (approximately $82 million) for emergency business-stabilization relief and dispensed an additional 3.15 trillion won (approximately $2.58 billion) to provide relief for firms experiencing difficulties taking out loans.[78]

Large conglomerates that produce semiconductors and displays in South Korea, including Samsung, SK, and LG, all took measures to secure their supply chains, including partnering with domestic suppliers and investing in their own production facilities for chemical materials they imported from Japan. Out of these three companies, SK Group appeared to take the most comprehensive set of localization measures. SK Hynix was already considering plans to diversify its supply

69 Song Jung-a, "South Korea Groups See Supply Chain Boost in Trade War with Japan," *Financial Times*, September 24, 2019, https://www.ft.com/content/644ecb2e-ddad-11e9-9743-db5a370481bc.

70 Goodman, et al., "The South Korea-Japan Trade Dispute in Context."

71 Ezell, "Understanding the South Korea-Japan Trade Dispute and Its Impacts on US Foreign Policy."

72 Ibid.

73 Ibid.

74 "Samsung Electronics Accounts for 20 Pct of S. Korea's Exports in H1," Yonhap News Agency, August 18, 2019, https://en.yna.co.kr/view/AEN20190818000500320.

75 Ezell, "Understanding the South Korea-Japan Trade Dispute and Its Impacts on US Foreign Policy."

76 Song Jung-a, "Samsung Uses Domestic Chip Chemical to Bypass Tokyo Export Ban," *Financial Times*, September 5, 2019, https://www.ft.com/content/389745a6-cf89-11e9-99a4-b5ded7a7fe3f.

77 Hyunjoo Jin, "South Korea to Spend $6.4 Billion on R&D to Cut Reliance on Japanese Imports," Reuters, August 4, 2020, https://www.reuters.com/article/us-southkorea-japan-laborers-ministry/south-korea-to-spend-6-5-billion-on-rd-to-cut-reliance-on-japanese-imports-idUSKCN1UV00M.

78 Kim Dae-yeong, *Soulbrain, Choego Sujunui Gosun-do Bulsan(12N) Daeryang Saengsanneungnyeok Hwakbo* (Soulbrain Co. Develops Mass Production Capacity for First-rate Hydrogen Fluoride (12 N))," Ministry of Trade, Industry and Energy, 2020, http://www.motie.go.kr/motie/gov3.0/gov_openinfo/sajun/bbs/bbsView.do?bbs_seq_n=162526&bbs_cd_n=81&cate_n=.

ROK GOVERNMENT AND PRIVATE-SECTOR MEASURES TO LOCALIZE AND DIVERSIFY SUPPLY CHAINS[1]

GENERAL GOVERNMENT MEASURES	● Invested $6.48 billion in R&D for semiconductor materials, parts, and equipment. ● Eased testing standards of related chemical materials. ● Shortened the time for granting permission for building chemical-materials production facilities from seventy-five to thirty days. ● Granted $82 million for emergency business-stabilization relief and earmarked an additional $2.58 billion for facilitating firms' loan processing	
HYDROGEN FLUORIDE (LIQUID GAS)	**Prior to export controls:** ● 44-percent dependence on Japan. ● Liquid hydrogen fluoride imported from Japanese firm Stella Chemifa and Morita Chemical Industries. ● Hydrogen-fluoride gas imported from Japan's Showa Denko	**Measures taken:** ● SK starts mass production of hydrogen-fluoride gas in June 2020; Samsung starts sourcing hydrogen-fluoride gas from domestic producers. ● Korean companies, Soulbrain, and RAM Technology mass produce liquid hydrogen fluoride. ● Sourcing diversification to Chinese factories for liquid hydrogen fluoride and US factories for hydrogen-fluoride gas.
PHOTORESISTS	**Prior to export controls:** ● 92-percent dependence on Japan. ● EUV photoresist imported from Japanese firms JSR and Shin-Etsu Chemical.	**Measures taken:** ● Samsung sources EUV photoresists from Belgium, and a joint-venture firm with Japan relocated to Korea ● Korean firm Dongjin Semichem starts producing argon-fluoride (ArF) photoresist. ● US firm DuPont announces plans to build EUV photoresist factory in Korea
FLUORINATED POLYIMIDE	**Prior to export controls:** ● 94-percent dependence on Japan. ● Imports from Japanese firm Sumitomo Chemical	**Measures taken:** ● Kolon Industries start mass production in 2019. ● SKC begins testing after establishing annual production capacity of one million square meters.

1 Adapted from Jang Joo-young, "With Judo Move, Korea Flips Script on 3 Key Materials Saga," *Korea JoongAng Daily,* June 28, 2020, https://koreajoongangdaily.joins.com/2020/06/28/business/economy/semiconductor-trade-ban-japan/20200628182000432.html ; with additional information and sources.

OTHER INVESTMENTS RELATED TO SEMI-CONDUCTOR SUPPLY CHAINS

- Hyosung announced it will invest $8.3 billion to expand its carbon-fibers production facility by 2028.[1]
- Hyundai Mobis announced it will invest $250 million to expand its production facility for eco-friendly car components.[2]
- POSCO Chemical announced it will invest about $200 million to build a new production facility for artificial graphite-cathode materials for rechargeable batteries.
- MEMC Korea opened a new production facility for new wafers.[3]
- LAM Research, which specializes in semiconductor-production equipment, moved its R&D facilities to South Korea.[4]
- SK Siltron acquires DuPont's silicon-carbide wafer business for $450 million.[5]

1 Kang, Seung-tae, "Tarilbon Naseon Daegieop-Hyoseong, Tansoseomyu…SK, Hyeoksinsojae Yeongnyang Ganghwa Mobail Gwanghakgisul Choegang Norineun Samseongjeonja (Big Corporations to Exit Japan—Hyosung, Carbon Fibers…SK, Samsung Eyes Strengthening Capacity for Innovation Materials and Pole Position in Mobile Optical Technology)l," Maeil Gyeongjae, August 30, 2019, https://www.mk.co.kr/news/economy/view/2019/08/680063/.

2 According to a Hankyung report, Hyundai Mobis produced its own eco-friendly car products in Choong-Ju, Choongbuk Province, and this represents an expansion of production facilities for these components closer to its final assembly plants in Ulsan. This report, as well as others, made no mention of Japan's export restrictions. Se-seong Oh, "Hyeondaemobiseu, Chinhwangyeongcha Jeonyong Ulsangongjang Chakgong (Hyundae Mobis Starts Building Ecofriendly Car Factory in Ulsan)," Hanguk Gyeongjae, August 28, 2019, https://www.hankyung.com/car/article/201908282960g; and Dong-hui Han, "Hyeondaemobiseu, Dubeonjjae Chinhwangyeongcha Bupumgongjang Ulsane Chakgong (Hyundae Mobis Starts Building Second Plant for Ecofriendly Car Components in Ulsan)," Chosun Biz, August 28, 2019, https://biz.chosun.com/site/data/html_dir/2019/08/28/2019082801146.html.

3 "Bandocheyong Sillikon Weipeo Saengsaneul Wihan Emiemssikoria Singyu Je2gongjang Jungong (MEMC Korea Company Completes New Second Plant for Semiconductor Silicon Wafers)," Republic of Korea Ministry of Trade, Industry and Energy, Foreign Investment Promotion Division Seoul, 2019, https://www.motie.go.kr/motie/ne/presse/press2/bbs/bbsView.do?bbs_seq_n=162359&bbs_cd_n=81.

4 LAM Research is a company that specializes in semiconductor-production equipment, and not semiconductor components. A Mekyung report says that LAM Research's move is likely due to its positive projection of the ROK semiconductor industry, and that firms like Samsung and SK have been trying to persuade LAM Research to move its R&D facilities to South Korea since the beginning of 2019. The report again makes no mention of the notion that the move was related to Japanese export restrictions.

5 SK Siltron acquired DuPont's silicon-carbide wafer business not because it depended on Japan for supply, but it wanted to beat Japanese firms that currently dominate the silicon-wafer market. SK Siltron sees itself doing so by making silicon-carbide wafers, which are technically different from silicon wafers that Japanese firms produce. SK Siltron says the move was, in part, related to the national trend in onshoring supply chains, but this cannot be viewed as a move to reduce dependence on Japan; *Chosun Biz*, November 9, 2019, https://biz.chosun.com/site/data/html_dir/2019/09/10/2019091002427.html.

chains for liquid hydrogen fluoride prior to the dispute.[79] It appears that the Japanese government's delay in granting permission to export the chemical material, in part, Ram Technology, eventually testing the final product by late 2019, according to industry sources.[80] Then, by June 2020, SK Materials, a semiconductor-component arm of the SK group that owns SK Hynix, announced it had started mass production of hydrogen-fluoride gas (etching gas), and that it aimed to increase localization to 70 percent by 2023.[81] In July, Korean media reported that South Korea managed to completely localize production of liquid hydrogen fluoride, with SK Hynix and Samsung Electronics both sourcing from domestic suppliers.[82] SK Materials is also understood to be developing technologies to produce other semiconductor chemical materials.[83] Samsung Electronics began sourcing etching gas from domestic suppliers and it secured a new supplier for ultraviolet photoresists from a Belgium-based company, two months after Japan placed export controls on

79 Hwang Jeong and Go Jae-yeon, "SK, Bulhwa Sooso Guksanhwa Seonggong…Bandochae Layinae Tooyip Shijak (SK Success in Localizing Hydrogen Fluoride, Supplying to Semiconductor Production)," *Hanguk Gyeongjae*, October 13, 2019, https://www.hankyung.com/economy/article/2019100201811.

80 Ibid.

81 Song Kyoung-son, "Pure-Enough Hydrogen Fluoride Produced by SK Materials," *Korea JoongAng Daily*, June 17, 2020, https://koreajoongangdaily.joins.com/2020/06/17/business/industry/SK-Materials-hydrogen-fluoride-semiconductor/20200617200900181.html.

82 "Han-Il Mooyeok JeonJaeng Ilnyeon…Aekchae Bulhwa Sooso Guksanhwa 100%, Gichae do Yeonnae Ganeung (One Year of Korea-Japan Trade War…100% Localization of Liquid Hydrogen Fluoride, Etching Gas to Be Completed Within the Year)," *Donga Ilbo*, July 9, 2020, https://www.donga.com/news/Economy/article/all/20200709/101893212/1.

83 Jung Min-hee, "SK Materials to Localize Photoresist Used for Semiconductor Lithography," *Business Korea*, June 18, 2020, http://www.businesskorea.co.kr/news/articleView.html?idxno=47738#:~:text=SK%20Materials%20to%20Localize%20Photoresist%20Used%20for%20Semiconductor%20Lithography%20%2D%20Businesskorea&text=SK%20Materials%20announced%20on%20June,gas%20used%20to%20manufacture%20semiconductors.

the product.[84] As of September 2019, Samsung Electronics also said that it is in the final stages of testing domestic production of liquid hydrogen fluoride, in order to partially diversify its supply chains. More recently, TOK Advanced Materials, a joint venture between Japanese photoresist maker Tokyo Ohka Kogyo (TOK) and Samsung C&T, began producing extreme ultraviolet (EUV) photoresists in South Korea to ensure stable supply to Samsung Electronics.[85]

To be sure, efforts by the South Korean government and firms have not resulted in a complete—or the most optimal—localization or diversification of all three chemical materials critical to semiconductor production. Some analysts argue that localization efforts have only been effective for hydrogen fluoride, and that it could take up to five years for South Korean domestic photoresists producers to be competitive.[86] Indeed, the ROK's hydrogen-fluoride imports from Japan declined to $4.03 million during the period between January and May 2020, down from $12.14 million during the same period in 2019.[87] However, its import of photoresists from Japan increased from $112.72 million in 2019 to $150.81 million in 2020 during the same period; fluorinated-polyimide imports also increased from $12.14 million to $13.03 million.[88] Sources from Samsung also told the media that the company had to replace imports from Japan with domestic, low-purity liquid-hydrogen fluoride in order to continue production—a suboptimal situation given that Samsung preferred to source high-quality liquid hydrogen fluoride from Japan, even if it was more expensive.[89] However, in spite of the fact that the state of localization and diversification has not been optimal for South Korean semiconductor firms, they also point out that they preferred a situation in which they have guaranteed security over their supply chains, even if it comes with some shortfalls in quality.[90]

There are still uncertainties about how much the trade dispute might disrupt global value chains of semiconductor manufacturing. As long as Korean-Japanese relations do not improve, and as disputes continue over complex historical issues and domestic politics, South Korean firms are still vulnerable to export restrictions and supply-chain disruptions. In the short term, South Korean semiconductor producers face much larger production losses than the potential decrease of Japanese exports to South Korea. One estimate indicates that the short-term export loss for ROK semiconductor producers—if supply disruptions were to occur—is approximately two hundred and fifty times that of Japanese chemical exporters.[91] In the long term, however, Japanese producers could also lose out in the ROK export market because South Korean chipmakers could have incentives to reduce supply-chain risks by diversifying their supplies with domestic and non-Japanese suppliers (e.g., Intel and TSMC)—not just in specialized chemicals, but throughout the entire semiconductor value chain.[92] In order to prevent both economies from any strategic secondary shocks caused by the COVID-19 pandemic, it is important to start a dialogue between South Korea and Japan to find a solution to keep economic and commercial issues separate from political issues.

B. Reshoring: The COVID-19 Pandemic and Global Supply-Chain Disruptions

The global economy faces strategic uncertainty, mainly due to the four elements examined above, exposing GVCs to more non-market risks that increasingly shape companies' investment strategies and decision-making. It is hard to say that the COVID-19 pandemic alone has changed firms' views and strategies. However, the pandemic crisis—combined with worsening US-China relations, trade war, and signs of decoupling—is affecting firms' views of vulnerability and risks with regard to GVCs more fundamentally.

There is much discussion among US administration officials and on Capitol Hill about the pandemic serving as a catalyst to energize reshoring efforts. Given that companies' location decisions cannot be dictated by Congress or the White House, the key question is whether and how to create incentives that motivate companies to voluntarily change their business strategies to onshore their production lines, in order to protect national security.

84 Song, "Samsung Uses Domestic Chip Chemical to Bypass Tokyo Export Ban"; Kim Jaewon, "Samsung Secures Key Chip Supply in Belgium as Tokyo Curbs Exports," *Nikkei Asian Review*, August 10, 2019, https://asia.nikkei.com/Spotlight/Japan-South-Korea-rift/Samsung-secures-key-chip-supply-in-Belgium-as-Tokyo-curbs-exports.

85 Park Eun-hee and Kim Young-min, "Japanese Firms Start Making Photoresists in Korea," *Korea JoongAng Daily*, July 2, 2020, https://koreajoongangdaily.joins.com/2020/07/02/business/industry/photoresist-TOK-EUV/20200702200000423.html.

86 Song Young-son, "Lack of Disruption Doesn't Mean Trade War Isn't Dangerous, Experts Warn," *Korea JoongAng Daily*, June 29, 2020, https://koreajoongangdaily.joins.com/2020/06/29/business/industry/Japan-materials-export-restrictions/20200629202700313.html.

87 Ibid.

88 Ibid.

89 Jung Yong-hyo, "Nikkei 'Il Gyujae-ae Samsung LG Daechae Gongjeong Gaebal…Ilbon Tagyuk' (Nikkei 'Samsung and LG develop substitutes in response to Japan's export control…Harms Japan')," *Hanguk Gyeongjae*, May 20, 2020, https://www.hankyung.com/international/article/202005205623i.

90 Ibid.

91 Goodman, et al., "The South Korea-Japan Trade Dispute in Context."

92 Ibid.

In order to tackle this challenging question, it is important to examine how companies are reacting differently to supply-chain disruptions due to COVID-19. Some studies, including AT Kearney's seventh annual Reshoring Index, argue that global manufacturing is moving away from China, and the US technology industry seems to remain the most vulnerable due to potential decoupling of the US and Chinese economies, because it is so dependent on supply chains in China in terms of revenue exposure.[93] The US Semiconductor Industry Association (SIA) is ramping up to lobby for major funding of $37 billion to reshore and help maintain US competitive equality with China and other countries whose governments are subsidizing firms in order to compete against the United States. This plan seems to be well suited to the current reshoring plan, as the US government has been emphasizing the importance of specific industries, mostly emerging and high technology, and is stepping in to help them compete, as they would otherwise lose their market shares.

In contrast, few firms are willing to entirely give up on production in China, particularly if they sell to the Chinese domestic market. Seventy percent of US firms operating in China have no plan to move their production and supply chains out of China, according to an April 2020 joint survey by the US Chambers of Commerce in Beijing and Shanghai and PricewaterhouseCoopers.[94] For instance, Apple is an exemplary case of why some firms are not only going to stay in China, but may even deepen their presence. Notably, the Chinese company Luxshare has acquired its first iPhone-assembly plant in a direct challenge to Taiwan's Foxconn, which has been Apple's largest supplier to date.[95] Luxshare offers lower prices with competitive quality that could help Apple further deepen its network in the huge Chinese market. Other major US firms like Intel and Starbucks have also invested further in China despite the pandemic.[96] Non-US firms like Nestlé and Adidas have done the same.[97] At the same time, rising production costs, increased tariffs, and increased tensions in the US-China relationship have led to changes in production and investment plans for most firms.

It is also interesting to see how Asian countries are reacting differently to supply-chain disruptions caused by the COVID-19 pandemic. As McKinsey analysts have noted, the coronavirus shock will restructure GVCs to increase supply-chain resiliency, with production moving closer to markets.[98] China is close to Asian markets and economies where high-tech industries' manufacturing is located. It is critical for countries like Japan and South Korea—whose high-tech, electronics, and automobile industries were hit by the pandemic—to promote recovery in their key industries. While they realize that overreliance on a single country for supply chains is a strategic mistake, they cannot help but refrain from moving their supply chains in order to to keep their supply chains open and operating in the short term.

Moving out of China will be challenging for high-tech business, given the benefits of being close to other stages of supply chains and staying close to a key market that they service. Also, it is not just about making things in China, but also about selling things in China. So far, Japan has said it will support the US government's efforts to reorganize strategic supply chains to bypass China. For South Korea, how and whether firms are going to join such efforts will be much more challenging and complicated than governments' statements.

It is interesting to note that countries like India, Vietnam, Taiwan, and Malaysia are likely benefiting from the US-China trade war by attracting some firms that are moving their production lines out of China. India is developing an area of land bigger

93 Patrick Van den Bossche, et al., "Trade War Spurs Sharp Reversal in 2019 Reshoring Index, Foreshadowing COVID-19 Test of Supply Chain Resilience," Kearney, 2020, https://www.kearney.com/documents/20152/5708085/2020+Reshoring+Index.pdf/ba38cd1e-c2a8-08ed-5095-2e3e8c93e142?t=1586268199800&utm_medium=pr&utm_source=prnewswire&utm_campaign=2020ReshoringIndex.

94 "Most U.S. Firms Have No Plans to Leave China Due to Coronavirus: Survey," Reuters, April 16, 2020, https://www.reuters.com/article/health-coronavirus-china-business/most-us-firms-have-no-plans-to-leave-china-due-to-coronavirus-survey-idUSL8N2C504I.

95 Lauly Li and Cheng Ting-Fang, "China's Luxshare Buys iPhone Plant to Strengthen Apple Ties," *Nikkei Asian Review*, July 17, 2020, https://asia.nikkei.com/Business/China-tech/China-s-Luxshare-buys-iPhone-plant-to-strengthen-Apple-ties.

96 "Starbucks to Invest $130 Million for Roasting Plant in China's Kunshan," Reuters, March 13, 2020, https://www.reuters.com/article/us-china-starbucks/starbucks-to-invest-130-million-for-roasting-plant-in-chinas-kunshan-idUSKBN2100LM#:~:text=Starbucks%20to%20invest%20%24130%20million%20for%20roasting%20plant%20in%20China's%20Kunshan,-1%20Min%20Read&text=BEIJING%20(Reuters)%20%2D%20Starbucks%20will,2022%2C%20it%20said%20on%20Friday.

97 "Nestlé China to Invest CHF 100 Million in Factories, Including Pet Food and Plant-Based," Nestlé, press release, May 20, 2020, https://www.nestle.com/media/news/nestle-china-investment-factories-pet-food-plant-based; Kathleen E. McLaughlin, "Adidas Investment in China is Paying Off," *WWD*, August 7, 2008, https://wwd.com/business-news/financial/adidas-investment-in-china-is-paying-off-1705380/.

98 Knut Alicke, Richa Gupta, and Vera Trautwein, "Resetting Supply Chains for the Next Normal," McKinsey & Company, July 2020, https://www.mckinsey.com/~/media/McKinsey/Business%20Functions/Operations/Our%20Insights/Resetting%20supply%20chains%20for%20the%20next%20normal/Resetting-supply-chains-for-the-next-normal.pdf.

than Long Island to attract business moving out of China.[99] In June 2020, the Narendra Modi administration also earmarked about $6.6 billion in financial incentives to attract multinational corporations producing mobile phones, a program that provides 25-percent incentives on capital expenditure for producing electronic components, semiconductors, and other parts.[100] Samsung and Apple's partners Foxconn, Wistron, and Pegatron have applied for the program.[101] Taiwan has been at the forefront of cooperating with the United States to shift supply chains out of China. TSMC has announced plans to build a new plant in the United States, and Quanta Computer (the world's third-largest electronics manufacturing service, which supplies data centers to Facebook and Google) and Innolux (a display maker owned by Apple supplier Foxconn) are increasing their investment in Taiwan, in order to reduce their reliance on Chines assembly lines and boost Taiwan's localization efforts.[102] Meanwhile, US tech leaders such as Microsoft and Google are stepping up efforts to relocate production of new devices from China, potentially to Vietnam and Thailand. According to a World Bank survey, of thirty-three companies that have shifted production from China since the trade war began, twenty-three have moved to Vietnam, with the rest relocating to Malaysia, Thailand, and Cambodia as of October 2019.[103]

Each country and company has different interests with regard to national security calculations and business risk, sometimes conflicting and converging, when doing business with China. GVCs are developed geographically based on specialization, and their reallocation often requires high upfront capital expenditure. Few studies exist that estimate the costs and benefits associated with value-chain modifications for reshoring, the lead times involved, and whether likely modifications actually provide greater security for value chains. When it comes to reshoring of high-tech supply chains, the deep embeddedness of the ecosystem in East Asia and the underlying structure of supply chains make companies resistant to dramatic restructuring.[104]

Whether, and to what extent, the COVID-19 pandemic and the US-China decoupling will catalyze reshoring to the United States is uncertain. So far, rising Chinese production costs and US-China trade disputes have led supply chains to relocate to other low-cost manufacturing hubs like Vietnam and Mexico. In addition, supply-chain resiliency may turn out to be more effectively met by having alternative suppliers, surge production capacity, and stockpiles than the location of production within the United States or any particular country. The current efforts to realign global supply chains focus on enormous subsidies and other incentives for domestic reshoring, such as tax credits and state block grants. Another effective mechanism would be "targeted funding" in innovation and research, in order to incentivize the commercialization of new technological breakthroughs and make the US economy more competitive.[105]

99 Unni Krishnan, "India Steps Up Effort to Grab China's Title of the World's Factory," Bloomberg, June 4, 2020, https://www.bloomberg.com/news/newsletters/2020-06-04/supply-chain-latest-modi-sees-china-decoupling-as-india-s-gain.

100 Ragini Saxena and Santosh Kumar, "India Plans $6.6 Billion in Incentives to Woo Smartphone Makers," Bloomberg, June 2, 2020, https://www.bloomberg.com/news/articles/2020-06-02/india-plans-6-6-billion-in-incentives-to-woo-smartphone-makers.

101 Manish Singh, "Apple's Partners and Samsung Apply for India's $6.6 Billion Local Smartphone Production Program," *TechCrunch*, August 1, 2020, https://techcrunch.com/2020/08/01/apples-partners-and-samsung-apply-for-indias-local-smartphone-production-program/.

102 Debby Wu, "TSMC Scores Subsidies and Picks Site for $12 Billion U.S. Plant," Bloomberg Quint, June 16, 2020, https://www.bloombergquint.com/china/tsmc-confident-of-replacing-any-huawei-orders-lost-to-u-s-curbs.

103 Resty Woro Yuniar, "Jokowi Tells Ministers to Take Advantage of US-China Trade War, as Investors Bypass Indonesia," *South China Morning Post*, September 5, 2019, https://www.scmp.com/week-asia/economics/article/3025818/jokowi-urges-ministers-take-advantage-us-china-trade-war.

104 *The Future of Global Supply Chains Post COVID-19, Atlantic Council*, June 26, 2020, https://www.atlanticcouncil.org/event/the-future-of-global-supply-chains-post-covid-19/.

105 Ibid.

4. POLICY RECOMMENDATIONS

While this report has highlighted the profound, diverse risks that GVCs face, there remain key opportunities for reducing exposure to risk, especially political instability, by following the recommendations offered below. In particular, the US-ROK relationship provides an ideal model of partnership for the United States with other allies, and helps to address the drivers of risk identified in this report.

1. The United States should step up its efforts to work with its allies and partners, in order to develop sufficient supply in trusted global value chains. In an era of strategic uncertainty, China is playing an increasingly important role as both a supply and demand hub in global value-chain networks. The United States and key allies, including South Korea and Japan, should send a clear and orchestrated message to other partners about the goals and approaches to US-China strategic competition. Gaps between the rhetoric and actions of the US government when it comes to these allies have created undue uncertainty among partners, increasing their vulnerability to supply-chain disruptions and slowing the response to US-China decoupling.

2. Fundamentally, the United States should reevaluate the benefits, costs, and collateral effects of trade policy measures, particularly the use of export controls. Thus far, this approach might have helped the United States gain leverage in its economic confrontation with China, but these policies have failed to lower the US trade deficit, have also increased production costs in the United States, and have damaged Washington's relationship with its allies and partners, as well as its standing as a global leader.[106]

3. The United States should define clear strategic objectives, and equally clear messaging to allies and partners, across the full range of international economic policies. Organized messaging and consistent action will provide the clarity necessary to facilitating allied and partner participation. South Korea should be an early partner in US efforts to diversify and enhance resilience of GVCs in the face of potential disruptions, given the ROK government's existing close coordination with private firms on this issue, and the importance of these issues in South Korea.

4. The US government should commit to limit its own supply-chain interventions to narrowly targeted, time-limited actions, and avoid systemic interventions in the ICT supply chain that have effects on all hardware or software users. This commitment should include software and software updates, as well as hardware.[107] Even if governments are unwilling to give up all attempts to compromise supply chains, they could improve ICT security for all users through committing only to limited interventions that are directly targeted at particular users, with a time limit on effectiveness, along with a reliable kill switch.[108] These can be useful even without an overt enforcement mechanism, as a publicly breached commitment can have a powerful effect on both national reputation and credibility.[109]

5. Both South Korea's government and private firms should reduce their vulnerability to supply-chain disruptions by diversifying away from single-point-of-failure firms or sole-source vendors wherever possible. The array of recent experiences—the ROK-Japan trade dispute, the US-China trade war, and the COVID-19 pandemic crisis—have made it clear that overreliance on a single country continues to pose serious risks to supply-chain disruptions. Creating an intraregional cluster of suppliers for major industry sectors can help alleviate the risk of disruptions.

6. The United States and South Korea should work together to map supply-chain networks of national significance, including semiconductors and associated high-technology industries. Building on nascent mapping efforts from the US Department of Homeland Security's National Risk Management Center and DoD Cybersecurity Maturity Model certification program, the two countries should build these maps in close cooperation with the private sector, and leverage them to respond quickly in the early days of a future disruption crisis.

106 Miyeon Oh, *Coronavirus Could Bring the United States' East Asian Allies Closer to Beijing, Atlantic Council, New Atlanticist*, March 23, 2020, https://www.atlanticcouncil.org/blogs/new-atlanticist/coronavirus-could-bring-the-united-states-east-asian-allies-closer-to-beijing/.

107 Dr. Trey Herr, et al., *Breaking Trust: Shades of Crisis Across an Insecure Software Supply Chain, Atlantic Council*, July 26, 2020, https://www.atlanticcouncil.org/in-depth-research-reports/report/breaking-trust-shades-of-crisis-across-an-insecure-software-supply-chain/.

108 Levite, "ICT Supply Chain Integrity," 12–15.

109 An example is the commitment made by the Chinese government in 2015 in the Strategic and Economic Dialogue with the United States to refrain from state-sponsored cyber hacking to acquire commercial technology and trade secrets. The resumption of this activity soon after the agreement was one of the most important factors sowing distrust of dialogue with the Chinese government, not just in the Trump administration, but across both parties in Congress and across US officials.

7. The United States and South Korea should create sector-specific government-private-sector steering committees in the following high-technology industries to coordinate with the private sector and work with non-governmental organizations to provide cooperative platforms to manage the convergence of commercial technology and national security.

1. Steering Committee on Semiconductors: The United States and South Korea, together with Japan, Taiwan, and the Netherlands, should establish this committee to identify shared geopolitical risks in their value chains, and to explore ways to enhance interdependence and secure supply chains among trusted partners.

2. Steering Committee on Artificial Intelligence (AI): The United States and South Korea should establish a committee to foster cooperation toward more secure AI technologies in line with South Korea's stated goal to become a global leader in AI, and reflecting the complementary strengths in hardware and software between the two countries.

3. Steering Committee on 5G: The United States and South Korea should establish a steering committee to work to reconcile national security and business interests in telecommunications, starting with the promotion of responsible global development and deployment of 5G infrastructure and potential partnership with the ten leading democracies (the so-called "D-10") on 5G.[110]

4. Steering Committee on Quantum Computing: The United States and South Korea should establish a steering committee that identifies ways to further private- and public-sector linkages on quantum computing toward more secure networks, such as Samsung's $55-million funding for US quantum-computing hardware and software company IonQ.[111]

5. Steering Committee on Autonomous Vehicles: The United States and South Korea should establish a steering committee that facilitates deeper US-ROK private-sector partnerships on autonomous vehicles, building on examples of cooperation (e.g., Hyundai-Adaptive and Hyundai-Aurora as joint ventures and previous ROK-US discussion held in Washington, DC, in March 2019).

8. The United States and South Korea should organize a private-sector initiative to identify measures that would increase the resilience of existing Indo-Pacific value chains at manageable cost, and with lead time for the private sector. The United States and ROK, as long-term allies and trading partners, should collaborate to diversify global value chains in the Indo-Pacific and improve the resilience of their high-tech industries, given these firms' importance for long-term economic growth. Restructuring global supply chains is a long-term, expensive task, as supply chains have developed geographically to take advantage of specializations, particularly in industries with high upfront capital requirements, and are strongly driven by market pressure on corporations.[112] Direct consultation with private-sector leaders will be essential to these efforts, in order to identify areas where de-risking business and de-risking national security intersect, creating the greatest opportunity for realistic cooperative efforts.

9. The United States should lead efforts to establish a multilateral regime to enhance GVC resilience to strategic shocks such as global health crises, geopolitical crises, and natural disasters. The COVID-19 pandemic has made clear the importance of building resilient GVCs, both to guarantee consistent availability of essential crisis items such as medical supplies and equipment, and to reduce the broader economic disruptions to industries such as automotive manufacturing that result in delayed long-term economic recovery.

10. The United States and South Korea should cooperate on strategic stockpiling of key products and materials, including medical supplies and equipment, to help absorb any major supply disruptions and demand spikes. In addition to building GVCs that are more resilient to strategic shocks, it will be important to recognize that the limited surge capacity in a crisis, even for highly resilient GVCs, will require diligent maintenance of strategic stockpiles in critical components and medical supplies. Stronger cooperation among US allies and partners on this front can help allocate important inventory where it is needed most, benefiting all involved by helping to reduce the global repercussions of a developing crisis.

110 *D-10 Strategy Forum, Atlantic Council*, https://www.atlanticcouncil.org/programs/scowcroft-center-for-strategy-and-security/global-strategy-initiative/democratic-order-initiative/d-10-strategy-forum/.

111 Stephen Nellis, "Samsung, UAE Funds Lead US$55m Investment in Quantum Startup," *ITNews*, October 23, 2019, https://www.itnews.com.au/news/samsung-uae-funds-lead-us55m-investment-in-quantum-startup-532810.

112 Willy C. Shih, "Bringing Manufacturing Back to the US Is Easier Said Than Done," *Harvard Business Review*, April 15, 2020, https://hbr.org/2020/04/bringing-manufacturing-back-to-the-u-s-is-easier-said-than-done.

5. FURTHER RESEARCH

This research project has been conducted in partnership with the Korea Institute for Advancement of Technology (KIAT). The project included the establishment of an advisory committee to exchange views on the current geopolitical and economic landscape of global value chains of advanced materials and technology components. The advisory committee also reviewed and provided guidance on the report that helped identify the key variables and unanswered questions for the new risks associated with global value-chain disruptions during periods of strategic uncertainty.

This paper, as an outcome of the research project, aims to provide the foundation for a multi-year effort expanding the initial work on US-ROK cooperation to include other allies and partners in the Indo-Pacific region, broader geoeconomic trends, and emerging technologies of the Fourth Industrial Revolution and beyond. Future research under this body of work will include industry-specific case studies that can be developed with this paper's policy recommendation on creating sector-specific steering committees for the high-technology industries' value chains. In particular, the ubiquity of networked communication and new technological developments, such as robotics, big data, artificial intelligence, 5G, and the Internet of Things have reshaped the risks and economics of the global value chains, along with great-power competition—and will continue to do so.

The next phase of the project aims to examine and answer the following questions about selected industry sectors: What are the viable strategies for the public and private sectors to deal with the complex network structure of global value chains and digital technology? What are the most effective strategies for firms and governments to define and secure global value chains in the future? How can the United States work together with its allies and partners to enhance public-private partnership to reduce vulnerability to supply-chain disruptions? In an era of great-power competition and intensified US-China decoupling, what are the implications and suggested strategies for firms and policymakers?

ABOUT THE AUTHORS

Dr. Miyeon Oh is director and senior fellow of the Asia Security Initiative (ASI) housed within the Atlantic Council's Scowcroft Center for Strategy and Security. Under her direction, ASI promotes forward-looking strategies and constructive solutions for the most pressing issues affecting the Indo-Pacific region, particularly the rise of China, in order to enhance cooperation between the United States and its regional allies and partners. The key mission of ASI is to translate US policy objectives and strategies into nuanced messages to Indo-Pacific stakeholders, as well as to incorporate Indo-Pacific voices into the Washington policy community to help adapt and revitalize the rules-based international system. Her areas of expertise include US-China competition and its implications for US allies and partners, changing economic architecture in the Indo-Pacific, cross-border infrastructure development and China's Belt and Road Initiative, global supply chains of advanced and emerging technologies, energy security, Sino-Russian relations, denuclearization of North Korea, US-Korea-Japan trilateral cooperation, and the US-ROK alliance. She has been selected as the 2017 Strategy and Policy Fellow by the Smith Richardson Foundation and was a foreign policy pre-doctoral research fellow at the Brookings Institution. Additionally, Dr. Oh has a significant background in public policy and international affairs, including experience with the United Nations and Korea's Ministry of Foreign Affairs and Trade. She has earned master's degrees from both the Harvard Kennedy School of Government and Yonsei University in Korea, and received her PhD from John Hopkins University's School of Advanced International Studies.

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Dr. Robert Dohner recently completed a career of twenty years at the US Department of the Treasury, where he served in five successive administrations. His last position was as deputy assistant secretary for international economic analysis and senior Asia advisor, where he provided advice on the global economic outlook, on emerging economic issues, and on strategic direction for international affairs at Treasury. Previously, he was deputy assistant secretary for Asia, responsible for the region extending from Pakistan and India through China, Korea, and Japan, and supervising over twenty professionals, including six overseas Treasury attachés. He helped establish and played a key role in the Strategic Economic Dialogue with China (under the Bush Administration) and the Strategic and Economic Dialogue with China (Obama Administration), where he helped define US government negotiating objectives across twenty US Departments and agencies, and he negotiated macroeconomic reforms and financial sector openings with the Chinese government. He also helped develop Treasury's Financial and Economic Dialogue with India. He played a central role, working with Congress, in US economic reengagement with Myanmar and the revision of legislation that had blocked US engagement with Myanmar. He represented Treasury as the US Asia-Pacific Economic Cooperation (APEC) Finance Ministers Deputy and as the US Association of Southeast Asian Nations (ASEAN) Finance Ministers Deputy. He was Treasury's representative in Japan from 1997 to 2002, directing an office of five people that was instrumental in shaping Treasury and US Government policy towards Japan through Japan's financial upheaval and prolonged recession. He also shaped Treasury's discussions with Japanese authorities during the implementation of Big Bang financial liberalization, and negotiated on issues that included securities investor protection, the modification of firewall rules to allow global risk management, and the introduction of the Financial Services Agency (FSA) no-action letter process. Prior to his work on Japan, he was director of Treasury's Office of Central and Eastern Europe, where he negotiated the winding up and release of funds from the Polish Bank Privatization Fund with the Polish Ministry of Finance. Before joining Treasury, Dohner was a senior economist at the President's Council of Economic Advisers on international trade issues, a principal economist at the Organization for Economic Cooperation and Development (OECD) working on Eastern Europe, and senior economic adviser to the undersecretary of state for economic and agricultural affairs during the first Bush Administration. He was a professor at the Fletcher School of Law and Diplomacy at Tufts University, a visiting professor at the Stanford Business School, and worked at the General Agreement on Tariffs and Trade (GATT) in Geneva. Robert Dohner began his career in international finance working for the Monetary Authority of Singapore as a Henry Luce Scholar. He has a PhD in economics from the Massachusetts Institute of Technology.

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