Mizuho Economic Outlook & Analysis

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China's "explosive buying" fuels Japan's industrial robot exports

< Summary >

◆ Since 2017, Japan's capital goods shipments for exports have been growing substantially. Item-wise, the main growth driver is industrial robots mainly bound for China.

◆ The background of this rapid growth includes the heightening need for labor-saving on a global scale. Furthermore, the rise in capital investment appetite driven by the recovery in the global economy and policy support measures such as "*Made in China 2025*" has become a tailwind for increasing Japan's industrial robot exports.

◆ We believe that for the time being, Japan's industrial robot exports will be supported by labor-saving needs and the Chinese government's policy measures. But China's potential shift to in-house robot production may become a risk factor in the mid-to-long term.

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1. Japan's capital goods shipments are improving, particularly for the overseas market

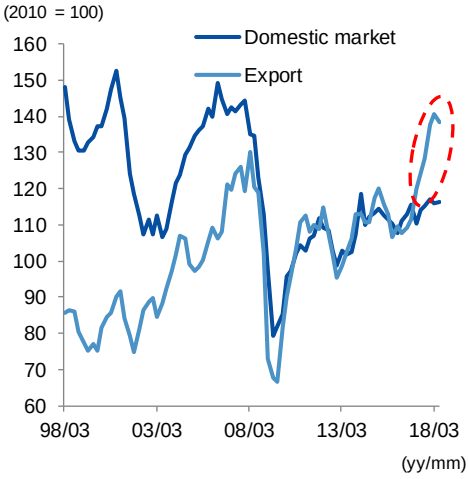
Since 2017, Japan's capital goods shipments (excluding transport equipment) have been on a recovery track. Capital goods shipments are notably higher compared with goods such as producer, consumer and construction goods, and continue to show strong growth in 2018. Among all capital goods shipments, shipments for exports purpose is particularly strong (**Chart 1**). If we look at the data starting from 1998 when statistics first became available, the level of capital goods shipments for the domestic market today is hovering well below the level at the time of the IT bubble and just before collapse of Lehman Brothers, albeit shipments are on an improving trend. On the other hand, capital goods shipments for exports skyrocketed after 2017 and exceeded the level before the Lehman shock, hitting a record high over the past 20 years. In general, capital goods shipments are said to reflect the trend of capital investment in the domestic market, but we understand that the recent growth in capital goods shipments has been driven by the strong capital investment boom in the overseas market, rather than the domestic market.

In this report, we analyze what factors lie behind the growth in capital goods shipments for exports since 2017 and forecast their sustainability.

2. Industrial robots are the driving force behind capital goods shipments

First we identify the items driving the growth in capital goods shipments. According to the shipment trend of items classified as capital goods in the *Indices of Industrial Production* compiled by the Ministry of Economy, Trade and Industry, six items have recovered to the level of 2007 before the Lehman shock, namely, industrial robots, [1] electric meters, measuring instruments and controllers for industry, analytical instruments, semiconductor products machinery, and

Chart 1: Capital goods shipments for domestic and overseas markets



Note: The data above excludes transport equipment.
Source: Made by MHRI based upon the Ministry of Economy, Trade and Industry, *Indices of Industrial Domestic Shipments and Exports* and *Indices of Industrial Domestic Shipments and Imports*.

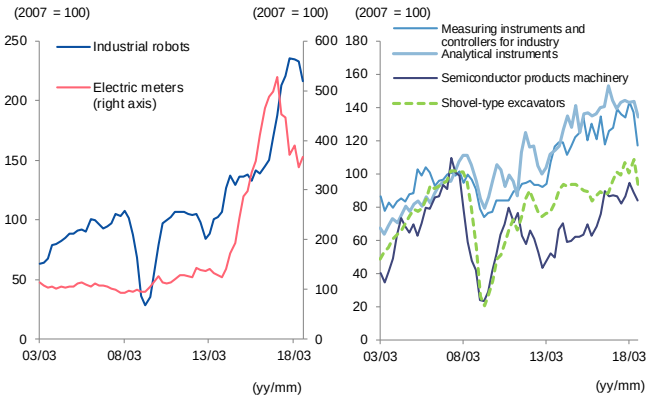
[1] Industrial robots consolidate shipment index of numerically controlled robots (weight: 24.0) and playback robots (weight: 15.5) using their weight.

shovel-type excavators (**Chart 2**). And since 2017, industrial robots and electric meters have particularly demonstrated a strong recovery and have exceeded the 2007 level to a significant extent.

By looking at each item's cumulative contribution to capital goods shipments, we can confirm which items actually pushed up recent capital goods shipments. **Chart 3** depicts cumulative contributions of capital goods shipments by item starting from 2012. The graph reveals that products with a higher weight, such as semiconductor products machinery (share[2]: 8.9%) and shovel-type excavators (7.6%), have contributed to the increase in capital goods shipments, but the biggest contributor is industrial robots. The share of industrial robots in the capital goods shipments stands at 3.4%, which is less than half of the share of semiconductor products machinery and shovel-type excavators, but their cumulative contribution exceeds that of semiconductor products machinery and shovel-type excavators. The cumulative contribution of the other three items, including electric meters, has mostly remained unchanged over the covered period.

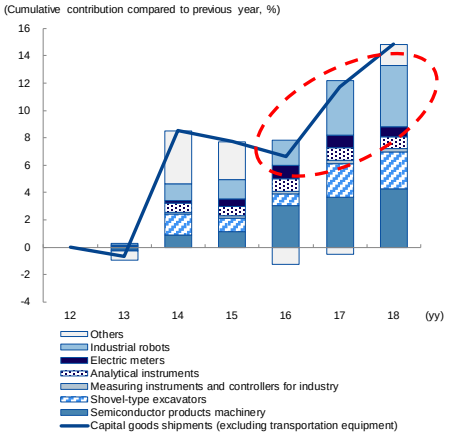
Thus, although industrial robots have a smaller share, their substantial increase since 2017 has fueled capital goods shipment growth. In the following section, we will focus our analysis on industrial robots.

Chart 2: Six items with shipment growth



Source: Made by MHRI based upon the Ministry of Economy, Trade and Industry, *Indices of Industrial Production*.

Chart 3: Cumulative contribution of capital goods shipments by item



Notes: 1. Cumulative contribution starting in 2012.
2. The value for 2018 is the average of the period from January to July.

Source: Made by MHRI based upon the Ministry of Economy, Trade and Industry, *Indices of Industrial Production*.

[2] Here, share means the proportion of each item in the weight of capital goods shipments (excluding transport equipment) (1177.6).

3. Exports of industrial robots are surging mainly bound for China

As we saw in section 1, capital goods shipments for exports showed particularly strong growth. Now we also want to confirm the trend of industrial robot shipments for the domestic market and those bound for overseas. But since the *Indices of Industrial Production* does not disclose this breakdown by item, we need to refer to the "industrial robots, not elsewhere specified or included" data stated in the *Trade Statistics* of the Ministry of Finance. In addition, the Japan Robot Association (JARA) releases *Manipulators and Robots Statistics*(in Japanese only) where we can confirm the breakdown of industrial robots by shipment to domestic and overseas markets.[3]

Chart 4 shows the trend of industrial robots' total shipment and shipment for exports in two patterns of (1) "*Industrial Production Shipments + Trade Statistics*" and (2) "*Manipulators and Robots Statistics*." Although the two graphs show slightly different movements due to the difference in the statistics' definition, we can see that growth in shipments for exports starts exceeding that of total shipments from 2010 in both graphs, and the pace of export growth becomes faster in 2017, with the range of deviation between the domestic and overseas markets widening. As a result, we believe it is fair to say that the growth driver of industrial robot shipments is exports.

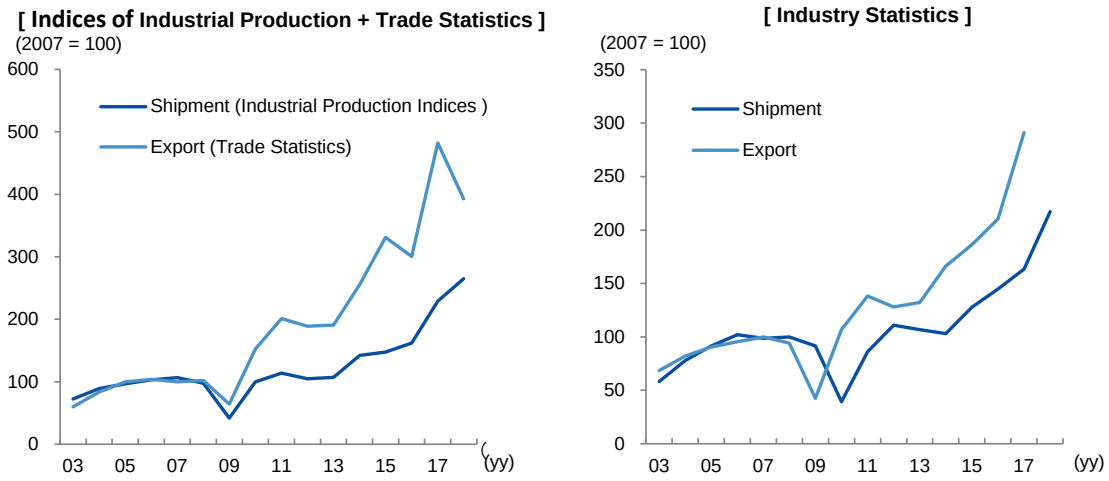
It should be noted that since there is no big difference in the interpretation of the two statistics, we use the *Trade Statistics* to follow the development of industrial robot exports in the following sections. We did so because the *Trade Statistics* offers data over a longer period compared with other statistics, as well as more detailed information on destination country/region for exports.

Chart 5 shows the export destinations of industrial robots (volume basis). The graph reveals that exports bound for China are growing explosively. Exports are growing not only for China but also Asia NIEs, ASEAN, the EU and the US.

Due to the sharp growth in exports to China, the share of industrial robots by export destination is also changing. Although the United States was the main export destination up until 2008, the share of exports to China rose to over 40% after 2014 (**Chart 6**).

[3] The classification of "industrial robot" is inconsistent in the *Industrial Production Shipments* and *Trade Statistics*. While industrial robot is defined as the sum of numerically controlled robots and playback robots in the *Industrial Production Shipments*, the *Trade Statistics* also includes other industrial robots. However, considering that numerically controlled robots and playback robots occupy a majority share of industrial robot production according to the *Current Production Statistics*, and that there is no difference in the interpretation with the industrial statistics as will be explained later, the report employs the *Trade Statistics* to conduct its analysis.

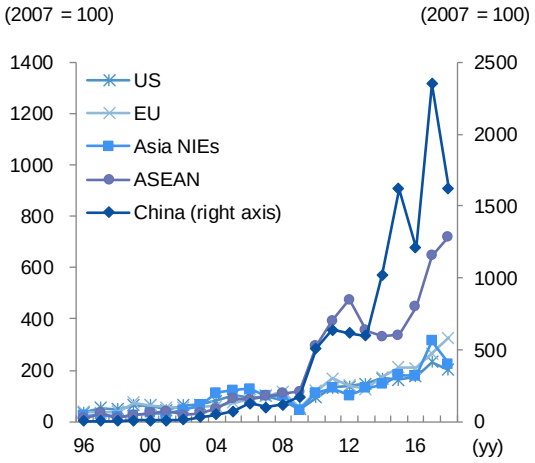
Chart 4: Shipment of industrial robots to domestic and overseas markets



Notes: 1. The data above is on a volume basis.
2. Shipment is the total of shipments for domestic and overseas markets.
3. Data for 2018 is extended using the year-on-year change rate of the period from January to July.
Source: Made by MHRI based upon the Ministry of Economy, Trade and Industry, *Indices of Industrial Production* and the Ministry of Finance, *Trade Statistics*.

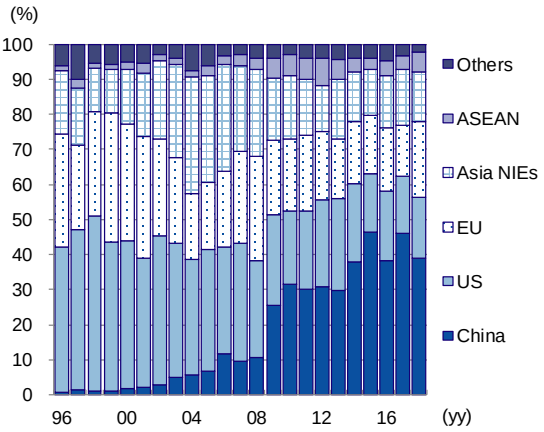
Note: The data above is on a unit basis.
Source: Made by MHRI based upon the Japan Robot Association (JARA), *Manipulators and Robots Statistics*.

Chart 5: Industrial robot export volume by destination



Notes: 1. Data for China includes export to Hong Kong. Data for Asia NIEs excludes export to Hong Kong. Data for ASEAN excludes export to Singapore.
2. Data for 2018 is extended using the year-on-year change rate of the period from January to July.
Source: Made by MHRI based upon the Ministry of Finance, *Trade Statistics*.

Chart 6: Share of industrial robot export volume by destination



Notes: 1. Data for China includes export to Hong Kong. Data for Asia NIEs excludes export to Hong Kong. Data for ASEAN excludes export to Singapore.
2. Data for 2018 is extended using the year-on-year change rate of the period from January to July.
Source: Made by MHRI based upon the Ministry of Finance, *Trade Statistics*.

4. Heightening global need for labor-saving is another reason for industrial robot export growth

There are three main factors behind the accelerated growth in industrial robot exports mainly to China since 2017. The first factor is an improvement in company profitability and capital investment appetite due to the recovery in the global economy; the second is the heightening need for labor-saving; and the third is support measures such as subsidies launched by the Chinese government.

(1) Recovery in the global economy causing capital investment incentive to pick up

For the first factor, during the period from 2015 until early 2016, global economic growth slowed because of such factors as the stagnant economic situation in China and resource-rich emerging countries. But thanks to the bottoming out of crude oil prices, revival of China's economy, and improvement of the IT cycle, the global economy turned for the better toward 2017. With an improvement in company earnings following the recovery in the global economy, firms' incentive to invest in equipment started picking up in Japan's main export destination countries such as the United States. In addition, it seems that policy support including the large-scale tax reduction program implemented by the Trump administration, which was inaugurated at the beginning of 2017, has also helped investment appetite to improve. In fact, new orders of core capital goods in the US started to demonstrate an upward trend in 2017 (**Chart 7**), revealing that orders related to equipment investment are actually growing.

We hold that these situations have triggered companies to invest more in industrial robots.

(2) Heightening need for labor-saving due to the decline in working-age population

Next we look at the second factor, labor-saving. **Chart 8** depicts the growth rate of working-age population (15-64 years old) by country and region. The graph shows that the growth rate of working-age population in Japan's main export partner countries, such as the US, Europe and Asia, is on a downward trend, while the rate in China has dropped into the negative territory since 2015.

When the working-age population stops growing, companies find it more difficult to secure enough workers and are compelled to raise labor costs. If we look at China's labor costs, we see that costs began to surge to a greater extent compared with other Asian countries in 2015 when the working-age population growth started to decline (**Chart 9**).

In China, it seems that the labor shortage and surging labor costs have generated a greater need for manpower saving, which has pushed up the demand for industrial robots. And as mentioned earlier, firms' robust appetite for capital investment is also fueling the

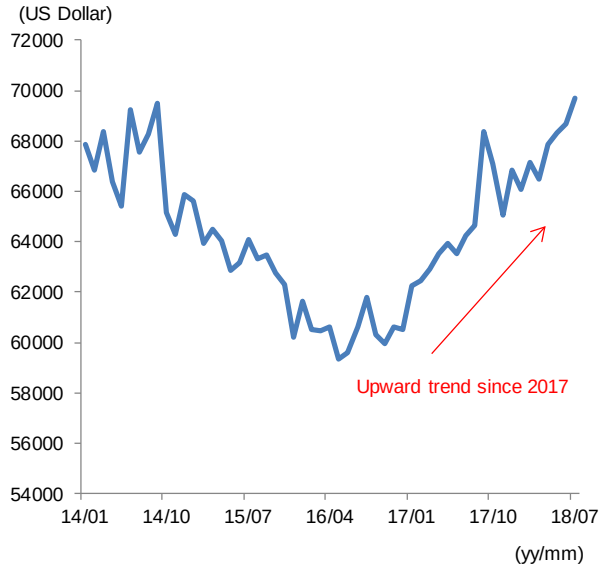
introduction and repurchase of industrial robots. We hold that this phenomenon is not confined to China, but is also common in the US, Europe and NIEs where the working-age population is not increasing as much as expected.

(3) Policy support in China including subsidies also giving a boost

In addition to the labor-saving demand, the Chinese government's support measures, including a subsidy based on the "*Made in China 2025*" plan to upgrade China's manufacturing industry, is giving a boost to the export of industrial robots by Japan.

"*Made in China 2025*" outlines the action guidelines for China to become the world's leading manufacturing country and was unveiled by China's State Council in May 2015.[4] In October that year, the government also released its technology roadmap targeting ten key sectors that include the robotics industry for priority promotion in "*Made in China 2025*." With a view to expanding the robotics industry and raising its domestic production ratio,[5] the roadmap has set the target to increase the unit sales of robots to 150,000 by 2020 (of which 75,000 units are domestic production) and to 260,000 by 2025 (of which 180,000 units are domestic production).[6] We believe the Chinese government is providing policy support such as subsidies for the purpose of achieving these targets.

Chart 7: New orders of core capital goods in the US



Note: The data above is the value of capital goods excluding national defense and civilian aircraft.
Source: Made by MHRI based upon the United States Census Bureau.

And these policy support measures actually seem to be bearing fruit. According to the data released by the Chinese Robot Industry Alliance ("CRIA"), robot sales in China

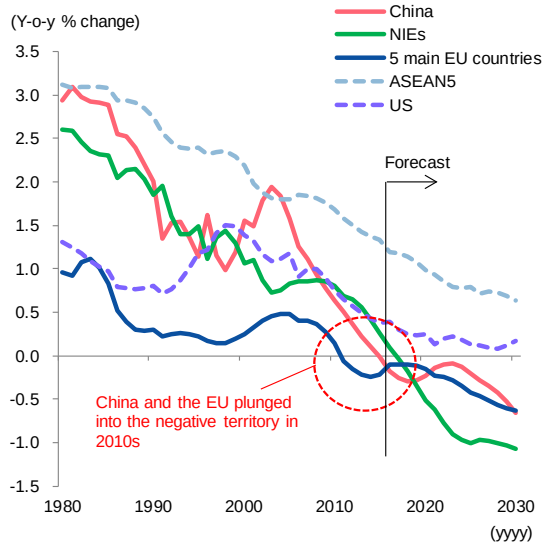
[4] More specifically, China has set the target in three stages with a view to becoming a leading manufacturing country by 2049, the 100th anniversary of the founding of the People's Republic of China. The country first aims to enhance the quality of its overall manufacturing industry and labor productivity by 2025, then reach the mid-level position of the world's leading manufacturing nations by 2035, and further fortify its position as a leading manufacturer by the 100th anniversary of the state establishment in 2049, taking the lead among the global manufacturing countries. "*Made in China 2025*" stipulates the nation's goal of the first stage until 2025.

[5] We calculated the ratio by using the "market share" stated in the "*Made in China 2025 Key Area Technology Roadmap*" as a share in unit sales.

[6] According to the original text, target unit sales of industrial robots are expressed as "anticipated value (预计)," whereas the target of domestic robot production is expressed as "target (目标)," employing different words, respectively.

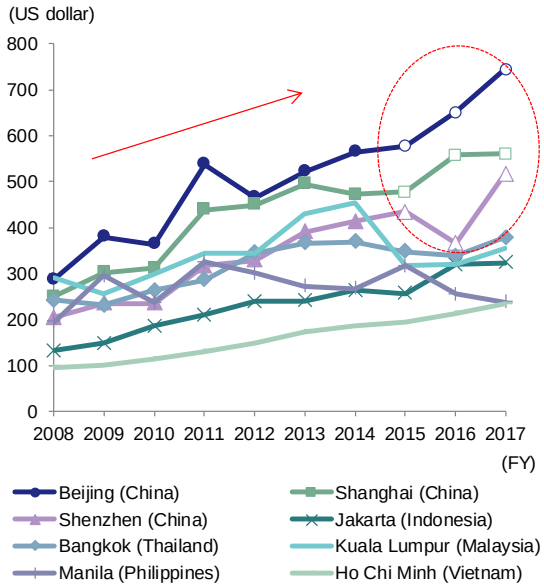
surged from 68,000 units in 2015 to 141,000 units in 2017, and the pace of robot sales is so fast that the 2020 target may be achieved sooner than later (**Chart 10**). Unit sales have increased more than twofold in just two years since the "*Made in China 2025*" plan was announced in 2015, and it is difficult to explain this development by the need for manpower saving alone. We believe the Chinese government's policy support, including the subsidy to achieve the 2025 target, is another factor pushing up the demand for industrial robots.

Chart 8: Growth rate of working-age population by country and region



Note: The data after 2016 is a forecast.
The five major EU countries are the UK, France, Germany, Spain and Italy.
NIEs include three countries excluding Hong Kong.
ASEAN5 does not include Singapore.
Source: Made by MHRI based upon the United Nations, *World Population Prospects 2017*.

Chart 9: International comparison of labor costs in Asia



Note: The data above is the basic monthly salary of workers in the manufacturing sector.
Source: Made by MHRI based upon JETRO, *Comparative Survey of Investment Related Costs*.

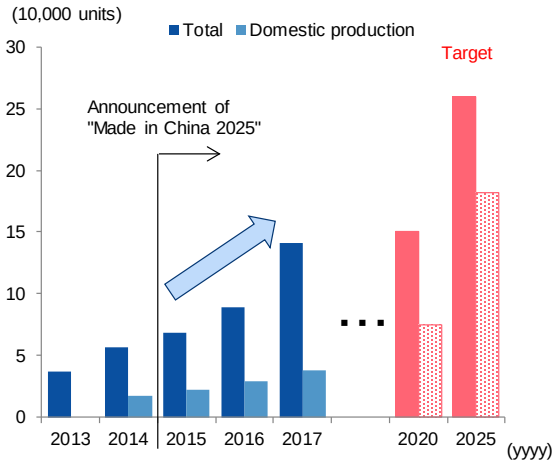
(4) Such a phenomenon having a positive impact on Japan

Now we shift our topic to China's domestic production target. The number of domestically-produced robots as of 2017 stood at 37,000 units, accounting for a small 30% share of the total market. Furthermore, compared to 2015, the number of domestically-produced robots increased by only 15,000 units, and the share of domestic production saw no increase (2015: about 31%). This means that the rest of the market is dominated by robots made in other countries.

There are two routes through which foreign-made robots arrive in China: imports from other countries or purchase from the local affiliates of overseas robotics companies. Which route does China use to procure robotics?

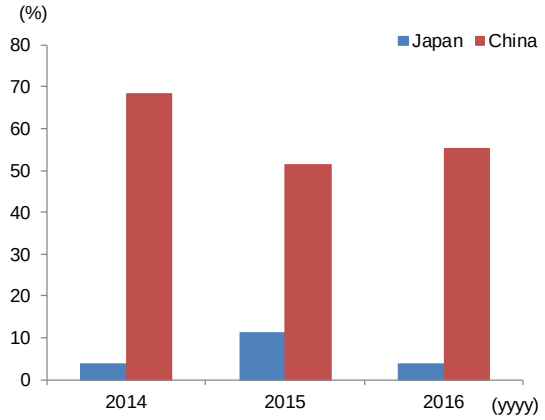
Chart 11 shows the share of imported robots in the total industrial robot supply. According to the graph, while the import ratio of Japan is less than 10%, China's import ratio exceeds 50%, implying that China is largely dependent on imports. Furthermore, **Chart 12** depicts China's import ratio by specific country. Looking at trends since 2007, Japan has always maintained a top share and has exceeded 70% since 2014.

Chart 10: Robot unit sales in the Chinese market



Notes: 1. Unit sales data for domestically-produced robots for 2013 is not available.
2. The domestic robot production target is calculated by multiplying the domestically-produced robot unit sales forecast by the target share (market share).
Source: Made by MHRI based upon the Chinese Robot Industry Alliance.

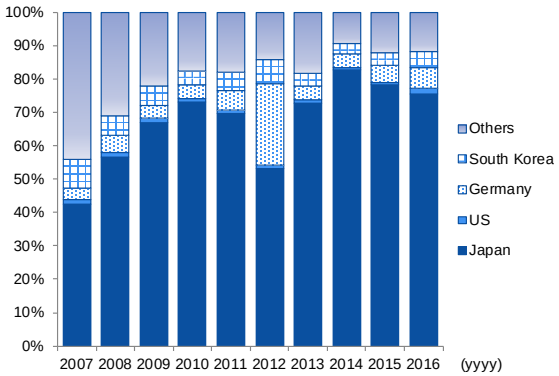
Chart 11: Import ratio of the total industrial robot supply



Note: Import ratio = import units / (production units + import units – export units).
Source: Made by MHRI based upon the National Bureau of Statistics, the Ministry of Economy, Trade and Industry, *Current Production Statistics*, and the United Nations, *UN Comtrade*.

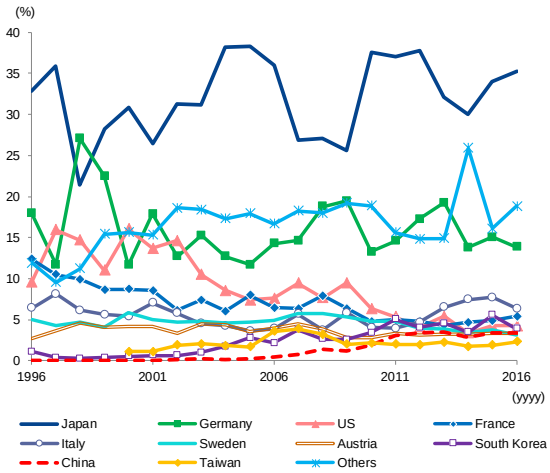
Industrial robots have traditionally been Japan's specialty, with Japanese manufacturers such as Yaskawa Electric Corporation and Fanuc Corporation boasting top-ranked competitiveness in the world. Japan's share in the world's total export of industrial robots is around 30%, and the country has maintained a leading position over the past two decades (**Chart 13**). With Japan's advanced technology, particularly in the field of high-end industrial robots, it seems that China is currently importing a large number of Japan-made robots to promote the country's introduction of industrial robots. In other words, although China's ultimate goal is to manufacture robots domestically, it has no choice but to depend on imports for the time being, a necessity that has energized Japan's export of industrial robots.

Chart 12: Import ratio of Chinese industrial robots



Note: The data above is on a volume basis. We used the HS code of the 2007 standard.
Source: Made by MHRI based upon the United Nations, *UN Comtrade*.

Chart 13: Share of industrial robot exports by country



Note: We used the HS code of the 1996 standard.
Source: Made by MHRI based upon the United Nations, *UN Comtrade*.

5. Our spectrum analysis indicates that overseas demand of industrial robots is supported by labor-saving needs

If we summarize the discussion thus far, overseas demand of industrial robots is fueled not only by the recovery in the world economy and the Chinese government's policy support, but also by the need to save labor due to changes in the population structure.

With a view to confirming the degree of each factor's push-up effect, we conducted a spectrum analysis by CF filter[7] on the volume of overseas industrial robot orders.[8] In other words, we broke down the fluctuations of the time-series data into cyclical factors such as economic trend, and long-term structural factors such as technological innovation, and visualized the effects.

Chart 14 shows a breakdown by short-term components (within 4 years), mid-term components (4 to 11 years), and long-term components (11 to 20 years). Now let's take a look at the data after 2017.

The long-term components started generating a push-up effect after the latter half of 2016 for the first time in about seven years. This coincides with the time when China's working-age population started to decline, and we interpret this as a sign of the rising

[7] For details of the CF filter, refer to Higashi and Kawata (2017) "Recent Developments in Durable Goods Consumption: A Perspective from Spectrum Analysis" (*BOJ Reports & Research Papers*, March 2017).

[8] For the analysis we used *Machinery Orders* by the Cabinet Office as it offers long-term time-series data. Since the sales value of industrial robots is not broken down into domestic and international sales, we used the data of international order value. It should be noted that since international orders out of the total industrial robot order value in 2017 are significant at 74%, a major part of the sales value is considered to be international sales.

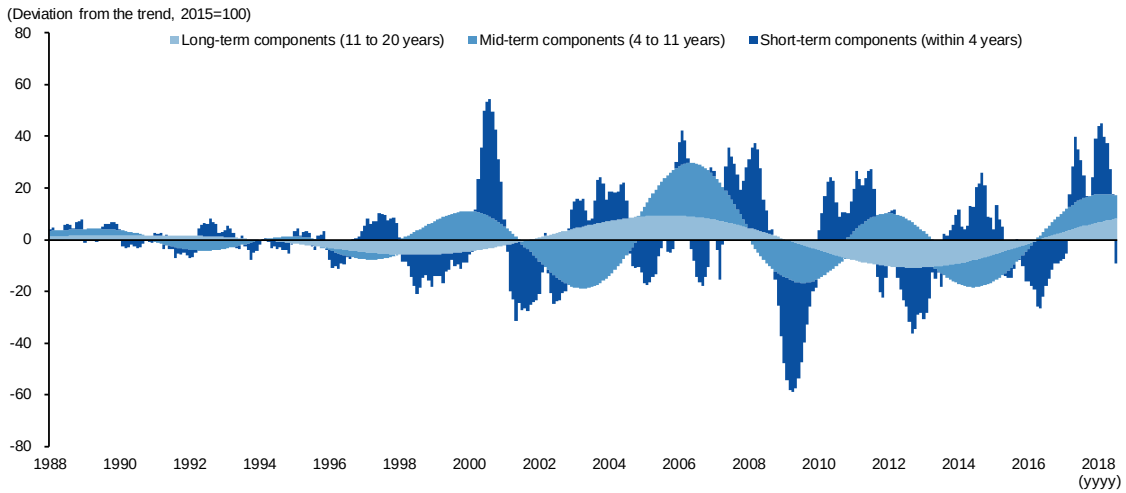
need to economize manpower following changes in the population structure centered on China.

Next, we believe the mid-term components reflect the economic cycle and repurchase demand. In fact, the term of statutory useful years of electronic parts and devices, electric machinery and equipment, and transportation machinery and equipment manufacturing facilities is included in the mid-term components, which turned to an increase in 2016 for the first time in about three years, suggesting that repurchase demand is increasing amid an upturn in the world economy.

Finally, the short-term components include one-time fluctuations, including statistical noise, and their rise after 2017 has been remarkable. We believe this is a result of improving investment appetite thanks to measures such as the Trump administration's tax cuts and the realization of the impact of the Chinese government's policy measures.

In the light of the above argument, the factors behind the increase in industrial robot demand include not only a favorable turn of the global economy and policy support by the Chinese government, but also the heightening need for labor-saving following changes in the population structure.

Chart 14: Cycle analysis of industrial robots' overseas orders using CF filter



Notes: 1. The data above is the three-month moving average of seasonally adjusted figures as calculated by MHRI.
2. We set the period of the mid-term cycle by referring to the statutory useful years of electronic parts and devices, electric machinery and equipment, and transportation machinery and equipment manufacturing facilities.
Source: Made by MHRI based upon the Cabinet Office, *Machinery Orders*.

6. Industrial robot exports have slowed down in the short-term, but there is no reason to be overly concerned.

We need to be alert, however, to the fact that the push-up effect of the short-term and mid-term components have peaked out in 2018. The reasons behind this for the mid-term components may be the slowdown in repurchase demand and a gradual decline in the

growth momentum of the world economy as a reaction to last year's strong growth. For the short-term components, dissipation of the Chinese government's policy support effects and heightening concern over the bleak economic outlook due to US-China trade friction may be the reasons for the current situation.

Considering the past cycle, the push-up effect of the mid-term components will gradually weaken, and the short-term components are not expected to be more effective in the near future. We forecast that the pace of increase in industrial robot exports will slow down in the near future, but for the following reasons we see no need to be overly concerned that Japan's industrial robot export will face strong downward pressure.

First, the world economy in the coming years is expected to continue on an expansionary track led by the United States on the back of its favorable employment situation and tax reduction effects.[9] This will help firms avoid a situation where their investment incentive diminishes significantly.

Next, since our observation based on the past cycle suggests that the push-up effect of the long-term components will peak around 2020, we can expect the current tendency of industrial robot demand being buoyed by labor-saving needs to continue for a while. In fact, the working-age population in China and the EU is predicted to decline further, and the pace of working-age population growth will also slowdown in ASEAN and the United States (**Chart 8**). Thus, we hold that labor-saving needs will heighten even further in the future. The ratio of industrial robots per worker is still relatively low in China compared with other industrialized countries, such as Japan and Germany (**Chart 15**), so we can conclude that significant room remains for growth in industrial robot demand.

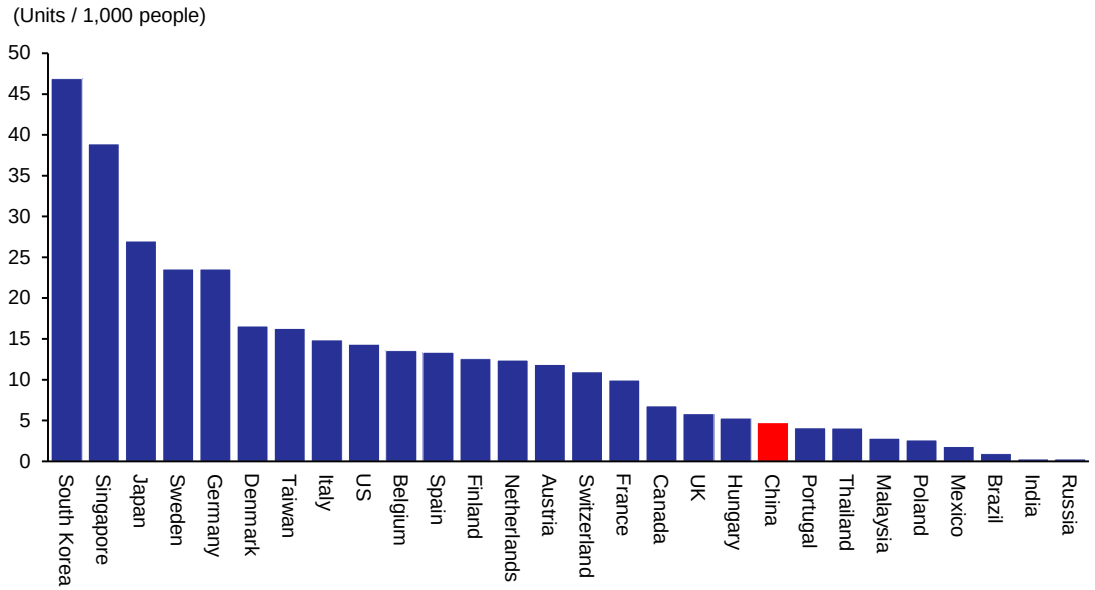
Also, since it is highly likely that the Chinese government will continue its policy support, including subsidies, until the 2025 target (**Chart 10**) is attained, we expect the effect to surface again.

In sum, it is difficult to imagine that the various factors fueling the rise in industrial robot demand, such as worldwide labor-saving needs and China's policy support measures, will disappear any time soon. While we cannot expect the same level of growth in Japan's industrial robot exports as in the past, we hold that the level of demand will stay solid in the future. If we refer to the Ministry of Finance's *Trade Statistics*, although the export quantity of industrial robots after February 2018 has been on a declining trend compared to the previous year, this is largely a repercussion of the unusually strong growth (year-on-year growth rate in 2017 was +60%) recorded in the

[9] For details, refer to "FY2018, FY2019 Economic Outlook–Despite ongoing expansion, the global economy is maturing. Keep a close eye upon the escalation of trade friction" (August 13, 2018, https://www.mizuho-ri.co.jp/publication/research/pdf/eo/EconomicOutlook1808s.pdf).

preceding year. The average export quantity during the period from January to July 2018 has been hovering above the level of 2016 (**Chart 4, left chart**), so we can predict that the export volume will maintain an upbeat trend.

Chart 15: International comparison of robot per worker ratio in the manufacturing industry (2015)



Source: Made by NHRI based upon the IFR (International Federation of Robotics), ILO and CEIC Data.

7. In the mid-to-long term, China may produce industrial robots on its own or invite production sites from overseas

However, from a mid-to-long term perspective, we need to be alert to the possibility that China will start in-house production of robots. The "*Made in China 2025*" plan carries the ultimate target of shifting its robot industry to domestic production, and there is a concern that should China promote the in-house production of robots in the mid-to-long term, Japan's exports may be substituted by Chinese robots.

If we compare the revealed comparative advantage (RCA) index[10] that measures export competitiveness by country (**Chart 16**), Japan's export competitiveness excels conspicuously compared with other nations, and it seems less likely that other countries will catch up with Japan at an early stage. Since China's low competitiveness is a matter of fact, imports will continue to be the main industrial robot procurement route for the Chinese market for a while.

But as the "*Made in China 2025*" plan makes progress, there should be no surprise if Chinese manufacturers steadily accumulate robot production know-how and start

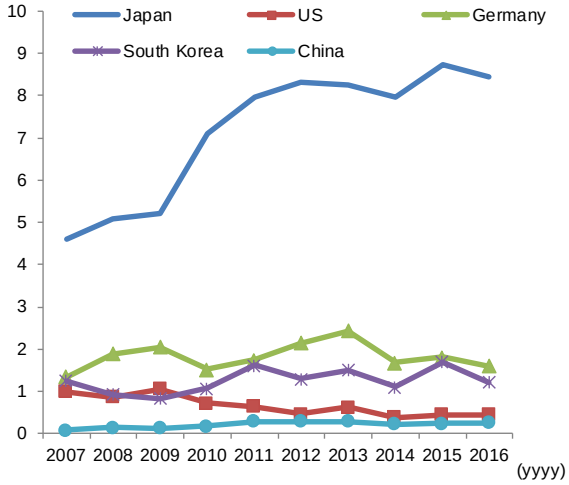
[10] Revealed Comparative Advantage (RCA) index = ((export value of product i of the subject country) / (total export value of the subject country) / ((export value of product i of the world) / (total export value of the world)).

in-house production of industrial robots and their parts at some stage.

Furthermore, although Japanese makers are currently limiting the scope of local production in China to low-end products, they may accelerate the transfer of production sites to China in view of the potential growth of the Chinese market. In this case, Japanese exports will meet with downward pressure, and if Chinese companies' manufacturing technology further improves thanks to the spillover of Japanese expertise, it may expedite China's in-house robot production faster than anticipated.

Currently, Japan's capital goods exports are largely driven by China's "explosive buying" of robots. If Japan's exports of industrial robots bound for China fall significantly, Japan's capital goods exports may encounter downward pressure. The key developments supporting continued growth in Japan's capital goods exports are (1) whether Japan can maintain its superior export competitiveness of industrial robots, and (2) whether exports of other capital goods such as semiconductor manufacturing equipment will increase or not.

Chart 16: Revealed comparative advantage (RCA) index for industrial robots



Source: Made by MHRI based upon the United Nations, *UN Comtrade*.