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Policy Implications of the Biden Administration's Global Supply Chain Reorganization

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I. Introduction

The Biden administration, which began in January 2021, has begun promoting the U.S.-centered re-structuring of the supply chain. There are two policy goals. One is to address the supply chain vulnerabilities that the U.S. has experienced. The other is to deal with another supply chain crisis that may occur in the future. To do so, President Biden first signed Executive Order 14017 on 'America's Supply Chains' on February 24, 2021 to check and resolve supply chain risks in the four key items (semiconductors, large-capacity batteries, important minerals including rare earths, and pharmaceuticals) and six key industries (defense, health, ICT, energy, transportation, and agriculture). As a follow-up to the Executive Order, the White House announced a 100-Day Supply Chain Review Report on June 8 in 2021, which contains supply chain risks, opportunity factors, and policy recommendations for the four key items mentioned above. Furthermore, reports by relevant ministries with the investigation results were also released on February 24 in 2022 followed by supply chain inspections for the six major industries.

Considering the role and importance of the U.S. and China in Republic of Korea (ROK)'s global supply chain, the U.S. supply chain reorganization and decoupling policy are expected to have a significant impact on the ROK economy. There are three reasons for this assumption. First, among the four key items included in the aforementioned supply chain restructuring, the semiconductor and electric vehicle (EV) battery industries are major export industries of the ROK. Secondly, these industries are closely related to the U.S.

and China in ROK's global supply chain. Finally, those industries are one of the main causes of the U.S.-centered supply chain reorganization discussion, which are key fields in the technological hegemony competition between the U.S. and China. Given the geopolitical background and industrial characteristics of these two industries, it seems that now is the right time to systematically analyze the trend and impact of supply chain reorganization.

II. Economic Impact of the U.S.-centered Supply Chain Reorganization Policy

We empirically analyze the impact of changes in semiconductor and EV battery export shares by country on changes in per capita GDP. The econometric model of this empirical analysis is based on the 'Solow growth model'. Based on the model, the difference generalized moment method (Difference GMM) regression model, one of the dynamic panel model estimation methods, was estimated to control for endogeneity. The target countries for the analysis are 61 countries around the world, and the analysis period is set for a total of 13 years from 2008 to 2020. In the baseline model of this analysis, the dependent variable is GDP per capita by country (GDP per capita), where log is taken.

$$\log(GDPC_{c,t}) = \alpha + \gamma \log(GDPC_{c,t-1}) + \delta X_{c,t} + \beta \log(Export\ Share_{c,t}) + \theta_c + \lambda_t + \epsilon_{c,t}$$

The export share of semiconductors and EV batteries was calculated by summing the exports of each major item in the industry (based on 4- and 6-digit HS codes) and then calculating the export share of semiconductors and EV batteries to the world by country and year. Table 1 shows the estimated results, which analyze the effect of changes in the export share of these industries on changes in per capita GDP by country. Column (2) of Table 1 shows the estimated results that an increase in the export share of semiconductors has a positive effect on per capita GDP growth. Focusing on specific figures, it can be seen that when the semiconductor export share rises by 1%, GDP per capita increases by about 0.12%. In addition, according to column (3), a 1% increase in the EV battery export share increases per capita GDP by approximately 0.34%, indicating that an increase in the EV battery industry's export share also has a positive effect on increasing per capita GDP. Furthermore, in columns (1)-(3), the increase in GDP per capita in the previous year has a positive effect on the change in GDP per capita in the current year at the statistical significance level of 0.1%. Based on the statistics of the Arellano-Bond test in every Column, per capita GDP in the current period is correlated with per capita GDP in the previous period at the 10% level of statistical significance. It appears that there is an autocorrelation in the error term on a first-order basis.

Next, the dynamic panel model estimation method was used to analyze the impact of changes in export and import concentration by item of semiconductors and EV batteries on changes in net exports by item in the U.S. and ROK. Similar to the previous analysis, a regression model was estimated using the differential generalized moment method to construct a dynamic panel based on annual export and import data of major items in the semiconductor and EV battery industries (based on 4-digit and 6-digit HS codes) and to control for endogeneity. In this case, the dependent variable of the regression model is the logarithmic net exports of each major item in the U.S. and ROK, and the key explanatory variable is the following regression using the export concentration or import concentration as a proxy variable for supply chain restructuring in terms of sales and purchases of final goods by industry. CR represents the concentration index for exports or imports of the semiconductors or the EV batteries in the equation below.

$$\log(NetExport_{i,t}) \\ = \kappa + \zeta \log(NetExport_{i,t-1}) \\ + \beta \log(CR_{i,t}) + \mu_i + \pi_t + \nu_{i,t}$$

Table 1. The Effect of Changes in Export Share of Semiconductors or Batteries on Changes in per Capita GDP

	(1) log($GDPC_t$)	(2) log($GDPC_t$)	(3) log($GDPC_t$)
△log($GDPC_{t-1}$)	0.819*** (0.017)	0.794*** (0.023)	0.779*** (0.019)
△log(Gross Fixed Capital Formation)	0.055*** (0.005)	0.055*** (0.005)	0.052*** (0.005)
△log(Labor Force)	0.241*** (0.031)	0.265*** (0.041)	0.307*** (0.038)
△log(High-tech Exports)	0.001 (0.001)	0.001 (0.001)	0.003** (0.001)
△log(Semiconductor Share)		0.115* (0.050)	
△log(EV Battery Share)			0.337*** (0.060)
Year Dummy	included	included	included
Observations	606	606	606

Arellano-Bond Test	Lag	z	P>z	z	P>z	z	P>z
	1	-1.84	0.07	-1.77	0.08	-1.88	0.06
	2	-1.18	0.24	-1.16	0.25	-1.18	0.24

Notes: 1) Standard errors are in parentheses.
2) Significance level: * p<0.05, ** p<0.01, *** p<0.001.
Source: Author's estimation.

According to columns (1) and (2) of Table 2, the increase in net exports of electrical semiconductors in the U.S. in the previous year reduces the net exports of the corresponding item in the current year at the 0.1% statistical significance level. However, according to column (1), the sign of the estimation coefficient for the change in the U.S. semiconductor export concentration for the current year was negative, but there was no statistical significance. Conversely, an increase in the concentration of U.S semiconductor imports for the current year seems to have a positive effect on the increase in net exports of that item, but this result is also not statistically significant.

Table 2. The Effect of Changes in the U.S. Semiconductor Export/Import Concentration on Changes in the U.S. Net Exports

		(1) log(Net Export$_t$)		(2) log(Net Export$_t$)	
△log(GDPC$_{t-1}$)		-0.202*** (0.044)		-0.239*** (0.044)	
△log(Export Concentration)		-0.648 (1.263)			
△log(Import Concentration)				1.137 (1.485)	
Year Dummy		included		included	
Observations		954		866	
Arellano-Bond Test	Lag	z	P>z	z	P>z
	1	-18.81	0.00	-16.98	0.00
	2	-0.38	0.70	2.27	0.02

Notes: 1) Standard errors are in parentheses.
2) Significance level: * p<0.05, ** p<0.01, *** p<0.001.
Source: Author's estimation.

Table 3 shows the impact of changes in ROK's semiconductor export or import concentration on changes in ROK's net exports by item. First of all, contrary to the estimated results in the case of the U.S., an increase in ROK's net exports of semiconductor in the previous year increases net exports of the same item for the current period, which was statistically significant. In addition, the impact of changes in ROK's semiconductor export concentration and import concentration on the change in ROK's net export for the corresponding item appears to be different. According to Column (1), if the export concentration of semiconductors increases by 1%, ROK's net export of the same item decrease by 4.72%. In other words, if the supply chain is reorganized so that semiconductor exports are concentrated in a certain region, this could negatively affect economic growth by reducing ROK's net exports for the same item. On the other hand, according to Column (2), unlike the case of export concentration, the change in semiconductor import concentration in ROK has no statistically significant effect on the change in net export of the item.

Table 3. The Effect of Changes in ROK Semiconductor Export/Import Concentration on Changes in ROK Net Exports

<table>
<tr><th></th><th colspan="2">(1)
log(Net Export$_t$)</th><th colspan="2">(2)
log(Net Export$_t$)</th></tr>
<tr><td>△log(GDPC$_{t-1}$)</td><td colspan="2">0.449***
(0.003)</td><td colspan="2">0.554**
(0.187)</td></tr>
<tr><td>△log(Export Concentration)</td><td colspan="2">-4.724***
(0.018)</td><td colspan="2"></td></tr>
<tr><td>△log(Import Concentration)</td><td colspan="2"></td><td colspan="2">1.889
(1.378)</td></tr>
<tr><td>Year Dummy</td><td colspan="2">included</td><td colspan="2">included</td></tr>
<tr><td>Observations</td><td colspan="2">954</td><td colspan="2">866</td></tr>
</table>

<table>
<tr><td rowspan="3">Arellano-Bond Test</td><td>Lag</td><td>z</td><td>P>z</td><td>z</td><td>P>z</td></tr>
<tr><td>1</td><td>3.73</td><td>0.00</td><td>4.58</td><td>0.00</td></tr>
<tr><td>2</td><td>-1.60</td><td>0.11</td><td>-2.06</td><td>0.04</td></tr>
</table>

Notes: 1) Standard errors are in parentheses.
2) Significance level: * p<0.05, ** p<0.01, *** p<0.001.
Source: Author's estimation.

Table 4 shows the impact of changes in the U.S. EV battery export or import concentration on changes in the U.S. net exports of the same product. First of all, according to Column (1), changes in the concentration of the U.S. EV battery exports did not have a statistically significant impact on changes in net exports. However, according to Column (2), when the concentration of EV battery imports in the U.S. increases by 1%, net exports of the product decrease by 15.72%, and this result is statistically significant at the 5% level. In other words, if the U.S. supply chain is reorganized in such a way that semiconductor imports are highly dependent on a specific region, this may reduce the U.S. net exports of the item and act as a factor hindering economic growth.

Table 4. The Effect of Changes in the U.S. EV Battery Export/Import Concentration on Changes in the U.S. Net Exports

		(1) log(Net Export$_t$)		(2) log(Net Export$_t$)	
△log(GDPC$_{t-1}$)		29.720*** (2.082)		30.576*** (2.005)	
△log(Export Concentration)		12.938 (8.626)			
△log(Import Concentration)				-15.723* (6.146)	
Year Dummy		included		included	
Observations		143		143	
Arellano-Bond Test	Lag	Z	P>z	z	P>z
	1	-2.62	0.01	-2.93	0.00
	2	-2.63	0.01	2.78	0.01

Notes: 1) Standard errors are in parentheses.
2) Significance level: * p<0.05, ** p<0.01, *** p<0.001.
Source: Author's estimation.

Table 5. The Effect of Changes in ROK EV Battery Export/Import Concentration on Changes in ROK Net Exports

		(1) log(Net Export$_t$)		(2) log(Net Export$_t$)	
△log(GDPC$_{t-1}$)		1.005*** (0.047)		1.061*** (0.047)	
△log(Export Concentration)		-0.604*** (9.139)			
△log(Import Concentration)				-0.706** (0.237)	
Year Dummy		included		included	
Observations		117		117	
Arellano-Bond Test	Lag	z	P>z	z	P>z
	1	-2.63	0.01	-2.16	0.03
	2	-1.74	0.08	-1.85	0.06

Notes: 1) Standard errors are in parentheses.
2) Significance level: * p<0.05, ** p<0.01, *** p<0.001.
Source: Author's estimation.

Table 5 shows the impact of changes in ROK's EV battery export or import concentration on changes in ROK's net exports of the relevant product. Compared with the previous estimate of the U.S. EV battery net exports, it can be seen that the increase in ROK's EV battery export concentration had a statistically significant negative impact at the 0.1% level on ROK's net exports. On the other hand, although not included in Table 5, the estimated coefficient for the change in ROK's EV battery import concentration for the current year had a positive sign and was not statistically significant. Based on these estimation results, it can be seen that from ROK's perspective, an increase in the concentration of battery exports or imports may have a negative impact on economic growth by reducing ROK's net exports of the product.

III. Conclusion

The Biden administration has been pushing for domestically-oriented supply chain restructuring in the semiconductor and EV battery industries, which are important strategic materials in terms of national security. Given that the policy stance of the U.S. is expected to continue even after the change of administration, the ROK needs to develop a norm-based cooperation plan from the beginning of supply chain cooperation with the U.S.

First, in the semiconductor sector, it is necessary to promote supply chain cooperation with the U.S. in a direction that guarantees the autonomy of enterprises in the industry while ensuring the sustainability of the supply chain. For example, in the case of the ROK, Japan, and Taiwan, which are being invited to participate in FAB4, a U.S.-led semiconductor advisory body, it cannot be ruled out that the U.S. may request detailed corporate information related to the semiconductor supply chain in order to achieve supply chain stabilization. In particular, since customer information or inventory and sales information can have a significant impact on a company's product pricing strategy, it should be protected for the sake of supply chain sustainability.

In addition, in the EV battery sector, it is necessary to effectively communicate our position on norm-based supply chain cooperation between ROK and the U.S. through dialogue channels with the U.S. to prevent the recurrence of discriminatory application of laws against ROK, such as in the case of the 「Inflation Reduction Act」. President Biden clearly demonstrates a protectionist perspective based on U.S. national interests., such as providing tax credits only for North American electric vehicles through the 「Inflation Reduction Act」. This is highly likely to violate the obligation of national treatment (NT), one of the core principles of the KORUS FTA. In other words, due to the limited tax credit provisions for vehicles manufactured in North America, there is a possibility that ROK-made EVs may suffer from price discrimination relative to EVs manufactured in the U.S. However, in the case of products for which tariff rates are determined by the concession table, unless otherwise specified, the FTA Most Favored Nation Treatment (MFN) clause does not apply.

The U.S. has been promoting various subsidy policies to enhance its industrial competitiveness in the process of restructuring its supply chain. It is judged that companies that meet the requirements to receive the battery subsidy of up to $7,500, and those that do not, will make a big difference in the price competitiveness of EVs with the passage of the 「Inflation Reduction Act」. As a result, ROK EV battery makers, which rely on China for most of the key minerals needed for battery production, are feeling the pressure of supply chain restructuring. In addition, it is known that 70% of electric vehicle models in the U.S. do not receive subsidies immediately due to the strict tax credit requirements of the 「Inflation Reduction Act」. The provision of the tax credit benefits only applies to EVs produced in North America is also causing concern in the related industry.

In a situation where China's influence to lead the global EV battery market is increasing, the ROK government must actively support ROK EV battery makers to effectively expand their supply chains. In the short term, it is expected that the production base of global EV battery companies, including ROK EV battery manufacturers, will be concentrated in North America due to the influence of the supply chain reorganization policy being promoted by the Biden administration. However, since ROK companies are currently planning to mass-produce lithium-ion batteries through joint ventures with the U.S. automakers, it is highly probable that the contract will take form of an exclusive supply of EV batteries to the U.S. partners. Ultimately, it is believed that both countries will need to make efforts to diversify risks by diversifying the purchasing and sales supply chains. As analyzed above, the concentration of the supply chain for the lithium-ion battery industry in the U.S. and the concentration of the supply chain for the purchase and sale of copper products in the ROK have a negative impact on the net exports of the products in both countries, respectively, which may hinder economic growth. KIEP

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