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Remaking Energy Policies for Global Sustainability: The Case of Flying Geese Model and Path Dependencies in East Asia

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In East Asia, the path of economic integration that started at the end of World War II, through catch-up industrialization, took a distinguished path. Started in Japan and supported by diffusion of technologies through learning and easier relocation of industries within the region, energy intensive industrialization expanded into countries with fewer development operations. Aided by official development assistance and foreign direct investment, the emergence of production networks across Southeast and East Asia permitted second- and third-tier economies to catch up with advanced economies in technology, technical skill development, and narrow the development gaps. The pattern of East Asia's catch-up has been extensively studied, with the 'Flying Geese' model being the well-known paradigm. This process of catch-up also leads to increased emissions and air, water, and soil pollutions, and to movement of emission intensity and pollutions to second- and third-tier economies. From the perspective of the energy–development nexus, does it mean that East Asia's growth pattern still could not break away from the historical path dependency in energy-intensive industrialization observed elsewhere?

This and the following questions are pursued in the paper: What factors lead to the emergency and subsequent dispersal of the 'flying geese'? What were the main characteristics of integrated environmental and energy policy formulation during the dispersal, and what lessons could be learned from those experiences for sustainable future? To our knowledge, this paper is the first such direct attempt to understand the link between the Flying Geese model and energy policies in East Asian economic development. Using the historical data on trade and energy consumption, we demonstrate that East Asian governments have proactively addressed energy intensity concerns, and have further intensified the policy. We also draw lessons learned from the model for its potential application in solving global sustainability challenges.

Keywords: Economic history, energy policy, industrialization, production networks, sustainability
JEL Classification: F01, F14, N10

1. Introduction

The 20th century is characterized by two developments of global importance. First, Asia has become the dynamo of the global economy, with its rapid industrialization and integration into the global economy through trade, financial flows, and other forms of economic and political change. Asia's output today equals roughly that of Europe or the Americas and may well be 50% larger than these regions by 2030 (IMF, 2015). This extraordinary economic expansion has broken the cycle of poverty, lifting hundreds of millions out of poverty. Second, the rapid economic growth of the region has consumed roughly a third of global resources such as energy (ADB, 2013). The open regionalism and economic integration of East Asia that have facilitated the successive growth of the high-performing economies of Japan, the Republic of Korea (henceforth Korea), and China show that energy-intensive industrialization occurs across different economies under a variety of factor endowments, pointing to an observed pattern of path dependence[1].

The prevailing account of world economic history remains roughly as follows. In the first half of the 19th century Great Britain became the 'workshop of the world', and the rest of the world specialised in exporting primary products. Countries in Europe achieved industrialization through technological innovation and by importing capital and machinery using export earnings. The vast natural resources imported from Asia into Europe fuelled growth, with induced changes in inter-regional trade, labour migration, and technology. The movement to labour-saving, capital-intensive, and resource-intensive technology also was mostly observed in the United States, which had close economic and social links with Europe. Energy-intensive and polluting technologies, such as the use of coal and steam engines, paved the way for the industrial revolution. They also contributed to carbon emissions and further replacement of labour.

In East Asia, economic integration, which started at the end of World War II through catch-up industrialization, took a distinct path. Beginning in Japan and supported by the diffusion of technologies through learning and easier relocation of industries within the region, energy-intensive industrialization expanded into countries with fewer development

[1] Path dependence explains how the set of decisions one country faces for any given circumstance is limited by the decisions one has made in the past, even though past circumstances may no longer be relevant. In energy and economic policy history, path dependence can refer either to outcomes at a single moment in time, or to long-run equilibria of a process that is often influenced by a partnering country.

options. Aided by official development assistance (ODA) and foreign direct investment (FDI), the emergence of production networks across East Asia permitted the second- and third-tier economies to catch up with advanced economies in technology and skills and narrowed the development gaps.

The pattern of East Asia's catch-up economic growth has been studied extensively, with the 'flying geese' model being the best-known paradigm. This process of catch-up also led to increased emissions; the creation of air, water, and soil pollution; and the movement of high-intensity emissions and pollution to second- and third-tier economies. From the perspective of the energy–development nexus, does this mean that East Asia's growth pattern still could not break away from the historical path dependency on energy-intensive industrialisation observed elsewhere?

This is the question we are interested to pursue in this paper. We ask three questions: What factors lead to the emergence and subsequent dispersal of the flying geese? What were the main characteristics of integrated energy and environmental policy formulation during the dispersal? And what lessons can be learned from those experiences for a sustainable future? To our knowledge, our work is the first direct attempt to understand the linkages of the flying geese model and energy policies in East Asia's economic development. We will demonstrate that East Asian governments have taken proactive measures to address energy intensity concerns, and the policy effort has been further intensified.

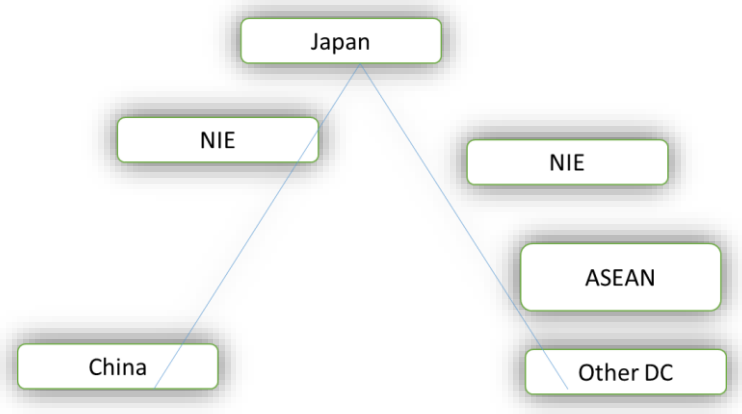
The chapter is structured as follows. First, we give a brief overview of the flying geese model to describe its general features. We highlight the process of their foundation and factors leading to their flight formation. We then focus on low-emission technologies that accompanied the formation of the flying geese and assess how so-called 'Asian values' figure in integrated energy and environmental planning. Finally, we draw lessons from the flying geese model for its potential application in solving global sustainability challenges.

2. The Flying Geese Metaphor

In the 1930s, the Japanese economist, Akamatsu (1962), postulated a multi-tier hierarchical pattern to describe how industrialization spreads. In a broader sense, his model examined the characteristics of East Asia's economic integration and its hidden costs. In the flying geese model of regional integration, industrial development is transmitted from a lead

goose (Japan) to the follower geese (newly industrializing economies – the Association of Southeast Asian Nations (ASEAN) 4 namely Indonesia, Malaysia, Singapore and Thailand, China, Hong Kong, Korea, Taiwan, etc.) (Figure 1).

Figure 1: Flying Geese Pattern of Asia



ASEAN = Association of Southeast Asian Nations, DC = developing countries, NIE = newly industrializing economy.
Source:Authors

Kojima (2000) and Kasahara (2004) explained the flying geese model as a division of labour at the regional level. Traditionally, there have been two types of international division of labour: vertical, which prevailed in the 19th century and defines the relationship between the industrialised countries of Europe and the resource-supplying countries of Asia and Africa; and horizontal, typified by Europe with intra-regional trade, often among countries at the same stage of economic development and sharing a common culture. By contrast, the flying geese pattern of East Asia evolved in the middle of the 20th century and represents a special kind of developmental dynamics. At that time, Japan, the leading goose, began to catch up with Europe and the United States in the production of non-durable consumer goods, durable goods, and capital goods, in that order. Later, East Asia's newly industrialized economies – Korea; Taiwan; and ASEAN countries such as Indonesia, Malaysia, Singapore; and Thailand – followed in Japan's footsteps. Because East Asian countries are so variable and backward in terms of their economic development, natural resource endowment, and social capital, economic integration based on the European model, which adopted a top–down approach based on subsidiarity principles, is out of question. Yet, it is precisely this diversity in economic resources and absorptiveness of technology, that worked to facilitate

the flying geese pattern of shared development, as the region was able to take advantage of this distinctiveness to develop with a supportive division of labour.

The most noticeable characteristic of the flying geese pattern of East Asian regional development is its hierarchical structure. Parties involved in this type of arrangement are not initially equal, as there always is a dominant country − the 'leading goose'− that pilots the rest of the gaggle. The patron–client value relationship is typical of this kind of hierarchical networking (Lin, 2011). In this sense, the flying geese organizational pattern can offer an explanation for Japan's technical and economic superiority and its desire to help the other Southeast and East Asian countries catch up.

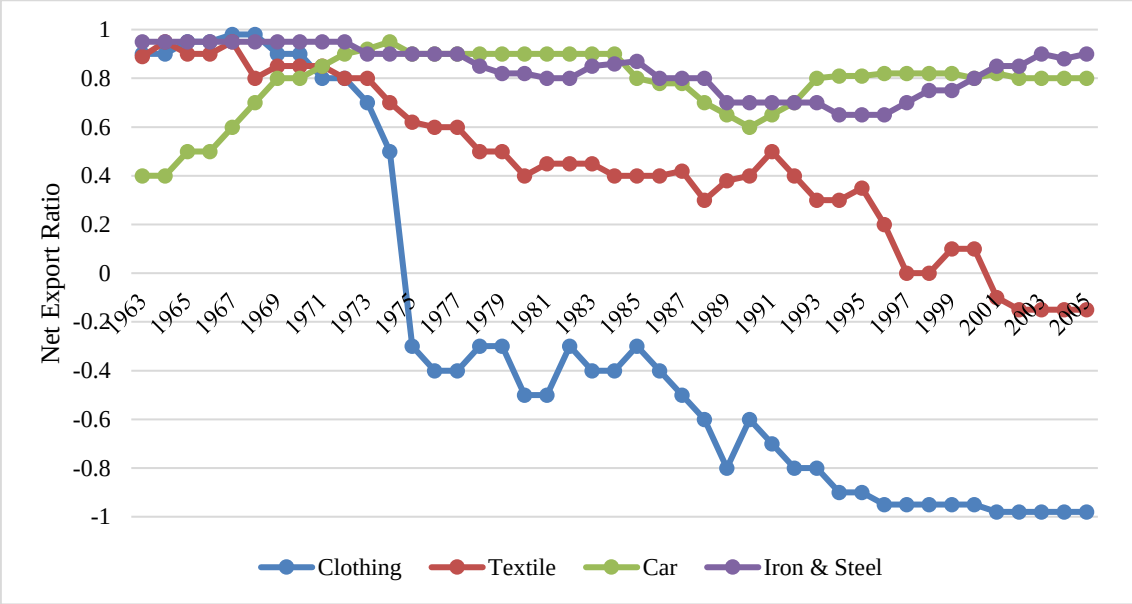
While the flying geese model is often applied to the pattern of regional economic development or multiple countries in sequence, it can also applied to the pattern of economic development in one specific country.

2.1. The one-country flying geese model

The flying geese model postulated by Akamatsu is based on Japan's industrial development, namely of the yarn and wool industries, and draws statistical evidence from the import, production, and export of Japan's industries from the 1860s to the 1930s (Akamatsu, 1962). He explained the fundamental pattern of the flying geese model in four stages. At stage one, the country begins to import manufactured goods. In stage two, domestic industry starts to produce manufactured goods that were previously imported, while importing the capital goods to manufacture those consumer goods. At stage three, domestic industry starts to export the manufactured consumer goods. At stage four, the consumer goods industry completes the catch-up with industry in developed countries, the export of consumer goods starts decline, and the capital goods used in the production of the consumer goods are now exported.

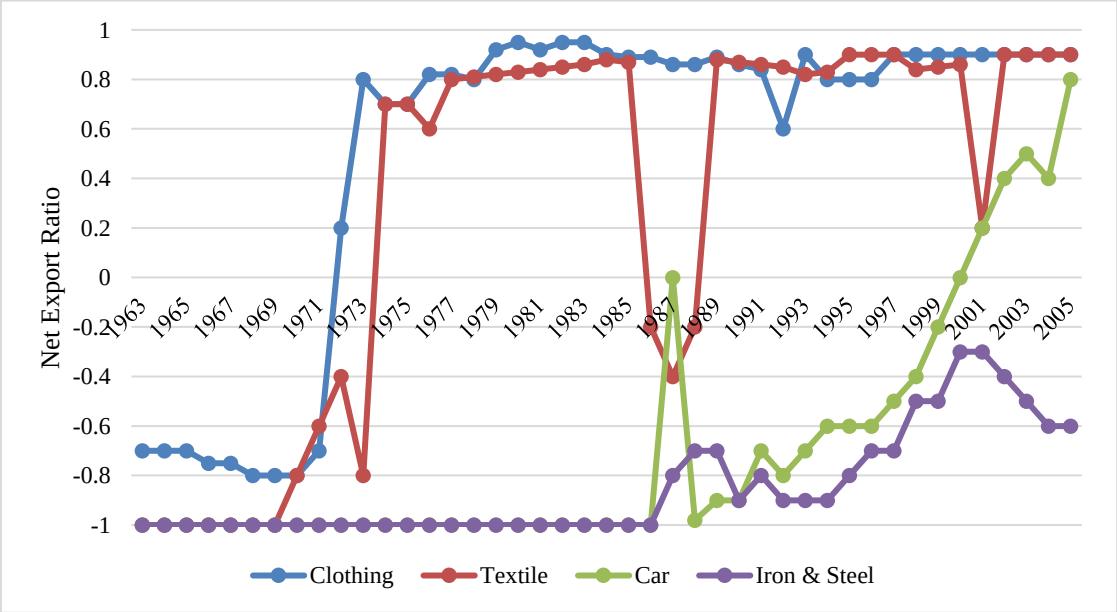
This model is tested for Japan from the 1960s to 2005 using the COMTRADE database of the United Nations Conference on Trade and Development. Figures 2 and 3 show the development of four industries in Japan and Thailand: clothing (SITC 841), textile yarn and thread (651), passenger cars (7321), and iron and steel (674). These industries are selected to represent their impacts on energy and the environment, with the impact of clothing being light relative to the others in terms of its energy intensity and generation of waste and pollution.

Figure 2: Flying Geese Pattern of Japan



Source: Authors.

Figure 3: Flying Geese Pattern of Thailand



Source: Authors.

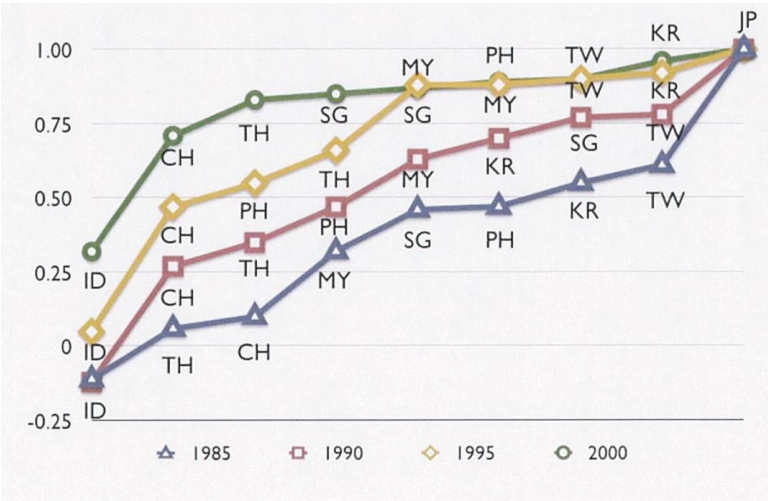
In Figure 2, Japan's flying geese pattern shows that the clothing industry declined earlier than the textile industry, and the iron and steel industry developed earlier than the passenger car industry. Figure 3, the flying geese pattern of Thailand, shows that the clothing industry developed first and the textile industry followed, and that the passenger car industry came first and the iron and steel industry followed. The clothing and textile industry developed

earlier than the passenger car and iron and steel industry. Figure 3 matches the hypotheses of Akamatsu (1962) that states that in catch-up economies, light industries develop first and heavy industries follow; downstream industries come first and upstream industries follow.

2.2. Regional economic development through the flying geese model

The flying geese pattern for East Asia is illustrated in Figure 4. During the 1970s, the newly industrializing economies – Hong Kong, Korea, Singapore, and Taiwan – followed Japan in developing industries that initially produced non-durable goods, then durable consumer goods, and then capital goods. The ASEAN countries of Indonesia, Malaysia, and Thailand followed in the third tier. Japan is the model's leading goose. In the 1970s, Japan used its technical and economic power to establish a sophisticated production network with other East Asian countries. This can be further investigated by comparing the export structure of East Asian countries (those of ASEAN, China, Korea, and Taiwan) during that period, using the 24 sector Input-0utput tables for the analysis during 1985–2000.

Figure 4: Correlation of Export Structure of Second- and Third-Tier Geese with Leading Goose, Japan, 1985–2000

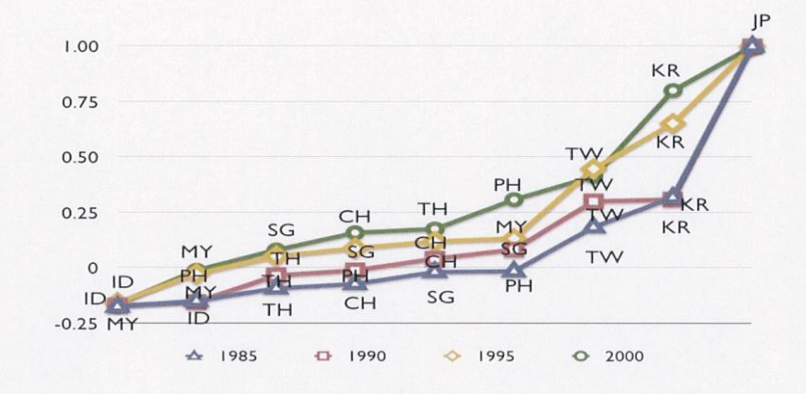


CH = China, ID = Indonesia, JP = Japan, KR = Republic of Korea, MY = Malaysia, PH = Philippines, SG = Singapore, TH = Thailand, TW = Taiwan.
Source: Kumagai, 2008

In 1985, the order of the flying geese is clear: Japan is the leading goose, Taiwan and Korea follow, then come the ASEAN countries and China. However, by 2000, the follower geese have caught up and the slope of the graph has flattened. It seems that the flying geese pattern of economic integration in East Asia changed during 1985–1997, and Japan is no

longer the sole leading goose in the region – Korea and China have taken up part of the lead. If, however, the machinery sector is removed, a quite different pattern emerges. As Figure 5 shows, the order and slope of flying geese in East Asia have not changed much over the years.

Figure 5: Correlation of Export Structure of Second- and Third-Tier Geese with Leading Goose, Japan, Excluding the Machinery Sector



CH = China, ID = Indonesia, JP = Japan, KR = Republic of Korea, MY = Malaysia, PH = Philippines, SG = Singapore, TH = Thailand, TW = Taiwan.
Source: Kumagai, 2008

This is understandable, as the development of new industries such as electronics is quite different from the original pattern of industrial development proposed by Akamatsu in 1962. The development of the electronics industry in East Asia, especially after 1970, is based on off-shore production networks and original equipment manufacturing through free trade zones (Kumagai, 2008). This is fundamentally different from the market-driven industrial development of Japan, which is the basis of Akamatsu's flying geese model.

Nevertheless, one important aspect of East Asian integration is that the apparent catch-up of the second-tier economies in which the progress of the flying geese was maintained and reinforced through the use of ODA, which facilitates trade-oriented FDI. Through this means, the comparatively disadvantageous production of the lead flying goose or geese is transplanted onto a follower flying goose, strengthening its comparative advantage. Table 1 shows the increasing role of ODA and FDI in Japan's economic relationship with ASEAN, the second-tier geese.

Table 1: Economic Relationship of Japan with the Association of Southeast Asian Nations

Year	Trade		Foreign Direct Investment		Official Development Assistance	
	$ million	%	$ million	%	$ million	%
1967	2,209	9.9	74	26.9	180	52.8
1968	2,440	9.4	60	10.8	135	43.9
1969	3,100	9.9	75	11.3	143	42.1
1970	3,673	9.6	123	13.6	170	45.8
1971	4,159	9.6	152	17.7	177	41.0
1972	4,997	9.5	213	9.1	242	50.6
1973	8,047	10.7	621	17.8	322	42.1
1974	13,369	11.4	564	23.5	360	40.9
1975	12,290	10.8	856	26.1	381	44.7
1976	13,799	10.5	1,041	30.1	360	40.9
1977	15,730	10.4	636	22.7	266	29.9
1978	18,566	10.5	917	19.9	447	29.4
1979	25,923	12.1	595	11.9	569	29.8
1980	34,245	13.9	927	19.7	701	35.9
1981	36,162	13.3	2,834	31.8	797	35.4
1982	34,304	14.0	801	10.4	682	28.9
1983	32,377	12.7	973	11.9	724	30.0
1984	36,160	11.8	906	8.9	833	34.3
1985	31,462	10.3	935	7.6	800	31.2
1986	28,644	8.5	855	3.8	914	23.7
1987	35,153	9.3	1,524	4.6	1,679	32.0
1988	43,853	9.7	2,713	5.8	1,920	29.9
1989	51,775	10.7	4,684	6.9	2,132	31.5
1990	62,236	11.9	4,082	9.2	2,299	33.1
1991	69,438	12.6	3,696	8.9	2,149	24.2
1992	72,257	12.6	3,867	11.3	2,975	35.1
1993	83,485	13.9	3,040	8.4	2,255	27.7
1994	98,187	14.6	4,957	12.0	1,883	19.5
1995	125,921	16.1	5,475	10.8	2,228	21.1
1996	127,483	16.7	6,382	13.2	1,693	20.3
1997	120,689	15.8	7,780	29.8	1,354	14.4
1998	85,994	12.8	4,454	18.0	2,356	22.1
1999	88,873	12.1	1,032	4.6	3,920	32.2
2000	127,773	14.7	207	0.6	3,126	23.1
2001	111,294	14.7	4,013	10.4	2,108	21.4
2002	109,097	14.4	4,256	13.1	1,747	20.9

Sources: METI, Tsusho Hakusho, MOF – Financial statistics, MOFA – Waga Gaiko Kinkyo.

Meanwhile, from 1960s, as had been the case with East Asian newly industrializing economies, Japan assisted the third-tier ASEAN geese in their efforts to industrialize and

modernize their economies by supplying them with vast amounts of foreign aid that catalysed further private investments. Although there had been no formal declaration from Japan of its intention to form and lead another gaggle of flying geese after Hong Kong, Korea, and Taiwan, in terms of economic interdependence and production network, Japan had successfully carried out a de facto regional integration in Asia.

The most prominent features of the second and third gaggle of flying geese are that (i) in the bid for regional integration, the leading goose, Japan, relied solely on its economic power and technology prowess; (ii) Japan employed its ODA to consolidate its production network in East Asia; and (iii) the Government of Japan made efforts to couple private capital that could able to levered by ODA plans. The regional production network established through flying geese in East Asia is a form of informal economic integration. It involves no formal institution or intergovernmental agreement but works according to the business logic of transnational activities.

2.3. The flying geese model in changing times

The flying geese phenomenon has been the subject of several debates, especially on whether the geese are still in flight or have landed. While it is difficult to analyse the dynamics empirically because of insufficient disaggregated data, it appears that since 1997, the flying geese pattern has continued in East Asia and has the potential to help other low-income ASEAN and South Asian countries catch up. Japan, which had comparative advantage in the late 1960s in many lighter manufacturing industries, continues to leave that space to other developing countries. Other East Asian economies climbed onto the ladder during 1990–2010 and have begun to take over larger shares of global production. Table 2 illustrates this phased development. For example, in the early 1990s, Japan continued to be the dominant player in toys but was clearly moving up the technology ladder to more sophisticated games such as Nintendo and Sony PlayStation. By the late 1990s, China dominated conventional toys production. A country ranking established from data at the World Trade Organization 6-digit level for exports in the World Integrated Trade Solution database also shows that Korea used to be a major exporter of footwear in the early 1990s but has now moved out of the sector, leaving the space to India and Thailand. In pharmaceuticals, India caught up with Japan over a 20-year period. China has been moving up in the ladder in the iron and steel and electrical machinery industries since the 1990s.

Table 2: Country Ranking of Selected Industries in 1990 and 2010

Ranking	Pharmaceuticals		Footwear		Iron and Steel		Electrical Machinery		Toys	
	1990	2010	1990	2010	1990	2010	1990	2010	1990	2010
Japan	1	2	5	5	1	2	1	2	2	2
Korea	4	4	2	4	2	3	2	3	3	4
China	2	3	1	1	3	1	3	1	1	1
Thailand	5	5	3	3	5	5	4	4	4	3
India	3	1	4	2	4	4	5	5	5	5

Source: World Integrated Trade Solutions (WITS) database. http://wits.worldbank.org/

The 1997 Asian Economic crisis tested the efficacy of flying geese-based regional development. At that time, Radelet and Sachs (1997) suggested that the way for Asia to move forward from the crisis was to develop new industries with the transfer of technology and production process from advanced countries to the poor countries in order to link them. Ljungwall and Sjoberg (2005) observed that following the flying geese pattern of development has resulted in Asia's speedy recovery from the economic crisis. The 2008 global financial crisis once again led policy makers to revive the essence of the flying geese model as a means to energise regional markets and develop new production network hubs, including on green industries, such as solar photovoltaics. That encouraged more inter- and intra-regional trade and helped the countries address the negative social impacts of the crisis. The revival of the flying geese model for meeting the 2030 Agenda for Sustainable Development and the Paris Climate Agreement will probably see a new wave of countries involved. Whereas Japan used to be the lead driver, the new flying geese will perhaps have China, India, Korea, and Thailand at the helm, with lower-income ASEAN and South Asian countries following.

3. The Changing State of Energy and the Environment under the Flying Geese Paradigm

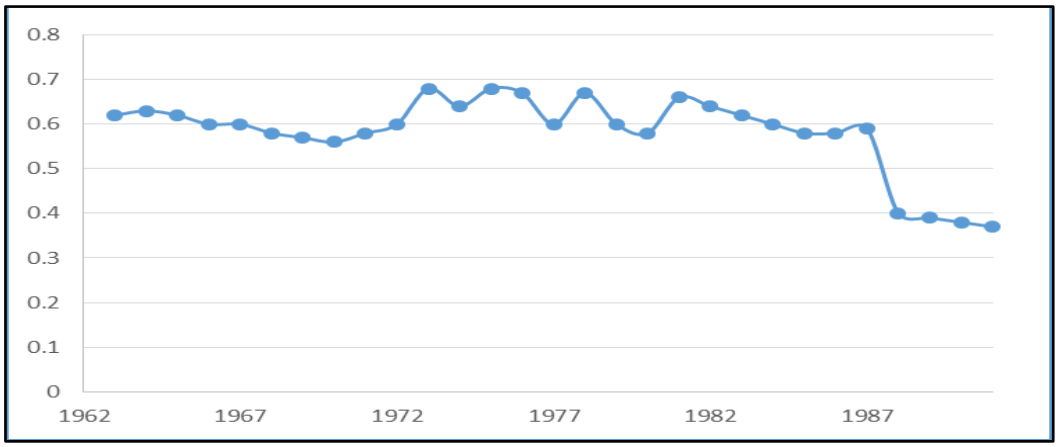
The flying geese paradigm of East Asia regional development, which closely followed the logic of the market, aided or created by FDI and ODA, postulated that industrial production shifts in accordance with the comparative advantages and development choices of the flying geese. Countries located at a higher position in economic history and regional hierarchy provide the initiatives for the region to collectively catch up. This mechanism is a seen as a disguised framework of trickle-down effects that reduced inequalities among the East Asian countries and narrowed development gaps. The critical question is whether such a mechanism of regional integration would promote long-term sustainable development from the perspective of energy conservation, emissions reduction, and environmental protection. The complex reality of the flying geese pattern in East Asia does not lend itself to an orderly catching-up process towards sustainability, but shows a path dependency in integrated energy and environmental policy making.

3.1. Relative decline of carbon-intensive polluting production with the one-country flying geese model

The flying geese pradigms has a profound impact on increased energy consumption and pollution. In 1955, the total energy supply of the leading goose, Japan, stood at 64 million tonnes of oil equivalent (Mtoe). The main energy source at that time was carbon-intensive coal, which accounted for 47% of total supply. The primary energy supply continued to expand in line with economic growth, totalling 385 Mtoe in 1973. The first oil crisis of 1973 and second oil crisis of 1979 prompted Japan become aware of the need for energy conservation. Although the country's primary energy supply continued to increase, the pace slowed due to energy sector regulations and a change in industrial structure induced by the flying geese. A sector-by-sector breakdown shows that after peaking at 165 Mtoe in 1973, the final energy consumption of the industrial sector declined continued to 130 Mtoe in 1982. Manufacturing industries curbed their final energy consumption by shifting their emphasis from materials-based production moved to lower-tier flying geese and energy conservation technologies were introduced are introduced, in response to high oil prices. The iron and steel industry in particular has made remarkable progress in promoting energy conservation. As a result, the proportion of final energy consumption by manufacturing industries declined from 36% in 1974 to 26% in 2006. The combined portion of four energy-intensive industries – steel, paper and pulp, chemicals, and cement – declined from 44.4% in 1974 to 31.0 % in 2006. 'as production moved to lower-tier flying geese and energy-conservation technologies were introduced…'?

It is interesting to note that, compared with the other light sectors, such as textile and yarn, and Japanese manufacturing as a whole, the share of these four sectors trended strongly downward during 1963–1993 (Figure 6). As a proportion of clean sector production, the output of high-carbon sectors dropped over 60% in 1963 to about 30% in the mid-1990s (Figure 6). As a proportion of total manufacturing production, these four sector outputs also dropped from about 25% in the early 1960s to about 15% in the mid-1990s.

Figure 6: Industrial Production Ratio (energy intensive/non energy intensive) of Leading Goose, Japan



Source: Authors.

The time analysis also shows clear breaks in the trend during the rapid increase in oil price in 1973 and 1979. Since these heavy industries have relatively high energy intensity, the short-run response to the energy price increase was a push-through to customers and a temporary escalation of output value relative to the value of sectors with lower energy intensity. After each break, however, the downward trend quickly reasserted itself. Reasons for this change could be an increase in the energy price and the relocation of some polluting industries to other parts of East Asia.

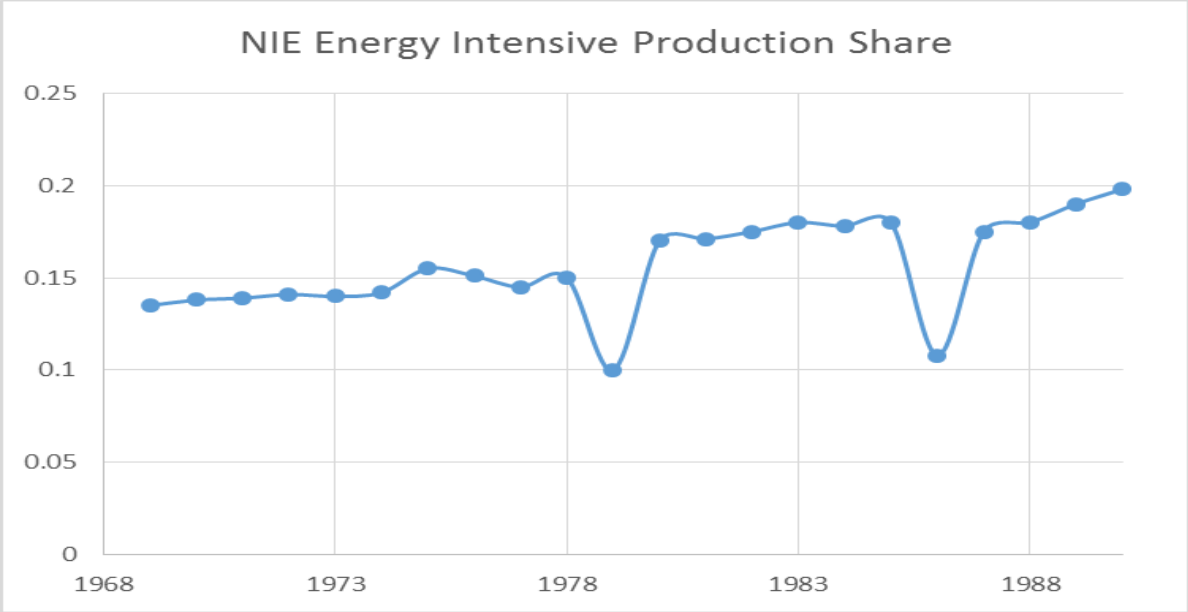
3.2. Energy- and pollution-intensive production in the regional flying geese model

The impact of the change in energy prices and relocation of industries in the catch-up process are illustrated in Figure 7 for Hong Kong, Indonesia, Korea, Malaysia, Taiwan, Thailand, and Singapore from 1969 to 1990. Third-tier flying geese countries show a steady

upward trend in the share of carbon-intensive production – a mirror image of the downward trend in the leading goose, Japan, during the same period. Superposed on this steady increase are pronounced turning points in import–export ratios of the second-tier flying geese from the mid-1970s for high-carbonindustries. The trend also exhibits a sudden shift downward in the mid-1970s, due to the oil crisis, but is approximately constant otherwise.

Although several interpretations are possible, these trends are consistent with the following argument. During the 1970s, rapid economic growth and the relocation of industries from the leading goose coincided with stricter regulations in Japan, relatively weak energy efficiency standards and environmental laws in second-tier flying geese, and stable energy prices worldwide. During this period, the relative demand for energy-intensive and polluting industrial production fell in Japan and grew at least as rapidly as domestic production in the second-tier flying geese of East Asia and other ASEAN countries. Many of these countries were ready to catch up in the flying geese formation.

Figure 7: Polluting Sector Production Share of Third-Tier Flying Geese, 1969–1990



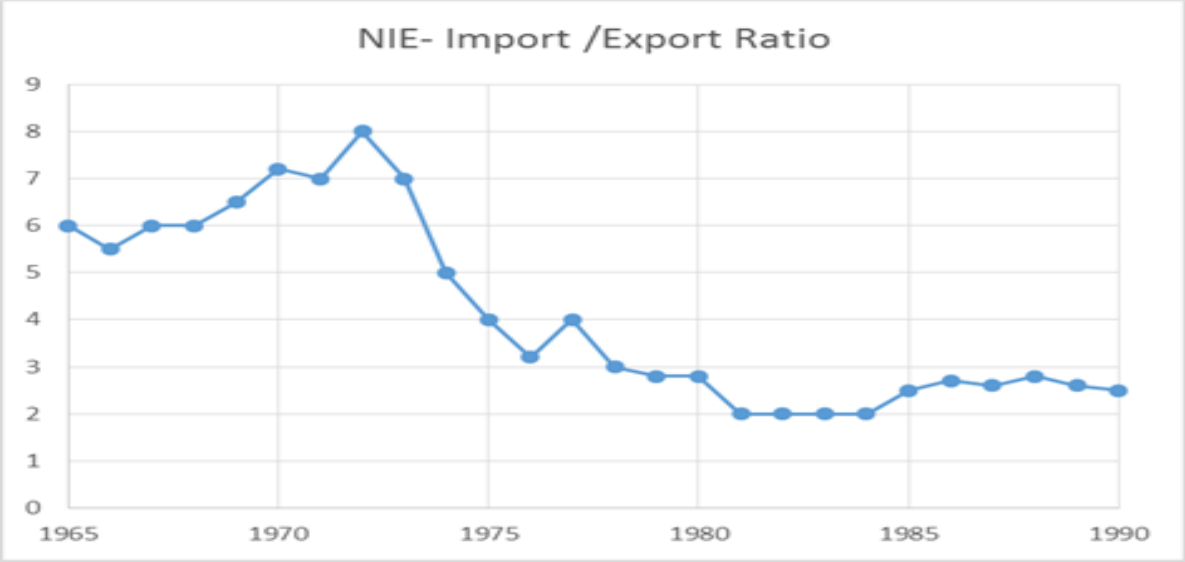
Source: Authors.

When the two oil shocks hit, the sudden shift in energy prices changed conditions significantly. From the position of net importers of energy- and pollution-intensive goods, ASEAN and other East Asian countries experienced a rapid decline in import–export ratios as weaker regulation and, possibly, lower energy prices altered the comparative advantage of energy-intensive production (Figure 8). Pollution-intensive production grew faster in East

Asia and ASEAN countries and receded more quickly in the lead flying goose than could have been predicted from environmental Kuznets curves.

By the late 1980s, three mitigating factors had again altered the East Asian sustainability landscape significantly (Hettige et al., 1998). First, as economic growth continued, the second- and third-tier geese experienced some decline in the income elasticity of demand for high-carbon sectors such as iron and steel. Second, rising awareness of environmental problems and fossil fuel use led to the enactment and enforcement of stricter energy and environmental regulations in Indonesia, Korea, Taiwan, and Thailand. Third, the energy price gap narrowed as world oil prices stabilised and Hong Kong, Korea, Singapore, and Taiwan abandoned their energy subsidies for industry. As a result, the share of energy-intensive production stabilized. The import–export ratio also stopped decreasing. But ASEAN remained a significant net importer of pollution-intensive products because of the investment structure of production networks and the resources needed.

Figure 8: Import–Export Ratio Polluting in Second Products, 1965–1990



Source: Authors.

4. Rethinking of Sustainability and Policy Path Dependencies under the Flying Geese Framework

It is important to consider both economic growth and environmental conservation together during the industrialization phases. However, thinking on a global or regional scale, actions on sustainability can sometimes lead into a kind of delusion. The proposition that the world as a whole or East Asia in particular should continue to register growth does not necessarily equate with the proposition that all countries and the region are achieving growth. Some places have positive growth, others zero, and some negative, depending on industrial relocation, which is also reflected in changes in energy and environmental parameters, as shown in Table 3.

Table 3: Impacts of Flying Geese on energy consumption in Selected Countries

	Energy imports, net (% of energy use)		Energy production (Mtoe)		Energy use (kg of oil equivalent per capita)		Fossil fuel energy consumption (% of total)	
	1973	2010	1973	2010	1973	2010	1990	2010
Japan	90.8	80.1	29.5	99.3	2964.2	3895.7	84.5	80.9
Taiwan								
Korea	68.6	82	6.8	45	632.3	5060.2	83.8	82.9
China	-1.1	10.7	431. 4	2200	483.7	1845.7	75.7	87.5
ASEAN 4:								
Malaysia	-0.4	-22	6.1	90.9	520.1	2648.5	88	94.8
Indonesia	-148.7	-81.4	94.9	379.9	307.1	866.8	53.4	66.7
Thailand	47.7	40.1	8.2	70.6	388.6	1766.9	63.8	80
Philippines	53.2	41.7	8.1	23.6	439.9	434.2	43.1	60.1

Source: IEA (2014).

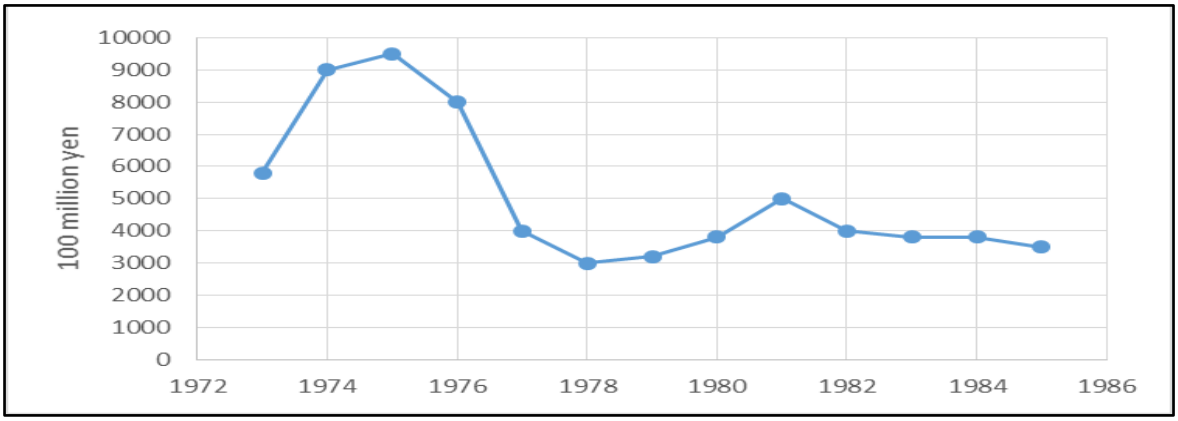
The timing of the introduction of stricter energy and environmental regulations and institutional investment in energy conservation that accompany the catch-up process influence the sustainable development aspirations and policy-making process of the flying geese countries.

4.1. Institutional matrix for remaking energy and environmental policies in flying geese catch-up

The timing of stricter energy and environmental regulations and institutional investors has had an impact on the pursuit for new energy and environmental policies. In the leading goose country, Japan, cities such as Kitakyushu, Osaka, and Tokyo had enacted some

pollution-control measures by the mid-1960s, and Japan's first water quality preservation law was enacted in 1958. However, strong opposition from growth-oriented stakeholders hampered the national movement towards stricter regulation until the 1960s. During 1967–1970, a succession of regulations covering industrial air and water emissions were enacted. As regulatory activity increased and the oil crisis occurred, Japanese industry went through a period of rapid adjustment to new energy and environmental norms. Figure 9 shows how the mid-1970s witnessed a surge of investment in energy efficiency and pollution control by Japanese industry. In light of the trend, it is plausible to suppose that tightened regulation had an impact on the relative fortune of pollution-intensive production in Japan during in the 1970s and early 1980s.

Figure 9: Emission- and Pollution-Control Investment by Big Enterprises in Japan, 1972–1985



Source: Authors.

Japan's energy efficiency improvement and pollution-control policy also provided subsidies to private enterprises for energy and environmental conservation investments. These took the form of tax benefits and loans at favourable interest rates. Table 4 compares government subsidies and financial outlays by private enterprises.

Table 4 shows that, even if the compliance costs for regulations are taken into consideration, the level of public sector financial aid to industries was sufficient to mitigate the burdens placed on the private sector. However, tightened regulation and subsidies cannot fully explain the decline of pollution-intensive production in 1960s, which was the start of the catch-up process by the newly industrialized economies of Korea and Taiwan, and the newly industrializing economies in East Asia.

Table 4: Comparison between Government Subsidies and Financial Outlays by Enterprises (100 million yen)

Policy Instruments – Govt. Subsidies		Outlays by enterprises	
Tax Reduction for pollution control devises For national tax For local tax	619 370 249	Contribution by enterprises by compensation law	356
Public expenditure for Pollution control projects	438	Expenditure by private enterprises on pollution control project	483
Public loan to enterprises	343		
Total	1,400		839

Source: Miyamoto, 1981.

4.2. The role of local government in shaping national policies

The private sector decisions and national policies on sustainability were also shaped by local government in unconventional ways at the start of the flying geese phenomenon in late 1970s. The number of protest movements demanding stronger measures against fossil fuel use increased at that time in Japan. As a result, progressive mayors and governors were elected in Kitakyushu, Osaka, Tokyo, and Yokohama. Although local governments may enact ordinances and bylaws, as a rule, such ordinances cannot exert stronger control than that envisaged by the national government policy. Generally, local governments sought ways of controlling pollution without conflicting with national law.

One innovative method was pollution-control agreements. These agreements between local governments and industries defined the essential duties of business managers and energy auditors in protecting the environment and conserving energy. The first such agreement was signed in 1964 between the city of Yokohama and an electric utility when a new coal-fired thermal power plant was planned for construction near a densely populated residential area. At that time, in spite of a 1962 law on emissions control, electric power plants were exempted from local government jurisdiction. The Yokohama case was a landmark because a local government was able to induce an industry to undertake energy-efficiency and pollution-control measures. Two factors made it possible for this local government to enforce stricter standards than those of the central government (Sakumoto, 1992): the local government had technical staff with sufficient specialised knowledge to

advise the electricity utility, and the citizens gave ample support to the agreement. Following the Yokohama City agreement, in 1968, a pollution-control agreement was reached between the Tokyo metropolitan government and an electric power company in Tokyo. Since both the Tokyo and Yokohama agreements were innovative, effective, and successful in controlling pollution, similar agreements were concluded around the nation in 1960s. All of them derive their effect from local government persuasion rather than legal force of ordinances.

In Korea, Taiwan, and some ASEAN countries, where public desire for local autonomy in pollution prevention and for reform of the public finance system drew increased traction in 1970s, the Japanese experience as lead flying goose not only provided relevance but also triggered similar agreements by Seoul (1976), Taiwan (1979), Bangkok (1983), and Bandung (1986). This can be seen as a spill over effect of the flying geese phenomenon, as these cities house many transnational companies.

4.3. Path dependencies of flying geese in integrated energy and environmental policy making

The hidden cost of industrialization and the catch-up process through or because of the flying geese effect is also visible in the region. The path dependencies that being studied, understood, and implemented are the areas in which Japan has been a path setter in making integrated policies with the participation of the private sector and local governments. Examples of such progressive policy areas include the polluter pays principle, proceeds of the performance improvement, namely energy savings and pollution reduction, of both automobiles and the automotive industry, and energy taxation.

For a comparative analysis, it is convenient to group the flying geese economies as shown in Table 5. Cascading effects within second- and third-tier flying geese and path dependency can be seen in 1970s and 1980s, although rapid change in locational conditions and the advantage of energy- and pollution-intensive industries and sectors in catching up could also have influenced the policy-formulation process.

The integrated energy and environmental policies that the first-tier flying geese, Korea and Taiwan, adopted from Japan after a time lag are as follows. First, Korea and Taiwan have employed a Japanese system to facilitate the construction of electric power plants. In areas where residents have opposed prospective sites for electric power plants, a type of electric power tax has been established. Proceeds from the tax have been used as compensation to finance policies that encourage site selection and approval, thereby

speeding up the process. Second, they introduced tax cuts and subsidies for corporate pollution countermeasures. This type of policy has not been initiated for the sole purpose of environmental preservation, but rather as a part of industrial policy. Third, they adopted a policy of coastal development involving the filling in of land with waste. This method provided significant economic value in that it simultaneously offered an inexpensive way to dispose of industrial solid waste while providing new land for development. In other words, the flying geese model for energy conservation and environmental protection as comprehended and introduced by second-tier flying geese does consist not only of experiences, lessons, and policies of the lead goose, but also of process by which they are created.

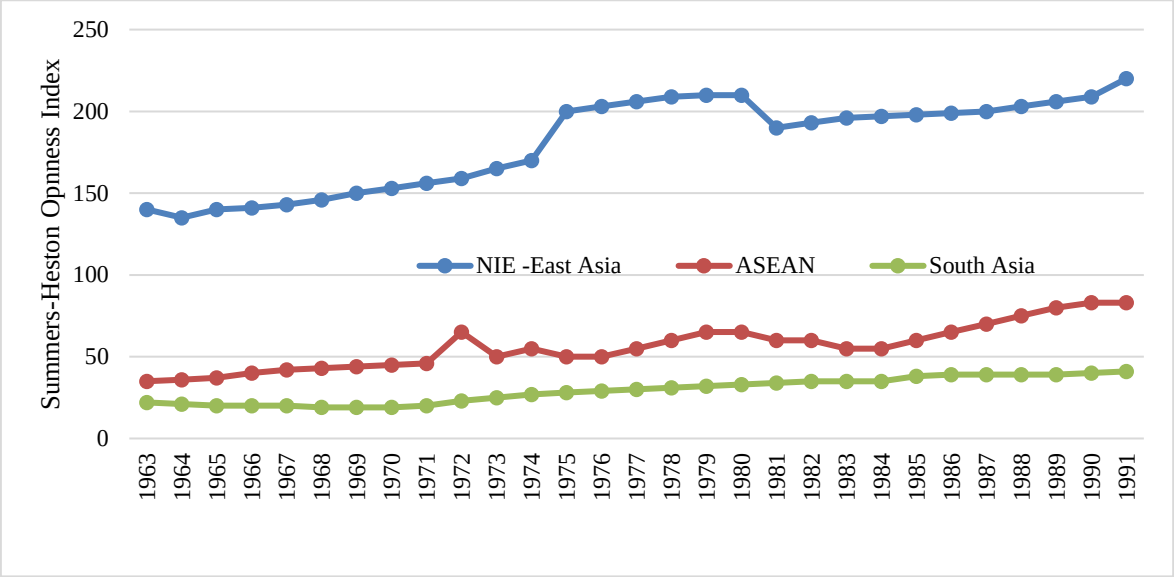
Greater progress on environmental issues through openness to new ideas and best practices. Figure 10 shows change in degree of trade openness, which provides opportunities to absorb technologies that bring sustainability. When the timing of energy and environmental regulations formulated during 1963 – 1991 are superimposed, it can be seen that the second-tier flying geese of East Asia were relatively open in the 1970s, or in other words, at the beginning of high energy efficient and environmental conservation law and were already experiencing environment friendly growth. The members of ASEAN began to liberalize their economies significantly in the 1970s, and in the 1980s, introduced strict energy efficiency and environmental regulations. In contrast, in South Asia, which did not follow a structured flying geese pattern, the introduction of stricter energy and environmental regulations was delayed until the mid-1990s.

Table 5: Initial National Energy and Environmental Legislation

	Energy Efficiency	Renewable Energy	Air	Toxics
Japan	1971	1973	1967	1958
Taiwan	1975	1977	1971	1960
Korea	1978	1980	1974	1965
Singapore	1978	1990	1974	1974
Malaysia	1977	1980	1977	1979
Indonesia	1988	1990	1988	1981
China	1975	1978	1975	1989
Thailand	1985	1985	1985	1989
India	1974	1980	1981	1986

Source: Authors.

Figure 10: Openness of Selected Asian Countries



ASEAN = Association of Southeast Asian Nations, NIE = newly industrialized economy.
Note: Summer–Heston Openness index = (exports + imports)/nominal gross domestic product
Source: Authors.

4.4. Advantages of policy backwardness within the flying geese paradigm

The continued existence of some sustainability challenges, such as low energy efficiency and environmental destruction, does not necessarily mean they will become a national priority under the flying geese paradigm, which is based on market rationality, compared to the state-owned developmental paradigm. It is not until energy and environmental costs exceed the economic limit that their existence is widely recognized by society and policy countermeasures will be implemented. Unfortunately, social recognition of an environmental problem and countermeasures often requires substantial amounts of time and stakeholder agreement. This policy backwardness could be manifested in the area of green technology absorption. When Korea and Taiwan established their heavy and chemical industries in the 1970s, the development of technology to overcome energy shortages and environmental problems had already become a major priority in Japan, the leading flying goose, and was available on the market. As a result, the second-tier flying geese were able to import production systems that incorporated more efficient and low-carbon green technologies. Korea and Taiwan have developed heavy industry at a faster pace and in a more environment friendly manner than Japan did. Therefore, it seems reasonable to conclude that the environmental damage incurred during the catch-up process

can be made relatively light if the flying geese pattern is followed by appropriate technical, economic, and knowledge assistance.

One critical difference between Japan's energy and environmental policy formulation and that of second-tier flying geese such as China, Korea, and Taiwan has been in the area of technological and organization innovation. Amsden (1989) has pointed out that Korea and Taiwan differed from Japan in that their energy efficiency improvement and pollution prevention came about primarily because of learning rather than innovation. Beginning with Korea and Taiwan, the late-industrializing ASEAN countries were the first to attempt to penetrate world export markets with little more competitive advantage than low wages. By contrast, industrialization and energy conservation in Japan have a strong indigenous innovative base. The second- and third-tier flying geese countries have had a far greater and longer-lasting dependence on imported technology, primarily from the leading flying goose, Japan. Those industries that have been successful in making backward linkages from the production of end use to intermediate goods, such as the textile machinery industry, have essentially acquired the capability to manufacture standard products developed in Japan through reverse engineering, licensing of know-how, and learning by doing. As a result, most manufacturing in East Asian and ASEAN countries depends on continued imports of key components and machinery. By contrast, Japanese companies not only possessed the ability to absorb and improve upon foreign technology through indigenous research and development systems, but also have built strong marketing networks that facilitated worldwide brand recognition in environmental protection.

5. Conclusion

The impressive economic history and development performance of East Asian economies has been the subject of debate. The phenomenon of regional economic integration based on the flying geese paradigm clearly explains that a region-wide industrial catch-up will result in trickle-down benefits. The flying geese theory postulated that hieratically sequenced regional economies could systematically exploit their comparative advantages through an orderly migration of industrial activities. It implies that developing economies can catch up sooner by being part of a flying geese formation provided they orientate themselves towards more advanced economies. This paper analysed the flying

geese pattern of regional integration that emerged in East Asia at the later part of the 20th century. It found that the flying geese paradigm requires not only successful support from the leading flying goose or geese, but also effective coordination among the second- and third-tier flying geese, where the identification and timing of industrial shifting should be mutually understood, beneficial, and based on market rationality. Being the lead flying goose and emerging lead flying geese, Japan, China, Korea, India and other newly industrialized economies must increase their trade in services through new production networks with other ASEAN and South Asian countries. This would narrow developmental gaps.

It is also seen that the region's energy and environmental status is influenced by the sequential take-off of the flying geese. Countries with open economic policies have benefited from new types of investment and technical assistance and have become successful followers in the catch-up process towards sustainability. The cross-country analysis also found a pattern of evidence that is consistent with the pollution havens story. However, pollution haven effects are transient as there is a path dependency in formulating progressive energy and environmental regulations. The ODA and FDI that have facilitated the flying geese pattern could be used to transfer clean technologies and thus create another dependency path. However, too much dependence on foreign technology is to be discouraged in the new wave of flying geese. Second- and third-tier flying geese should capture the spillovers of the FDI to promote indigenous innovation. South–South dependency within the regional production hierarchies will also facilitate green productivity and enhance skills formation.

In closing, it is worth asking whether the flying geese pattern of regional economic development is a cause for optimism or pessimism in relation to meeting the Sustainable Development Goals and the Paris climate agreement targets. A plausible answer seems to be both. It is comforting to see that the energy-related emissions of major economies, such as China, Europe, India, Indonesia, Japan, and the United States, are set to peak and latter decline because pollution intensity has an elastic response to income growth and a new flying geese pattern is emerging that incorporates low-carbon production networks. It is clear that the climate targets can achieved with reliable environmental safeguards on trade policies, public–private partnerships for technology transfer, and investment in innovation. Cross-country differences and backwardness in energy and environmental regulations reflect a broad cascading continuum of experience and the potential capacity to dwarf carbon leakages. Some portion of international adjustments, such as universal carbon pricing,

waning of energy subsidies towards energy efficiency improvement, and progressive strengthening of environmental regulations within the framework conditions of flying geese path dependencies, could play an important role in the meeting the sustainability targets.

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