Architecture-based Comparative Advantage in Japan and Asia

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1 INTRODUCTION

Asia has become a global center of manufacturing during the last quarter of the 20th century. First, Japan was the only major exporter of manufacturing goods from Asia. Then, yen was rapidly appreciated after The Plaza Accord in 1985, and newly industrialized economies (NIES) such as Korea, Taiwan, Hong Kong and Singapore emerged as exporters of relatively standardized goods. Japanese manufacturing firms also started to shift their production facilities mainly in ASEAN countries.

In the 1990s, China emerged as major exporters of certain labor intensive goods. NIES also continued to expand their manufacturing bases. Japanese economy stumbled, but its trade surplus continued to be significant. America came back as a center of digital network goods and softwares. How can we explain these dynamics of manufacturing competitiveness? In this situation, after all, we may better go back to the basics of comparative advantage theory.

Generally speaking, when there is good fit between a nation's characteristics and an industry's characteristics, the industry tends to enjoy competitive advantages in that country. Ricardo's Theory of Comparative Advantage implied that "good fit" is translated into relatively high labor productivity vis-a-vis other countries (Ricardo, 1971). Neoclassicists such as Heckscher, Ohlin and Samuelson advocated that countries having larger endowment of a certain productive resource (for example, labor-rich countries) will have better fit with industries that heavily use this particular resource (for example, labor-intensive industries), assuming that productivity is identical across the countries (Hecksher, 1949; Samuelson, 1948). More recent version of competitive advantages (e.g., Porter, 1990; Cho and Moon, 2000) also follows this tradition of fit between industry and country characteristics.

In more recent years, however, various phenomena that are difficult to explain using existing theoretical frameworks alone have been emerging. These phenomena include the recent fact that Japan has been apparently surpassed by China, Korea and Taiwan in some technology-intensive products (e.g., DRAM, CD media, DVD recorder), which were assumed to be Japan's stronghold for many years.

2 EXPORT COMPETITIVENESS OF JAPAN'S INTEGRAL ARCHITECTURE PRODUCTS

Against this background, the author advocated that we need an additional framework that focuses on "fit between organizational capacity and architecture" – a version of the comparative advantage theory seen from our observations of manufacturing activities on the shop floor.

Specifically, this framework argues that Japanese manufacturing firms, facing high economic growth amid shortages of work force, materials and money, tended to engage in economically rational long-term transaction/long-term employment. As a result, they built organizational capability that emphasizes teamwork among multi-skilled workforce, or "*integrative organizational capability of manufacturing*," which raised their productivity and quality simultaneously. Toyota Production System is a typical example of such a capability (Monden, 1993; Fujimoto, 1999).

On the other hand, it was thought that there are two basic types of product-process architecture: (1) "*Integral architecture*" with complex interdependence between product functions and product structures (such as automobiles, etc.); (2) "*Modular architecture*" in which the relationship between a product's functional and structural elements have a simple and clear one-to-one correspondence (such as personal computers, etc.) (Ulrich, 1995).

It was also thought that Japan, which is a country with a high endowment of "*integrative organizational capability*" stemming from its long-term employment and long-term transaction practices, tends to have a competitive advantage in "integral architecture" products – a prediction based on our "*architecture-based comparative*" hypothesis. In other words, Japan, where coordination-oriented organizational capability has been concentrated due to its historical trajectory in the late 20th century, tends to export *coordination-intensive goods*, or products with integral architecture.

3 PRELIMINARY EMPIRICAL RESULTS

With this framework of capability-architecture matching, can this new approach to industrial competitiveness demonstrate additional explanatory power for the reality of Japan's industrial competitiveness? Although the research is still at the exploratory stage, The Manufacturing Management Research Center (MMRC) at the University of Tokyo conducted a survey analysis of selected Japanese manufacturing firms in cooperation with the Ministry of Economy, Trade and Industry (METI). The survey targeted both assembled products and processed products (chemicals, etc.), including automobiles, household appliances, electronics, parts, industrial machines, chemicals, iron and steel, fibers, and food and drink (Fujimoto and Oshika, 2006).

As the results indicate, our "integral architecture index," constructed from about a dozen of questions regarding architectural characteristics of each product surveyed, and export ratio of the product (export value/domestic production value) in question generally statistically significant positive correlations (**Figure 1**). The positive correlations were

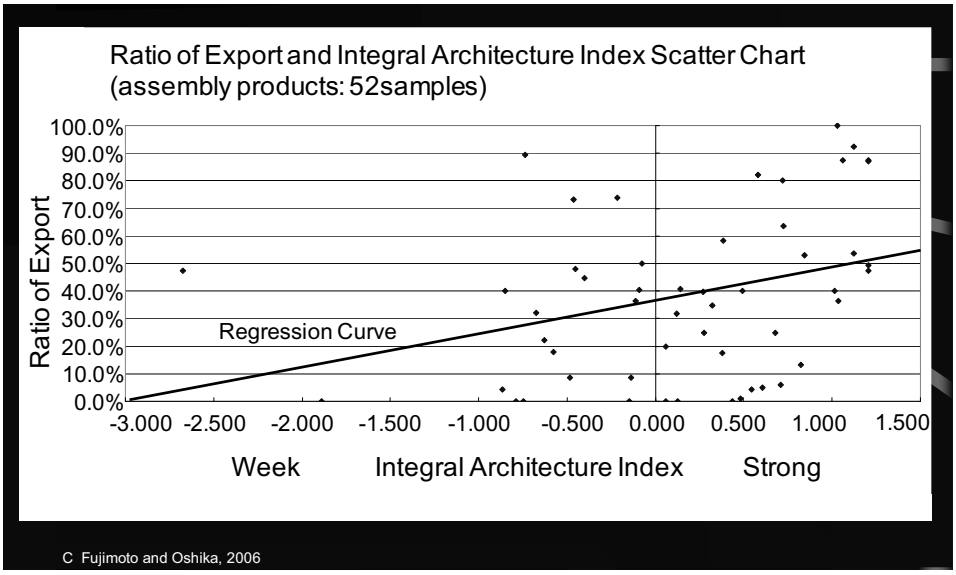

Figure 1: Ratio of export and integral architecture index (assembly products : 52 samles)

observed in both fabrication- assembly goods (e.g., machinery) and process goods (i.e., chemical). Also, the integral architecture index was positively correlated with not only export ratio, but also foreign activity ratio (export plus overseas production/domestic production), indicating that Japanese multinational firms tend to be good at integral architecture products wherever they are produced.

4 HYPOTHESES ON ARCHITECTURAL ADVANTAGE IN ASIA-PACIFIC AREA

Let's turn to architecture-based comparative advantage outside Japan. The following hypotheses are very preliminary and impressionistic ones, which are based mostly on ad-hoc empirical and historical observations of each geographical area (**Figure 2**).

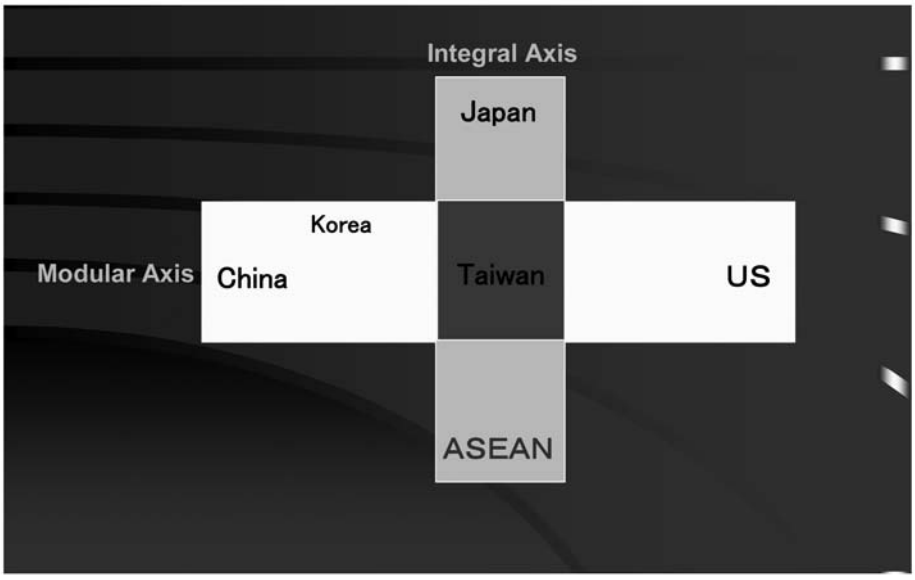

Figure 2 : Architectural gepolitics : a prediction in the pacific region

The basic logic is the same across the regions, however: Each region has its own historical path; A certain type of organizational capability tends to become concentrated in a certain region as a result of emergent capability-building process, which causes concentration of region-specific capability; Products with a certain type of product-process architecture and other characteristics tend to match better with a certain type of organizational capability, that results in relatively high productive performance (e.g., productivity, lead time, and quality).

Hypothesis on America: In a sense, America has been a country of immigrants in the past few centuries. In other words, it continued to attract human resources with industrial and technical knowledge and skills. For a society of this dynamism, it made sense to minimize coordination in order to make use of newcomers' capability as quick as possible.

As a result, American industries tended to emphasize division of labor, specialization, standardization of work, clear job demarcation, and use of market mechanism, while minimizing coordination efforts. Thus, the American System of Manufacture, throughout the 19th century, emphasized interchangeable parts and specialized equipment while minimizing coordination on the shop floor (e.g., fitter). American Mass Production System perfected this idea in the early 20th century. In the last decades of the 20th century, America rediscovered the power of a manufacturing system that economizes coordination cost—the Silicon Valley model of designing and producing digital network goods.

With this social and historical background, the framework of the architecture-based comparative advantage predicts that America-based firms tends to show comparative advantage in certain *technology-intensive modular architecture goods*.

Hypothesis on China: In the late 20th century, China, under the Communist Party regime, adopted Soviet-style national innovation system, in which industrial R&D activities were highly concentrated at the nation state level. Manufacturing firms in China were virtually equal to factories without R&D functions. The design of Chinese products tended also to lag behind that of advanced countries. Thus, when China chose an open economy path in the 1970s, many of its manufacturing firms, those in Southern coastal provinces in particular, had to acquire design information for their new products by licensing foreign technologies or copying foreign products.

For rapid catch-up of product design, many of the Chinese firms, state-owned or private, went for buying licensed or copied parts as generic modules and quickly started up new manufacturing businesses by mix-and-match of such de-facto generic components. The author calls this type of products "*quasi-open architecture*." Many of the machinery industries, such as motorcycle, truck, air conditioner, TV, and other digital consumer goods, were occupied by more than one hundred assembly makers. Copy parts themselves were also produced by hundreds of local suppliers. These firms also tended to rely on mix-and-match of standard equipment and low-wage temporary workers from low-income regions of inland China.

As a result, by the end of the 20th century, China became a major exporter of *labor-intensive modular architecture goods*. Thus, through a very different historical path, America and China became two major producers of relatively modular goods in the Pacific-rim side of the globe. This sharply contrasts with postwar Japan, which became a major exporter of integral architecture products.

Hypothesis on Korea: The most distinctive feature of the postwar Korean economy is a small number of large conglomerates, called Chaebols (e.g., Hyundai and Samsung), which somewhat resemble prewar Zaibatsu in Japan (The two share the same Chinese characters). Each Chaebol was controlled by its founder-owner and family. Because of strong top-down control by the founder-owners, Korean Chaebols tended to have strength in quick decision-making and investment on capital-intensive processes.

Thus, Korean large firms tended to have advantages in standard capital intensive goods, where mix-and-match of the latest production equipment results in competitive products, such as general purpose steels, DRAM, and CLD. In other words, Korean export power is highly concentrated in *capital-intensive modular architecture goods* produced by large firms, many of which stem from Chaebols.

Hypothesis on Taiwan: Taiwan is another significant exporter of manufacturing goods. Taiwanese economy maybe characterized as that of "competitive small country" (e.g., The Netherlands). Taiwan, because of its complicated history in the 20th century, and because of its geographical location (the intersection of America-China-Japan-ASEAN axes) has had strong economic links with the U.S., Japan, and mainland China. Taiwanese export-oriented firms tend to be good at making the most of their overseas linkages in building their organizational capabilities.

Where the products are modular and technology intensive (e.g., digital network goods), Taiwanese specialist producers tended to create networks with American firms. Where the products are integral (e.g., the automobile), Taiwanese firms tend to link themselves to the Japanese production networks. Thus, their strength resides in *versatility* of quickly moving between modular and integral architectures.

Hypothesis on ASEAN countries: As far as manufacturing competitiveness is concerned, ASEAN countries (except Singapore) have not demonstrated concentration of distinctive organizational capability. Although there is a significant degree of variety among ASEAN countries, none of them has industrial agglomeration of local firms that are technologically competitive. ASEAN countries have long functioned as production bases of the Japanese and Western multinational firms.

As such, ASEAN's manufacturing firms were mostly dependent on product designs originating from the multinational firms. Certainly, it is not realistic to foresee emergence of a cluster of ASEAN local firms with distinctive design capability in the near future. However, some of ASEAN countries, such as Thailand and Vietnam, may emerge as production bases of *labor-intensive integral architecture goods*. Their potential advantage over typical Chinese factories may be that it is easier for the former to keep multi-skilled workers with relatively low wages. China may possess a huge supply of low-wage single skilled workers, but the wage level tends to be higher and increasing for multi-skilled workers because of the volatile nature of Chinese labor market.

The key for this possible path toward integral goods is training for multi-skilled workers. In order for ASEAN economies to avoid direct competition against China, which is overwhelmingly strong in labor-intensive modular products,

the former may find it beneficial to differentiate themselves from China by focusing on low-price, labor-intensive integral architecture goods. In order to produce such products competitively, it is crucial to strengthen teams of multi-skilled workers. The most effective training fields for this type of work force are, obviously, factories of Japanese firms. Thus, ASEAN firms may have a chance to become the export center of *labor-intensive integral architecture goods*, but only potentially at this point.

5 IMPLICATION FOR ODA IN ASEAN COUNTRIES

Japan's ODA to ASEAN nations have been historically significant in terms of its volume. It may need to be more strategic in the future. That is, a significant portion of Japan's ODA to ASEAN firms may be used for training of multi-skilled workers. Large scale systems and high-tech equipment may look spectacular, but it is difficult to differentiate to create distinctive manufacturing competence vis-à-vis China, a giant in modular manufacturing. The main players of such capability-building are Japanese and ASEAN manufacturing firms, but policy makers can assist their strategic activities.

Policy makers of both Japan and ASEAN may need to share a strategic vision and road map regarding manufacturing competitiveness in Asia. High technology and large systems may be favorite items for bureaucrats, but if all the countries go for such technologies, they are not necessarily the strategic solution for sustainable manufacturing competitiveness.

Asia-Pacific Area is probably the most competitive region in manufacturing. And this is the very reason why policy makers and industrialists in this region need to have a keen sense of comparative advantage. Architecture-based framework of comparative advantage may give them some additional insights. As Ricardo advocated, a country cannot be a major exporter of goods with all kinds. This principle holds true in the case of product architectures as well.

REFERENCES

Cho,D.-S. and Moon,H.-C. (2000) From Adam Smith to Michael Porter: Evolution of Competitiveness Theory. Singapore: World Scientific.

Fujimoto,T. (1999) The Evolution of a Manufacturing System at Toyota. New York: Oxford University Press.

Fujimoto,T. and Oshika,T (2006) "A Memo on the Hypothesis of Architecture-based Competitive Advantage" MMRC Discussion Paper --.

Hecksher,E.F. (1949) "The Effect of Foreign Trade on the Distribution of Income." In Howard S. Ellis and Lloyd A. Metzler, eds., Readings in the Theory of International Trade. Homewood: Irwin.

Monden,Y. (1993) Toyota Production System (2nd. ed.), Norcross, GA: Industrial Engineering and Management Press.

Porter,M. (1990) The Competitive Advantage of Nations, New York: Free Press.

Ricardo,D. (1971) On the Principles of Political Economy, and Taxation. Baltimore: Penguin.

Samuelson,P. (1948) "International Trade and the Equalization of Factor Prices." Economic Journal, 58, 165-184.

Ulrich,K. (1995) "The Role of Product Architecture in the Manufacturing Firm," Research Policy, 24, 419-440.