Research Report 2014-722

The Dynamism, Internationalization and Structural Change of the Korean Industries

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2014. 12.

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Summary

Chapter 1. Introduction

1. Background and Purpose of Research

□ Korean industry's "sandwich theory"

It would not be an exaggeration to say that the Korean industry has always been dominated by the "'sandwich theory." The "sandwich theory" has become a reality recently with China becoming the center of global trade. The new focus of the "sandwich theory" is that Korea's core manufacturing industries—shipbuilding, steel, and electronics—are now in their maturity stage but that there are no future industries that can take their place.

□ Analysis of industry · and trade dynamism

Positioned between advanced countries and emerging markets,

the Korean industry has always responded quickly with restructuring every time the "sandwich theory" came up. As in the past, to take the challenge posed by the "sandwich theory" and to turn it into an opportunity, Korean industries need to compare themselves with core competing countries and be clear about the direction of their development. This research studies the structural changes of Korean industry and trade from an industry dynamism perspective. It compares and analyzes Korean industries with major countries to evaluate the position of Korean industry and trade and to survey the reality of "sandwich theory."

2. Research Composition

In chapter 2, this study aimed to analyze the structural change in industry productivity based on structure-based industrial development theory. In chapter 3, trade sophistication analysis calculated export complexity index and product proximity index to analyze how industry dynamism is reflected in export product structure. In chapter 4, global value chains analysis used the International Input-Output Table to evaluate the position of major countries by analyzing global value chains and study the relationship between international industries. Lastly, in chapter 5, policy recommendations will be made for the creative development of Korean industries.

Chapter 2. Korean Industry's Structural Change and Productivity

1. Industry Dynamism and Economic Growth

□ Industrialization and economic growth

This study surveyed the growth pattern of the global economy by country in the past half-century. The survey reveals that there is a clear difference between countries that succeeded in industrialization and countries that failed. The original advanced countries that led the technology industrialization frontier formed an advanced countries club since the 1960s and achieved a stable 2 to 3% average annual growth in per capita income. Among latecomer countries Japan, Korea, Taiwan, Singapore and other Asian New Industrial Countries succeeded in absorbing and learning advanced technology and knowledge with their convergence-type industrialization and joined the advanced industrial country ranks one by one. With the exception of a few countries, most of the remaining countries repeatedly experienced growth, stagnation, and fall in industrialization and their per capita income fall greatly behind advanced countries.

□ Industry productivity and income convergence

The major index used in measuring dynamism in industry is the industry's labor productivity. Therefore, per capita income closely correlates with labor productivity. During 1960-2010, the produc-

tivity gaps between original advanced countries, Japan, and Korea compared to the US have narrowed so the per capita income level has come closer to the US level. China also started out with very low productivity and per capita income, but thanks to the late-comer industrialization following Japan and Korea; it is closing in on the US. Meanwhile, Argentina, Brazil, Mexico were not able to narrow the gap with the US for labor productivity and per capita income.

2. Productivity Gap between Industries and Change in Industry Structure

□ Structure-based industrial development theory

The industrialization experienced by world's major economies shows that structural changes to industry took place with labor moving from the agriculture industry that has low productivity to manufacturing that has high productivity. This change increased the overall industry productivity, resulting in a "structural change bonus." On the other hand, when the late industrialization era started, labor moved from manufacturing that has high productivity to the service industry that has low productivity. This structural change dropped the overall productivity resulting in a "structural change burden." It is easier to accumulate large-scale capital, to implement technology innovation and to apply economies of scale in the manufacturing industry than it is in the agriculture or service industry, making it more advantageous to increase productivity. Structure-based industrial development theory considers that

manufacturing is the engine of growth for economic growth and supports manufacturing-centered industrialization.

□ International comparison of labor productivity using purchasing power parity

The labor productivity of Korea and its competing countries Japan and China, and Brazil that represents Central and South America was compared against the US. The comparison showed that Japan had the highest labor productivity followed by Korea, while China and Brazil had very low labor productivity. China's labor productivity began very low in 1970 but it has steadily increased. In contrast, Brazil's labor productivity fell after the 1980s and was outranked by China. Korea's labor productivity has steadily caught up with the US and Japan since 1970, when industrialization began in earnest, but it is still only at half-level of the US. Compared to the manufacturing industry, the market service of the four countries above was very low compared to the US.

□ Difference in productivity and economic growth

Generally, during the industrialization era, when high-productivity manufacturing industry absorbs employment, income increases when the productivity gap between industries narrows. In contrast, during the late-industrialization era, as low-productivity service industry absorbs employment, income increases when the productivity gap between manufacturing and service industries becomes bigger. The trend from 1970 to 2010 shows that there is clear

convergence of productivity among advanced countries, but this is not clear in the case of developing countries.

□ Bipolarization of Korean industry's productivity

From 1963 to 1990 Korea's manufacturing industry experienced structural change bonus where productivity and employment grew hand in hand, while the retail industry experienced this from 1963 to end of 1990s. In contrast, the individual and business service industry had higher productivity compared to manufacturing during the 1960s, but after 1970, it has only absorbed employment while lagging in productivity. From the 1990s, the manufacturing industry's structural change bonus turned into a "burden" with productivity continuing in growth but employment starting to fall. Since 2000s, even the retail industry has taken on an employment reducing structure due to large scale retailers, and is experiencing structural change burden.

3. Breakdown and Comparison of Productivity Structural Change Factors

□ Method of breakdown

Structural change in industrial productivity can be broken down into the following three factors. The first factor is "within-industry effect" where employment structure remains the same but the industry's internal productivity structure changes. The second factor is employment structure change followed by productivity structure

change, which branches out into two. One is "static reallocation effect" where the industry productivity level does not change but there is only employment ratio change. The other is "dynamic reallocation effect" where both industry productivity and employment levels change.

□ International comparison of factor breakdown

A look at the Korean industry's labor productivity level trend over time shows that it has decreased with 5.18% in the 1980s, 4.00% in the 1990s, and 2.42% in the 2000s. This trend is similar to the Korean economy's decrease in potential growth rate. A look at each decade shows the following. During the 1980s, both "within-industry effect" and structural change effect were bigger than 0, making total industry productivity a very high 5.18%. During this period, both manufacturing and service industries' structural change effect were bigger than 0, resulting in "structural change bonus." During the 1990s, the structural change effect of manufacturing industry became negative and adversely affected productivity growth. During this period, the service industry began to absorb labor from the manufacturing industry, so the structural change contributed to improving productivity. The "structural change burden" trend in manufacturing industry and "structural change bonus" trend in service industry continued during the 2000s.

The structural change in industrial productivity experienced in Korea after the 1990s is a common phenomenon in the industrialization age. However, in Korea this experience was amplified by the unique experience of Asian Financial Crisis during the 1990s. In

the case of the US, it was the first country to complete industrialization with employment in manufacturing industry decreasing since the 1950s, followed by the start of late- industrialization. The US trend in the 1980s and 90s shows the typical late-industrialization phenomenon. The manufacturing industry experienced "structural change burden" while the service industry experienced "structural change bonus." In the case of Hong Kong, productivity structure already became centered around the service industry in the 1980s, achieving a successful structural change. During the 2000s, the center of Hong Kong productivity completely shifted to the service industry, which promoted both employment and productivity, an ideal late-industrialization state.

□ Comparison of structural change in Korea and Hong Kong

Korea' manufacturing industry has a very high productivity contribution ratio. In contrast, Hong Kong's service industry has an absolute contribution ratio. Hong Kong's industry productivity has continued to be higher than that of Korea because Hong Kong's restructuring into service industry was successful. In other words, Hong Kong's service industry experienced rapid productivity increase accompanied by increased employment, so the service industry is playing a leading role in the coupled growth of productivity and employment. A smooth structural change during industrialization age will take place when the manufacturing industry's productivity level becomes relatively higher accompanied by increased employment level. In the same way, the ideal structural change for late-industrialization would be for the service industry

to take on and continue the role that the manufacturing industry played during the industrialization age. Korea and Hong Kong are showing different aspects of late-industrialization with each experiencing "structural change bonus" and "burden."

Chapter 3. Korean Industry's Internationalization and Export Sophistication

1. Industry Dynamism and Export Capabilities

□ Theoretical background

The industry's dynamic development can be described as "Lego theory of development." This is referring to the Lego blocks that can be used to create various models. All countries have unique capabilities to combine their productivity capabilities (Lego blocks) to create a varied and complex product (Lego model). In order to produce a high-end product (complex Lego model), a country must have high productivity capability level (various Lego blocks). The reverse would be true as well. A country with high productivity capability can produce varied and complex products.

□ Product space analysis

Economic growth differs depending on how the product structure of a country's production and export changes. However, there is a limit to analyzing complex export product structure using tra-

ditional trade theory only. Generally, meta information in trade statistics rather than trade analysis is used to draft and analyze the importance of a product and the relationship among products into a “product space” that helps make export product structure more understandable.

2. Product Proximity and Complexity

□ Analysis procedure

The first step of product space analysis is to use the structural information (meta data) in trade statistics to estimate the product complexity and proximity. The second step is to take the estimated the product complexity and proximity of the target and see how useful they are in analyzing export sophistication or industry dynamism. The third step is to use the estimated product complexity and proximity among products and add product centrality estimated through network analysis to draft a product space map. Then, this is used to compare Korea and major economies. The product proximity is an index that refers to the link size among products and product complexity and product centrality are indices that refer to the product importance.

□ Product complexity and industrial development

Diversity and scarcity are two factors of product complexity. Used narrowly, they can be used to measure industrial development level; and used more widely, they are highly related to per

capita income. In other words, a country with more sophisticated industry structure and per capita income has more diverse export products and the export basket scarcity becomes higher. Statistically interpreting this, product complexity has a positive correlation with per capita income. The product complexity index can be used not only to explain per capita income but also to forecast per capita income. In other words, a country with high export complexity compared to income level experiences fast per capita income increase while a country with lower export complexity compared to income level has slower increase in per capita income.

□ International comparison of product complexity index

Complexity index can be estimated on country-level or on product-level. Countries at the top level of complexity index are usually advanced countries with high per capita income, showing that the complexity index has a positive correlation with per capita income. Japan ranked at the top of export complexity in 1995 and 2012. This ranking shows that Japan's strong manufacturing industry is well reflected in its export structure. Switzerland came in second followed by Germany in third place. These countries were similar to Japan in that they have strong manufacturing industries. Countries that rose greatly in ranking in 2011 compared to 1995 are Korea, Taiwan, Singapore, the Czech Republic, and Hungary. Like Japan, these countries' industries developed centered on export manufacturing industry and gained high levels of complexity, which promoted export sophistication.

3. Product space analysis

□ Industrial development and product space

"Product space" is a visual network structure that marks the product nodes, and links the product proximity. On product space, advanced countries that have already completed industrialization have concentrated comparative advantages in high-complexity "core industries" such as machinery, metal, and chemicals. Compared to this, least-developed countries with very low levels of industrialization have comparative advantage randomly distributed across "peripheral industries" made up of primary products. Middle power countries show random clusters of comparative advantage slightly off center with clothing and electronics etc.

□ Korea, China, Japan, the US product space comparison

This study compared the product space of Korea, China, Japan, and the US. The US and Japan has a stronger comparative advantage compared to Korea and China. Japan, with a strong competitive advantage in manufacturing industry has a very strong comparative advantage in core industries. The export product structure of the US and Japan in 1995-2012 shows that their comparative advantage clusters in core industries have diminished slightly, indicating the progress of de-industrialization. In the case of electronics industry, the US has already lost much of its comparative advantage, and Japan also has seen its comparative advantage reduced. The reason is that the electronics industry has rapidly moved its production

facilities to China and other latecomer development countries and that the US and Japan specialized in high-end finished products or in core parts and material.

Korea and China had very clear comparative advantages in peripheral industries in 1995, but as of 2012, their comparative advantage has greatly moved to the core industries. Korea and China's export product map of 2012 shows that Korea and China have formed some clusters in the electronics industry and parts of the core industries following the US and Japan. In particular, Korea and China have formed almost equal or stronger comparative advantage clusters in the electronics industry compared to Japan, indicating that the Korea, China era has started in the electronics industry. However, neither Korea nor China have formed a product family group with comparative advantage in the core industries on par with the US and Japan, and it is difficult to narrow the gap with the two countries.

To put the four countries' product space analysis in terms of the "sandwich theory," the speed that Korea is following the US and Japan is slower than the speed China is following Korea. Although Korea's comparative advantage in the core industries has increased, China's comparative advantage in the core industries is increasing at a faster rate; therefore, the comparative advantage gap between Korea and China was greatly reduced.

□ Comparison of export capabilities index

The export capabilities index was estimated using product importance and market share. The estimate result showed that Chi-

na's market share in the global market increased greatly, and its export capabilities ranking rose from 8th place in 1995 to 1st place in 2012. In 1995, the first and second positions for export capabilities index were Germany and the US respectively, but in 2012 China surpassed these two countries to take the top position. With its overwhelming export volume China has taken over the global market and due to this its export product sophistication has also increased greatly.

Korea's export capability ranking also rose from 13th place to 7th place, strengthening its position in the global market. This is thanks to Korean core industries that are doing well in the global market, achieving increased export volume and export sophistication at the same time. Other countries that have increased export capabilities index were Mexico, Thailand, Poland, the Czech Republic; countries in Asia, North America and Europe that served as outposts for processing and assembly exports.

Korea and China's export capabilities increased the most in electronics. In particular, China's export capabilities in this industry grew rapidly becoming two-fold of Germany and 4.5-fold of the US in 2012. As for the auto industry, Germany's export capabilities were highest with 2.3-fold greater than the US, followed by Japan, China, and Korea. As for the general machinery industry, Germany ranked first as well with 1.5 times the US followed by China, Japan, and Korea.

Chapter 4. Expansion of Global Value Chain and Raised Position of Korean Industry

1. International Trade Vertical Specialization and Value-Added Trade

□ Global value chain and international trade vertical specialization

Recently, international trade has been characterized by the international specialization of production and sales process that promotes trade by creating a value chain made up of many businesses. The analysis of the various activities of international trade vertical specialization showed that businesses with R&D, product planning, design, engineering, marketing and customer services took away much of the added-value. Meanwhile, businesses that supplied simple parts or provided only labor through assembly had very little added-value. To accurately find out a country or industry position in the global industry, one needs to do a global value chain analysis to see how much contribution it makes to value-added trade.

□ Value-added trade analysis method

Usually, publicly available trade statistics include both intermediate goods and finished products; that means that added-value is calculated twice. Therefore, analyzing the global value chain structure should start with breaking down the added-value of each

industry. In order to analyze the global value chain structure, gross exports should be broken down to identify the source and output of added-values included in gross exports.

□ International comparison of gross export

This study analyzed how major economies' positions have changed from 1995 to 2011 regarding gross exports and value-added exports. The analysis shows that the US, Germany, Japan, the UK and France formed a five-power system until 2000. However, starting from 2005 China began to rapidly emerge as a major exporting country. As of 2011, China is competing with the US in gross exports and value-added exports for the top position. Korea ranked 11th in gross exports in 1995 and rose to 5th place in 2011, but as for value-added exports, it remained in the 10th position during the same period.

The deepening global value chain brings about an increase in intermediate goods trade; therefore the value of "VAX ratio," which is value-added exports divided by gross exports becomes lower after eliminating the redundant calculation of intermediate goods. A study of each country shows that the US, Japan and other advanced countries that are heavily dependent on the domestic industry, or resource rich countries like Russia that export a lot of energy and raw materials, have high levels of VAX ratio. On the other hand, Korea, Taiwan, Mexico and other countries that are heavily depending on intermediate goods import have low levels of VAX ratio.

Global value chain income (GVC income) refers to the value-add-

ed induced by the final global demand for manufactured goods. The manufacturing industry's competitive power can be more accurately measured with GVC income rather than the gross exports amount. Looking at the ranking of 2011 GVC income shows that advanced countries and China are on top while Brazil that has a big resource industry and India that has a big IT service industry have entered the top ten positions. Korea is heavily dependent on imported intermediate goods, so the value-added in Korea is relatively small and its ranking is outside of the top ten range.

2. Global Value Chain Structure Analysis

□ Vertical specialization(VS)

Vertical specialization (VS) is a concept that contrasts with value-added exports (VAX). It is an index that measures how much overseas factor (overseas value-added) takes up in gross exports. The US and Japan have industry structures that are heavily dependent on domestic industry so their VS ratio is low. Countries that are heavily resource-centered industries with large domestic value-added ratio or that have service industries as core industries such as Russia, Australia, Brazil, and India, also have low VS ratio. Korea imports much of its raw materials or parts, so has a VS ratio almost at the level of EU emerging markets.

The electronics industry, due to parts modularization, has developed into an industry with a production system spread across the world. Due to this, many countries' VS ratio has increased. In particular, the Czech Republic, Hungary and Mexico are coun-

tries with assembly-type electronics industry. Their VS ratio in 2011 amounted to 60~70%. The electronics industry of the US, Japan, Germany and other advanced countries that are specialized in producing intermediate goods have a VS ratio of less than 30%. The VS ratio of the Korea electronics industry was 28% in 1995 and rose to 37% in 2011.

□ Reverse vertical specialization(VS1)

Reverse vertical specialization (VS1) measures the value-added share of a specific country in the gross export of another country. VS1 ratio, along with VS ratio, is used as an index to determine the position of a country or an industry downstream or upstream in the global value chain.

The VS1 ratio distribution of each country shows that advanced countries that are strong in upstream industries(parts, software) had high VS1 ratio and emerging markets specialized in downstream industries(finished products) had low VS1 ratio. Among advanced countries, the US and Germany had very high VS1 ratio and the UK and other advanced countries also had relatively high ratio. The US, Germany and the UK had a big presence overseas centered on multinational companies, and led the international trade vertical specialization. China's role in the global value chain has grown in a short period of time so its VS1 ratio grew drastically from 1995 to 2011. Through the Asian value chain China has not only more finished goods, but also intermediate goods exports, and its contribution to other countries' export has increased greatly.

□ Global value chain structure

VS ratio and VS1 ratio have a non-linear inversely proportional relationship. In other words, when the VS ratio is high, the VS1 ratio does not change; but when the VS ratio is low, the VS1 ratio increases higher than proportion. The US, Germany, China, Russia and the UK have low VS ratio and very high VS1 ratio, and they have a leading influence on the global value chain.

The global value chain structure seen through network analysis shows that Germany, the US and China are the three countries with dominant influence. In 2011, the global value chains were divided into Germany-led the EU value chain, the US-led North American value chain, and China-led Asian value chain and Russia- led Baltic region's value chain. Korea is included in the Asian value chain along with Japan and Taiwan and at the same time contributes to Slovakia and other value chain countries' exports.

The contribution ratio of major economies in global value-added trade was divided into VS and VS1. It showed that the US VS1 contribution ratio which was 16.9% in 1995 fell to 11.2% in 2011, but it is still leading China and Germany. While the VS1 contribution ratio of the US, Germany and Japan fell, China's VS1 contribution ratio grew from 2.1% to 9.2%, and now is the highest after the US. China's VS contribution ratio also grew from 2.5% to 9.9%, showing that China is playing an important role in both value-added exports and imports. Korea's VS1 contribution ratio was 2.5% in 1995 and has not changed significantly, but the VS contribution ratio grew significantly from 3.4% to 5.4%.

3. Analysis of the Relationship between International Industries

□ Deepening industrial relationship among countries

In the past 20 years, the industrial relationship among countries has deepened due to increase in intermediate goods trade following the international trade vertical specialization. The deepening industrial relationship among countries is inducing a coupling of the industry production and economic changes among countries. The Great Recession experienced simultaneously by the global economy after 2008 was caused by the coupled production of major economies' industries. Using the Input-Output Analysis method, this study calculated the mean value of production amount induced by the relationship between international industries. In 1995 the amount was 598 dollars while in 2011 it increased around 30% to 777 dollars. The standard deviation of production inducement amount also increased from 30,954 dollars to 49,150 dollars, implying that the inter-industry relationship had become very diverse.

□ Global industry position from sensitivity perspective

This study calculated the production inducement size (sensitivity) of each country caused by the change in global demand. As of 2011, major advanced countries and China have taken their places among the global top ten. China took the top position in 2011 in terms of production inducement amount over the US and Germany because of its sudden growth as the global industry's intermediate goods supplier. Japan, Belgium, Finland have gone down in rank-

ing in their "sensitivity" in 2001 compared to 1995 and their roles in global industry have weakened. In contrast, Korea's sensitivity grew from 9.2 to 17.1, and its global ranking rose from 16 to 12, four rankings showing that its role in global industry has grown stronger.

The sensitivity of each country's industry was also analyzed. Russia's mining industry was shown to have the most sensitivity to global demand. Germany's metal and chemical industry and the American business services also were on top of the sensitivity distribution. In the case of China, the parts and material industry's supply capacity grew greatly, so the electronics, metal, chemicals industry entered the global top 10 industry ranking. Korea's sensitivity grew the most in the electronics industry, rising from 73rd in 1995 to 41st in 2011 in its global ranking.

□ Global industry position seen from network centrality perspective

The network centrality index was used to study the changes of the top 20 global industries. It clearly shows that China's major industry has emerged as the center of global industry. Just until 1995, China's industry was not even included as a global core industry, but by 2011 seven of its industries including electronics, metal, and chemicals became core industries. The top ranking industries in 1995 were the US business services and German chemicals that took first and second positions, but by 2011 China's electronics and metal industries took the top two positions. China's electronics, the US business services and the German metal industry were also at

the top of sensitivity ranking as seen above. The core industries are deeply interlinked and play an important role in the global intermediate goods supply because they are most sensitive to global demand change and have a great effect on other country's industries.

□ Korea's relationship among international industries

Korea's relationship with international industries shows that Korea's demand has the most sensitive effect on China, the US and Japan. The Chinese industry's sensitivity to Korea's demand rose significantly from 0.77 to 4.45 during the period of 1995 to 2011. Until 1995, the major supplier of intermediate goods to domestic industry were the US and Japan, but by 2011 China replaced the US and Japan to become the major intermediate goods supplier. Looking at the Korea-China inter-industry relationship trend, both countries' production inducement has not only increased but the industries of production inducement have shifted to the electronics, metal and chemical industries. This implies that the deepening Korea-China inter-industry relationship has served as an opportunity for industrial development to both countries.

Chapter 5. Korean Industry's Direction in Creative Development

1. Evaluation on Korean Industry's Dynamism

The Korean industry's labor productivity compared to the US

was not even 20 in 1960 but it grew to almost 60 by 2010, showing the fastest convergence among least developed countries. An evaluation of the effect on global trade shows that Korea, along with China, has risen in its ranking in global trade. China has risen from 8th place in 1995 to 1st in 2012 in the export capabilities index and Korea has risen from 13th to 7th during the same period. In 2011 Korean core industries—electronics, metal and chemical—entered the top 50 to 100 ranking in centrality index. However, Korea's gross exports is only 33% compared to the US but its value-added exports and value-added exports contribution ratio are 25% and 19% respectively compared to the US. To gain a better understanding of the "sandwich" situation Korea finds itself, one must understand that not only is China is converging fast, but Korean industries are converging slowly.

2. Industry Development Strategy and Task

The vision and goal of Korean industry development is to create a strong industry economy where both manufacturing and service industries grow based on knowledge and innovation. In order for Korea's export structure to develop more focused on value-added exports, it needs to shift its policy direction to be more "software-based" rather than "hardware-based." The Korean manufacturing industry must continue to try to sophisticate the export cluster centered on core manufacturing industry. The Korean manufacturing industry should try to continue to create products in new-manufacturing industries such as electronics, mechanics, metal, and chemical that are knowledge-intensive, and that can po-

sition Korean to lead the global market. Korean companies should focus and select high value-added R&D, product planning · design, advanced parts production and put in efforts to grow company capability in those areas.

In order to improve Korean industry's productivity, it needs to raise the productivity level of the service industry itself or decrease the employment absorption of service industries that have low-productivity. To increase the service industry's productivity, businesses should expand their R&D, and develop human resources and the government should relax regulations. These efforts will increase competitive power and promote innovative activities. Korean businesses will be able to develop enough capacity to create or dominate the global value chain when big conglomerates and SMEs pursue value innovation and organically integrate their value chain to strengthen their competitive power and create high-value added opportunities. Externally, Korea should closely observe the value chain trends that include the US, Japan, China and Asian emerging markets and pioneer mutually- beneficial inter-industry relationships.