Japan's Innovation Strategy toward Asia

Yumiko Okamoto

Professor, Faculty of Policy Studies, Doshisha University

Abstract

In the Asia-Pacific region, there is a growing move to explore a new growth paradigm. Innovation is the central theme of this activity. In Europe, there is a tendency to regard the rise of Asian emerging countries as a threat with their increasing innovative capacity. For Japan, does their rise provide an opportunity or pose a threat? While the improvement of the innovative capacity of Asia as a whole is something to celebrate, aren't there problems and challenges? Moreover, if Japan is to make full use of Asia's vitality to achieve its own growth while contributing to the development of the region, what kind of strategy should it adopt? This paper is intended to answer those questions.

Our analysis found that while the innovative capacity of Asia as a whole has increased when measured against any benchmark, that is more of a growth opportunity than a threat for Japan, which is making a clear shift to Asia in its foreign R&D investments. However, at the same time, it has become clear that the Asia-Pacific region faces some serious problems, such as widening differences in innovative capacity between countries within the region, the closed nature of innovation models in the Northeast Asia and a lack of a regional framework for R&D cooperation.

In light of the above findings, we proposed the following three Asia innovation strategies that Japan may pursue.

(i) Increasing ODA budget funds (particularly for ODA projects covered in the current account budget) and promoting economic cooperation featuring open innovation.
(ii) Improving the business environment in the region by utilizing the TPP and the RCEP.
(iii) Establishing an Asia-wide innovation system.

Japan should aggressively pursue an Asia innovation strategy that can take advantage of the region's vitality to promote Japan's growth while continuing to contribute to the peace and prosperity of Asia and the Asia-Pacific region as a major economic power.

Keywords: innovation, FTA, ODA, innovation system, absorption capacity

I. Introduction

Prime Minister Shinzo Abe announced Japan's participation in the negotiations toward the conclusion of the Trans-Pacific Partnership agreement (TPP) on March 15, 2013. Currently, the TPP is drawing a lot of attention not only within Japan but also throughout the world because this agreement has the potential of laying out the foundation toward the

formation of a Free Trade Area of Asia-Pacific: FTAAP). So is the Regional Comprehensive Economic Partnership Agreement (RCEP).

The formation of a Free Trade Area (FTA) is not the only movement that is unfolding in the Asia-Pacific region. For instance, for the first time in the history of the Asia-Pacific Economic Cooperation (APEC), the growth strategy was adopted together with the agreements to promote and facilitate free trade and investment at the 2010 APEC Leaders' Meeting.[1] The reason behind this is that the APEC leaders all recognized the necessity of a new growth paradigm to make the FTAAP sustainable, so that the region prospers further through free trade and investment. The crucial point is that "innovation" was placed at the center of the growth strategy.

Entering the 21st century, Europe has recognized the rapid increase of the innovative capacity of some Asian countries such as China, Korea, and India, and debated whether the rise of these countries will pose a threat or provide a growth opportunity to its own countries (Leadbeater and Wilsdon 2007). What about Japan? Does the emergence of Asian rapidly industrializing economies pose a threat or offer an opportunity to the economy of Japan?

However, Asian economies are not equal in the degree of innovative capacity. As Okamoto (2011a) points out, the differences that exist among Asian countries are far greater than those in Europe and America in many respects. Moreover, Asian countries are increasingly integrated through free trade and investment, but remain disconnected in the production of intangible assets, such as knowledge of science and technology (Okamoto 2011a, Okamoto and Fukasaku 2013). What is the role for Japan to play as one of the Asian leaders under these circumstances?

These are the two main questions this paper addresses. First of all, Section II discusses a growing move to explore a new growth paradigm and the importance of innovation in the theme in particular. What is the new growth paradigm? What is the role for innovation to play? Section II also discusses the importance of knowledge creation and/or acquisition activities in the process of innovation as well as the type of system that promotes innovation the best.

After introducing several measures to quantify the innovative capacity, Section III empirically examines to what extent the innovative capacity increased in the Asia-Pacific region during the last couple of decades to begin with. The empirical observation is followed by the discussion of whether the emergence of Asian newly industrializing economies is posing a threat or provides a new growth opportunity for Japan.

The Asia-Pacific region is not without any problems, however. On the contrary, some of the issues are becoming serious and could comprise a formidable barrier to further free trade and investment in the near future. Section IV summarizes major challenges facing the Asia-Pacific region.

Based on the above observation, Section V discusses the role Japan needs to play in the

[1] See "2010 Leaders' Declaration: Yokohama Declaration – The Yokohama Vision – Bogor and Beyond" <WWW.APEC.ORG>. The latest access is January 18, 2013.

region and the innovation strategy Japan should adopt toward Asia so that both Japan and Asia could prosper together.

II. Recent Literature on the New Growth Paradigm and Innovation

II-1. Emergence of a new innovation paradigm and the reason behind it

In APEC 2009 in Singapore, leaders not only reconfirmed the Bogor Goals to achieve free and open trade and investment in the Asia-Pacific region, but also started to seek a post-Bogor agenda (Yamazawa 2012). Thirty years passed by since the establishment of APEC, and leaders called for joint efforts to pursue a new growth paradigm in Asia-Pacific cooperation for the 21st century.

In response to this, in APEC 2010 in Yokohama, the leaders adopted the "APEC Leaders' Growth Strategy" for the first time in the history of the Asia-Pacific region, in addition to the further promotion of trade and investment liberalization and facilitation. The APEC's growth strategy consists of the following five attributes: balanced growth, inclusive growth, sustainable growth, innovative growth, and secure growth. In regard to its action plan, the leaders identified five work elements such as structural reform, human resources and entrepreneurship development, green growth, knowledge-based economy, and human security.

Among the above five attributes, "balanced growth" to seek growth across and within member economies through macroeconomic policies, and "secure growth" to seek to protect the region's citizens' economic and physical well-being and to provide the secure environment necessary for economic activity are unusual because they are not part of the conventional growth strategy. However, the inclusion of the rest ("inclusive growth", "sustainable growth", and "innovative growth") in the growth strategy is epoch-making because it indicates that APEC started to pay an equal degree of attention to the qualitative as well as to the quantitative aspects of growth.

There are two factors behind it. The first factor is the substantial changes that have occurred among the APEC member economies since the initiation of APEC. First of all, the fruits from the growth have not been shared widely and equally across the member economies and the regions within each country yet. Many of the East-Asian countries have been growing rapidly since the 1970s partly due to the adoption of freer and more open trade and investment policy, resulting in the formation of a growth center in the world.[2] They also succeeded in the substantial reduction of poverty. Despite the great achievements made so far to date in the region, people in the APEC member economies have not had an equal opportunity to participate in, contribute to, and benefit from global and regional economic growth yet. In addition, the natural environment degraded substantially within some APEC member economies, endangering the sustenance of growth. Moreover, innovative growth is highly

[2] See World Bank (1993) for the details.

expected of a country such as Japan suffering from a long period of economic stagnation and of others suffering from the so-called middle income trap[3].

A new growth paradigm started to be explored in the Asia-Pacific region also because APEC member economies have come to recognize the inadequacy of measures such as Gross Domestic Product (GDP) alone to represent the well-being of people in the region. For instance, in the United States, the Bureau of Economic Analysis considers the way to reflect the growing income disparity among households, industries and regions in measures such as GDP. Some of the local governments of China also evaluate its performance these days not only from the aspects of growth but also from the sustainability of environment (Wolverson 2010). Stiglitz et al. (2010) provides some theoretical background behind the emergence of the new growth paradigm as well.

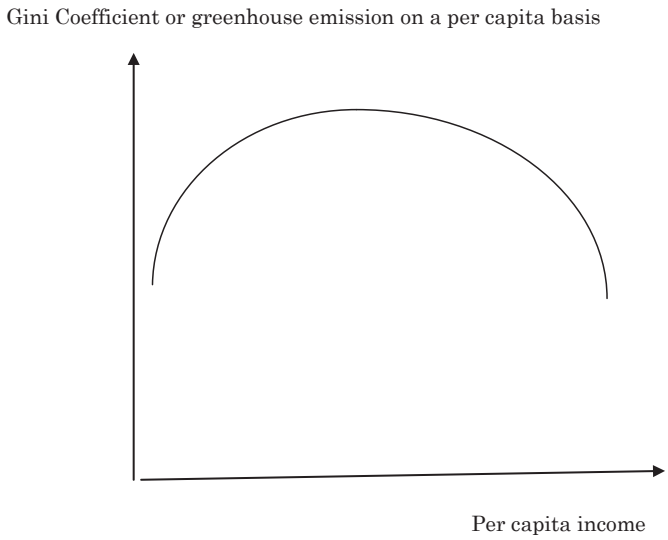
II-2. The importance of innovation and its definition

Entering the 21st century, APEC member economies began to explore a new growth paradigm and included it as part of the post-Bogor agenda, resulting in the adoption of the growth strategy at the 2010 APEC Leaders' Meeting in Yokohama. The strategy consists of five attributes. In my opinion, innovation is at the central theme of the growth strategy because not only is innovative growth highly regarded in the strategy per se, but also both the achievements of inclusive and sustainable growth themselves require "innovation".

Figure 1 shows the Kuznets inverted-U hypothesis. Kuznets is well known partly because he found that there was a tendency of worsening income distribution in the early stage of development before reaching its peak (See figure 1). A tendency of environmental degradation during the early growth process has come to be recognized widely among economists as well later on. If this hypothesis holds in both cases, there is no way for a country to achieve inclusive, sustainable and innovative growth at least in the early stage of development. However, if the trade-off is inevitable, especially in such big and rapidly growing countries as China and India, the human and environmental damages that may arise during the early growth process of these economies could be enormous. To avoid the tragedy, we need a new pattern of growth. That in turn requires a series of innovation, such as the development of a new way to increase energy efficiency, of new and clean energy sources, of electric cars, etc. (Mitsuhashi, et al. 2010).

[3] See Okamoto (2009).

Figure 1 Inverted-U Hypothesis



(Source) the author's construction

Moreover, if the fruits of growth are not going to be shared widely in the early stage of development, as shown in Figure 1, the economic policy may not be sustainable at least politically. The view is shared widely these days that the poverty is one of the fundamental causes of the globalization of terrorism.

To solve the problem of poverty, a variety of new social businesses are being born in emerging countries. Those businesses are being generated to meet the needs of people in the lower income bracket of developing countries in particular.[4] This is considered a new type of innovation. Innovation lies at the core of the new growth paradigm.

Before discussing further, "innovation" is defined here at this point. First of all, "innovation" and "invention" are often mixed together. While the latter refers to the stage of generation of a new product and/or process concept, the former can be used only when a new product and/or process are commercialized and disseminated widely in society (Fagerberg 2005).

In addition, the coverage of "innovation" is much wider than conventionally thought. For instance, Schumpeter includes in innovation not only the introduction of a new product or a new production process into society, but also the opening up of a new market, the development of new materials, and the formation of a new organization and/or institution (Schumpeter 2006). Schumpeter also emphasizes that a new form of economic or social innovation often occurs through a new combination of existing resources. In conventional economics, the introduction of either a new product or a new production process is often referred to as

[4] People with the annual income of under 5,000 US dollars occupy 44.6 percent of total population of emerging economies, as of 2010 (METI 2011: 152).

"innovation". But, in reality, an equal degree of impact also tends to be generated in society through other channels, such as the finding of a new market, the introduction of new materials, or the formation of a new organization or institution (Fagerberg 2005).

Moreover, innovation can be classified either as a radical or as an incremental depending on its novelty. Although Schumpeter tends to emphasize the former pattern of innovation, both types of innovation tend to be treated equally these days due to the advancement of innovation studies. The neglect of the latter type of innovation may overlook important economic advancements in society (Fagerberg 2005).

II-3. The emergence of the systems of innovation approach

Then, how and in what way does innovation occur? This is a central theme in the studies of innovation. According to Fagerberg (2005), the number of publications on innovation studies has tended to increase rapidly since the 1990s, partly because conventional economics cannot give an answer to the question to a full extent.

First of all, although the neoclassical growth model represented by the Solow growth model played an important role both in theoretical and empirical studies of economics for a long time, the model does not have an explanatory power in regards to why and in what way innovation occurs. This is because the process of technical and technological progress is treated as a black box, or given externally in the neoclassical growth model.

The new growth model that emerged in the late 1980s and in the beginning of the 1990s[5] has a much better explanatory power for the process of innovation than the neoclassical one because the process of innovation is endogenized[6] and written explicitly with the usage of advanced mathematical techniques in the former. However, the new growth model cannot explain the process of innovation fully either, because it is becoming clear with the advancement of studies that innovation does not occur in isolation. In other words, not only the behavior of individual firms but also the environment surrounding those firms play a critical role in determining the process of innovation (Edquist 2005).

The systems of innovation approach that emerged in Europe around the same time of the rise of the new growth model argue that not only the behaviors of firms alone but also organizational, institutional, geographical and historical environments surrounding them influence the process of innovation to a great extent (Edquist 2005). Initially, the national systems of innovation approach was dominant. According to it, the characteristics of each country are said to be reflected in the process of innovation the most. Since the mid 1990s, however, the regional systems of innovation approach emerged instead, partly because the role of the nation started to be questioned widely due to the impacts of globalization. The regional systems of innovation theory made a great impact on the implementation of innovation policy at the regional level, at least in Europe (Fagerberg 2005 and Okamoto

[5] See Barro and Sala-i-Martin (1995) for details.

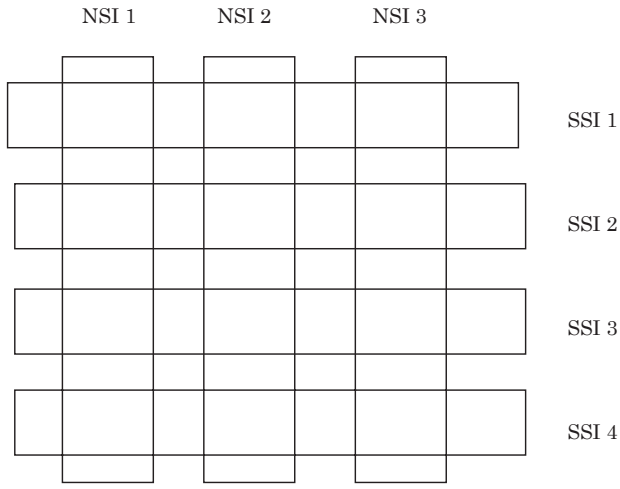
[6] The roles of human capital and research and development (R&D) activities are explicit in the process of innovation. See Sawada (2003).

2011b).

At the same time, it has become clear that it is quite difficult to explain the process of innovation only within a certain geographical boundary, either national or regional, partly due to the globalization of the activities of firms (Okamoto 2011b). As such, more recently, the sectoral systems of innovation approach started to emerge, claiming that the systems of innovation differ sharply among sectors even within the same country or region, but encompass the systems of innovation across the countries within a sector (Malerba 2005). Moreover, the sectoral systems of innovation framework are beginning to be utilized widely in the industrial development studies of developing countries.[7]

Figure 2 shows the increasingly complicated system of innovation in the arena of global economy in a simple manner. National Systems of Innovation (NSI) in Figure 2 could be replaced by Regional Systems of Innovation (RSI) depending on the situation. According to Carlsson (2006), the differences found in the systems of innovation among countries and/or regions tend to persist despite the globalization of firms, technology and industries. On the other hand, Archibugi et al. (1999) argue that the geographical boundary, either national or local, are becoming blurred these days in the process of innovation due to the impact of economic globalization. In other words, it does not seem to be very useful to argue any longer which type of approach for the systems of innovation can explain the process of innovation the best. It entirely depends on the situation.

Figure 2 Increasingly Complicated Systems of Innovation



(Note) NSI stands for National Systems of Innovation. SSI stands for Sectoral Systems of Innovation.
(Source) The author's construction based on Figure 1 in Chung (2012)

[7] See, for instance, Malerba and Mani (2009).

II-4. Science, technology and innovation

Finally, the relationship among science, technology and innovation is discussed. As argued in Section II-2, the most advanced level of science and technology is not a necessary nor sufficient condition for the emergence of innovation: the development of a new market as well as the introduction of a new form of organization could be an important source of innovation. In other words, the high level of science and technology alone does not guarantee the emergence of innovation. Both economic and social aspects of innovation cannot be overlooked.

But it is also true that the role of science and technology to play in the process of innovation is becoming increasingly important these days. First of all, as Fagerberg and Verspagen (2002) points out, the level of a science and technology base required for developing countries to catch up with advanced ones are increasing day by day. In other words, the entry level of a knowledge base needed for developing countries to join the global value chain is gradually going up.

Second, it is almost impossible to access an external science and technology knowledge base without accumulating its own knowledge substantially first. Knowledge bases necessary to create innovation are advancing and diversifying to a great extent these days, so that not only developing but also developed countries need to acquire a new form of knowledge and technology through external sources (Fagerberg 2005). To do so, however, it is important for any country to try to maintain or to increase the level of absorption capacity[8] through its own research and development (R&D) activities as well.

III. Increasing Asian Innovation Capacity and its Impact on Japan

Then, to what extent is the innovative capacity advancing in Asia? Is the speed of advancement so rapid that Europe needs to feel threatened? What kind of message does Japan need to obtain from the emergence of Asian rapidly industrializing economies?

III-1. Measurement of innovative capacity

Indicators to represent the degree of the intensity of research and development (R&D) activities have been used most frequently as a way to measure the innovative capacity of individual economies (Smith 2005). Cohen and Levinthal (1989, 1990) emphasize that firms are not engaged in R&D activities only to acquire a new form of knowledge and create intangible assets on their own. Cohen and Levinthal (1989, 1990) found that firms are engaged in R&D activities also because they need to continue to increase the level of their absorption capacity through R&D and continue to be able to access external sources of new

[8] See Cohen and Levinthal (1989 and 1990) as regards to how the concept of absorption capacity is introduced.

information and technology. This implies that R&D has two faces. One is to acquire a new piece of knowledge and technology on its own. The other is to increase its own absorption capacity, so that firms become able to access the external sources of knowledge and technology widely. In other words, the usage of R&D as a way to measure firms' innovative capacity can be justified theoretically as well.

Smith (2005) introduces two other ways to measure firms' innovative capacity. One is the usage of patents data. The other is the usage of research publication data. Although none of the above three measures are perfect (Smith 2005), this paper utilizes them as a proxy of the innovative capacity of firms and/or countries.

III-2. Increasing innovative capacity of Asia

III-2-1. East Asian Renaissance?

The World Bank published the book titled The *East Asian Miracle: Economic Growth and Public Policy* in 1993.[9] Fourteen years later, the Bank published another book titled *An East Asian Renaissance: Ideas for Economic Growth.*[10] The book of the latter was published because the continuation and the expansion of the wave of Asian high economic growth starting with the industrial rise of Japan after World War II meant a lot more than just growth.

Table 1 shows the change in shares of Gross Domestic Product (GDP) by country or region between 1820 and 2030. The share of Asia was not small at all at the beginning of the 19th century. Asia occupied around 60 percent of the world GDP then. The share of Asia declined down to only around 15 percent once mainly due to the large impact of the Industrial Revolution that started out in the UK; however, it began to rise again since the 1960s because the wave of high economic growth that started in Japan in the 1960s continued to shift to other Asian countries one after another. Maddison (2008) estimates that the share of Asia will reach around 53 percent by 2030 (See Table 1). This may imply the renaissance of East Asia.

[9] See World Bank (1993) for the details.
[10] See Gill and Kharas (2007).

Table 1 Shares of World Gross Domestic Product, 1820-2030 (%)

	1820	1950	1973	2003	2030
Western Europe	23.0	26.2	25.6	19.2	13.0
USA	1.8	27.3	22.1	20.7	17.3
Australia, New Zealand, and Canada	0.1	3.4	3.3	3.1	2.5
Japan	3.0	3.0	7.8	6.6	3.6
Rich	**27.9**	**59.9**	**58.7**	**49.6**	**36.4**
China	32.9	4.6	4.6	15.1	23.8
India	16.0	4.2	3.1	5.5	10.4
Other Asia	7.4	6.8	8.7	13.2	15.4
Eastern Europe	3.6	3.5	3.4	1.9	1.3
Former USSR	5.4	9.6	9.4	3.8	3.4
Latin America	2.1	7.8	8.7	7.7	6.3
Africa	4.5	3.8	3.4	3.2	3.0
Rest (All countries except Rich)	**72.1**	**40.1**	**41.3**	**50.4**	**63.6**
Asia as percentage of world	**59.3**	**14.9**	**24.2**	**40.5**	**53.3**

(Source) Maddison (2008), p.74.

III-2-2. A measure of innovative capacity – the trend of R&D expenditures

The important point is whether the revival of East Asia is accompanied by the increase in innovative capacity and the growth of the region is sustainable or not. Table 2 shows that the share of Asia excluding Japan in the total R&D expenditures of the world was only around 1.8 percent in 1973; however, it rose up to around 19 percent by 2007. In addition, R&D expenditure as percentage of GDP went up to 1.2 percent by 2007 from only around 0.4 percent in 1973 in Asia (See Table 2). Although the difference between East Asia and advanced economies is still large in the intensity of R&D activities, the innovative capacity of East Asia seems to have gone up gradually but steadily over the past 30 years.

Table 2 Global Distribution of R&D Spending, and R&D as Percentage of GDP by Country or Region, 1973 to 2007

	1973		1980		1990		1999/2000		2007	
	Share %	R&D/ GDP %	Share %	R&D/ GDP %	Share %	R&D/ GDP %	Share %	R&D/ GDP %	Share %	R&D/ GDP %
Developed Countries	**97.2**	**2.4**	**93.4**	**2.3**	**89.8**	**2.3**	**79.0**	**2.3**	**75.9**	**2.3**
North America	33.7	2.3	31.0	2.2	38.2	2.6	37.2	2.7	34.7	2.6
Japan	7.9	NA	10.2	NA	16.3	3.1	13.0	2.9	13.0	3.4
Others	55.6	NA	52.2	NA	35.3	NA	28.8	NA	28.2	NA
Developing Countries	**2.8**	**0.4**	**6.6**	**0.4**	**10.2**	**0.7**	**21.0**	**0.9**	**24.1**	**1.0**
Asia	1.8	0.4	4.0	NA	6.2	0.8	17.4	1.1	18.9	1.2
Latin America	0.8	0.3	1.7	0.5	2.8	0.5	2.8	0.6	2.9	0.6
Others	0.2	NA	0.9	NA	1.2	NA	0.8	NA	2.3	NA

Note: NA stands for not available.

(Source) The author's construction based on Annex 1 in Arond and Bell (2010)

III-2-3. Other measures of innovation capacity – Numbers of publications and patents granted

Table 3 shows the ranking of countries in terms of the number of research publications and the number of patents granted by the US Patent and Trademark Office (USPTO). In this paper, the research publications include both natural and social science articles.

Table 3 Ranks in Science and Engineering Article Output and Patents Granted by US Patents and Trademark Office, Selected Countries

Country	S&E Article Output		Country	Patents Granted	
	1989	2009		1992	2008
USA	1	1	USA	1	1
China[1]	15	2	**Japan**	2	2
Japan	3	3	Germany	3	3
UK	2	4	**Korea**	12	4
Germany	5	5	**Taiwan**	9	5
France	6	6	Canada	6	6
Canada	7	7	France	4	7
Italy	8	8	England	5	8
Korea	35	9	**China**[1]	21	9
Spain	13	10	Italy	7	10
India	10	11	Holland	10	11
Australia	9	12	Australia	13	12
Holland	11	13	Israel	16	13
Russia[2]	4	14	Switzerland	8	14
Taiwan	28	15	Sweden	11	15
Brazil	25	16	Finland	15	16
Sweden	12	17	**India**	31	17
Switzerland	14	18	Belgium	17	18
Turkey	39	19	Austria	14	19
Poland	17	20	**Singapore**	39	20

[1] The figure includes Hong Kong.

[2] Data of the year of 1989 are those of the USSR, not just Russia.

(Source) National Science Foundation (2004, 2010, 2012)

Table 3 clearly indicates the rise of the innovative capacity on the part of East Asian countries. First of all, the paper examines the ranking of countries by the number of publications. According to Table 3, the performances of China and Korea are outstanding in particular. The ranking of China was only “15” in 1989; however, it surpassed Japan to rise to “2” by 2009. The same is true of Korea. The ranking of Korea was as low as “35” in 1989 indeed. It went up to as high as “9” by 2009. Although not so outstanding as China nor Korea, the performance of Taiwan is pretty good: the ranking of Taiwan went up from “28” to “15” between 1989 and 2009. Although the innovative capacity of India rises step by step, its relative position in the global research environment still stays the same.

The paper also examines countries’ innovative capacity through changes in the ranking of countries by the number of patents granted. The changes in the ranking of countries observed in Table 3 also indicate the rise of China, Korea and Taiwan in terms of patents granted. According to the same table, besides these three countries, India and Singapore are also very active in patent filing. In 1989 neither India nor Singapore was among the best 20 performers. Both of them are now among the best 20 (see Table 3). Here, special attention needs to be paid to Singapore, because although the size of the country is very small at least in terms of population (5 million people), its ranking in terms of the number of patents

granted went up from as low as "39" in 1989 to "20" in 2008. This implies that the technological capability of Singapore is rising remarkably.

As discussed in Section II-3, innovation differs from invention. Although newly acquired scientific and technological knowledge could be an important source of innovation, that alone does not automatically lead to the creation of innovation (Fagerberg 2005). However, the acquisition of scientific and technological capability by East Asian countries clearly has expanded the innovative capacity of the region.

III-3. Does the rise of East Asia pose a threat to Japan or not?

III-3-1. Analytical framework

Whether the rise of East Asia poses a threat to Japan or not depends on Japan itself. On one hand, the presence of Japan could be eroded significantly due to the rapid increase of scientific and technological capability on the part of other East Asian countries. In East Asia, business competition among firms is increasingly becoming intense these days. Unless Japanese firms are able to cope with this tough competition innovatively, firms of other East Asian countries may catch up or even surpass those of Japan.

On the other hand, however, knowledge bases underlying any innovation are more and more advanced and diversified these days. This means that none of firms can be self-sufficient in terms of knowledge required to generate a single innovation, even in advanced economies such as the US. As such, the adoption of an open innovation model[11] is becoming more dominant than before in constructing any kind of business. This can also be true of Japan. The increasing importance of the adoption of a new type of innovation model implies that the rise of East Asia may not be bad at all for Japan, because it is becoming easier for Japan to find a partner for R&D collaboration and cooperation than otherwise.

III-3-2. Does Japan collaborate with other East Asian countries more widely than before?

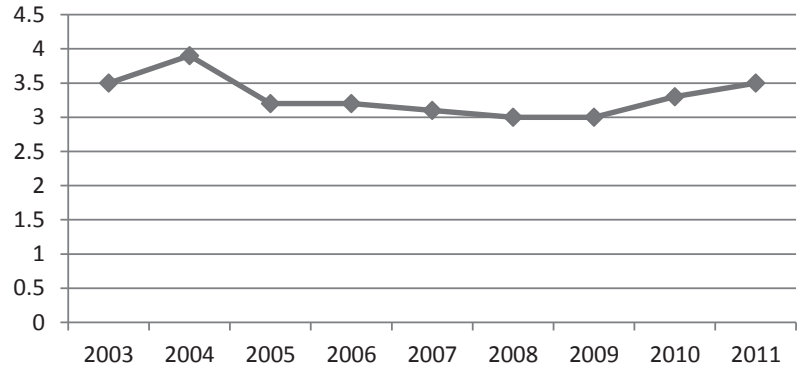
Since the 1980s Japan has had an intensified economic relationship with other East Asian countries through trade and investment, resulting in the formation of Japan's extensive production network in the region. This lays out a good foundation for further collaboration between Japan and other countries in such activity as the production of new knowledge precisely owing to the rapid increase of scientific and technological capability on the part of East Asian countries.

Yes, the open innovation model does not seem to be adopted widely among Japanese firms yet. Figure 3 shows changes in overseas R&D spending as percentage of total R&D

[11] Chesbrough (2003) introduced the concept of open innovation model.

expenditures[12] of Japanese firms between 2001 and 2011. According to the figure, Japan's overseas R&D spending as a percentage of the total still stays around 3 percent or so. Japanese companies have not adopted the open innovation model across the borders yet.

Figure 3 Overseas R&D Spending as Percentage of Total (%)



(Source) METI(2013)

The changes in the shares of overseas R&D spending by country over the past one decade, as shown in Table 4, however, does indicate something new. According to the table, while the shares of R&D spending in the US and in Europe tend to decline, that of Asia do increase substantially: although the share of Asia was only around 13 percent at the beginning of the 21st century, it more than doubled to reach around 30 percent by 2011. This implies that subsidiaries in East Asia of Japanese companies are no longer just production nor sales centers. They came to play a certain role in the R&D activities of Japanese firms.[13] The rising innovative capacity of other Asian countries seems to provide a great opportunity for Japanese firms to expand R&D activities abroad.

[12] Overseas R&D spending as percentage of total R&D expenditures = 100 X (Overseas R&D spending) / (Overseas R&D spending + Domestic R&D spending). The paper uses figures in *Science and Technology Research Report* of the Ministry of Internal Affairs and Communications (R&D expenditures spent domestically by Japanese firms) as a proxy of Domestic R&D spending of Japanese firms.

[13] Wakasugi and Ito (2011) also refers to the changing nature of Japanese firms' overseas activities.

Table 4 Changes in Shares of Japanese Firms' Overseas R&D Spending by Country or Region (%)

	North America	Europe	Asia	Within Asia				Others
				China	ASEAN4	NIEs3	Others	
2001	51.6	34.2	13.1	1.9	4.6	6.4	0.3	1.1
2002	60.5	25.6	12.3	2.1	4.1	5.9	0.2	1.6
2003	46.9	34.4	16.4	3.4	6.0	6.6	0.4	2.3
2004	46.2	27.0	23.3	3.2	11.8	7.3	0.9	3.5
2005	39.4	37.0	21.4	5.8	6.0	9.0	0.6	2.3
2006	47.5	29.5	21.2	6.8	4.4	9.2	0.8	1.8
2008	43.9	28.8	25.6	10.5	6.1	7.9	1.1	1.7
2009	42.0	26.3	29.7	12.9	7.1	8.0	1.7	2.0
2010	37.0	28.1	33.1	12.7	7.2	10.4	2.9	1.8
2011	39.7	25.4	30.8	14.4	6.2	7.7	2.4	4.1

(Source) The author's construction based on data from *the 32*th to *the 42th Summaries of Basic Research on Overseas Business Activities*, published by the Ministry of Economy, Trade and Industry. They were downloaded from <WWW.METI.GO.JP>. The latest access is March 20, 2013.

III-3-3. Is Japan's scientific and technological capability declining?

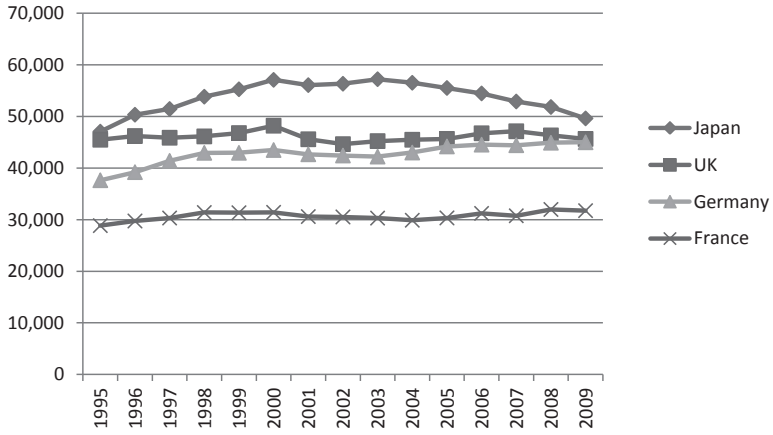
Section III-3-2 has shown that the rising innovation capacity of East Asia is welcome for Japan because it may provide a great opportunity for Japanese firms to adopt an open innovation model to a greater extent than before. But, that really depends on whether Japan can maintain its own innovative capacity at the high level as well.

As discussed extensively in Section II, Cohen and Levinthal (1989, 1990) argue that whether firms can utilize external sources of knowledge and technology depends on their own absorption capacity, which in turn depends on whether those firms are engaged in R&D activities on their own. What about the absorption capacity of Japan?

Figure 4 shows the trends in the number of publications of major advanced countries excluding the US between 1995 and 2009. According to it, Japan surpassed the UK in 1995[14] to be the second largest producer of academic papers only next to the US. Although the number of research publications continued to rise at least for the subsequent ten years, it peaked around the year of 2003. Since then, Japan's total number of publications continues to decline.

[14] See Table 5-35 of National Science Foundation (2004).

Figure 4 Trends in Article Output of Science and Engineering of Major Advanced Countries Excluding USA, 1995-2009

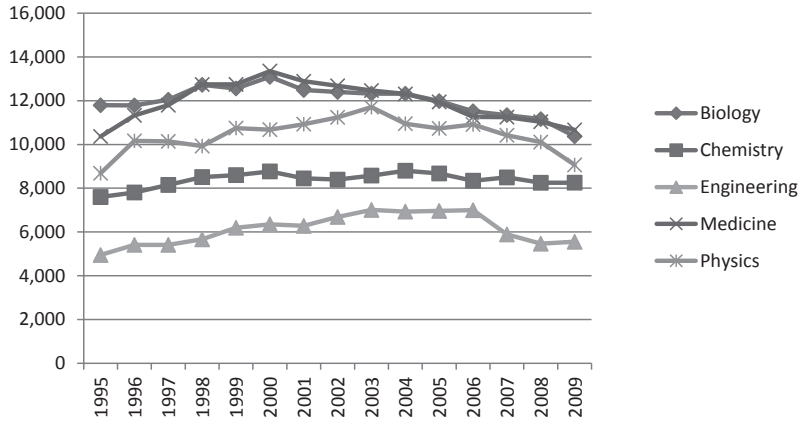


(Source) The author's construction based on Data from National Science Foundation (2012)

What about other developed countries? During the same period, advanced countries such as France and the UK at least succeeded in maintaining the level of publications in terms of the absolute number, although it did not go up either. Moreover, the number of publications of Germany even continues to increase after 1995, almost reaching the level of the UK by 2009. It is only in Japan that the total number of publications has declined since the mid-first decade of the 21st century.

Figure 5 shows the trends in the number of publications by field for Japan only. According to it, the number of publications tends to decline more or less in all fields except chemistry, such as biology, physics, engineering, and medicine. The rapid decline in fields such as physics and engineering in recent years is surprising because the presence of Japan in these two fields has been regarded as high.

Figure 5 Trends in Japan's Article Output by Field



(Source) See Figure 4.

Of course, Figures 4 and 5 show the overall trend of Japan as a whole. As such, they do not necessarily represent the declining trend of the innovative capacity of Japanese firms per se. However, as the systems of innovation theorists argue, the level of innovation activities is determined not only by the behaviors of firms but also by the environment surrounding them, such as the knowledge creation and dissemination activities of universities and/or public research institutes. In other words, the main actor of innovation is business firms but actors such as universities and research institutes place a profound impact on the innovative activities of firms as well through various channels.

Whether Japan could utilize the increasing innovative capacity of other East Asian countries for her own benefit seems to depend very much on its revival[15] of the level of science and technological capability.

IV. Challenges Facing Asia

IV-1 Growing disparity in innovative capacity

The rising innovative capacity of Asia as a whole is desirable very much because its increasing capacity could enable this region to generate a sustainable and inclusive pattern of growth and to establish a new growth paradigm in it. This does not mean, however, Asia does not face any challenges. One of the most serious problems the Asia-Pacific region needs to

[15] It is very important to identify what caused the recent decline in terms of the number of academic articles in many fields. It could be possible that the principle of competition that has been introduced in academic research since the early part of the first decade of the 21st century might have changed the priorities of R&D activities among researchers: the priorities may have shifted away from the engagement in basic research toward that in applied research and/or patent application. Before concluding, further investigate is required.

solve is the growing disparity in innovative capacity among countries (see Okamoto 2011a for details).

Table 5 shows the intensity of R&D (defined as R&D spending as percentage of GDP) and researchers per thousand workers for major APEC member economies as well as for India, and the change in shares over the decade. According to the table, the innovative capacity of countries such as China, Taiwan, Korea and Singapore has been increasing remarkably between 1997 and 2007. The outstanding record of these Asian economies can be identified regardless of the measures used: either expenditure on R&D or R&D researchers per thousand workers. In fact, some of them nearly reached the level of developed countries.

Table 5 R&D Intensity and Personnel in the Asia Pacific Region (%)

Country	R&D Expenditure as Percentage of GDP		Researchers per Thousand Workers	
	1997/98	2007/08	1997/98	2007/08
Advanced Economies				
Australia	1.51	2.35	6.74	8.23
Canada	1.71	1.88	6.07	7.79
Japan	2.94	3.44	9.41	10.06
New Zealand	1.08	1.17	4.38	8.08
USA	2.58	2.71	8.03	8.81
Emerging Asian Economies (the innovative capacity is rapidly increasing)				
China	0.65	1.43	0.76	1.93
Hong Kong	0.43	0.75	2.09	5.12
Korea	2.41	3.29	4.45	9.49
Singapore	1.64	2.49	5.53	11.30
Taiwan	1.87	2.68	5.80	10.30
Emerging Asian Economies (the innovative capacity is increasing)				
India	0.70	0.76	0.31	0.35
Malaysia	0.40	0.63	0.38	0.86
Thailand	0.10	0.21	0.13	0.56
Emerging Asian Economies (the innovative capacity needs to be enhanced)				
Brunei [1]	NA	0.02	NA	0.59
Indonesia [2]	0.07	0.08	0.46	0.18
Philippines	0.15	0.11	0.17	0.19
Vietnam [3]	0.19	NA	0.23	NA
Latin America				
Chile	0.50	0.68	1.00	2.00
Mexico	0.36	0.37	0.55	0.81
Peru	0.09	0.15	NA	NA

[1] The average of the years of 2002, 2003, and2004

[2] Data of the years of 2000 and 2009 respectively

[3] Figure of 2002

(Source) Table 1 in Okamoto and Fukasaku (2013) and and Table 2-3 in Okamoto(2011a).

There is, however, a growing gap between such countries as China, Hong Kong, Korea, Taiwan, Singapore and the rest of developing Asia. For instance, although India ranks in

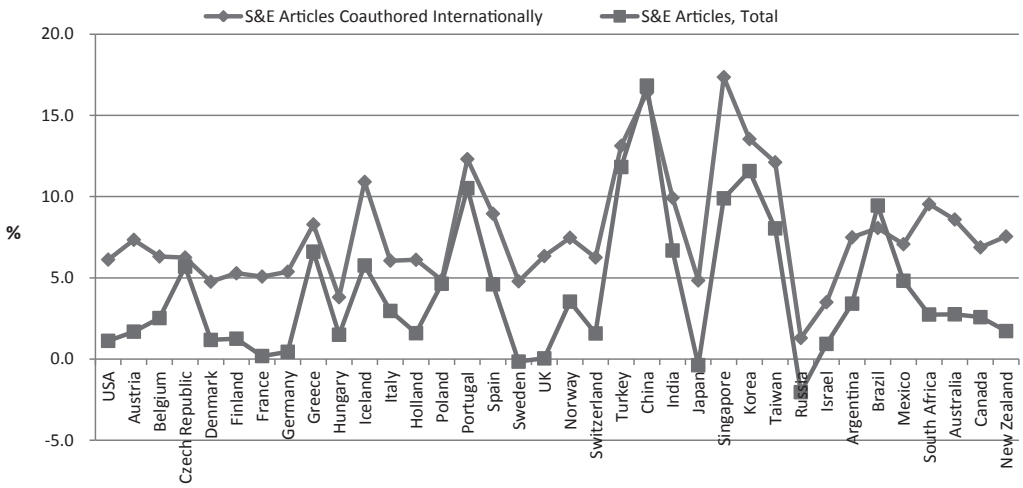
among the top 20 best performers in terms of patents granted as observed in Table 3, the rate of its change is still not very large on a per capita basis, let's say, in comparison with China. Excluding Singapore, there is still a lot of room for ASEAN countries to improve their innovative capacity, although that of Malaysia and Thailand is improving to a certain extent. As Okamoto (2011a) points out, the forces of both convergence and divergence seem to exist in the Asia-Pacific region in regards to the capacity of innovation necessary for growth.

IV-2 Inward-looking innovation system

Another challenge facing the Asia-Pacific region is the degree of openness of the systems of innovation. Since science and technology advance so fast these days, it is almost impossible even for a developed country to create new information and knowledge all alone. The same is true in the case of companies. None of the big companies can be self-sufficient in the process of innovation any longer. In other words, the adoption of an open innovation model is increasingly required in the global economy.

Figure 6 compares the average annual growth rate of the total number of science and engineering (S&E) articles and that of S&E articles co-authored internationally for selected countries individually. The figure indicates that S&E articles co-authored internationally grow at a faster rate than the total number of S&E articles for all of the countries except large emerging countries such as China and Brazil. This implies that the degree of openness is increasing on a global scale in the process of innovation.

Figure 6 Annual Average Growth Rate of Number of S&E Articles, Total and Coauthored Internationally, 1998-2008



(Source)The author's construction based on National Science Foundation (2010, 2012).

The degree of openness is not, however, still high especially in Asia excluding Singapore.

Table 6 shows S&E articles co-authored internationally as the percentage of the total between 1998 and 2008. According to it, shares of S&E articles co-authored internationally increased in all of the Asian countries except China; however, Asia's level of openness is still very low, except for Singapore.

Table 6 S&E Articles Co-authored Internationally as Percentage of Total (%)

	1998	2008
USA	22.7	36.8
EU	56.4	79.9
Asia		
China	30.7	29.6
India	20.3	27.4
Japan	18.6	30.9
Singapore	37.0	71.3
Korea	29.1	34.7
Taiwan	18.7	27.1
Russia	40.0	55.9
Australia	37.1	64.5
Canada	42.7	64.3
New Zealand	45.4	79.2
Mexico	57.8	71.5

(Source)The author's construction based on National Science Foundation (2010, 2012)

In the case of the EU, not only was the level of openness high from the early days of its history but also even that increased substantially between 1998 and 2008. Among APEC member economies, the degree of openness increased in countries such as Russia, Australia, Canada, New Zealand and Mexico. The level of openness increased substantially from only around 20 percent to nearly 40 percent even in the US, although its science and technological capability is already high to begin with. This implies that there is a lot of room for Asia to become much more open than now in the process of innovation.

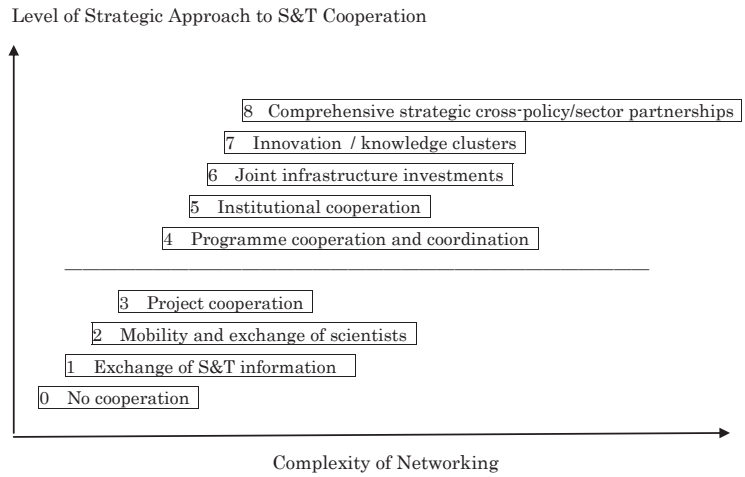
IV-3. Lack of R&D cooperation in the Asia-Pacific region

The other challenge is how to cooperate more not only in the construction of a free trade area but also in the conduct of research. It is well known that economic linkage has strengthened substantially among Asia-Pacific countries through more free and open trade and investment policies since the 1990s.[16] In other words, APEC member economies have become more integrated than before among each other through trade and investment. The higher degree of economic integration in Asia was not, however, accompanied by the greater level of coordination and cooperation in the area of research and development. This makes a sharp contrast with EU.

[16] See Yamazawa (2012) for the details.

Okamoto and Fukasaku (2013) argue that the high degree of integration and cooperation among member countries has been incorporated in the areas of both trade and investment and R&D in Europe as early as since the establishment of the European Economic Community (EEC) in 1957, the predecessor of the European Union (EU). More concretely, the European-wide systems of innovation have been constructed step by step, as shown by Figure 7.

Figure 7 Development Stages of International Science and Technology Cooperation



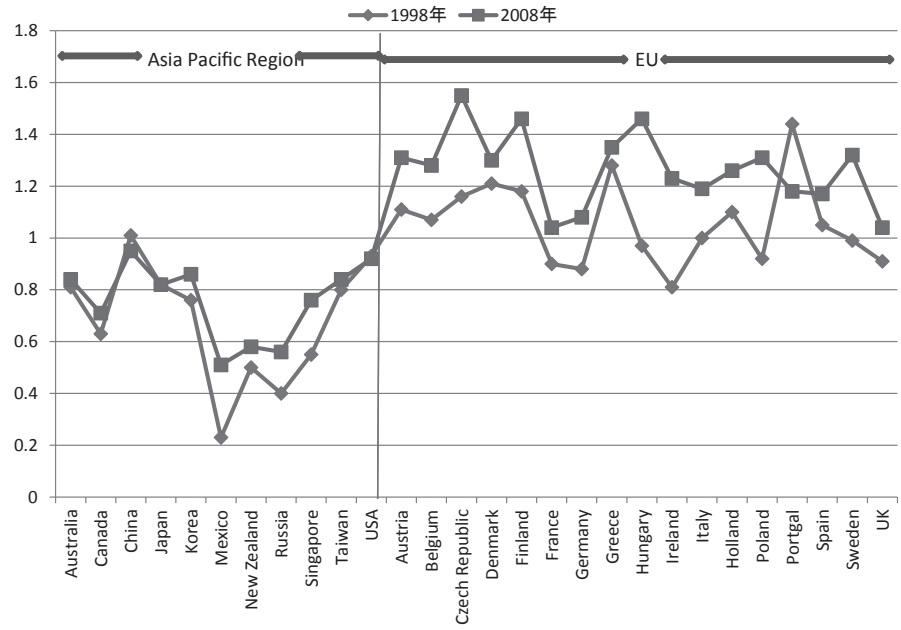
(Source) Könnölä and Haegeman (2012), P.194.

Now, let us see empirically how the Asia-Pacific region differs from the EU in the degree of regional R&D cooperation through the calculation of *the index of international collaboration*. One of the simplest measures is defined as the ratio of country A's rate of collaboration with country B divided by country B's rate of total international authorship. More concretely, the index of international collaboration is calculated as follows:

$$\text{The index of international collaboration is} = \frac{\text{(country A's articles coauthored with country B / country A's internationally coauthored articles)}}{\text{(country B's internationally coauthored articles / the total number of internationally coauthored articles).}}$$

Figure 8 shows average indexes of international collaboration for selected pairs of countries in the Asia-Pacific region and in the EU respectively. Figure 8 includes countries that produce more than 1 percent of all internationally coauthored articles in 2008 only. The left-hand side of Figure 8 shows how far selected countries in the Asia-Pacific region collaborate with others within the same region in R&D activities. The right-hand side of the same figure shows the degree to which countries in the EU collaborate with other EU members.

Figure 8 Averages of the Indexes of International Collaboration for Selected Pairs of Countries in the Asia- Pacific Region and in EU



(Source)The author's construction based on National Science Foundation (2010)

What is clear from Figure 8 is that while not only was the degree of regional R&D collaboration lower in 1998 but it also did not change very much between 1998 and 2008 in the Asia-Pacific region. Not only was the degree of R&D collaboration already high in 1998 to begin with but it also increased substantially over the subsequent one decade in the EU. It demonstrates that partnerships in R&D activities are increasingly becoming even more intense than before within the EU than within the Asia-Pacific region.

V. What Kind of Innovation Strategy does Japan need to adopt toward Asia?

The paper has found that the increasing innovative capacity of many of Asian countries may provide a great opportunity for the Japanese economy, as they have the potential to become good partners of Japan in innovative activities. On the other hand, it has also been found that there are a couple of challenges both Japan and other Asian countries face, and that those issues need to be addressed and solved within the region.

V-1. Economic cooperation to narrow the growing gap of innovative capacity among Asian countries

While it is very important for Japan itself to curb its declining science and technological

capability,[17] a shift to Asia within overseas R&D spending of Japanese firms is outstanding. This shift is taking place because it is becoming more and more important for Japanese firms to produce goods and services that meet the needs of the growing local Asian markets. According to METI (2013), Japanese firms continue to shift their production process overseas.[18] In addition, the increasing role of Asia is observed both in the trend of overseas sales revenue and the number of overseas employees by region.[19]

As observed in Section IV, however, we also found the growing disparity among countries in Asia in terms of innovative capacity. There is an especially large difference in it between Northeast Asian economies such as Japan, China, Korea, Taiwan, and ASEAN countries excluding Singapore. Japanese firms alone will no longer be able to provide all of the goods and services that meet the needs of growing Asian markets in a swift manner. Universities and research institutes in these emerging countries are increasingly important for Japanese firms, because they are the main organizations and institutions that educate young people in emerging economies. These educated people could become valuable human resources for the innovative activities of Japanese firms. These universities and research centers could be good collaborators in R&D activities of Japanese overseas firms, institutionally. As such, it is important for Japan to contribute to the enhancement of the innovative capacity of these emerging countries and to increase the efficiency of overseas R&D activities of Japanese firms through various economic cooperation schemes.

Official development assistance (ODA) still could be an important means to achieve the objective. Unfortunately, ODA's original budget in the total general account of Japan continues to decline (Figure 9). Although it is understandable given the huge and outstanding amount of public debt, the degree of the recent decline in the ODA budget is substantial. The original ODA budget peaked in 1997 at the amount of 1.1687 trillion yen. Since then, it continues to decline, hitting the amount of only 557.3 billion yen in the fiscal year of 2013.[20] The original ODA budget declined more than 100 percent over last 16 years. In other words, since 1997 the original ODA budget continues to decline at the annual rate of 4.7 percent in nominal terms, hitting the level as low as that of the mid-1980s in 2013.

---

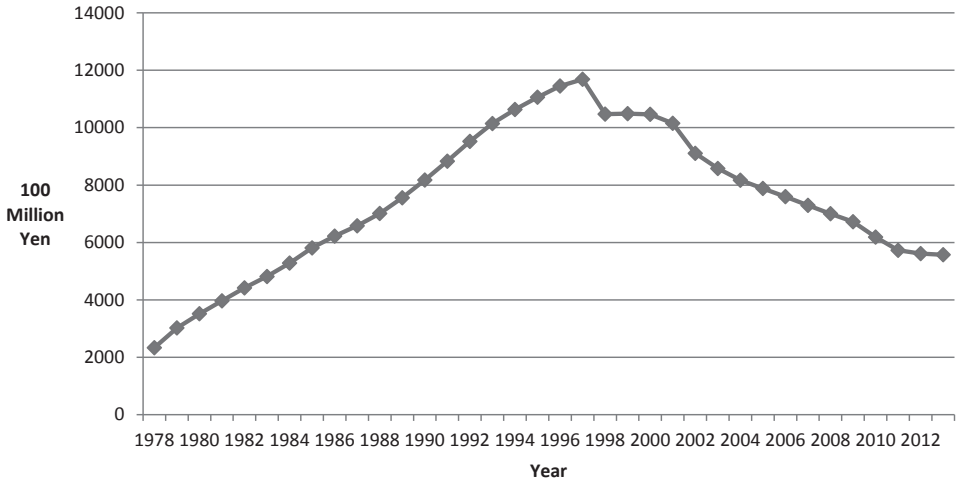
[17] According to Nikkei Industry Newspaper (2013), not only the declining trend of the number of science and engineering articles output has not been curbed yet, but also the number of citation of academic articles published by top-level Japanese universities is declining.

[18] According to METI (2013), overseas production ratios based on data of Japanese companies already owning subsidiaries abroad increased steadily from 29.1 to 32.1 percent between 2002 and 2011. Those ratios based on data of all manufacturing companies also increased from 14.6 to 18 percent over the same period.

[19] Sales revenue generated in Asia as percentage of total overseas revenue of Japanese firms increased from 39.8 to as high as 49.3 percent between 2002 and 2011. Japanese companies' employees in Asia as percentage of the total number of Japanese companies' employees abroad went up slightly from 70.9 to 71. 3 percent over the same period.

[20] See original ODA budgets provided by the Ministry of Foreign Affairs in <http://www.mofa.go.jp/mofaj/gaiko/oda/shiryo/yosan.html>. The latest access is April 19, 2013.

Figure 9 ODA's Original Budget in Total General Account, Japan



(Source) Data of ODA Budget provided by the Ministry of Foreign Affairs. They were downloaded from <http://www.mofa.go.jp/mofaj/gaiko/oda/shiryo/yosan.html>. The lastest access is April 19, 2013

Of course, the rapidly declining original ODA budget in total general account of Japan does not necessarily mean a huge decline in the total ODA budget per se because the main financial resources of Japanese ODA are not only tax revenue but also the government's borrowing from the private sector. As such, the ratio of ODA yen loan is high in Japan.[21]

However, it is highly questionable whether ODA yen loan is suitable for ODA projects intended to develop human resources for innovative activities and/or to enhance the science and technology capability of emerging developing countries, because those ODA projects do not generate revenue on their own immediately. Rather, those projects have the nature of public goods. In addition, ODA expenditure as a percentage of Japan's Gross National Income (GNI) was only 0.18 percent in 2011, one of the lowest among developed countries.[22] It seems to be important to reconsider ODA as an important means of foreign diplomacy.

The adoption of an open innovation model could be very useful in the field of economic cooperation as well. Of course, the Government of Japan has already co-financed ODA projects with such international organizations as the World Bank and the Asian Development Bank since the 1990s. We observe, however, a new trend in the field of international cooperation recently. That is, foreign assistance is increasingly provided by non-members of the Development Assistance Committee (DAC) of the Organization for Economic Cooperation and Development (OECD). China is one of the good examples (Ministry of Foreign Affairs 2012). Therefore, it could be possible for Japan to cooperate and collaborate with such Asian countries in the provision of foreign assistance in order to enhance the absorption capacity of

[21] According to Ministry of Foreign Affairs (2013), ODA yen loan as percentage of total ODA budget is 52.4 percent.

[22] See Table and Figure IV-31 in Ministry of Foreign Affairs (2013).

Asian developing countries.

Moreover, the cooperation and collaboration with Japanese firms could also be very useful and even imperative in the provision of ODA, because it is private enterprises that are the engine of innovation and growth in reality. The shift to Asia in overseas R&D activities of Japanese firms is outstanding. Therefore, the establishment of a closer linkage between the Government of Japan and private sectors could be all the more useful to enhance the effectiveness of ODA projects in developing Asia.

V-2. Improvement of business environment to promote innovation through the utilization of FTA, etc.

One of the challenges the Asia-Pacific region, especially Northeast Asian countries such as China, Japan, Korea and Taiwan, face in the 21st century is how to promote open innovation. Of course, it all depends on to what extent each country or firm finds the adoption of an open innovation model valuable. But, to promote open innovation across the border requires the establishment of an enabling environment for innovation activities in Asia. The innovation policy APEC adopted in 2011 is a good point to start.

APEC leaders adopted the policies to promote innovation as well as open and non-discriminatory trade and investment at the 2011 APEC Summit held in Honolulu, Hawaii, in the US, reconfirming innovation is a key to enhance the "quality" of growth in the Asia-Pacific region. "Effective, non-discriminatory and market-driven innovation policy" is the one thing APEC leaders agreed to. More concretely, as shown in Table 7, the innovation policy consists of 14 agreements and capacity building activities that will further assist economies to promote the policy. The essence of this strategy is nothing but open and non-discriminatory trade and investment policies that foster competition, promote access to technology, and encourage the creation of innovations and capacity to innovate necessary for growth.

Table 7 Promoting Effective, Non-Discriminatory, and Market-Driven Innovation Policy, Excerpts

1	Develop and maintain an open economy
2	Develop and adopt new and innovative business models
3	Maintain regulatory systems that are transparent and non-discriminatory
4	Promote open investment
5	Encourage the use and participation in the development of voluntary, market-led, and global standards
6	Ensure that technical regulations and requirements do not create unnecessary trade barriers
7	Develop and implement technical regulations and requirements consistent with APEC-OECD Integrated Checklists on Regulatory Reform
8	Provide effective protection and enforcement of intellectual property rights
9	Refrain from adopting or maintaining measures that make the location of the development or ownership of intellectual property a condition for eligibility for government procurement preferences
10	Ensure that the terms and conditions of transfer of technology, etc. should be consistent with WTO
11	Promote government procurement policies that are transparent and non-discriminatory
12	Implement information and communication technology policies in such a way as to minimize the trade-distorting impact
13	Effectively and efficiently manage spectrum so as to enable innovative use of this resource
14	Encourage cooperation and integration among researchers and laboratories, including joint R&D
Addition	Develop capacity-building activities to promote effective, non-discriminatory and market-driven innovation policy

(Source) Annex A of the APEC Leaders' Declarations agreed on November 13, 2011 in Honolulu, Hawaii, USA.

To make this innovation policy and strategy really effective, Japan needs to participate actively in the negotiation of the Trans-Pacific Partnership agreement (TPP). The TPP agreement is more than a traditional trade agreement intended to eliminate border barriers to trade and investment; it also deals with behind the border impediments to trade and investment to be comprehensive, such as new rules on investment, competition, intellectual property rights, and government procurement. The TPP agreement is, therefore, consistent with the principles and contents of the innovation strategy adopted at the 2011 APEC Leaders' Meeting in 2011 (see Table 7).

As of November 2013, not all APEC member economies have participated in the TPP negotiation yet. But, Japan's participation in the negotiation is highly expected to invite other members to join in it. The TPP agreement will place a profound impact on the negotiation toward the conclusion of RCEP. Currently, East Asian countries including India and all of the ASEAN countries as well as China, Japan and Korea participate in the negotiation of RCEP.

It is very important for Japan to be actively involved in the negotiation of regional agreements such as TPP and RCEP and to construct new rules and frameworks in the region, so that an enabling environment for open innovation is generated and the capacity to innovate necessary for growth is built.

V-3. Toward the construction of a region-wide innovation system

Although very innovative, the market-driven innovation policy alone may not be enough to promote open innovation region-wide. The origin of the APEC innovation policy dates back to the early part of the 1990s. Despite a large number of projects implemented so far, their effectiveness in the promotion of innovation seems to have been limited in the region (Okamoto 2013). The low effectiveness of those projects seems to lie partly in the lack of their sustainability. The systems of innovation theorists[23] argue that innovation will be promoted only when new actors emerge, the new relationship develops among them, and an enabling environment for innovation is constructed institutionally. That, in turn, requires the construction of region-wide systems of innovation.

Of course, the systems of innovation developed in the EU do not have to be the best model for Asia. Asia has to find its own way to innovate effectively. However, the active promotion of cooperation and collaboration in R&D as well as that of open trade and investment has generated a large number of fruits at least in Europe. They include 1) the region-wide and extensive development of business networks, 2) the enhancement of private firms' R&D activities through the European-wide program, 3) the development of human resources in the field of research and their regional mobilization within Europe through the program, 4) the generation of joint research results such as the joint publication of academic articles and the joint filing of patents, 5) the establishment of industry-university cooperation and collaboration, 6) the promotion of the participation of small and medium-sized enterprises in the systems of innovation, the standardization of products and technology, 7) the S&T policy coordination among European countries, and 8) the efforts made to find a solution to the problems that member countries in the EU commonly face (Okamoto and Fukasaku 2013). A large number of positive results have been born through their joint efforts to promote innovation in Europe.

Entering the 21st century, it is evident that APEC member countries face an increasing number of common economic and other challenges. As such, it is imperative for countries within the region to begin developing an institutional mechanism to enhance regional research cooperation and collaboration. The diversity of instruments of cooperation and collaboration developed over decades in Europe seems to present patterns and models that APEC could modify and develop its own instruments of co-operation and collaboration, in order to find a solution to emerging issues in the region, such as global climate change, the necessity of developing new energy and material resources locally, the development of effective prevention and/or warning systems for natural disasters, and the finding of effective infection control measures.

The sustainability of those projects, in turn, depends on how far the institutional building progresses to strengthen the linkage among universities, research institutes and firms. As the third largest economy in the world and as a matured country, Japan needs to contribute further

[23] See Fagerberg (2005) and Edquist (2005), for instance.

to build region-wide systems of innovation for Asia or for APEC or both.

VI. Summary

Following Japan that grew fast in the 1960s, many of the Asian countries have achieved a high rate of growth. Now, Asia is known as a growth center of the world. This achievement is remarkable because Asia was one of the poorest regions in the world immediately after the World War II.

Entering the 21st century, countries in the Asia-Pacific region have come to face common and serious challenges, such as the growing income disparity, the lack of economic and social infrastructure, global climate change, the underdevelopment of natural resources and energy, the region-wide spread of new infectious diseases, the outbreaks of natural disasters across the region and the underdevelopment of effective prevention and/or warning systems for natural disasters. As a result, APEC member economies come to recognize the necessity of exploring a new growth paradigm. That resulted in the adoption of the new growth strategy by the leaders at the 2010 APEC Meeting in Yokohama. The core of the growth strategy lied in the concept of "innovation". In other words, the future of the Asia-Pacific region highly depends on the capacity to innovate necessary for sustainable and inclusive growth.

Europe regards the rising innovative capacity of Asia as the source of concerns as well as opportunities for its member economies. What about Japan? What does it mean for Japan? Does it provide opportunities or raise some concerns for the future of Japan? Even though the rising innovative capacity of Asia as a whole is good per se, aren't there any challenges facing the Asia-Pacific region? What kind of strategy does Japan need to adopt, so that new emerging issues in the region could be solved and the economy of Japan revitalized? This paper was written to find the answers to these questions. The following is the summary of the findings.

First of all, the rising innovative capacity of Asia was found to imply a great opportunity for Japan because Japan's shift to Asia away from developed countries in overseas R&D activities is outstanding. The revitalization of the Japanese economy has to capitalize on the rapidly growing market of Asia, which in turn requires the development of goods and services truly demanded in the local market. Japan can only do so if highly skilled personnel can be employed locally. That also requires local institutions of higher education. Thus, the rising innovative capacity of Asia provides a good opportunity for the economy of Japan to revitalize.

There are, however, challenges facing Asia and the Asia-Pacific region as well. One of them is a growing disparity among Asian countries in terms of the capacity to innovate necessary for growth. The remarkably growing innovative capacity is observed only in countries such as China, Taiwan, Korea, Hong Kong, and Singapore. In fact, the gap between these Northeast Asian countries and ASEAN economies, excluding Singapore, tends to rise.

Second, despite the rising innovative capacity, the systems of innovation still tend to be inward-looking in Northeast Asian countries such as China, Japan, Korea and Taiwan. Even

advanced economies or large-scale companies can no longer be self-sufficient in terms of knowledge creation and acquisition. A shift to more open systems of innovation is needed.

Third, the degree of regional R&D cooperation and collaboration is still very low in the Asia-Pacific region in comparison with Europe. The institutional building is required in the former to be able to cope well with new emerging challenges APEC member economies commonly face.

Based on the above findings and analyses, this paper made three concrete proposals to promote innovation region-wide. The first one is the revival of ODA (especially ODA in the general account budget) in Japan and its strategic usage. Economic cooperation toward sectors such as education and research and development in developing Asia may not be able to be provided in a large scale through the loan program, because of the nature of public goods the assistance projects possess. The "open innovation model" was also proposed as a manner in which ODA is provided to developing Asia.

Second is the improvement of business environment in the Asia-Pacific region through Japan's active participation in the negotiations toward the conclusion of both TPP and RCEP. Many of the East Asian countries are still not very open in their systems of innovation. APEC leaders adopted the effective, non-discriminatory and market-driven innovation policy at the 2011 APEC Summit in Honolulu. The adoption of the region-wide innovation policy and the agreement of FTA such as TPP may contribute to the establishment of more outward-looking systems of innovation across the countries.

Third is the promotion of the construction of a region-wide systems of innovation. Of course, it is private firms that innovate. However, innovation does not occur in isolation. It is influenced very much by the environment of surrounding firms, such as the network development among actors, the institutional building that may influence their behavior as well as S&T policy coordination and cooperation. The construction of the region-wide systems of innovation is considered to be beneficial for Japan as well as for other Asian countries, because APEC member economies increasingly face common challenges and need to cope with them in a joint manner.

References

Archibugi, D., et al. (1999), "Innovation Systems in a Global Economy", *Technology Analysis & Strategic Management* Vol.11 No. 4, pp. 527-539.

Arond, E. and M. Bell. 2010. "Trends in the Global Distribution of R&D Since the 1970s: Data, their Interpretation and Limitations", STEPS Working Paper 39. Brighton: STEPS Centre.

Barro, R. and X. Sala-i.Martin (1995), *Economic Growth*. McGraw-Hill, Inc.

Carlsson, B. (2006), "Internationalization of Innovation Systems: A Survey of the Literature", *Research Policy* Vol.35 No.1, pp. 56-67.

Chesbrough, H.W. (2003), *Open Innovation: The New Imperative for Creating and Profiting from Technology.* Harvard Business School.

Chung, Chao-chen (2012), "National, sectoral and technological innovation systems: The case of Taiwanese pharmaceutical biotechnology and agricultural biotechnology innovation systems (1945-2000)", *Science and Public Policy* Vol. 39 No.2, pp. 271-281.

Cohen, W. M. and D. A. Levinthal (1989), "Innovation and Learning: Two Faces of R&D", *The Economic Journal* Vol.99 (September), pp. 569-596.

Cohen, W. M. and D. A. Levinthal (1990), "Absorptive Capacity: A New Perspective on Learning and Innovation", *Administrative Science Quarterly* Vol.35 No.1, pp. 128-52.

Edquist, C. (2005), "Systems of Innovation: Perspectives and Challenges", *The Oxford Handbook of Innovation*, edited by J. Fagerberg, D.C. Mowery, and R.R. Nelson. Oxford University Press, pp. 181-208.

Fagerberg, I. (2005), "Innovation: A Guide to the Literature", *The Oxford Handbook of Innovation*, edited by J. Fagerberg, D.C. Mowery, and R.R. Nelson. Oxford University Press, pp. 1-26.

Fagerberg, J. and B. Verspagen (2002), "Technology-gaps, innovation-diffusion and transformation: An evolutionary interpretation", *Research Policy* Vol.31 Issues 8-9, pp. 1291-1304.

Gill, I. and H. Kharas (2007), *An East Asian Renaissance: Ideas for Economic Growth*. World Bank.

Könnölä, T. and K. Haegeman (2012), "Embedding foresight in transnational research programming", *Science and Research Policy* Vol.39 No.2, pp. 191-207.

Leadbeater, C. and J. Wilsdon (2007), *The Atlas of Ideas: How Asian Innovation can Benefit Us All*. London: DEMOS, <http://www.demos.co.uk/files/Overview_Final1.pdf>. The latest access is October 13, 2011.

Maddison, A. (2008). "Shares of the rich and the rest in the world economy: income divergence between nations, 1820-2030", *Asian Economic Policy Review* Vol.3 No.1, pp. 67-82.

Malerba, F. (2005), "Sectoral Systems: How and Why Innovation Differs across Sectors", *The Oxford Handbook of Innovation*, edited by J. Fagerberg, D.C. Mowery, and R.R. Nelson. Oxford University Press, pp. 380-406.

Malerba, F. and S. Mani (2009), *Sectoral Systems of Innovation and Production in Developing Countries: Actors, Structure and Evolution*. Edward Elgar.

Ministry of Economy, Trade and Industry (METI) (2011), *White Paper on International Trade and Economy 2011* (in Japanese) <www.meti.go.jp>. The latest access is March 21, 2013.

_____(2013) "The 42th Summary of Basic Research on Overseas Business Activities in 2011" (in Japanese) <www.meti.go.jp>. The latest access is April 15, 2013.

Ministry of Foreign Affairs (MOFA) (2012), *Japan's Official Development Assistance White Paper* **2011** *Japan's International Cooperation* (in Japanese) <www.mofa.go.jp>. The latest access is April 19, 2015.

_____ (2013), *Japan's Official Development Assistance White Paper* **2012** *Japan's International Cooperation* (in Japanese) < www.mofa.go.jp>. The latest access is April

19, 2015.

Mitsuhashi, N., et al. (2010), *Introduction to the Japanese Economy 24th ed* (in Japanese). Nikkei Newspaper.

National Science Foundation (2004), *Science and Engineering Indicators 2004*, <www.nsf.gov>. The latest access is March 31, 2013.

_____ (2010), *Science and Engineering Indicators 2010*, <www.nsf.gov>. The latest access is March 31, 2013.

_____ (2012), *Science and Engineering Indicators 2012*, <www.nsf.gov>. The latest access is March 31, 2013.

Nikkei Industry Newspaper (2013), "The number of academic articles cited internationally of Tokyo University is the highest in Japan, but continues to decline in the world ranking for the last three years, according to a private US source" (in Japanese), *Nikkei Industry Newspaper*, dated April 17, 2013, p. 6.

Okamoto, Y. (2009), "Changes in the dynamism of the East Asian economy: Trade and FDI Nexus" (in Japanese), *Changes in the East Asian Economy: A Reflection on Ten Years after the Currency Crisis*, edited by N. Nishizawa and J. Kitahara. Koyo Shobo, pp. 73-90.

Okamoto, Y. (2011a), "A New Geography of Innovation? Opportunities and Challenges Facing the Asia-Pacific Region", *APEC Study Center Consortium Conference 2011: Key Findings and Policy Recommendations: Green Growth, Trade Integration and Regulatory Convergence*, edited by V. K. Aggarwal and R. Feinberg, <http://publications.apec.org/publication-detail.php?pub_id=1224>, pp. 23-38. The latest access is March 30, 2012.

Okamoto, Y. (2011b), "Stem Cells as a Driver of Knowledge Economy: Progress and Challenges Facing Scotland", <http://www.sussex.ac.uk/spru/research/sewps#2011>. The latest access is June 30, 2012.

Okamoto, Y. (2013), "Innovation Policy and APEC" (in Japanese), *A New Economic Order of the Asia-Pacific Region*, edited by I. Yamazawa, et al. Keiso Shobo, pp. 192-205.

Okamoto, Y. and Y. Fukasaku (2013), "APEC and Innovation Policy: Lessons to Learn from Europe", *Doshisha Policy and Management Review* Vol.14 No.2, pp. 79-91

Sawada, Y. (2003), *Basic International Economics* (in Japanese). Shinseisha.

Schumpeter, J. A. (2006), *The Theory of Economic Development with a New Introduction by J. E. Elliott*. Transaction Publishers.

Smith, K. (2005), "Measuring Innovation", *The Oxford Handbook of Innovation*, edited by J. Fagerberg, D.C. Mowery, and R.R. Nelson. Oxford University Press, pp. 148-177.

Stiglitz, J. E., et al. (2010), *Mis-measuring Our Lives: Why GDP Doesn't Add Up*. The New Press.

Wakasugi, R. and B. Ito (2011), *Global Innovation* (in Japanese). Keio University Press.

Wolverson, R. (2010), "GDP is not a panacea. But, is there an alternative measure?" (in Japanese), *Foreign Affairs Report* (Oct. 2010), <http://www.foreignaffairsj.co.jp/subscribersonly/archive/201208/Wolverson.htm>. The latest access is March 25, 2013.

World Bank (1993), The *East Asian Miracle: Economic Growth and Public Policy*. The Oxford University Press.

Yamazawa, I. (2012), *APEC: New Agenda in Its Third Decade*. ISEAS.