A Note on Global Supply Chains in the After-COVID-19 Era

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A Research Note on Global Supply Chains in the After-COVID-19 Era[1]

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Abstract: This exploratory article aims to preliminarily describe and analyze the spread of new coronavirus (COVID-19) infections and its impact on global and local supply chains in Japanese manufacturing industries and firms. Based on existing literature on industries, firms, and disasters, we characterize the 2019-2020 new coronavirus pandemics as "the first global and invisible disaster in the era of global competition," in which risks of factory shut-downs caused directly or indirectly by infections can happen at any part of the global supply chains. This is also an invisible disaster that affects human productive resources, as opposed to visible disasters that destroy non-human physical productive resources. In the latter case, the organizational capabilities for quick recovery of damaged sites and ramp-up of substitutive production are key factors, while the protective capability for defending the factory and keeping it uninfected is critical in the latter case. We argue that the spread of the new coronavirus infections is a global disaster that broke out in the middle of intense global competition, so dynamic balance between supply chain competitiveness and robustness/resilience, including quick switching between a competition-focused mode and a disaster-focused mode, is crucial. In this situation, certain factories with higher levels of deep-level competitiveness and anti-disaster robustness, strengthened historically by intense competition and major disasters in the past, may take central roles in enhancing the competitiveness and robustness of a firm's global supply chain as a whole. We also discuss the future possibilities for rebalancing the supply chains of Japanese firms in Asia with the help of a triangular model consisting of Japan, China, and ASEAN countries.

Keywords: new coronavirus (COVID-19) infection, global disaster, invisible disaster, recovery capability, substitutive production capability, protective capability, balancing supply chain competitiveness and robustness, capability-transferring role of Japanese factories, rebalancing Asian supply chains.

1. Scenarios for the after- COVID-19 era : A cycle of stability and crises

As of the first half of 2020 the actual status of the COVID-19 pandemic is not entirely certain, so at the time of the writing of this paper nothing definite can be said about what the after-COVID-19 world will look like. Therefore, currently no accurate projections can be made and only a certain number of scenarios can be contemplated.

1. A "better" scenario: This is by no means the best scenario because it still involves a large number of people losing their lives but it is probably a better scenario. Based on the results of the pandemic countermeasures taken by different countries, an effective vaccine or medication is eventually be developed and through vaccination or herd immunity the pandemic will come to an end in a year or two. Even so, if we consider past experience with global pandemics, in the age of globalization it will most likely be inevitable that every decade or so there will be a global pandemic.

2. Influenza scenario: If, like the flu virus, the COVID-19 virus mutates rapidly and frequently, a new vaccine will have to be developed every year but there still may be a pandemic every few years due to incomplete vaccination. If a medication like Oseltamivir (also known as Tamiflu, used to treat and prevent Influenza A and B) is developed, the mortality rate may fall but the virus may still continue to spread.

3. Common cold scenario: The worst scenario is probably one that is similar to the spread of the common cold but in this case also accompanied by high mortality rates. As is well known, the cold affects the upper respiratory tract but the trouble is that there are a multitude of virus strains that cause the common cold which makes it harder for the immune system to respond effectively, which in turn makes the development of a vaccine highly improbable. Current medication only alleviates symptoms and does not cure the common cold. If COVID-19 follows this pattern, there will be a pandemic for several months every year and it is entirely possible that travel restrictions and lock-downs will become part of every-day life.

In other words, the after-COVID-19 world may face different degrees of travel restrictions, ranging from once every decade or so to every year, and currently it is not possible to say how often there will be restrictions. In any case, it seems likely that firms will need to change the way they manage their production locations and global supply chains depending on which scenario plays out. Therefore, now is the time to start making contingency plans to deal with all possibilities.

2. Capability building and disaster response in the era of global competition: A historical perspective

2.1. Supply chain competitiveness and robustness

Japan is a country where a large number of earthquakes, floods, and other disasters often occur. One of the benefits of the long experience of having to deal with natural disasters is that, compared to other countries, Japanese industry enjoys improved supply chain recovery capability and supply chain robustness/resilience[2] to natural disasters. Even in large-scale national disasters such as the 1995 Kobe earthquake and the 2011 earthquake and tsunami, the best Japanese domestic manufacturing facilities were able to manifest their rapid recovery capability. In local disasters, such as the fire at a manufacturing facility of Aishin in 1996, suppliers were also quick to respond with flexible substitutive production which significantly helped recovery.[3] It is also a fact that Toyota is among the top manufacturers in the world in terms of supply chain competitiveness and supply chain robustness/resilience.[4]

However, until now the capability to recover from physical damage to facilities due to visible domestic disasters has attracted more attention, and the response to invisible global disasters such as global pandemics has remained under-researched.

It is entirely possible that the best Japanese firms and manufacturing facilities will be able to utilize their crisis response capability, which they have been building up in their effort to respond to visible domestic disasters, to respond to invisible global disasters this time, and again display strong supply chain robustness, even internationally. Moreover, they may be able to do this without impairing their supply chain competitiveness.

What must not be forgotten is that at least in the last thirty years earthquakes and epidemics have been happening in the era of global competition among firms. The general human mentality is to focus on emergency response when overwhelmed by the ferocity of a disaster and thus lose sight of the big picture; however, even in the case of disasters we must remember that global competition will continue to occur on a daily basis. So, what is important is to be able to strike the right balance between supply chain competitiveness and robustness.

Thus, for example, calls for redesigning supply chains so that they will conform to exclusively domestic sourcing in the middle of a pandemic tend to underestimate the importance of the balance between robustness and competitiveness, and raise serious questions as to whether this can be a sustainable long-term strategy.

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[2] In this paper the terms *supply chain robustness* and *supply chain resilience* are considered to be basically synonyms. The term *robustness* is probably more adequate when discussing "visible" disasters such as the 2011 earthquake and tsunami, whereas the term *resilience* is probably more adequate when discussing "invisible" disasters such as wide-spread infections. In any case, in this study they have the same meaning.

[3] See Nishiguchi & Beaudet (1998)

[4] See Fujimoto & Heller (2018), Chap. 8.

2.2. Thirty years of mega-competition and mega-disasters

The discussion of the need for balance between supply chain competitiveness and supply chain robustness has to be made from the long-term perspective of history and should not be guided by short-term goals. To do so, we need to look at what has happened in the last thirty years, or the so-called post-Cold War era. The key point here is the almost simultaneous emergence in the 1990s of two phenomena, namely, global competition and digitalization.

In the 1990s after the Cold War ended, China—a country with a large population and wages as low as one twentieth of those in Japan—joined the global market, causing a large number of companies to lose their price competitiveness and leaving them struggling to survive in the increasing global competition. At the same time, assisted by the revolution in digital information, many Japanese manufacturers of household electric appliances who had already begun to rapidly introduce modularity into their product architectures, as well as old industries such as the textile industry, saw their international competitiveness decline, with a large number of domestic manufacturing facilities being closed down and transferred to China or other overseas territories. By contrast, manufacturers of products with complex integral architecture such as high performance automobiles were able to keep their competitive edge in product design and preserve their important position in Japanese exports. To put it another way, the fate of the international trade of Japan was decided by comparative advantages or disadvantages in product design.

However, in contrast to the USA with its rather unilateral and almost complete transfer of manufacturing facilities to China, even those Japanese industries that had seemingly lost their international competitiveness continued to hold onto their domestic production locations tenaciously. With the help of innovations in production along the lines seen at Toyota, companies in these industries were able to significantly increase their productivity (sometimes as much as several times) and turn their remaining domestic manufacturing facilities into competitive mother factories (i.e., domestic plants that are able to compete with overseas plants).

With the exception of still competitive products like automobiles and fine chemicals, domestic production facilities that were unable to keep up with digitalization and having lost large chunks of their business to low-wage countries, were having a very difficult time in the past thirty years, which by the way coincided with the Heisei era (1989-2019) in Japanese history. However, even at the end of the Heisei era manufacturing accounted for more than 20%, or more than 100 trillion yen of the approximately 500 trillion yen Japanese GDP, with nearly ten million people employed. Moreover, this continued high demand for products manufactured in Japan occurred even as birthrates declined and the population aged, which caused a serious manufacturing labor shortage in Japan. Incidentally, among the G7 countries only Germany and Japan have manufacturing industries accounting for more then 20% of GDP. It appears that the Japanese manufacturing industry does not easily yield to earthquakes and other disasters, and in addition,

it seems to have stubborn staying power even in the face of adverse conditions in global competition after the end of the Cold War. This is the real condition of Japanese manufacturing, something which has eluded the attention of numerous newspaper articles and editorials that do not properly look at long-term trends in manufacturing.

2.3. The domestic manufacturing facilities remain largely uninterrupted

In the news on COVID-19 we often hear how office employees can work from home while people working at hospitals, supermarkets, restaurants, logistics companies, etc., need to be physically present at their workplaces. That is undoubtedly so, and it also holds true for people working in factories since, with the risk of stating the obvious, without any people at all a factory would simply not run. However, we rarely hear in the media that a large number of factories in Japan are still operating even in the extremely adverse conditions of the COVID-19 pandemic. This lack of attention is probably because it is seemingly normal that factories can still operate during a pandemic. However, this is certainly not so. (On a side note, in April 2020 many car factories in Japan had to suspend temporarily their production operations almost entirely due to reasons related to decreased demand for products or component shortages, not because the factories themselves were directly affected by the COVID-19 pandemic).

Thus, it can be argued that, although falling short of achieving total victory over fierce global competition in the last 30 years after the end of the Cold War, on the whole Japanese domestic manufacturing has survived and is still in fighting shape. Opinions in the media proclaiming the end of manufacturing in Japan can hardly be substantiated, empirically or theoretically, and if we consider the huge gap in wages (in the 1990s new factory workers received roughly 200,000 yen per month in Japan versus 10,000 yen in China), the success of the numerous remaining manufacturing facilities in Japan is not just modest, it is in fact astounding. The best Japanese domestic manufacturing facilities have demonstrated great persistence not only in the face of tough competition but also toward multiple devastating disasters as in the 1995 Kobe earthquake and the 2011 earthquake and tsunami. Let us, then, take a look at some of the fundamental discussion points concerning disasters and supply chain robustness.

3. The basics of the response to visible disasters

3.1. Visible disasters and invisible disasters

The current COVID-19 pandemic is the first truly global disaster in the era of global competition. Consequently, attention should be given not only to the most recent emergency responses but also to changes that will take place in the after-COVID 19 era in the industrial competitiveness of individual countries, the structure of global industry, and the geographical distribution of global supply chains.

As mentioned before, despite having to fight against heavy odds during the post-Cold War era, the surviving Japanese manufacturing industry (more than 20% of GDP) has developed great tenacity to present stubborn resistance to both devastating disasters and strong competition. With rising wages in China and manufacturing facilities around the world thrown into confusion due to viral infection, it is even possible that the Japanese manufacturing industry, which has already shown great fighting spirit in adverse conditions, will be able to receive greater international recognition.

Simultaneously with short-term emergency countermeasures, now is the time to also consider a long-term response to severe global competition. The best Japanese firms (Toyota and others) have been tempered by visible domestic disasters such as earthquakes and floods that cause physical damage to their facilities; however, there are a number of question marks regarding their ability to respond to invisible global disasters such as the current COVID-19 pandemic. Some of these question marks are generated by the fact that the current situation differs from previous disasters in two major aspects. Firstly, it is a global disaster, meaning that it is not possible to predict what factory in what part of the world will have to stop operating, and secondly, it is an invisible disaster, meaning that even if there is no damage to facilities, employees may still not be able to be in the facility due to viral infection. The challenge here is whether the best Japanese manufacturers can deal with these newly emerged aspects of disasters.

To begin with, let us consider the basic differences between visible disasters and invisible disasters. In the event of a visible disaster that causes physical damage, whether it affects a large area as in earthquakes, tsunami, and floods, or a locality as in fires and explosions, damage is done *inside* production facilities, including those of suppliers. In addition to daily preventive measures, the key to effective response to visible disasters is supply chain recovery capability in the early stages of a disaster. This capability has two major components: on-the-spot recovery capability and substitutive production capability.

3.2. Response to visible disasters

Effective response to visible disasters needs to be built on the following considerations (Fujimoto and Heller, 2018). First, regardless of whether it is finished products or components, for each article produced by the plant the following four items need to be examined urgently: demand volume per day, inventory volume, lead time for on-the-spot recovery, and lead time for substitutive production. Then, the number of days worth of inventory on hand can be obtained by dividing the inventory volume by the demand volume per day. The result will vary depending on the product but most likely it will be somewhere in the neighborhood of two weeks. Extra attention needs to be paid to products whose demand may increase sharply depending on the

nature of the disaster (for example, medical devices or masks), in which case the number of days worth of inventory on hand will decrease rapidly.

Having made this first step, there will be three basic options for ensuring supply chain robustness, both domestically and internationally. The main goal is to ensure that the number of days necessary for supply chain recovery does not exceed the number of days worth of inventory on hand (i.e., supply will not stop). First, if the lead time for on-the-spot recovery at the damaged facility is shorter than the lead time for substitutive production, then all efforts should be directed toward on-the-spot recovery, with substitutive production having a backup role. Second, if the number of days worth of inventory on hand and the lead time for substitutive production are both shorter than the lead time for on-the-spot recovery at the damaged facility, then temporary substitutive production should be selected until production at the damaged facility can resume. And third, if production at the damaged facility cannot resume in the foreseeable future, then production should be transferred to another area or region permanently, with preference given to production facilities of the same firm in unaffected regions over those of different firms or in-house production.

Also, preliminary measures to minimize supply chain disruption need to be considered before a disaster actually occurs. In relation to that, it has often been suggested that such measures include inventory increase and permanent multiplication and dispersal of production lines. Note, however, that under the guiding principle of balance between competitiveness and robustness, inventory increase and redundancy in production lines should be chosen only if they do not reduce the competitiveness of products and production processes, so basically they should be implemented only as a last resort, with capability building in disaster response having top priority.

3.3. Virtual dual sourcing of production lines

On the assumption that the leading Japanese firms and the best manufacturing facilities have strong on-the-spot recovery capability and substitutive production capability, the author argues that virtual dual sourcing of production lines (i.e., making a single production line potentially serve as two production lines by ensuring rapid transfer of design information), is more effective than permanent duplication of production lines, which carries the risk of reducing operating rates (Fujimoto, 2012; Fujimoto and Park, 2014). Installing two production lines in different places for products with identical designs without regard to future consequences is likely to jeopardize long-term global competitiveness if the operating rates of both lines drop and manufacturing costs rise due to redundancy. What is important is to always strive for balance between competitiveness and robustness. Leaning too far to one side or the other may easily lead to wrong decisions.

The discussion so far has been centered on the role of organizational capability in the emergency response to visible disasters as exemplified by Japanese firms. Can this organizational

capability also help with the emergency response to invisible disasters such as the COVID-19 pandemic? The next section will address this question.

4. COVID-19 and the defensive capability of supply chains

4.1. Response to invisible disasters

In general, the main difference between visible disasters and invisible disasters lies in the location of the damage. Visible disasters strike *inside* production facilities and the response is directed toward *recovery* inside, whereas invisible disasters caused by viruses striking *outside* production facilities and the response is to protect the inside of the production facilities from damage coming from outside, i.e., a protective response is directed toward *defense* against outside threats. The latter can be likened to a besieged castle where the defenders need to bring in provisions and at the same time prevent the enemy from entering the castle.

A recent example of an invisible disaster is the Fukushima nuclear disaster where manufacturing facilities in the vicinity of the nuclear power plant had to be permanently closed down due to inability to prevent radiation from entering the facilities. To continue with the metaphor, in that case the castle fell to the enemy and had to be abandoned.

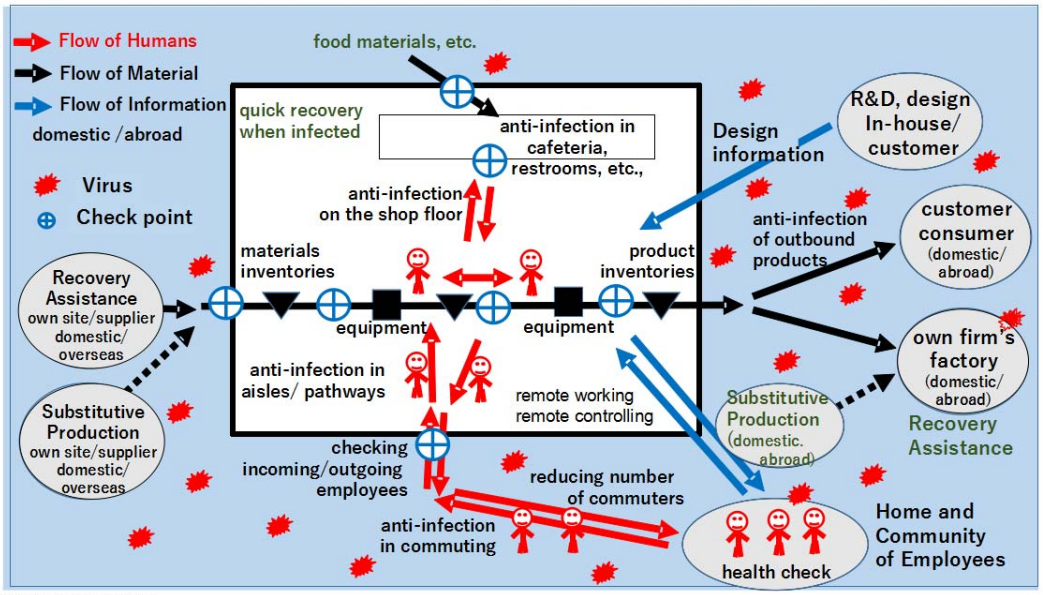
Unlike radiation, however, COVID-19 needs human-to-human transmission or indirect contact via contaminated surfaces to spread itself, so if proper screening procedures for people and supplies are conducted, manufacturing operations in plants can continue largely uninterrupted, unless the national or local authorities order closure.

4.2. The defensive capability of manufacturing facilities against contamination

If employees get infected, it means that the defense has been breached, the manufacturing facility has been contaminated and has to be shut down, and can reopen only after a thorough decontamination and proper countermeasures to prevent cluster infections among its employees. If proper measures (e.g., sanitary control, physical distancing between employees, staggered commuting and working hours, readjustment of production operations, teleworking for administrative personnel, etc.) have been implemented, they are likely to reduce the risk of cluster infections, thus potentially reducing the time the plant has to remain shut down.

These defensive measures are shown in Figure 1 in a more organized form as flows of human beings, materials, and information. Assuming that COVID-19 spreads via respiratory droplets and contaminated surfaces, and that the infection is still active outside the factory, the minimum that needs to be done to keep operating rates high includes the following countermeasures (the basic premise being that the authorities do not shut the facility down):

Figure 1. Value and Virus stream Map (VVSM) for Analyzing Anti-COCID-19 Defense



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1. Border control (checking employees at the entrance of the factory for anti-virus protection)
2. Hygienic control of inbound direct materials, food, etc., for anti-virus protection
3. Hygienic control within the factory (washing hands, disinfection, wearing masks and protective clothing, ventilation, positive/negative pressure rooms, etc.)
4. Using physical distancing and staggered work times on the shop floor for anti-virus protection (stopping assembly lines where work is manually transferred; restoring automatic conveyor lines; inserting sanitation/disinfection stations between manual stations; more lines with fewer people; automation for eliminating or reducing manual work; one-way traffic in aisles/pathways inside the factory building; measures for physically separating workers from visitors; replacing morning/evening meetings with remote ones; remote communication between workers and supervisors; time spacing between shifts; dispersing employees checking-in time to avoid congestion, etc.)
5. Reducing number of employees in the factory (remote working by white-color employees; reducing operation time by decreasing production; remote-controlling of production lines, etc.)
6. Anti-virus protection measures while commuting (avoiding public transportation as mush as possible; using POVs (privately owned vehicles), car-pools and ride sharing by employees, etc.)
7. Checking and supporting employees' health management while at home; employees' education on anti-infection protection and countermeasures if infected
8. Hygienic control of products and other outbound materials

9. Quick and thorough sanitation and washing activities for quick recovery from factory shut-down if infection occurs inside the factory.
10. Support for downstream and upstream factories, warehouses, and other sites in their protective capability-building and recovery efforts (both in-house sites and suppliers/vendors)

If we consider the historical background and the present state of organizational capability building, it will be seen that the best Japanese firms have already proven that they possess strong recovery capability against physical damage and, with regard to the above-mentioned countermeasures, it is quite possible that they will be able to demonstrate strong defensive capability against viral infections (the latter still needs to be verified with data).

As mentioned before, regardless of how strong their protective capabilities are, manufacturing facilities have to shut down and the flow in the supply chain has to stop if the national government or the local authorities mandate a lock-down. In the spring of 2020 the Japanese government or local authorities did not mandate a lock-down, so employees could still go to work and, compared with facilities in other world regions, Japanese domestic manufacturing facilities basically continued to operate (with the exception of April 2020 when manufacturing facilities in the automotive industry had to adjust their production volume due to demand shortage).

4.3. Global disasters and the Japanese manufacturing facilities

During global disasters of the kind represented by COVID-19 where it cannot be reasonably anticipated what manufacturing facility in which country will stop production operations, it is entirely plausible that, of all global supply chains, the Japanese domestic manufacturing facilities will be the last to stop and the first to ramp up production operations once the disaster is over. Although domestic facilities in Japan have been at relative disadvantage due to high wages, not only have they reached high standards for productivity, quality, and flexibility in manufacturing as illustrated by the so-called mother factories, but they are also likely to have sufficient organizational capability to be the driving force behind global supply chains, irrespective of whether the disaster response calls for supply chain recovery capability for visible disasters or supply chain protective capability for invisible disasters like COVID-19.

In the long run, by demonstrating excellence in recovery capability and protective capability in past and current disasters, the best Japanese domestic manufacturing facilities may raise awareness of the importance of global supply chain reconstruction among manufacturers in the after-COVID-19 era.

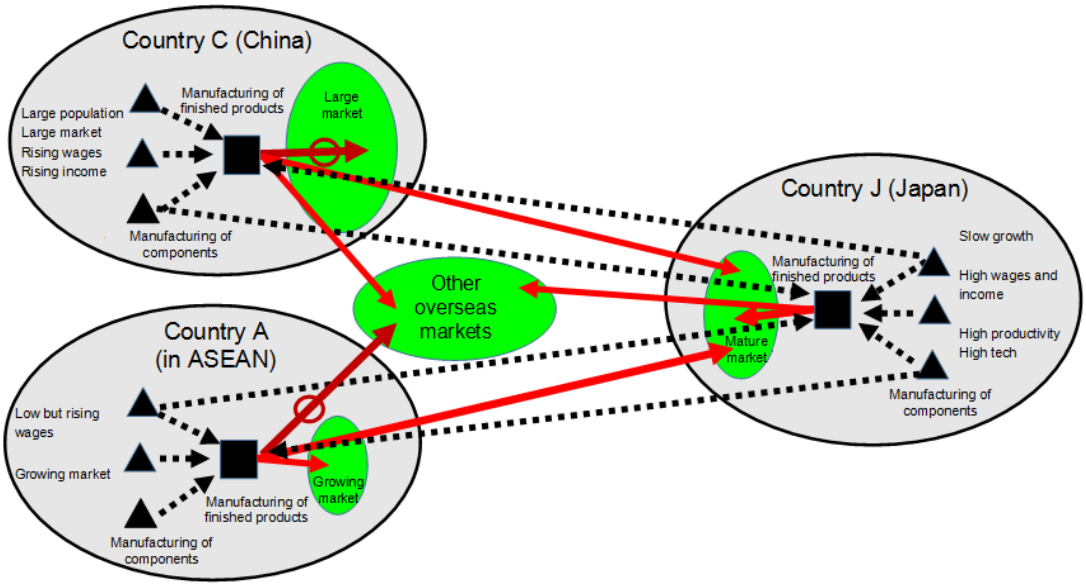
5. Global/Local supply chains in the after-COVID-19 era – the example of Asia

5.1. The supply chain triangle in Asia

Based on the preceding observations, this section presents a rough estimation of the possible course that global supply chain reconstruction and the restructuring of international division of labor may take in the after-COVID-19 era. Let us first consider a simple model.

The model, as shown in Figure 2, depicts the global supply chain as a triangle, with one manufacturer in country J (assumed to be Japan), one in country C in Asia (assumed to be China) and one in country A (assumed to be an ASEAN country, for example Vietnam).

Figure 2. After-Covid 19 supply chain (in Asia, at normal times)



Country J is a high-cost country, however, owing to high productivity, quality, flexibility and rapid response to changes, the manufacturing facilities there have been able to fend off competition for thirty years and are currently acting as mother plants for facilities in other regions, continuing to produce a number of cost-competitive products. These facilities are so-called "competing mother plants" that have a strong recovery capability and substitutive production capability when disasters strike domestically and, in addition, a strong substitutive production capability when disaster affect other world regions.

The facilities in country C formerly had a competitive advantage in cost due to overwhelmingly lower wages, however, since 2005 the labor cost in Country C has been basically doubling every five years, so that the local wages which used to be twenty times lower than in

country J in the 1990s are currently only three to five times lower, with the consequence that a large number of products made by export-oriented facilities in that country have been losing their cost competitiveness. On the hand, however, the domestic market in country C has been growing rapidly, meaning that it still makes sense to have manufacturing facilities there to satisfy the needs of the expanding domestic market. The supply chains in country C benefit from a well-developed transportation infrastructure; however, past experience (problems with the supply of rare earth metals, the recent seizure of masks, etc.) shows that the authorities there do not hesitate to place entire plants and their supply chains under direct government control, which erodes trust in the supply chain system.

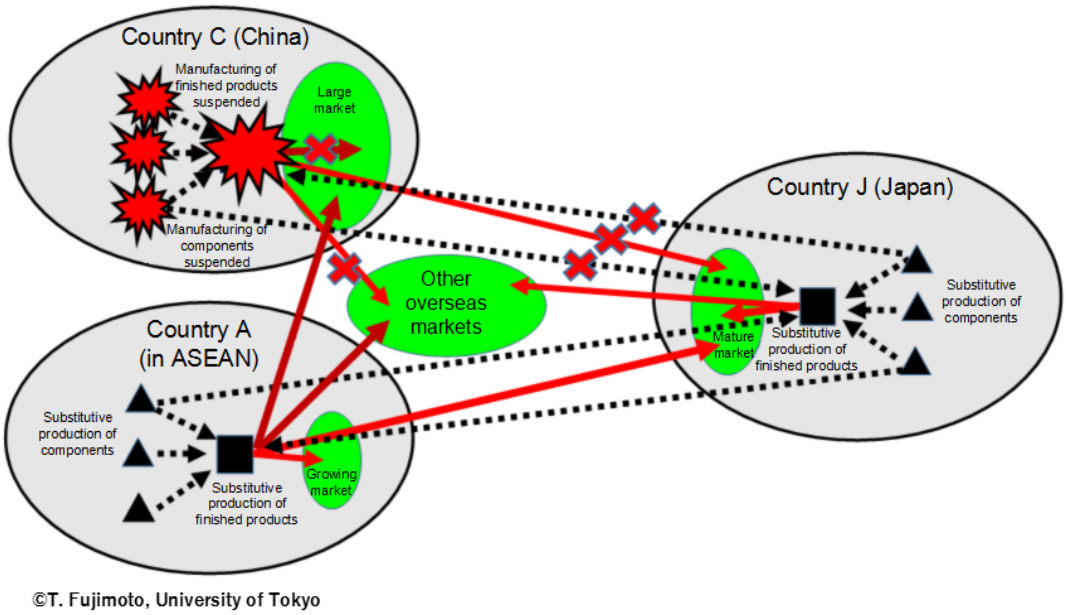
Before the 1980s the manufacturing facilities in country A were run by the government and were primarily used to meet the demands of the local market but since the 1990s the importance of export markets has been increasing. The economy of country A has been growing and the domestic market looks promising. Although the growth in recent years has lead to a gradual increase in wages, labor costs in country A is still lower than county C and it is quite possible that, in terms of cost competitiveness as an export base, the domestic manufacturing facilities may be positioned better than those in country C. The domestic transport infrastructure and supplier base, however, need a significant amount of assistance to get to the desired level of development.

Thus, confronted by rising costs, it is likely that some manufacturers may opt to relocate part of their facilities from country C to country A. This will lead to a situation where in country A there will be manufacturers from Country J (with predominantly integral product architecture, relatively higher wages and productivity) and manufacturers from country C (with predominantly modular product architecture, relatively lower wages and productivity). Consequently, the government of country A may need to adopt various policies and strategies to be able to accommodate both types of manufacturers.

5.2. Supply chain flexibility

Building on the preceding discussion, let us assume that manufacturers in all three countries are under the threat of plant closure and lock-down imposed by the authorities due to concerns related to the spread of a viral infection. Figure 3 shows what would happen if the manufacturers in country C are forced to shut down their facilities temporarily.

Figure 3. After-Covid-19 supply chain (lock-down in country C)



There are a number of supply chain configurations that are potentially well-adapted to operate under these conditions. Taking into account the logic of economics and strategy theory, as well as actual successful examples, however, the number of available options does not seem to be very large. One effective strategy that provides a significant degree of flexibility is to have manufacturing facilities in all three countries, with facilities in country J acting as mother plants maintaining overall competitiveness, facilities in country C producing mainly for the local market, and facilities in country A acting as an export base. When there is no crisis, this configuration is well-adapted to facilitate competitiveness internationally. If a crisis occurs, for example a pandemic, this configuration can be reconfigured into one that facilitates supply chain robustness by the swift adoption of reciprocal substitutive production.

The key point here is supply chain flexibility. In other words, instead of relying on a single configuration, firms should adapt to unexpectedly changing circumstances by rapidly modifying their supply chains to facilitate either competitiveness or robustness. To be able to do so, firms have to constantly improve their supply chain competitiveness, recovery capability, substitutive production capability, and protective capability.

5.3. Switching between competition-focused mode and disaster-focused mode

In the last thirty years, American firms have been making good use of China with its large population and low wages as a low-cost manufacturing base; however, in the current COVID-19

pandemic there are voices calling for a return to domestic sourcing, pointing out the weaknesses of overstretched supply chains. If carried out, this change would represent a move from one extreme end to the other. This is an argument that arises from the enormous intimidation caused by a global disaster, yet it clearly ignores the realities of global competition and the need for balance between competitiveness and robustness, and it is definitely not a wise long-term strategy for the after-COVID-19 era.

Regardless of the nature or ferocity of a global disaster, there is no need to contract supply chains to the limits allowed by domestic industry. When there is no crisis or emergency, choosing the location of a manufacturing facility should be based on striking a balance between two principles: comparative advantage (facilities concentrated in countries that provide the best opportunities as export bases) and local production (facilities dispersed among multiple countries locally manufacturing products and components with high transportation costs). So, before and even after COVID-19, the most competitive supply chains are always built on the optimal long-term considerations of international business.

However, once a crisis occurs, manufacturing facilities in Japan, with their integrated manufacturing organizational capability that draws on team strength, need to provide support for the recovery of facilities and component supply in disaster-stricken countries, and at the same time they need to be prepared to shift to domestic substitutive production rapidly in case supply from affected regions stops (i.e., they need to be able to reconfigure their supply chains rapidly). The dynamic capability that enables firms to do so has to be developed and accumulated from the time before a crisis occurs.

Moreover, not only manufacturing facilities in Japan but also all those in countries C and A in the model need to develop their competitiveness and accumulate recovery capability, substitutive production capability, and protective capability to make their supply chains resistant to both strong competition and devastating disasters. The accumulation of these capabilities needs to start before a disaster strikes and incapacitates their supply chains. Naturally, it is the manufacturing facilities in Japan with their rich experience in recovery from disasters that should pave the way for others to follow.

Thus, the optimal strategy for manufacturers is to make full use of global supply chains to enhance their competitiveness and at the same time to consistently develop their response capabilities (recovery, substitutive production, and protection) before a disaster strikes, and when it does, to shift rapidly to a configuration that enhances their supply chain robustness, and if necessary, to switch over to local supply chains.

Or conversely, manufacturers may prefer to give priority to competitiveness and build multiple reliable local supply chains based on domestic sourcing, and if any of the local supply chains is stricken by a disaster, shift to a global supply chain based on substitutive production. In

any case, such flexible global/local supply chains are one of the feasible strategies for the after-Covid-19 era that can be implemented in all three Asian countries in the model.

In the 21st century, firms that expand globally need to carefully pursue strategies for their response to both competition and disasters. However, creating supply chains that are too rigid and constrained within the tight limits of a local area due to an adverse experience caused by the initial shock of a disaster and thus forgetting the constancy of global competition and sacrificing international competitiveness is an overcautious reaction that can hardly be a feasible strategy in the medium- to long-term. Even firms with well-developed and competitive local supply chains may find themselves in an undesirable position if, confronted by a large disaster such as an earthquake, for no other reason than risk distribution they decide to disperse their production lines geographically, which may lead to a decline in their operating rates and cost competitiveness. What is important in the era of stiff international competition, catastrophic disasters, and infectious diseases is to prioritize competitiveness when there is no emergency and response capability when there is an emergency, as well as to swiftly reconfigure supply chains when necessary (i.e., it is important to have supply chain flexibility).

Addendum: Government projects for strengthening manufacturing facilities in Japan and ASEAN countries

Here, with the help of the concepts and the framework proposed in this paper, an attempt is made to examine the significance of two projects of the Japanese government from April 2020, namely, to promote networking among overseas supply chains and to provide monetary incentives for investment in domestic supply chains.

It can be argued that there is a certain amount of logic in a policy that encourages the strengthening of Japanese manufacturers domestically and in ASEAN countries since in the long run, having the goal of achieving an optimal global footprint for Japanese firms, this policy provides incentives for the balanced positioning of manufacturing facilities in Japan, China, and ASEAN countries. However, incorporating such policies in the COVID-19 emergency economic package does not appear to be a very sound budgetary decision

Change in the balance of triangular supply chains in Asia: First, let us consider the aforementioned projects in the long run. What the Japanese government is probably referring to in its newly promulgated policy is the issue of balancing production in the triangle of global supply chains in Asia, i.e., the model suggested in the previous discussion, consisting of country J (assumed to be Japan), country C (assumed to be China), and country A (assumed to be in ASEAN). So, let us take a brief look at the historical background and future outlook of this issue.

A look at the history of the issue will demonstrate that until the 1980s the major manufacturing facilities of Japanese firms were, of course, first in Japan, then in the West to deal

with trade frictions, and in some developing countries. However, in the 1990s after the end of the Cold War, taking full advantage of overwhelmingly low wages and its ability to mobilize its work force, China became the world's factory, spurring a large number of Japanese firms on to establish a manufacturing base there.

Among these firms were some which, pursuing short-term cost reductions, relocated all their manufacturing facilities to China or other Asian low-cost countries without leaving a mother plant in Japan and because of this they deprived themselves of the key to global capability building. Consequently, the entire supply chain of these firms was left to rely on low wages, with overseas manufacturing facilities struggling to increase their productivity and their long-term global strategy, instead of being successful, came to a dead end. The number of Japanese firms that appear to have gone too far in transferring manufacturing overseas is not small. The author of this paper is critical of the shortsightedness that appears to govern decisions made at the headquarters of such firms.

After the initial surge in the number of manufacturing facilities, the ability of China to provide low-cost labor reached its limit in the mid-2000s and since then wages have been doubling every five years, causing a gradual decline in the cost competitiveness of manufacturing facilities serving as an export base in China. To put it in perspective, although being perfectly aware that it is imperative to have manufacturing facilities in China, some firms began to suspect that they may have been too enthusiastic in moving their production base to that country.

However, for a variety of reasons Japanese firms with their large number of manufacturing facilities in China find it difficult to withdraw and, considering their efforts to establish an optimal global footprint, it is quite possible that many of these firms are still overly dependent on their Chinese production base. This problem stems largely from the irreversibility of global strategy, which in turn is generated by historical path dependence.

Many countries in ASEAN, on the other hand, are favorably positioned when compared with China in terms of labor cost (for example, Vietnam is about half that of China), and with gradually improving *genba* (on-site capabilities, workplace skills) and infrastructure levels, these countries are turning into an ideal export base for Japanese firms. In fact, even some Chinese firms are already relocating their manufacturing facilities to ASEAN countries.

To summarize, in the light of historical path dependence, accumulated experience of global competition in the last thirty years, and in contrast to the what this paper considers to be the current optimal strategy, it is likely that Japanese manufacturers have found themselves in a situation where they have too many manufacturing facilities in China and too few in Japan and ASEAN countries.

The importance of domestic facilities in Japan: In fact, some leading Japanese firms are already restructuring their supply chains along the lines suggested in this paper. In the 1990s the

electronic equipment company O relocated the production of its health care equipment products to its plant in China due to the modular product architecture of the main products which is not where Japan has a comparative advantage, thus practically shutting down its domestic manufacturing facility for the products. The Chinese plant of the firm was successful in developing its manufacturing capability and on the whole was able to achieve excellent results but due to rising labor costs in China it could no longer continue to serve as an export base, forcing company O to build a new manufacturing facility in a lower-wage ASEAN country. However, the fact that the company had plants in only two regions raised concerns over stability and generated internal debates so after all it was decided to reopen the almost defunct domestic facility which, although small in size, possessed significant flexibility and soon became a mother plant. It was thought internally that the reopening of the domestic facility laid the foundations for a more stable triangular organization of global production. So, it appears that the revision of global strategy with the goal of strengthening domestic and ASEAN facilities had already been carried out independently by some leading firms well before such a strategy was promoted by the Japanese government.

So, with regard to modifying the long-term global footprint of Japanese manufacturers and their supply chains, the two current projects of the government calling for a more balanced distribution of production capacity in Japan (mainly mother plants), China (old export base), and ASEAN (new export base) are not in conflict with the strategic orientation of leading Japanese companies.

More specifically, the projects of the Japanese government to encourage firms to strengthen their manufacturing facilities in Japan (monetary incentives for investment in domestic supply chains) and ASEAN (promote networking among overseas supply chains) fall in line with the intention of Japanese firms to optimize their long-term global strategies. In that sense, the author is of the opinion that as a long-term industrial policy these projects are adequate. If this policy indeed leads to a more balanced triangular organization of supply chains, then it should meet the demands of Japanese manufacturers in the 2020s.

Budget issues: However, putting projects aimed at long-term strengthening of manufacturing footprints domestically and in ASEAN countries in an economic relief package together with urgent economic countermeasures aimed at curtailing the COVID-19 spread that are necessarily short-term in nature, raises some questions. The first impression is that these projects appear to be taking advantage of the COVID-19 crisis.

The rationale behind the current government proposal is not entirely clear and the argument that the intention is to work out countermeasures against the spread of COVID-19 may be a far-fetched explanation of the existing problem. If the proposal is motivated by an intent to reduce dependence on imports from China and encourage investment in domestic manufacturing and in

countries best fitted for export due to the adverse experience of domestic shortages of masks and other protective clothing made of non-woven fabric for which Japan relies on imports from China, then this proposal does not contribute enough to achieving the original goal of providing support for restructuring global footprints and supply chains, which is what the long-term strategy of Japanese manufacturers should be.

To conclude, in contrast to what the optimal global footprint of Japanese firms should be, the cumulative effect of their global strategy and their history of competing globally for a long period of time is that numerous Japanese firms have most likely found themselves in a situation where the have too many manufacturing facilities in China and too few in Japan and ASEAN countries. In this context, the author thinks that the above-mentioned two subsidies with their goal of encouraging investment in domestic production and in ASEAN countries are appropriate as a long-term industrial policy.

However, the inclusion of these subsidies in the emergency economic package against COVID-19 is quite unexpected and gives the impression that financial stimulation for the restructuring of supply chains is piggybacking on the COVID-19 budget. To put it bluntly, the purpose of these subsidies is clear but the way they are granted is a little strange. Projects that tend to be financed by taking advantage of political or other trends can be frequently seen in the government budget and, personally speaking, this appears to be one of the techniques of bureaucratic organizations to operate in the gray area that represents the border between what is allowed and what is not allowed.

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