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COVID-19 and Global Value Chains

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I. Introduction

The ongoing spread of COVID-19 has increased biological risks from infectious diseases and limits the movement of human and material resources. Many literatures predict that COVID-19 is creating a new global supply chain shock, which may change the structure of the global value chain (GVC) in the near future.

While we need to delve into the impact of COVID-19 on the structure of GVC, there is much evidence that COVID-19 affects global production. In 2020, the suspension of production in China decreased the supply of intermediate goods to the world, with the result that production in many countries linked to China experienced difficulty in producing goods. Also, due to the wide spread of telecommuting work culture, there has been an increasing demand for IT-related products such as semiconductors. Due to the surge of demand, the production of IT-based items has also experienced difficulties. This evidence points to significant correlation between COVID-19 and the globalized production network, and it is necessary to trace the GVC structure changes following the COVID-19 outbreak.

To look at the changes in the global value chain structure after the spread of COVID-19, it is important to look at various factors affecting the global value chain and changes in the global value chain structure before the spread of COVID-19. This is because various factors are linked to production network before the spread of COVID-19. More specifically, factors such as the recent rise in labor costs in Asia, income changes in Asia, the expansion of policy uncertainties such as the Korea-Japan trade dispute, and the increase in natural disasters such as tsunamis and COVID-19 are all reshaping the current structure of the global value chain. In this context, this study aims to analyze the changes in the global value chain structure before and after the spread of COVID-19 using quantitative data, empirical

analysis, case studies, and corporate survey and derive government-level countermeasures and policy tasks.

II. Global Value Chain before COVID-19

Before COVID-19, there were many factors affecting the global value chain, such as the increasing level of policy uncertainty, increasing labor costs and income level in Asia, the introduction of new technologies, automation in production, and increase of natural disasters.

Factors such as high-level policy uncertainty and labor costs in Asia, and prevalent disaster occurrence increased overall production and trade costs, leading to localization and diversification of supply chains. Meanwhile, the introduction of digitalization and automation in production generally reduces production costs and increases supply chain complexity as many people can participate in globalized production regardless of their locations.

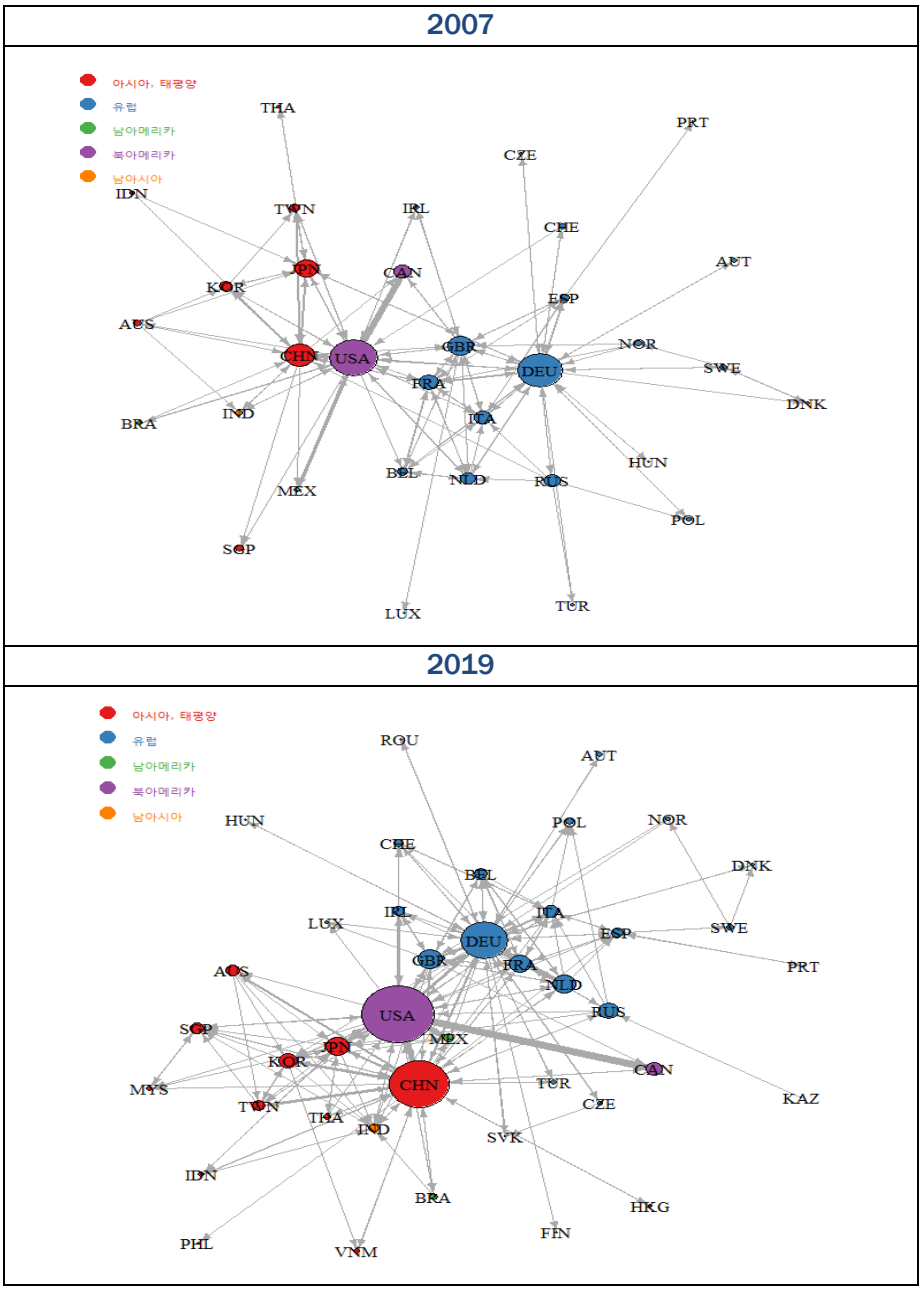
Many factors have contributed to increasing or decreasing production-related costs and reshaping the structure of the global value chain before COVID-19. First, we look at the change in GVC participation in the world. We find that the GVC participation rate between 2007 and 2019 decreased in East Asia and the Pacific regions, and increased in Europe, Central Asia, and Latin America. In particular, China's GVC participation rate decreased, whereas developing countries in Asia and North America such as Vietnam, India, and Mexico expanded. The trends in Asia are vastly influenced by the trends of China as it promotes more domestic-oriented policies. To fill the production gap of China, many developing countries, such as Vietnam, India, and Mexico, started to participate in the global production network.

When we compare the intermediate and final good global network between 2007 and 2019, we find that production is becoming more localized. Especially, we find that emerging countries in Asia such as Vietnam, India, Thailand, and Singapore are closely linked to other Asian countries like China, Korea, and Japan. We also find that the North American network has increased its links within the region. Mexico, in particular, is actively participating in the North American production network along with the United States and Canada.

When we look at the production length,[1] we find that the length has stagnated. However, following the US-China trade disputes, the length is slightly decreasing. This implies that the location of production and consumption has become closer. When we look at the trends by region, we find that the production length in most Asian regions (China, Korea, Taiwan, Indonesia, and India) except Australia and Japan has declined.

[1] The production length in the global value chain analysis measures the steps of final goods that travel from a country or industry to the final consumer.

Figure 1. Global Intermediate Network (2007, 2019)



Note1: The circle represents the size of exports of intermediate goods in the country, and the thickness of the network line indicates the size of the movement of intermediate goods. The larger the circle size, the greater the role in world export, and the thicker the line, the higher the degree of trade linkages for production.

Note2: Red circles = Asia Pacific countries, Blue circles = European Countries, Green circles = South American countries, Purple Circles = North American countries, Orange circles = South Asian countries.

Source: Author's calculation based on ADB-MRIO.

Taken together, the global value chain formed before COVID-19 is changing due to various factors, and this change can be summarized as stronger global supply chain connectivity centered on the Asian region, stronger production networks (Asia, EU, North America), and simplification of production length (market proximity).

III. Global Value Chain after the Spread of COVID-19

COVID-19 can work as both a supply shock and demand shock. On the demand side, many governments implemented strong distancing policies to prevent the spread of infection and/or recommended temporary closure of production facilities where infections have occurred

Due to the policies, producers have experienced difficulty in producing goods and services as the market demand and labor income have decreased. On the supply side, COVID-19 restricts the input of workers as it is a natural disaster transmitted through human-to-human contact. This has the effect of suspending production of companies or delaying shipment of goods.

Figure 2. Foreign Demand/Supply Exposures (2019)

Note: In this analysis, Asia represents 9 countries (excluding Myanmar), which are Korea, Japan, Taiwan, and ASEAN.
Source: Author's calculation based on ADB-MRIO.

Since COVID-19 works as a supply and demand shock, we can partially predict a COVID-19 shock based on foreign demand exposure and foreign supply exposure. Countries with high dependence on overseas demand (foreign demand exposure) are likely to have a relatively large impact from the decline of demand in counterpart trading countries. Also, countries with high dependence on foreign value-added (foreign supply exposure) are likely to have difficulty in production when suppliers have an issue providing intermediate goods in need. From the analysis, we find that countries such as Vietnam, Taiwan, Korea, Mexico, and Germany have a relatively high level of foreign and supply exposure. This implies that these countries are relatively sensitive to overseas demand and supply, so if there is a problem with overseas demand and supply, there is a high possibility of a domestic production shock.

When we look at the global trade after COVID-19, China's position in world trade remains strong. Also, demand for Chinese, Korean products is high from the EU and the US, showing there has been relatively less impact on trade in Asia. We also find that overall greenfield FDI has decreased, but the decline in regional investment is relatively low compared to other regions. Greenfield FDI shows that regional investment in North America and South Asia has increased overall.

From the evidence above, we find that the role of Asia in the global value chain remains strong, while the trends of increasing regional production persist. These trends imply that previous structural changes in the global value chain have continued after the spread of COVID-19.

IV. The Impact of External Shocks on Global Value Chain: Empirical Analysis

Through an empirical analysis, we try to identify whether various external shocks such as natural disasters (earthquake, flood, drought, heatwave, infectious disease, etc.) and technical disasters (road, port, airport accidents, industrial accidents, etc.) are effective factors on GVC trade (intermediate goods trade). In particular, we aim to find statistical evidence that health disasters, such as epidemics, are significant factors that affect intermediate goods trade.

Regarding the methodology and dataset, the analysis was based on a gravity model with a balanced panel dataset (Equation 1). We combine this with trade datasets from ADB-MRIO and external shocks from EM-DAT. The period of our dataset is from 2007 and 2019. The external shocks in this analysis are disasters, which include natural disasters (earthquakes, floods, heatwaves, landslides, etc.), health disasters (infectious diseases), and technical disasters (road destruction, airport closure, etc.). Intermediate goods trade in this analysis indicates value-added inputs to final consumption in exports, which is a proxy for a globalized form of production. The constructed dataset includes 62 countries in Europe, Asia, North

America, South America, and Oceania, and includes Korea as well.

$$lnGVC_{i,jt} = \beta_0 + \beta_1 Shock_{i,jt-1} + \beta_2 lnGDP_{i,t-1} + \beta_3 lnGDP_{j,t-1} + \beta_4 RTA_{ijt} + \gamma_t + \delta_{ij} + \varepsilon_{ij,t}$$

The analysis yields the following results. First, external shocks including health disasters are negatively correlated with GVC trade. The results imply that external shocks may negatively affect the global value chain by reducing intermediate trade, and health disasters like COVID-19 may also be a factor that hinders globalized production. More specifically, if the exporting country experiences an external shock, intermediate goods trade decreased by 53.7% compared to when there is no external shock. When there are external shocks in import countries, the intermediate trade decreases by 48.8%.

Second, the analysis reveals that the correlation between external shocks and GVC trade is smaller in countries with higher levels of trade openness and digitization. This suggests the importance of a support policy maintaining a high level of trade openness and digitalization in order to reduce the impact of external shocks on globalized production.

Lastly, the analysis shows that the correlation between labor damage (damaged personnel) and GVC trade is statistically significant along with capital damage (damage amount). The result implies that policies on damaged labor environment are necessary to restore the globalized production in times of external shocks.

V. Production Network Change after COVID-19: The Case of Global Leading Firms

To understand the changes in GVC structure, it is important to understand the suppliers and buyers of global leading firms. However, the information on global companies is highly restricted as this information includes business know-how. To solve this issue, we exploit Bloomberg Supply Chain Analysis (SPLC), which provides information on suppliers and buyers of target companies.

The case study analysis includes a total of 17 global companies in the industries of electricity and electronics; automobiles; and textiles, clothing, and shoes. We select these three industries because of their high level of GVC participation and FDI. To maintain the homogeneity of companies within the industry, the electric and electronic industries are analyzed mainly by semiconductor companies, and textile, clothing, and shoe industries are analyzed by fast-fashion brand companies.

The analysis reveals the following results. First, when we compare the suppliers' and buyers' connection between pre- and post-COVID-19, foundry companies like SMIC in China and TSMC in Taiwan diversified their supply chains, mainly with Chinese and Taiwanese companies. Supply chains and sales

networks of semiconductor design companies like Qualcomm's are concentrated in Taiwanese and European (France, UK, Netherlands, Finland, and Germany) companies. Semiconductor design and manufacturer companies like ST Microelectronics in Netherland and Samsung Electronics in Korea increase the share of Taiwanese suppliers.

Next, the analysis shows that Shanghai Motors in China, Volkswagen in Germany, Toyota in Japan, Ford in the US, and Hyundai Motor Group in Korea increase dependencies on Japanese and French suppliers.

Lastly, in the case of the world's top three fast fashion companies (Gap, Zara, and Uniqlo), the three leading companies increase the share of suppliers from Japanese companies.

Additionally, the results show that many of the firms in our sample have increased their investment in digitalization and automation since COVID-19. For instance, Qualcomm, TSMC, Samsung Electronics, Shanghai Automobile Group, and Keysight Technologies are jointly developing cellular-vehicle/object communication (C-V2X) technology[2] and 5G mobile networks in 2020.

All in all, the case study results confirm that the value chain of global representative companies is strengthening the value chain towards Asia and Europe, and the companies are preparing for digitalization and automation in production after COVID-19.

VI. Production Network Change after COVID-19: Korean Firms Overseas

Our study investigates the changes of supply and sales structure, causes of change, response, prospects, and policy demand at the firm level between the pre- and post-COVID-19 period through a firm-level survey. More specifically, the survey includes the four main areas of: changes in supplier and buyer structure, damage caused by and response measures to the COVID-19 pandemic, supply chain changes due to the COVID-19 pandemic, and potential GVC risks and policy demand.

The survey was conducted on 229 Korean companies in the electronics industry, transportation equipment industry, and textile, clothing and shoe industry. The collected survey shows that Vietnamese and Chinese firms accounted for 40.6% and 21.0% of respondents, while the nationalities of other responding firms were Poland/Slovakia/Germany (6.6% collectively), Cambodia/Myanmar/Philippines (6.6% collectively), and the United States (6.1%). Also, intermediate goods producers, known to have high GVC participation, accounted for 69% of the total, followed by consumer goods producers accounting for 29%.

When it comes to changes in suppliers and buyers, most Korean companies have increased the share of raw materials or interme-

[2] C-V2X technology enables the sharing of information between vehicles, pedestrians, and infrastructure.

diate goods procured or imported from Asian countries such as China, ASEAN, and South Asia, as well as sales to Asian countries. Also, the average number of raw materials, intermediate goods, and sales networks has decreased slightly (average 0.1 countries). The results imply that the firms are more prone to source goods from local supplies and serve the local market.

The survey also reveals that most firms are experiencing damage directly from COVID-19 due to downsized sales/export demand and supply chain disruption. Particularly, many intermediate goods producers responded that they have sustained severe damage due to the COVID-19 pandemic. To mitigate the issue, the firms are adjusting internal resources, such as reducing local employees to cut labor costs, or adjusting inventory.

Regarding the direct impact of COVID-19 on suppliers and buyers, some Vietnamese and Chinese companies have changed their supply or sales chain due to the direct influence of COVID-19, but these companies account for a very small portion of the total. This implies that the global value chain structure of Korean companies has not much changed after the spread of COVID-19.

Other than GVC-related risks, such as the environment of local investment and production, natural disasters, and global trade environment changes, Korean firms pointed out that digitalization and green economy transformation are important risk factors in a globalized production environment.

Lastly, the survey shows that Korean companies are requesting policies to restore the damage from COVID-19, such as promoting diplomatic cooperation with the local government and strengthening the local production environment.

VII. Policy Implications

After the COVID-19 outbreak, statistics and surveys show that global trade and investment have declined, while local companies are experiencing sluggish production and sales/exports. The evidence supports that the spread of COVID-19 is a major factor influencing global production. However, the GVC structure after COVID-19 has not changed significantly when compared to before COVID-19. Also, the majority of Korean firms have not changed their suppliers or buyers because of COVID-19. This evidence implies that the current structure of the global value chain is influenced by previous factors such as increasing policy uncertainty, such as the US-China trade conflict and changes of production and market environments in Asia rather than COVID-19 factors.[3]

[3] It is important to note that the analysis is based on short-term data, and should be followed with future studies on the COVID-19 shocks on GVC structure from a longer-term perspective.

Based on the results, this study suggests the policy directions of immediate policy response to short-term damage from COVID-19, and a long-term policy response towards health risks, digitalization and automation of production, and acceleration of the green economy.

To restore production network problems and respond quickly to future health risks, the study points out the importance of strengthening international cooperation for flexible labor movement in times of crisis, maintaining trade openness to secure supply and demand channels, and country- and industry-level support to fit the micro-level policy demand.

The study also highlights the need to respond to mid-long term risk factors through strengthening the linkage of Korea's production network with major partner countries/regions, establishing a global vaccine hub to respond quickly to health risks, and effective support on digitalized production and the green economy. KIEP