Executive Summary

Development of Regional Production and Logistics Networks in East Asia

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1 SIGNIFICANCE OF THE PROBLEM AND OBJECTIVES

The Association of Southeast Asian Nations (ASEAN) and East Asia have shown satisfactory growth and development in recent years. Their manufacturing sector's value-added as a proportion of GDP followed a general pattern of growth and structural transformation in line with Syrquin's paper (1988). We also observe the narrowing down of the economic development gap (i.e., late comers are now showing fast-growing GDP and increasing income per capita). Most importantly, the level of growth may stem from the fact that the ASEAN and East Asia now have a deeper regional economic integration, as a result of trade liberalization and the formation of industrial clusters or agglomerations. In other words, the economies in the ASEAN and East Asia showed an unprecedented improvement in their international production networks with lower business linkage costs.

However, most economic development theories in the past have not introduced explicitly the role of spatial economic dynamics. Most relied on heuristic assumptions

of perfect competition, constant returns to scale, etc., such that firms in a general equilibrium situation are free from issues of immobility of factors, scarcity of land input, congestion, and pure diseconomies. Increasing return to scale, thick markets, knowledge spillovers and other pure external economies are out of reach as well. Fujita *et al*. (1999) have resolved these shortcomings by proposing a general equilibrium model that drives forces of spatial concentration and dispersion of economic activity. The sustainability or instability of concentration depends on two forces; namely, *centripetal* force, which tends to promote concentration of economic activity, and *centrifugal* forces, which act against concentration. In an elemental model for two-region economy, industry disperses to two regions when transport cost is enough high, while the one region gets whole industry and the other region loses it as the transport cost decreases.

Agglomeration and regional growth have been further studied by Fujita and Thisse (2002, pp.338-431). A simple endogenous growth model for a two-region economy is used. This represents a combination of core-periphery model and differential products, with the R&D sector added explicitly, so that the number of firms that use skilled labor to create new varieties for the modern sector is variable. The study shows how the growth of the global economy depends on the spatial agglomeration of the innovation sector across regions. However, if the patents for new products can be transferred without cost, R&D activities will concentrate in a single region. The modern sector is either fully or partially agglomerated in the same region as the R&D sector. The core-periphery structure in which the innovation and the modern sectors are entirely agglomerated into the same region is stable when the transport cost of the goods produced by the modern sector is sufficiently low. If knowledge externalities among skilled workers become more localized, the range of transport costs expands to stabilize

the core-periphery relationship.

The R&D sector is a strong centripetal force at the multiregional level, amplifying the circular causation of the core-periphery model. This confirms that "growth and agglomeration go hand in hand" (Fujita and Thisse 2002, p. 391). In short, when the economy moves from dispersion to agglomeration, innovation follows at a faster pace and the unskilled labor residing in the periphery will prosper as well, provided that agglomeration is strong at the core.

The objective of the research is to study the dynamic process of industrial clustering of firms in selected ASEAN and East Asian economies. The nature of clusters (whether called "innovation clusters," "high-technology clusters" or "innovative milieu") has the following characteristic: geographical concentration that, according to Porter (1988, p.78), has a high degree of specialization, a large number of mainly small- and medium-size firms; ease of entry and exit; and a high rate of innovation. Smith (2006) has noted the pioneering study of Porter (1990) and Krugman (1991) on industrial agglomeration or clustering. The industrial clusters typology follows the proposition by Markusen (1996), who differentiates four distinct types of clusters as (1) *Neo-Marshallian industrial district cluster* (large number of small firms agglomerate; strong inter-firms link within the cluster; high proportion of workers in design-and-development type activities; a seedbed of innovation present; knowledge community activates generation and diffusion of knowledge that leads to a high rate of innovation); (2) *Hub-and-spoke cluster* (hub firms are typically large, with oligopolistic power and dominate a single industry; relationship with spokes takes the form of supply contracts); (3) *Satellite platform cluster* (concentration of branch plants of large

externally-owned and headquartered organizations; plants set up “stand alone” facilities detached in spatial terms with few linkages to other firms in the cluster; linkages are more to the parent corporation, or other branch plants located in other regions; investment decisions, finance, technical expertise, and business services are from external location and into a region; government-sponsored clusters can be high-technology centers; linkage between large foreign firms and small, local ones, with high degree of collaboration); (4) *State-anchored cluster* (universities, large public laboratories, and government offices acting as anchor). Porter’s work on clusters paid attention to the importance of competitiveness as a tool to promote national and regional growth and innovation. In sum, *clusters that are conducive to innovation have the following features: networking, specialization, ease of entry and exit, and resource mobility*.

In our study, the formation of industrial clustering is an essential step for emerging developing economies in catching up with forerunners. Additionally, it helps to stabilize the industrialization process and, through the business linkage within and outside the clusters, assists local entrepreneurs to acquire innovations in various forms.

Kimura and Kobayashi (2009) have two arguments on the dynamics of clustering. The *fragmentation theory* argues that the key to attracting fragmented production blocks is improving location advantages by creating special economic zones, and improving logistics infrastructure and customs procedures so as to reduce the cost of service links. On the other hand, the *new economic geography* emphasizes the effectiveness of utilizing the dispersion forces from congested neighboring cores. The study here fundamentally follows the work done by Fujita *et al*. (1999).

2 METHODOLOGY OF RESEARCH

In our study, we have attempted two levels of hypothesis testing. The first level pertains to a broad regional macroeconomic or general equilibrium economic effect of *agglomeration forces* versus the *dispersion forces* on economic activities (Kumagai *et al*. 2008, p. 10), which is in line with the new economic geography (NEG) model of spatial economics. The agglomeration forces drive the forward and backward linkage of the economic activities, while the dispersion forces are caused by immobility factors. Congestion has resulted in severe price competition among firms and rising land prices as well as wage rates. Mobile workers can choose between regions based on wage rates and price differentials. If transport costs are high enough and reach a limit or threshold, this can cause firms to lose in fierce price competitions even if the market size is large due to congestion. Economic activities will disperse as a result.

The contrary is true also when transport cost decreases to a certain point. In such a case, firms enjoy substantial profit from large markets with low procurement costs even if there is stiff price competition. This results in economic activities that foster agglomeration. The dynamic process of agglomeration can be simply shown as the "circular causality" between consumers and producers. The more consumers are located, the greater the demand for more variety of manufacturing goods, causing a backward linkage with scale of economies in specialized production. On the other hand, new varieties of manufactured goods to be produced will have forward linkages with high-income consumers who prefer a variety of choices. Therefore, the second level pertains

to the spatial economics of firms' behavior in the dynamic networking process and supply chains that result in clustering or agglomeration.

The first attempt is carried out by applying the IDE Geographical Simulation Model (IDE-GSM). The second attempt is the result of a field survey by the working group in their respective countries.

The study starts with the new geography model, where Kumagai *et al*. (2009) predicts the effects of an infrastructure development such as the completion of the East-West Economic Corridor[i] (EWEC). Kumagai *et al*.'s (2008) first-generation IDE-GSM was developed to determine the dynamics of locations of the population and industries in East Asia in the long term. It also predicts the impact of specific infrastructure projects on the economies at sub-national levels. Its fundamental hypothesis is that the inter- and intraregional income gaps may become wider as various trade costs such as transport costs, tariffs, and/or service link costs are lowered (Kumagai *et al*. 2008, p2).

The second-generation of IDE-GSM has been expanded to predict changes in the location of populations and industries in regions for seven sectors, namely, agriculture, automotive, electric and electronics, textile and garment, food processing, other manufacturing and services. The simulations reveal that the effects of infrastructure development on each region are significantly different by industry.

To investigate the typology of agglomeration or clustering of industries in the ASEAN and East Asian economies, specific case studies were done on Indonesia (JABODETABEK), the Philippines (CALABARZON), Vietnam (Hanoi and its vicinity), and Thailand (Bangkok and its vicinity). We also learned about Brunei's own pre-feasibility study on the infrastructure development of its geographic linkage to the

East Asia–ASEAN economies. Through the initiatives of a Japanese econometric analysis team (Machikita *et al*. 2009), we are able to test our hypothesis on the relationship between innovation clustering and industrial agglomeration. With country-specific linkage typology, we try to discover how innovation leads to certain production networking of firms in project areas. With each country-specific finding and policy recommendation, and hypothesis-testing put forth by the econometric study, we derive a typology of agglomeration in the ASEAN and East Asia that can lead to a common policy recommendation and strategy for the region.

3 RESULTS OF THE SIMULATION AND EMPRICAL ANALYSIS

3.1. Model Description and Simulation Results

3.1.1 Model description

As mentioned earlier, the IDE-GSM was developed first to determine the dynamics of populations and industries in East Asia in the long term. Secondly, it is used to analyze the impact of specific infrastructure projects, such as the East-West Economic Corridor in Continental South East Asia (CSEA), and of reduced border costs, on the regional and sub-national economies. This approach tries to quantify the cost and benefit of "integration."

The IDE-GSM was based on a general equilibrium framework of spatial economics with the following features: increasing return to scale; imperfect competition; heterogeneous demand system (i.e., love for variety in products); and endogenous agglomeration forces. The model incorporates a topology of administrative

cities and routes that are interconnected, per the study of Fujita, Krugman, and Venables (1999).

The first-generation IDE-GSM used CSEA as its study area for analyzing both backward- and forward-linkage economic integration. It is based on the hypothetical assumptions that a symmetric structure is maintained only when transport costs reach a particular level and that the core-periphery structure emerges when transport cost approaches the lower threshold.

The IDE-GSM covers 10 countries/regions: Singapore, Malaysia (Peninsular), Thailand, Myanmar, Cambodia, Laos, Vietnam, Bangladesh, Western India, and Yunnan, Guangxi and Guangdong provinces of China. Each country/region is subdivided into states/provinces/divisions. Each state/province/division is represented by its capital city. Altogether, there are 361 sub-national regions. The study at the sub-national level in the model is done with data on (1) GDP by sector (primary, secondary, and tertiary industries); (2) employees by sector; (3) longitude and latitude spatial location; (4) area of arable land; and (5) distance of 700 routes between cities under the road networks.

The general equilibrium effect under the IDE-GSM depends on the magnitude of such parameters as transport costs by industry; the elasticity of substitutions; labor mobility; consumption share of goods by sector; cost of labor in the production of agriculture; and input share of intermediate goods in manufactured goods production.

To perform the simulation, IDE-GSM was set with a baseline scenario with the following assumptions: (1) GDP per capita of each country is assumed to increase by an average rate for the year 2000-2005; hence, the GDP per capita of each city is

determined and compared with the baseline; (2) The national population of each country is assumed to increase exogenously; (3) There is no immigration between CSEA and the rest of the world.

The second-generation NEG model by Kumagai *et al*. (2009), called the IDE-GSM, was a refinement of the first generation model. The extended version of the IDE-GSM has the following features:

a) Economic sectors are expanded to include agriculture and five manufacturing sub-sectors: automotive; electric and electronics; textile and garment; food processing; other manufacturing sector; and services;

b) The model includes 361 cities expressed by the same variables as those in the first generation and linked by 691 routes expressed by variables on distance and average speed;

c) The assumptions on variables -GDP per capita growth, population growth, migration, speed of car, border costs of time for customs clearance- in the baseline scenario are similar to those of the first generation.

The refinement of the model has produced key results that will be helpful in giving a broad perspective on the spatial economic development in our study.

The findings from the first generation model are summarized as follows:

a) Border costs play a big role in the dynamic relocation of populations and industries. Physical infrastructure alone is not enough to capitalize on its advantage. Kumagai

et al. (2008, p 30) notes that a reduction of the border costs of time seems to be more effective than the development of physical infrastructure;

b) The nominal wage differential between cities, intra-nationally and internationally is the main driver for agglomeration. Bangkok and Ho Chi Minh, and their satellite regions and other capital cities and surrounding regions have higher nominal wages than the national average, and most of these cities have location advantage by having Bangkok as the "core" city. The wage differential can be balanced by an infrastructure development. The EWEC draws populations from the Bangkok metropolis to Northern/Northeastern Thailand and diverse populations from Vientiane to Savannakhet.

A model extension by Kumagai *et a*l. (2009) predicts the trend in agglomeration of population in 2005-2025. Per the model's results, the populations of Bangkok, Ho Chi Minh, Dongguan, Vientiane, and Krong Preah Sihanouk are expected to increase over the long term. From the simulation, Thailand may become a core country in 2025, while some Chinese cities will tend to be core-periphery. In sum, the model predicts similar population dynamics revealed by the first generation model.

3.1.2 Comparative Advantage and Agglomeration/Disperse of Industries

The model predicts industries' long-term agglomeration/dispersion trends by comparing the industrial comparative advantages in each region. This is based on the Revealed Symmetry Comparative Advantage (RSCA) index of industries in the baseline

scenario and the scenario of ‘Economic Effect of having the East West Economic Corridor with Customs Facilitation’

(1) Industrial Growth under the Baseline Scenario

Automobile Industry

The second-generation model has produced interesting results on the advantages of industrial location. Per the results, the automotive sector becomes an advantageous sector in some regions of India. This may be driven by a huge demand for automobiles as India has a large population with rising per-capita income. The initial production in the baseline of the automobile product is quite small.

It is quite interesting to learn that Bangkok and its vicinities, and some cities in the Northeast of Thailand such as Nakhon Ratchasima, regions around Ho Chi Minh and cities such as Vinh Phuc in Vietnam, Selangor and Malacca of Malaysia, and some regions in India and China such as Liuzhou, have a comparative advantage in the automotive industry.

Electronics Industry

The model also predicts that Shenzen, Hezhou, and Guangzhou of China occupy the top slots regarding comparative advantage in the electronics industry. In fact, the top seven regions are located in China. In sum, the comparative advantage in the electronics industry concentrates in Singapore, Malaysia, parts of Thailand, and China.

Textile and Garment Industry

The top 20 locations with the highest comparative advantage in the textile and garment industry include Pabna and Dhaka in Bangladesh, and Phnom Pen in Cambodia. It is expected that the cities in Bangladesh and Cambodia would occupy slots in the top 20 regional rankings because both countries have abundant labor and established industrial presence in their baseline. In fact, comparative advantage is dispersed across Cambodia, Vietnam, Thailand, China, and Bangladesh.

Food Processing Industry

It is interesting to learn that Ca Mau of Vietnam is predicted to be at the top rank among sites with a comparative advantage in food processing. It is followed by Soc Trang and Bac Lieu in Vietnam and some regions in Myanmar. In fact, comparative advantage in the food processing sector within the CSEA is dispersed. This can be explained by the fact that it is the latecomers that have higher potential to grow than the existing production regions in the baseline.

Again, comparative advantage in the food processing, and textile and garment industries tends to be dispersed, while that in the electronics and automotive industries tends to agglomerate in a small number of regions.

(2) Economic Effect of the East-West Economic Corridor and Improved Customs Processing

The infrastructure development involving EWEC, along with improvements in custom facilitation, can reduce the border cost of time in shipment, etc. The completion of EWEC in 2011 is expected to benefit the region economically. Such economic effects can be measured in terms of GDP growth rates from the baseline year and until the EWEC project reaches completion sometime between 2011 until 2025. The study found that Champasak of Laos will be the top gainer in GDP growth at 6.1 percent once the project is completed.

The customs facilitation will benefit parts of Laos, Vietnam, and Northeastern Thailand. It is interesting to note that the geographical periphery of the region, especially West India and Bangladesh, the Malay Peninsula, and Guangxi and Guandong provinces of China will also benefit from the EWEC. This is because the EWEC will reduce transport costs all over the region, and not only in the four core countries: Myanmar, Thailand, Laos, and Vietnam in the CSEA. Industrialization along the EWEC and its periphery has raised nominal wages and attracted migration, igniting a new round of circular causality between consumers and producers. In terms of the core and its periphery agglomerates, Cambodia is found to be affected by the dispersion of economic activities because of the presence of the EWEC. Surprisingly, many regions in Cambodia will have lower GDP growth potential as compared with the baseline.

Improved customs facilitation at the EWEC also gives rise to increasing RSCA of different industries in each region. Regions in Vietnam, Laos, and Thailand tend to gain

ranks in RSCA in comparison to regions in the remaining countries. However, the EWEC customs facilitation will help promote the development of the textile/garment and food processing industries.

Additionally, the new geographic approach to economic development has been laid out in Brunei's Brunei Darussalam-Indonesia-Malaysia-Philippines (BIMP) study. This study highlights the importance of a geographic approach to the economic integration of the ASEAN and the East Asian region. Geographically, Brunei's involvement in the project will complete the transport equation: its sea and air linkages supplement existing land linkages.

3.2. Empirical Analysis on Innovations, Linkages, and Performance of Firms

3.2.1 Research focuses

The second part of the study calls for an econometric analysis of firms' behavior in selected countries, namely, the Philippines, Vietnam, Indonesia and Thailand. The field survey on firms was conducted by a working group per location. Collected data are analyzed based on econometric procedure by Machikita *et al*. (2009). The study is an evidence-based policy formulation according to the Comparative Agglomeration Dynamics (CAD) presented by Machikita and Ueki (2008).

The CAD is a study of production and distribution with a spatial dimension. It raises the importance of geographic proximity, real linkages and management practice of industrial parks, by investigating the bottlenecks and effects quantitatively, and by identifying pathways for the causal effects of agglomeration on innovation. The study

has tried to identify the pro-competitive effects on firms by learning from knowledge that spilled over through established linkages. The CAD follows the proposition of spatial economics dynamics according to Markusen's typology (1996). The study by the working group also aims to investigate the dynamic effect of worker mobility, the contractual environment, and heterogeneous plants and production linkages in a single industrial park and/or multiple industrial locations.

A common questionnaire is used for each study area. The questionnaire consists of four parts: (1) Profile of sample firms in operations; (2) Innovation activities for business upgrade in the last three years; (3) Business linkages with present customers and suppliers; and (4) Sources of information and new technologies for innovation and business upgrade. The cross-references between variables and key words in our study are as follows:

Linkages explains any linkages or contacts between firms and customers or suppliers in term of local or foreign firm, university and industry R&D relations, government or public organizations and industry, dispatch of engineers to customers/suppliers, capital tie-up with customer/suppliers, duration of the relationship with the customer/supplier.

Agglomeration explains benefits from activities that firms obtain when situated near each other or in the same industrial estate or as an industrial cluster. This study refers to distance and travel time from firms to customer/supplier, and the just-in-time distribution system adopted by the customer/supplier.

Innovation explains product enhancements when firms introduce new products/services to the market, and adopt new processes such as buying new machines

or using facilities with new operational functions, improving existing machines, equipment or facilities, or introducing new technology into their production methods. In addition, this can refer to securing new suppliers, seeking new markets/customers, and improving business processes.

Performance explains the business performance of firms in comparison with the previous year's. Examples are when there is an increase in sales or profits, number of employees, value of exports, value of exports to developed countries, number of export destinations; productivity improvement in quality of products; reduction in product defects, production cost and lead times.

3.2.2 Overall findings from the empirical analysis

Machikita *et al*. (2009) have analyzed their results from a survey sample of 605 firms. This sample comprises 204 from the Philippines, 138 from Vietnam, 150 from Indonesia, and 113 from Thailand.

To investigate how the production network affects firms' incentive to innovate when inter-firm linkages become dense, questionnaires were sent to producers in selected industries. The sampling by product/industry included: Food products (13.31%), Apparel (17.47 %), Wood products (5.16%), Paper products (4.49%), Chemical products (9.82%), Iron and steel products (3.99%), Metal products (6.16), Machinery (4.99%), Electronics (8.99%), Automobiles (5.32%), and Transport (1.33%).

The study therefore focused on three major industries in four countries: (1) Food processing, apparel, and wood products for Indonesia; (2) Food processing, apparel, and

electronics products for the Philippines; (3) Food processing, apparel, and chemical products for Thailand; and (4) Chemical products, machinery, and electronics products for Vietnam.

The profile of firms in the sample are as follows: (1) Firms have been in existence for an average of 14 years; (2) Average employee size 293 persons per firm; (3) Most are local firms (60%), while joint venture and multinational enterprises (MNEs) are 13 percent and 25 percent of the total number; (4) If categorized by their functions, firms that produce raw materials are 46 percent of the total number; those producing components and parts, 28 percent; those producing final goods, 71 percent; and those engaged in the procurement of raw materials and parts, 24 percent. Around 77 percent of the firms are improving their product quality while almost 70 percent are working to reduce production defects.

Innovation in our study is classified into three categories: (1) Product innovation; (2) Process innovation; and (3) Securing of new customers and suppliers. Product innovations are being achieved by almost 45 percent of the sample. Those that achieve new market and product innovations based on a new technology are only 9 percent and 11 percent of the sample. Firms in metropolitan areas have a higher chance of securing new local suppliers and customers than those outside metropolitan areas. Here, 63 percent of the firms have secured new suppliers while 65 percent of metropolitan firms secured new customers. In comparison, 56 percent and 58 percent of companies in non-metropolitan areas had secured new suppliers and new customers, respectively.

Seventeen percent of those in the metropolitan areas succeeded in securing supplies from MNEs, as compared with 16 percent of firms not located in metropolitan

areas. Also, 30 percent of firms in metropolitan areas have secured linkages with customers that are MNEs compared with 21 percent of firms in non-metropolitan areas. About 27 percent of companies accepted technical assistance from their government or a public agency, while 23 percent cooperated with local universities.

Of the sample, 34 percent utilize their own R&D departments as sources of information and R&D, while 38 percent utilize the sales department as their source of information.

Since firms operating in the ASEAN and East Asia have to supply goods and services to domestic and international markets, they have to compete at the international level. Thus, they need to adopt new technologies and acquire new organizational structures to survive the competitive environment. They have to create new markets, secure new inputs to improve product quality, and introduce new products.

In their study, Machikita *et al*. aim to test whether innovation and linkages of firms are correlated. Empirically, they have to test the relationship of innovations and agglomeration through linkages, given that, empirically, industrial agglomeration has reinforced the growth of firms.

The number of innovations for each firm is the sum of the product innovations, process innovations (including organizational changes), and how firms decide to secure new customers and suppliers. The number of linkages is the sum of sources of information and new technology of the sample firms.

An average index of innovations---the count of firms' positive responses to the questions---is 8.96 for the pooled samples, and the score for linkages is 8.04.

The index of linkages is quite different across countries as a result of differences in industry composition and the nature of their production networks. In other words, agglomeration and the dispersion of firms are affected by the deepening relationship between linkages and innovation.

Machikita *et al.* analyze significantly different characteristics between linked and non-linked firms' innovations. The linked and non-linked firms are defined by the median linkages index level. If we believe that the cost of introducing new goods is hypothetically a decreasing function of the number of linkages, linked firms would have an advantage in product innovations. *However, their empirical study cannot find significant evidence that linked firms have succeeded in introducing new goods more than the non-linked firms. Neither is there any evidence that linked firms and non-linked firms will significantly differ in the new goods introduced to the new market, after securing a new technology.*

When it comes to how firms behave, linked firms are found to have achieved significant organizational changes as compared with non-linked firms in their process innovation. They have succeeded in reorganizing to market-based production processes--- i.e., adopted an ISO standard, introduced information and communication technology (ICT), and introduced internal activities in response to market changes. When firms have established a linkage with new suppliers, they will succeed in introducing new products. In addition, they can utilize a production process that brings with it cost efficiency as well as higher quality input.

The econometric estimates based on the samples indicate that firms with linkage relationships will tend to have higher propensities to secure new suppliers, both locally

and internationally, than non-linked firms. More specifically, an econometric analysis can prove that firms that had secured new suppliers, both locally and internationally, tend to have higher levels of innovation.

Whenever firms find it costly to import new parts and materials, they will rely on external linkages with new suppliers located outside their cluster to overcome obstacles. Firms that have many production linkages would attempt more new alternatives than would firms without linkages.

Firms and their partners, both suppliers and customers, are linked since they send and dispatch engineers to give or get advice. This type of linkage has statistically significant effects on firms' product and process innovations; e.g., to introduce new product varieties, or to adopt an ISO standard. Such positive effects will lower communication costs between firms and their partners that are located remotely.

Empirical results confirm that firms with linkages, such as having an engineering face-to-face consultation and frequent interactions with production partners, tend to be successful in innovations. The econometric model reports the following reasons: (1) The knowledge diversity between firms and their partners has spilled over from combinations of different linkages; (2) Firms without internal R&D can get accurate information of others' trials and errors by having many types of linkages; (3) In the face of rapid change in market demand, firms can cope with it via frequent face-to-face communications with their partners.

4 OVERALL SUMMARY OF FINDINGS

4.1. Effects of the Corridor Development on Agglomeration in East Asia

In our study, we have applied the new economic geography theory extensively by construction of a numerical geography simulation model. The model has a clear proposition and testing procedure on agglomeration and the spatial dynamic growth of regions in East Asia. We find that the population dynamics of the regions has responded to different levels of nominal wages in regions. Industrial agglomeration is possible with the introduction of infrastructure development projects such as the road system along the East-West Economic Corridor that links Myanmar, Thailand, Laos, and Vietnam. This specific plan has direct and indirect effects on regions in East Asia, especially on the countries that belong to the Greater Mekong Sub-region. Projects like this can reduce the time cost of crossing borders and therefore facilitate trade and industrial agglomeration in different regions. Thailand, Laos, Vietnam, South China, and part of India will benefit from the industrial agglomeration, while Cambodia will have to disperse its industry as compared with the baseline scenarios during 2011-2025. It is recommended that there should be a coordinated effort among these countries in East Asia so as to balance the benefits and drawbacks of the agglomeration dynamics in the region. Although the model predicts gains and losses for the regions, it is still highly probable that the EWEC will bring larger economic benefits than losses.

On the academic front, it is clear that the new economic geography simulation model developed in our study has predicted useful findings that can help identify solid policy recommendations. It does, however, need to be extended to cover the aspect of

income distribution explicitly in the model in future studies. The model extension would have to be with an internationally harmonized database for parameterization. We would like to recommend that this be pursued further through the continuous cooperation of all countries in East Asia. Especially, it is necessary to construct a common database on the spatial dynamics of networks in the East Asian regions.

4.2. Firms' Performance with Innovation, Linkage, and Agglomeration in East Asia

In our study, we have also further investigated firms' behavior in each country, namely, Indonesia, Vietnam, the Philippines, and Thailand. The working group in each country conducted a sample survey on firms. Questions asked touch on linkage, innovation, and agglomeration or clustering and the performance of firms in the identified locations. Interesting results have been reported by each study. The overall finding is that most agglomeration patterns in these developing countries may be closer to the "Hub-and-spoke cluster" mixed with "Satellite platform cluster" but without further study this is not conclusive at present. Furthermore, linkage and innovation are significantly related. Innovations are positively related to the performances of firms.

An econometric analysis confirms that (1) the more frequent the linkages, the deeper firms will be engaged with innovations, even if they have no R&D activity or are non-R&D firms from the beginning; (2) dispatching and accepting engineers to and from customers will induce firms to engage in innovations. Likewise, dispatching and accepting engineers to and from suppliers will bring about a similar outcome; and (3) utilizing more internal resources will also encourage more innovations.

The study also found that East Asia has obstacles to business upgrade and innovations. Of those sampled, 27.8 percent are faced with high costs of R&D equipment and services. Further, East Asian countries have a rather weak support system needed to deliver R&D services at a reasonable price. In fact, most East Asian countries do not have specific organizations in charge of knowledge creation, diffusion, utilization, and value creation/commercialization. Most importantly, East Asian countries have to deal with a shortage of skilled labor, particularly qualified engineers.

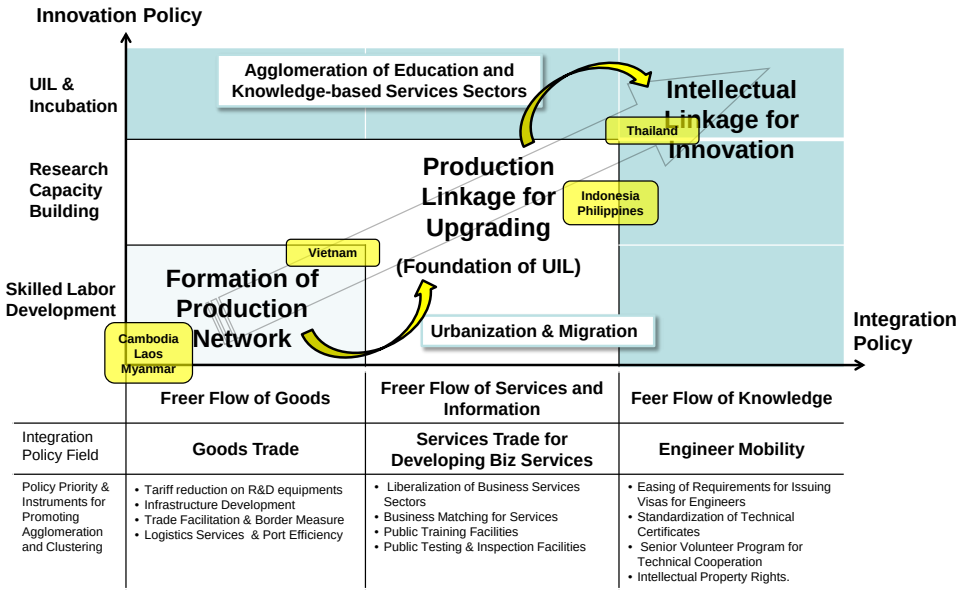
5 RECOMMENDATIONS ON INNOVATION AND REGIONAL INTEGRATION POLICY

It is necessary to facilitate linkages between firms-both among local firms, and between local firms and MNEs-whether they be intra-cluster or outside the agglomerated district. This should facilitate the spillover of knowledge and innovation from suppliers to firms and from firms to customers, and vice versa.

The analyses of this research project provide policy opportunities for East Asian countries to take full advantage of economic integration effects in their industrial development policy, on the basis of experimental and empirical evidences. The IDE-GSM provides some macroscopic perspectives on long-term effects of declines in broadly-defined transportation and border-crossing costs on both intra-national and international core-periphery structures. On the other hand, the questionnaire survey and econometric analyses focus on intra and inter-regional business linkages, shorter-term

firm-level effects of agglomeration and policy measures. The results of these complementary analyses enable us to derive the following six policy recommendations. The consequences of necessary actions are summarized in the following figure.

Figure 1. Pathway to Innovation



Source: Ueki (WG coordinator).

Recommendation 1: Strategic Development Policy with Target Industries and Balanced Regional Growth

The IDE-GSM revealed that the effects of infrastructure development on each region are very much different by industry. The model also produced the expected "core-periphery" structure, which will be salient for the implementation of customs facilitation measures. The IDE-GSM provides national and local governments with a

direction for nominating “potential” target industries for each region with proper infrastructure development planning. Policymakers in East Asia need to pay attention to the negative side-effects that some regions will lose population or industry dramatically due to the expected “core-periphery” structure.

Policymakers in East Asia can coordinate with each other to make full use of transportation infrastructure and avoid a clear segmentation in East Asian society between gainers and losers from the regional integration policy. Highly recommended is consolidation of the existing diplomatic channels or organizations to encourage closer dialogues between related parties, or the establishment of an international body for planning and coordinating the balanced and strategic development of infrastructure in East Asia. Countries in East Asia also can seek further cooperation in FDI and trade policies, including bilateral and regional agreements on trade/investment to promote them in the harmonized manner consistent with the population dynamics and industrial agglomeration predicted by the IDE-GSM. In addition to the regional gap, special attention should be paid to small and medium-sized enterprises that can act as the main driver of modernization and development in the region when the East Asian governments consider a long-term policy of linkage-innovation-agglomeration and performance.

Recommendation 2: Establishment of a Geographical Economic and Social Database in East Asia

The recommended strategic development plan should be reviewed and revised according to changing economic situations, the progress of improvements in

transportation infrastructure and industrial developments. An effective observation mechanism, ideally a PDCA (plan-do-check- act) cycle in, can be created. The establishment of a geographical economic and social database in East Asia is the first important step.

To conduct more accurate simulations with richer implications, more precise regional economic and demographic data are required at the sub-national level in each country. We need harmonized data as well as a harmonized data collection method in ERIA countries. ERIA is a suitable body to conduct capacity building for officials in national and sub-national departments of statistics. We also need more precise data on routes and corridors connecting regions. Information on the main routes between cities, times, modes of transport (road, railway, sea, and air) and border related costs should be collected and updated on a regular basis.

Recommendation 3: Facilitation of Movement of Goods for Promoting Innovation

Any improvement in goods movement promotes not only regional economic growth as expected by the IDE-GSM, but also innovations in intermediate goods importing countries, accompanying knowledge spillover to trade partner countries, rippled through international production networks. This spillover effect will strengthen the impact of the regional economic integration, with effective trade facilitation measures, leading to expanding production activities in the whole East Asian region.

Even though such positive impacts are expected, the firms responding to the questionnaire mentioned high tariffs as an obstacle to their productive and innovative

activities. This finding reveals that broadly-defined transportation costs and inappropriate border measures hinder technological upgrading and innovation. The urgent necessity of eliminating these impediments is supported by the empirical result verifying the dependence of firm-level upgrading and innovation on production networks. This policy implication is relevant above all to Vietnam among the surveyed countries, and definitely to other CLMV countries.

Economic integration with technological upgrading and an innovation policy is a key concept leading to the establishment of complementary relationships between “cores” and “peripheries”, or to changing the impression of a core-periphery structure from that of a “development gap” to one of “rich diversity.” The empirical study verified that diversified production networks are closely correlated with product innovations and diversifications of innovations. The policy focusing particularly on decreasing the transportation costs of intermediate goods will have the merit of strengthening production linkages between core and periphery industrial districts in the short run, and achieving upgrading and innovation in the long run, as a result of the increased diversity of available inputs.

Recommendation 4: Enhancement of Management Capability through Localized Business Interactions

Just-in-time delivery systems, which are based on localized partnerships for goods transactions, promote face-to-face communication and frequent interaction with production partners, enabling them to share deep and timely information about changes in the market and market turbulence. It can be considered that a JIT system provides

firms with useful information to adjust themselves to ever-changing market environments. They can therefore proactively change their internal management organizations, including introduction of ISO standards.

This empirical result suggests two policy implications. First, firms with a few continued customer-supplier relationships with specific partners, particularly small and medium enterprises (SMEs), should be at the core of policymakers' attention. Linked firms receive benefits from partners while providing important information about market changes to their other partners, especially their supplier. It is also important to devote policy resources to the implementation of JIT systems. If there are obstacles to implementing a JIT system that will help firms to upgrade, public assistance can be tapped to create such a network. Economies of networking, based on production linkages, could create such externality.

Recommendation 5: Consolidation of Intellectual Linkages by Developing Public Facilities and Services for R&D Support and Promoting the Private R&D Support Services Sector

The empirical study showed that linkages with the R&D-related public and private services sector, or intellectual linkages, are quite important for manufacturing firms in implementing innovative activities. Even so, such services are not necessarily available and affordable for companies, particularly SMEs in developing countries. High fixed costs related to R&D and other innovative activities need to be shared by firms in order to significantly decrease costs for the individual firm. In this sense, business associations, chambers of commerce and public R&D facilities should take a large role.

Nevertheless, the capability of these organizations is not rated highly by private firms.

There are urgent needs for improving public facilities and services, or promoting the private R&D-related services sector, to facilitate private efforts in innovation. Public resources can be intensively devoted to the development of public facilities for testing, business incubation, and training. Ariff (2008) shares common awareness of this issue. Deregulation and FDI promotion in the business services sector will also stimulate the development of private R&D supporting enterprises, and price competition among them. These policies will be effective for achieving industrial upgrading in the long run.

Recommendation 6: Facilitation of Movement of Knowledge Workers (Part of Service Liberalization)

Econometric analyses verified positive correlations between innovations by suppliers and dispatches of engineers from the suppliers to their customers, as well as between innovations by customers and acceptances of engineers from their suppliers. Face-to-face communication is recognized as one of the key channels of knowledge spillover: face-to-face communication allows sharing and utilization of market information in the development of new products. Therefore facilitation of movement of knowledge workers, above all engineers directly involved in innovation, is crucially important in the countries where labor market rigidities are serious obstacles to innovation, such as Thailand and Vietnam.

Engineer dispatches and acceptances observed from the questionnaire survey are

cross-border, while domestic movements of engineers are mainly done between distant places. Based on these observations, improving and expanding transportation infrastructure and services is fundamental to promoting knowledge diffusion through engineer exchanges. If we consider international movements of engineers, policy emphases should be placed on liberalization of services, including reduction of visa requirements and simplification of visa procedures for skilled engineers, mutual recognition of certificates, qualifications and occupational licenses for technical workers and other intellectual professions such as patent attorneys and lawyers. Dispatches of senior engineers from advanced economies such as Australia, Japan, Korea and New Zealand to developing countries can be one of the key potential fields of international cooperation programs to be expanded by aid agencies.

NOTE

[i] The East-West Economic Corridor (EWEC) is a geographical linkage between Vietnam and Myanmar via Thailand, by a road system. The proposal to develop the Greater Mekong Sub-region (GMS) will directly affect Myanmar, Thailand, Vietnam, Cambodia, and Laos PDR. It is complementary with similar infrastructure development projects such as the North-South economic corridor (NSEC) and the Southern economic corridor (SEC), according to Kumagai *et al*. (2008).

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