Industrial Clusters in East Asia:
Facts and Lessons for Developing Economies[*]

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I.   Introduction

For the last several years, we have been studying technological transfer, multinational corporations (MNCs), deregulation and globalization processes (see, for example, Kagami and Tsuji [2000]), and information technology (IT) (Giovannetti, Kagami, and Tsuji [2003] and Kagami, Giovannetti and Tsuji [2004],). In our recent studies, questions naturally arose as to why MNCs choose some locations for their plants and offices as opposed to others (see, for example, Kagami and Tsuji [2003] and Kuchiki and Tsuji [2004]). Also, why do IT-related firms agglomerate in certain places even though the Internet supersedes distance? Examples of the former are industrial clusters in certain Eastern European countries, coastal areas of China and some border cities of Mexico while examples of the latter are Silicon Valley in California, Bit Valley in Tokyo and Bangalore in India.

Increasingly, we came to the realization that the answers to these questions are absolutely essential to understanding, predicting, and explaining economic growth in developing countries. Industrial "clusters," as they are referred to by leading theorists, are often the drivers of regional and even national economic growth. As perhaps the most remarkable example, consider the aforementioned IT cluster in Bangalore. Without the IT industry explosion concentrated mainly in this city, India's economy would be growing at a slower pace, and would almost certainly not be commanding the international attention that it now does. Smaller nations are even more dependent on the economic output of one or two key regions.

Thus, we have recently undertaken a project of considerable magnitude – the observation and analysis of industrial clusters, taking into account recent changes in the global economy. Our effort, if successful, will provide invaluable information to key individuals in developing countries. With a comprehensive understanding of the clustering process in a contemporary context, business leaders and entrepreneurs will be able to take

maximum advantage of existing or emerging clusters; policymakers and business leaders will be able to deliberately promote the development of clusters in their nations; and researchers will have a head start toward a deeper understanding of the various processes at work.

Our current research represents the necessary first step in that process – namely, gathering and describing relevant examples of industrial clustering. Although assisting in the development of a general theory is our ultimate aim, empirical understanding of clustering is as yet incomplete. What we are currently attempting to do is to present and explore in-depth anecdotal evidence. By examining such well-researched examples, shrewd individuals should be able to learn by example, and make their own generalizations. Comparison is a key.

Several aspects of our current research set it apart from previous studies of industrial clusters. We have studied examples from all over the globe – specifically, from the key regions of Asia, Europe, and North America – and covered a wide array of industries, from traditional heavy industry to the software and IT industries. Ours is also some of the first research to focus on developing nations. Finally, we decided to direct much of our attention toward IT, and its effect on old industries as well as its creation of new ones.

This paper presents summaries of several examples from our current research. Section III describes a case study of clusters in Vietnam. Section IV details a case study of the Tianjin cluster in China, and attempts to make clear how clusters in Tianjin with various industries have been formed. Section V focuses on the Malaysian electronics industry and analyzes its competitiveness. Section VI looks at Bangalore, India and examines its local labor market as a basis for competitiveness.

II. Theoretical Background

The basic question is: why do firms gather, or agglomerate, in a certain region? This question is fundamentally related to main themes of economic geography, or spatial economics, such as why certain cities grow as opposed to others, or why certain cities decline. This cycle of concentration and dissolution (or dispersion) is thus the product of "centripetal" forces working against "centrifugal" ones.

Until quite recently, economists have paid only limited attention to the location of economic activity and to the choices firms and households make to decide where to produce or consume. Early works by Alfred Marshall and Harold Hotelling laid some basic premises for looking at the role of geography in economic decision-making. Marshall made some

speculation on the subject with his observation that: "Industries tend to cluster in distinct geographic districts, with individual cities specializing in production of narrowly related sets of goods".

In more modern parlance, Marshall argued that industrial districts arise because of:

- knowledge spillovers ("the mysteries of the trade become no mysteries; but are as it were in the air");
- the advantages of thick markets for specialized skills; and,
- the backward and forward linkages associated with large local markets.

Hotelling expanded on this idea by looking at location as a question of finding a stable equilibrium based on the location of the market under highly constrictive assumptions.

The work of Paul Krugman and Anthony Venables [1999] began a renaissance in geographic based economic analysis, which they dubbed, "new economic geography." The foundation of this analysis rests largely on monopolistic competition modeling with an emphasis on the interaction of increasing returns, transport costs and the movement of productive factors to understand the latent forces of economic agglomeration. Firstly, economies of scale and transportation costs imply that firms prefer to locate close to a large market (backward linkages similar to the Hotelling model). Secondly, consumers' love of variety in manufactured goods and transportation costs imply that workers would like to live close to a large market (forward linkages).

Another important concept regarding clustering is increasing returns, which are different from the classical models of perfect competition and constant returns. Krugman [1995] wrote "Increasing returns in production activities are needed if we want to explain economic agglomerations without appealing to the attributes of physical geography. In particular, the trade-off between increasing returns in production and transportation costs is central to the understanding of the geography of economic activities" (cited by Fujita and Thisse [2002], 7). If scale merits work, we must use different sets of analytical instruments, such as imperfect competition and monopolistic competition frameworks, combined with dynamic aspects.

Michael Porter of the Harvard School of Business developed an alterative approach to economic geography. Porter stresses that nations cannot succeed in isolated industries, but in clusters of industries connected through vertical and horizontal relationships. This system has an implicit concept based on a 'critical mass' of specific influences that will improve knowledge, share resources, and stimulate creativity, innovation and entrepreneurship. 'Porter-style' clusters in developing countries tend to be shallow and to rely primarily on foreign components, services and technology.

Industrial clusters include small-, medium-, and large-scale firms. Interactions among

these, in terms of economic activities, are quite frequent and close. Famous examples of industrial clustering are German printing equipment and Japanese robotics in Porter's terminology (Porter [1990]). The term "industrial districts" is used in the original Marshallian sense, or particularly applied for Italian cases where small-scale firms mainly gather to form an industrial town with a particular socio-cultural flavor. More precisely, industrial districts are characterized as (a) local systems of active integration between a community of people and a community of industrial firms, and (b) a flexible specialization characterized by the widespread presence of small-sized firms.

Until recently, industrial clusters could be explained successfully by the various existing theories mentioned above. The contemporary world economy, however, has undergone a new evolution, with transformations such as globalization, emerging of developing countries, demand shifts, and rapid technological changes such as the Internet Revolution. Industrial clusters in advanced countries have therefore had to adjust to these new shocks and survive under new conditions. Industrial clusters in the developing countries, as we mentioned, may serve as an engine of growth nation as a whole. The role of recent software industry clusters in certain developing countries, for example, has become important to these nations' national economies, in terms of employment, income and exports. These developments require new insights in the analysis of industrial clusters, since existing theories cannot explain all the forces at work. The examples we examine here will eventually allow us to identify, understand, and model these new forces.

III. Case Study 1: Industrial Clusters in Vietnam[1]

Government-led industrial parks and estates are a type of cluster often seen in developing countries. The study of Reidel and Record [2004] focuses on an example of this type – Industrial Zones (IZs), Industrial Parks (IPs) and Export Processing Zones (EPZs) in Northern Vietnam. The zones are considered a proxy for public goods in a developed country, i.e. in a developed country; entrepreneurs would expect to have quality infrastructure and institutions, such as electricity, roads, telecommunications, water supply and sewerage, etc. The infrastructure and administrative advantages of firms choosing to locate in the IZs were significant and that these factors were contributing toward the agglomeration of foreign invested firms and the promotion of economic growth in Northern Vietnam.

3.1. Vietnamese competitiveness and the environment for business

Without a doubt, Vietnam's economic growth story during the last decade can be called a success. The transition to a market economy has occurred comparatively smoothly and with relatively strong growth and economic stability throughout most of the 1990s despite institutional weaknesses and a policy bias against the private sector. Nevertheless, Vietnam remains a low-income country and the public sector still dominates the industrial economy of Vietnam, contributing some 50 percent of GDP. The state's share of output in the manufacturing sector has fallen somewhat over recent years from 59 percent in 1995 to 51 percent in 2001, but private domestic firms only accounted for about 9 percent of manufacturing value-added (GDP). Legal reforms in recent years have, however, greatly encouraged private sector development, and in early 2002, the status of the private sector was enhanced when a Party Plenum resolved that the private sector is "an integral part of the national economy." Stronger official endorsement of the private sector embodied in recent policy changes has helped build investor confidence.

Biases in favor of the public sector remain, but Vietnam is now beginning a period of rapid growth led by domestic businesses, rather than by FDI and commodity exports during the 1990s. The emerging corporate private sector is becoming more important as a source of investment and its contribution to national investment is rising fast (from 21 percent in 2000, to 29 percent in 2002). Through international trade, Vietnam has begun to capitalize on its principle area of industrial comparative advantage – low labor costs. Currently, Vietnam's garment industry is the second most important market after the European Union, and the country is now the second largest shrimp exporter to Japan, after Indonesia.

However, Vietnam's competitive potential is weakened by state monopolies (or cartels), which have kept costs high in areas such as, air transport, coastal shipping, railways, power and telecommunications. Vietnam is one of the most expensive countries in the world to make incoming and outgoing international telephone calls. Such infrastructure problems are a significant reason why so much foreign direct investment and new business activity is taking place in specially built Investment Zones. In the absence of private provision, government services tend to be driven by what officials think is important to supply, rather than driven by demand.

3.2. Industrial clusters in Vietnam

Agglomeration occurs also at a multitude of levels, from the Old Quarter of Hanoi serving the capital city to specialized economic regions, such as Silicon Valley in the US (software) or the City of London in the UK (financial services) that serve global markets.

This study looks at 4,400 enterprises engaged in a wide range of sectors – automobiles, cement, electronics, garments, motorcycles, paper, rice, seafood, software, steel, sugar, and

textiles – and their potential for clustering. Within these twelve sectors, three (garments, seafood and textiles) have been chosen for further analysis.   Using a basic definition of clustering based on firm density, our sample identifies the garment sector to have the greatest tendency to cluster, followed by textiles, rice, seafood and paper.

The results show that there are some signs of industrial agglomeration in Vietnam; however, these results must be taken into perspective with the transitional nature of the Vietnamese economy.   The ability of a particular cluster to form depends primarily on an environment conducive for private enterprises, i.e. institutional frameworks. The evidence suggests that reform has been the principle factor in generating private sector growth.   The 2000 Enterprise Law created much of the basic legislation that is in place now, and remaining efforts will need to focus on implementation.   If clusters are dynamic centers of growth, then understanding the development, management and stability of clusters is a matter of great significance for the future of Vietnam's economy. The experience of the leading economies of East Asia, such as Japan and Korea, should serve as examples for Vietnam. These countries demonstrate that a culture that is open to ideas, but also successful in conserving core values, is most likely to thrive in a global economy where knowledge is the dynamic driving force of economic development.   The role of the state in directing technological catch-up has decreased, while private enterprises have become the international drivers of technological development.

The reforms necessary for long-term and stable growth for the Vietnamese economy were noted at the Vietnam Business Forum (9 December, 2002):

- introduce greater competition to reduce costs closer to the regional levels in sectors such as telecommunications, power and shipping;
- ease restrictions on technology transfers;
- make business policies and regulations more transparent in their formulation as well as consistent enforcement to enhance predictability for investors;
- broaden the currently narrow tax base that puts a disproportionate burden on honest tax payers and slows the growth in employment;
- accelerate deregulation and to implement the Enterprise Law aggressively outside the main urban areas;
- correct misconceptions on the role of the private sector and enhance its role; and the importance of encouraging corporate social responsibility.

While Vietnam has taken steps in the right direction, there are still substantial institutional changes needed for continued growth.   The lesson for Vietnam is that the government is no longer the principle actor in driving economic and technological development. Its role has changed from setting the stage and creating a conducive enabling

environment to freely allowing entrepreneurship and innovation.

VI. Case study 2: Industrial Clusters in Tianjin, China[2)]

In Tianjin, industrial clusters of high-tech industries such as electronic information and automobiles and traditional industries such as bicycles and garments have appeared in an embryonic form. The network system of study between industrial clusters has also appeared. Affected and encouraged by developed industrial clusters around the world, in the interaction and competition of domestic industrial clusters, Tianjin is hopeful to form its own industrial clusters with advantages and studying-type regions with high dynamic ability.

There exist the following industrial clusters in Asia: southern China, Chu-Chiang River Delta in China, Penang, Selangor, Johor in Malaysia, Hochiminh and Hanoi in Vietnam, Bangalore in India, Zhong Guan Cun in China, Hsinchu Science Park in Taiwan, and Leam Chabang in Thailand.

With regard to new industries here, Donggang, Siquan, Xuejie and Rueyu [2004] choose the electronic information industry in Tianjin and the battery industry of green environmental protection. In traditional industries, the automobile manufacturing industry in Tianjin and the bicycle manufacturing industry are analyzed.

4.1. New Motive Force for Development of the Electronic Information Industry in Tianjin

In recent years, the electronic information industry in Tianjin has developed very quickly and taken on a healthy and rapid look. The rapid formation and development of the electronic information industry in Tianjin has the following obvious characteristics. (1) Exogenous Industrial Clusters. Exogeneity of electronic information industrial clusters is expressed from the following aspects: one is the dependence on foreign funds. The second is the increasingly large scale of foreign funds in the electronic information industry. The third is the ratio of foreign funds in the electronic information industry to gross funds. (2) Industrial clusters have taken on structural characteristics of 'single core'. The average scale intensity of Tianjin's enterprises is comparatively high; Enterprises are of relatively large scale; Single-core enterprises of industrial clusters are large-scale transnational corporations. (3) Rooting of Industrial Clusters and Foundation of Local Production Network. Rooting of industrial clusters is, in fact, the social and cultural characteristics within industrial clusters and institutional source of industrial cluster advantages. It plays an important role in the

further development of high-tech industrial clusters. (4) Industrial Clusters with Product Chain. Within electronic information industrial clusters in Tianjin, economic bodies connect with each other to form an inner value chain. It is a typical mode of product chain cluster. In this chain, 3 kinds of enterprises share work and cooperate with each other to form a product chain cluster with comparative power.

Some problems still exist in Tianjin's electronic information industry. Tianjin's electronic information industry has comparatively strong dependence; Institutional factors restrict the further development of industrial clusters; Local production network has not embedded deeply; Single-core structure of industrial clusters is fragile and unstable; There is no knowledge connection which is favorable for innovation.

Regarding these characteristics and problems, we raise a solution to the development of the electronic information industry in Tianjin in order to improve its competitive advantage and bring the clustering effect into full play. The solution is as follows. (1) Tianjin's electronic information industrial clusters should combine industrial advantage, policy advantage, low cost advantage and location advantage. (2) Structure of industrial clusters should develop from 'single core' to 'multiple cores' to form a competitive pattern within the region and to transfer and improve electronic information industrial technology. (3) Local industrial clusters with self-strengthening mechanism should be cultivated. Product chain clusters should be turned into innovation chain clusters so as to change regional comparative advantages into competitive advantages. (4) To speed up the process of reform for state-owned enterprises in the electronic information industry and to further complete institutional network within industrial clusters. (5) The electronic information industry should develop toward specialization, interconnection, internationalization and clustering through the combination of technology, institute and market. (6) From promoting investment by favorable policy, sound infrastructure and convenient trade environment to promoting investment by improving the ecological environment of enterprises in regional clusters.

4.2. Rise of Green Battery Industry in Tianjin

Tianjin Municipal Government has listed new energy (taking green battery as the dominant factor) in three pillar high-tech industries. Tainjin New-Tech Industrial Park also looks on new energy as a key-developing field. These measures have led to the rise of the green battery industry. Tianjin has distinct advantages in developing the green battery industry. These advantages are as follows. (1) The green battery industry in Tianjin has strong R&D and high ability of production; (2) Types of products are complete and the production chain has appeared in an embryonic form; (3) The industry has a vast range of prospects and great potential. Tianjin has been successful in opening up the market at home

and abroad. After 10 years' development, the green battery industry has a certain scale. However, as a growing industry, it still has some problems that demand prompt solutions. Through analysis of the basic situation and industrial construction of the green battery industry, this study raises some guidance suggestions.

4.3. Development Environment, Characteristics and Direction of Automobile Industrial Clusters in Tianjin

The automobile industry in Tianjin is an important part of China's automobile industry. Especially in the 20 years after reform and opening-up, the automobile industry in Tianjin has experienced rise and fall. Now it is facing the opportunity of starting a new undertaking. After decades of development, automobile industrial clusters have appeared in an embryonic form with the following development characteristics. (1) The accumulated development basis of the industry forms an advantage of human resource. (2) The unique product positioning under national industrial policy has gained some preemptive advantages. (3) The industrial agglomeration that regards Toyota as the center exists together with original industrial agglomeration. (4) Tianjin's automobile industrial clusters participate in the formation of a domestic oligarch market structure through its alliance with China FAW Group Corporation. (5) Because the industry is in the key stage of change from comparative advantage to competitive advantage, competitive advantage of the industry is not outstanding. (6) The competitive power of enterprises manufacturing automobile components is in decline on the whole, but some enterprises suddenly come to the fore. (7) The localization system of R&D of products has not been formed. (8) The means by which government affects industrial development is facing the requirements of change.

Beginning from the background of the automobile industry at home and abroad, we have analyzed the development characteristics and next it will raise the construction direction of the automobile industry in Tianjin in order to strengthen/sustain competitive advantage and to improve clustering effect of this industry. The constriction direction includes the following aspects. (1) Constructing two interrelated systems of the production chain; (2) Further participating in domestic competition of market structure of oligopoly in the form of overall industrial clusters; (3) Medium-scale and small-scale enterprises with quality management and innovative ability are the main factor in keeping the competition of the value chain; (4) Promoting change of the value chain from comparative advantage to competitive advantage and even to dynamic competitive advantage; (5) Government plays a positive role in cultivating industrial dynamic competitive advantage.

4.3. Analysis on Formation and Development of Bicycle Enterprise Clusters in Tianjin

Tianjin is the birthplace of China's bicycle industry. The bicycle industry in Tianjin has experienced rise and fall. In this process, unique bicycle enterprise clusters have been formed gradually. In the formation process of bicycle enterprise clusters in Tianjin, clustering effect plays a significant role in encouraging industrial development. Taking the formation characteristics, factors and development mechanism of bicycle enterprise clusters in Wangqingtuo as the starting point, the paper analyzes the development, structural features, competitive advantage of bicycle enterprise clusters and the structure of bicycle industrial clusters in Tianjin. The structural characteristics of Tianjin's bicycle industry are as follows: One is that the vertically integrated rigid mode of production of state-owned enterprises has not been adaptable to diversified and characterized market demand as well as technical improvement. These enterprise clusters are a substitute for this mode of production. Moreover, these enterprise clusters are located in the suburbs where it is easy to obtain a flexible labor force. Besides, the convenient conditions of transport and communication make it possible for enterprises to communicate with each other in commodities, service, information, labor force and technology. The other characteristic is that medium-scale and small-scale enterprises with a relatively high degree of specialization have formed clusters and the relationship between enterprises in the same industry or between related enterprises is dynamic competition and cooperation. This kind of relationship is helpful for clusters to keep sustained energy and competitive power.

From the above analysis, the paper concludes that the formation of Tianjin's bicycle enterprise clusters is the result of many factors, such as geography, economy, society, humanism, institution, technology, market and history. It is not the simple action of enterprises and cannot appear in a short time. Enterprises within clusters have an obvious coordination effect. Once this kind of organizational structure is formed, other regions have difficulty to imitate it in a short time. This should be considered a significant factor in the continuous improvement of the competitive power of Tianjin's bicycle enterprise clusters.

4.4. To Cultivate Tianjin's New Industrial Clusters

In the process of industrial agglomeration, high-tech industrial clusters and traditional industrial clusters have their respective characteristics in shaping process, features and development trends. Regarding these 4 industrial clusters as our research object, through contrast and analysis on shaping process, features and development trends, this study raises future characteristics and development trends for industrial clusters in Tianjin. The development trends are as follows: (1) A developed interrelated industrial cooperation system in which foreign-funded enterprises are the center. Tianjin's industrial clusters regard large foreign-funded enterprises as the center. Strictly speaking, this kind of industrial cluster

is still in the hierarchy of division of labor in the product chain and enterprises within clusters have not formed the interrelated connection of innovation network. Local enterprises depend on core enterprises for funds and technology and this will lead to the fragility and instability of industrial clusters. On the whole, the present local industrial clusters are still in the bottom of or outside of the global network and have not been embedded in the global production system. (2) To be good at study, imitation and innovation and to bring dynamic ability into full play. Through the alliance, medium-scale and small-scale enterprises may form a certain kind of scale economy and maintain, strengthen their own competitive advantage of technology and improve core and dynamic ability. (3) With the tie of market, industries in urban areas and industries in rural areas should be combined to form a rational structure of priorities. So far, Tianjin has formed a pattern of industrial clusters with the characteristic of distribution according to priorities in urban and rural areas. The enterprise clusters in capital-intensive or technology-intensive industries gather in economic-technological development areas, free trade zones, new technical industrial parks and some development areas in counties. Traditional industrial clusters have appeared in some industrial parks in villages and towns. Relying on new technology and new concepts of management, these traditional industrial clusters are being reformed into new industrial clusters. (4) Support by developed international supply chain and market network. The cooperation of international supply chain is the best choice to enter the international market. However, the final goal is not the internationalization of enterprises. The final goal of enterprises is to occupy market share and gain profits. The market network can collect rich market information for enterprises and provide unblocked channels for selling. (5) Positive enterprising concept and clustering culture. Tianjin's future industrial clusters of the new type should maintain and develop coordinated and open clustering culture. In addition, future industrial clusters in Tianjin should incorporate foreign advanced culture and cultivate compound competitive advantage.

V. Case Study 3: The Malaysian Electronics Industry[3)]

The paper of Okamoto [2004] focused on the Malaysian electronics industry, which has been successfully forming an industrial agglomeration since the mid-1980s and as a result, Malaysia has been a leading producer of electronics products in the international market. However, due to the recent rapid emergence of China as an industrial power, it may not be possible for the Malaysian electronics industry to sustain its current industrial growth. In order to analyze these issues, the paper empirically examines the international

competitiveness of the Malaysian electronics industry using various analytical measures. Utilizing these methods, it analyzes rigorously the Malaysian and Chinese electronics industries in the global market by examining whether two industries are competitive or complementary. Finally, the paper investigates whether the new rise of the ICT industry in Cyberjaya in Malaysia may constitute another industrial cluster to sustain the growth of Malaysia.

The Malaysian electronics industry disperses rather than concentrate all over the country, namely, the regional distribution of foreign and domestic investment tends to be dispersed among such states as Selangor, Penang, Perak, Johor, Negeri Sembilan, Melaka, Kedah, Pahan, and Sarawak. This is shown by examining Gini coefficients of foreign and domestic regional investment patterns in 1993 and 2002, which are 0.67 and 0.50, respectively. These values are significantly lower than those of China and Thailand, for example.

The recent flow of FDI into the Malaysian electronics industry shows that it went up enormously again in 2000, after the 1997 Asian crisis when the FDI flow showed a sharp drop. The characteristics of the recent flow of FDI are aiming for the expansion/diversification of existing investment and projects, and concentrating on the production of high value added products such as plasma TVs. These seem to reflect the prevalent strong level of confidence among foreign investors to undertake investments in Malaysia.

The competitiveness of the Malaysian electronics industry is also analyzed by calculating The RCA index, which indicates the comparative advantage of each commodity within a country compared with world trade structure. The paper shows that there is no change in that Malaysia continues to specialize in the production of electronics products in general, but some products such as office machines and computers raise the index, while such products as radios and sound recorders tend to decline. This means that the industrial competitiveness of Malaysia shifts away from the production of low value added products to that of high value added ones. Despite the closure of some establishments and the shifting of their operations to lower cost production countries such as China and Vietnam, many existing firms continue to engage in expansion or diversification of their investment projects in the production of relatively high value added products.

The paper also focuses on whether China is a threat to Malaysia, that is, the emergence of China as an industrial power may cause a significant impact on the Malaysian electronics industry. The background of this argument comes from the flow of FDI both into China and ASEAN. It is very clear that ASEAN cannot compete with China in terms of the absolute value of FDI inflow. Moreover, the gap seems to have become even wider in recent years as

the entry of China into WTO turned around the declining trend of FDI flow into that country, while the flow of FDI into ASEAN remains stagnant. In order to answer the above issue, the paper utilizes again the RCV index. The procedure is as follows: the RCA indexes are calculated for Malaysia and China for electronics products. Those indexes are ranked for each country respectively and the spearman's rank correlation coefficient between the rankings of two countries is calculated. If they show a high positive correlation, their trade structure is very competitive. That means that the emergence of China as an industrial power may have a significant impact on Malaysia. On the other hand, if the coefficient is near zero or negative, their trade structures are rather dissimilar and both could be complementary to some extent. The results of the analysis for the Japanese market show that in 1996 the coefficient was a little bit high (0.453), but statistically insignificant, while in 2000 the coefficient becomes even lower and close to zero (0.134). Considering the high degree of involvement of MNCs in the electronics industry in Malaysia and China, the paper concludes that MNCs tend to produce different types of electronic products in China and Malaysia, that is, China and Malaysia can be complementary in the electronics industry.

VI. Case Study 4: Bangalore's Software Cluster[4]

It is widely recognized that capital, technology, information and human resources embedded in the region are essential factors for firms to agglomerate. The study of Okada [2004] examines Bangalore, India as a case study, which is one of the centers of leading software clusters in the world, by analyzing the conditions under which knowledge-intensive industrial clusters in developing countries build competitiveness, with particular focus on the dynamics of the local labor market.   In other words, this study examines the characteristics of the local labor market such as an institutional mechanism for promoting innovation and strengthening competitiveness of its software industry.

In the 1990s, Bangalore emerged as the largest software cluster in India, achieving tremendous growth particularly since 1997, mainly through exports of lower-end software and IT-enabled services to the US market. In more recent years, leading IT global players such as Motorola, HP, TI, and IBM started outsourcing their R&D to Bangalore, allowing the cluster to gradually move up the value chain by engaging in higher-end services such as embedded systems. Lower-end IT-enabled services have also grown rapidly. A question posed by this study is: Why this phenomenal export growth occurred particularly in Bangalore? The answer is an affluent skilled IT-related labor force with proficiency in English in that region. As of 2001, approximately 80,000 IT professionals were working in

Bangalore, accounting for about 20% of the IT professionals in the whole country. The paper analyzes the factors to explain this in the demand and supply side of the labor market. The latter includes educational institutions in the region. In 1998, Bangalore established the Indian Institute of Information Technology (IIIT) as a joint initiative between government and industry. The IIIT-Bangalore was located right in the center of the International Technology Park (ITP), in order to improve the quality of training in IT-related courses and train IT professionals to meet industry needs. In addition, there were 106 engineering colleges in Karnataka: two are government-run and the rest are privately funded (as of 2001). Private engineering colleges in Karnataka account for 19% of the 553 all private technical colleges nationwide. These institutions greatly contributed to the IT-skilled workforce for the software industry in the region. Moreover, in-firm training is a principal means to develop IT professionals' skills in Bangalore. Because technology changes so quickly, firms need to keep upgrading their skill sets, by retraining their employees in 'hot skills.' The average life of technical skills is only three years. Major firms frequently update the skills profile of their employees through in-firm training, in technical skills, domain knowledge, and communication skills. It is said that firms spend about 5% of total labor costs on in-firm training, and on average employees spend 10 to 12% of their work time on such training.

Another characteristic of the local labor market for IT is found in its high mobility. The paper discusses the fact that the average IT professional works only two to five years at one firm. During the boom years between 1997 and 2001, the average labor turnover rate rose to 22 to 25%, sometimes even up to 30%, as engineers frequently moved to other firms offering higher salaries. After the IT industry slowed down in 2001, the industry average for labor turnover declined to 8%.

High turnover rate for seeking higher compensation brought about positive effects for skills development of workers. Workers in the software and services industry are in a fast career trajectory. The paper found an interesting fact through field research that in only four to five years, software engineers reach the top level, becoming project leaders. Software design engineers must have at least five years of experience, while software programmers must have at least more than 3 years of experience and junior engineers doing coding need only one year. Because of this fast-track career development, most leading firms have performance-driven and merit-based compensation schemes. This again causes high mobility in the local labor market.

Dynamism of the local labor market comes also from spin-offs, which is similar to that in Silicon Valley. Many workers in large MNCs such as HP and Motorola and in leading Indian firms leave to set up their own firms. Former Wipro employees, for example, have set up more than 100 firms with no assistance from the firm. These IT professionals use the

knowledge and skills they acquired at large firms in their new startup firms.   Relatively low capital requirements for such new startups, along with the growth of venture capital across the country, have facilitated this trend.

The paper successfully analyzes a so-called virtuous cycle that generated knowledge management in the region. The process was formed through the following mechanisms: (a) the state government quickly responded to the enormous growth in demand for skilled IT manpower through its manpower planning polices; (b) high intra-firm transnational mobility as well as inter-firm mobility has helped firms to quickly deploy and mobilize the skill sets they require; (c) the emergence of local labor market intermediaries in terms of staffing agencies as well as the industry-wide collaboration in carrying out a periodic compensation survey helped facilitate the working of the local labor market; and (d) both MNCs and leading Indian firms actively promoted in-firm training to upgrade the skills of the workforce in their internal labor markets.   These altogether have led the cluster to better mobilize the skills to meet the global demand and move up the value chain, and thus build competitiveness.

VII. Conclusions

We thus summarized some of the key studies in our ongoing research into the clustering phenomenon. Our conclusions can be briefly summarized as follows.

To build mature industrial clusters, good regional economic environment is needed. Good regional economic environment should, at least, include the following 6 factors. (1) Rich technological resources and its distribution media. The source of technological resources includes universities, national labs and scientific research institutes in enterprises. They can offer research achievements that are necessary for industrial sectors to seek a more consolidated competitive position. These achievements can be timely and efficiently transferred into industrial sectors through distribution media. (2) Human resource with high adaptability and organizations for development and training. Economic development requires that regions provide lots of professional personnel and a skilled contingent of workers for enterprises. Besides, through basic occupational education, higher education and continuous in-service education, regions should make human resource have the knowledge and skill that adapt them to competition and changes. (3) Abundant fund source. Competitive power of regional industries cannot do without the strong support of financial organizations. The functions of these financial organizations include raising enough funds for economic development and establishing an investment mechanism that can fully reflect

guidance for market competitive power. (4) Favorable macroeconomic environment with efficient management. This kind of management level is embodied in 2 aspects: one is that macroeconomic regulations can guide enterprises effectively and at the same time do not destroy the independence and competitive relation of enterprises; the other is that the tax system is beneficial to competition and at the same time, meets the needs of economic development and the public. (5) Well-developed infrastructure for software and hardware. The efficiency of regional economic activities is, to a large extent, affected by the condition of infrastructure. (6) Fair-scale groups of customers with discriminatory ability. Views of these customers and their requirements for products can reflect the basic trend of market changes and should be regarded as the basis for product innovation by enterprises.

The success of these industrial agglomerations depends on (1) infrastructure (highways, ports, electricity supply, etc.); (2) institutional framework (legal systems, participatory actors, coordination among actors, etc.); and (3) government support in terms of laws, taxation and finance. As shown in this paper, among them, the role of government is essential. In developing countries, the market mechanism to foster clusters does not function well due to regulations, bureaucracy, and the existing legal framework. Moreover, there is no proper market for capital and human resources. In such a case, the government must complement market mechanism and prepare the above three conditions. The cases of northern Vietnam and China provide good examples where collaboration in these three areas worked well.

In conclusion, we must deepen our theoretical understanding of this matter – i.e., answer the fundamental question of how growth and location affect each other (or whether regional discrepancies widen or disappear over time).

* This paper is based on "Introcution" and "Conclusion" of Kagami and Tsuji [2003] and Kuchiki and Tsuji [2004].

NOTES

1) This section is based on Reidel and Record [2004].

2) This section is based on Donggang, Siquan, Xuejie and Rueyu [2004].

3) This section is a summary of Okamoto [2004].

4) This section is a summary of Okada [2004].

References

Berg, S., M. Pollitt and M. Tsuji [2002], *Private Initiatives in Infrastructure: Priorities, Incentives, and Performance*, Edward Elgar, London, UK, September.

Donggang, Z., X. Siquan, B. Xuejie and L. Rueyu [2004] "Industrial Clusters in Tianjin Area," in Kuchiki and Tsuji [2004].

Fujita, Masahisa and Jacques-François Thisse [2002], *Economics of Agglomeration: Cities, Industrial Location, and Regional Growth*, Cambridge University Press.

Fujita, Masahisa, Paul Krugman, and Anthony J. Venables [1999], *The Spatial Economy: Cities, Regions, and International Trade*, The MIT Press.

Giovannetti, E., M. Kagami and M. Tsuji [2003]*, The Internet Revolution: A Global Perspective*, Cambridge University Press, Cambridge, UK, April

Kagami, M., E. Giovannetti and M. Tsuji [2004], *Information Technology Policy and the Digital Divide: Lessons for Developing Countries*, Edward Elgar, London, UK, March.

Kagami, M. and M. Tsuji [2000], *Privatization, Deregulation and Economic Efficiency*, Edward Elgar, London, UK, June.

Kagami, M. and M. Tsuji [2003], *Industrial Agglomeration: Facts and Lessons for Developing Countries*, Institute Developing Economies/JETRO, Chiba, Japan, March (forthcoming from Edward Elgar in 2005).

Krugman, Paul [1995], *Development, Geography, and Economic Theory*, The MIT Press.

Kuchiki, A. and M. Tsuji [2004], *Industrial Clusters in Asia: Their Coordination and Competition*, Institute of Development Economies/JETRO, Chiba, Japan, March (forthcoming from Macmillan in 2005).

Okada, A. [2004] "Bangalore's Software Cluster: Building Competitiveness through the Local Labor Market Dynamics," in Kuchiki and Tsuji [2004].

Okamoto, Y. [2004] "Agglomeration and International Competitiveness: Can Malaysia's Growth be Sustainable?" in Kuchiki and Tsuji [2004].

Porter, Michael [1990], *The Competitive Advantage of Nations*, Macmillan.

Reidel, J. and R. Record, [2004] "Industrial Cluster in Asia: Vietnam Case Study," in Kuchiki and Tsuji [2004]