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. At first, Japan was the only major exporter of manufactured goods in Asia. As the yen rapidly appreciated after the Plaza Accord in 1985, 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 to ASEAN countries.

In the 1990s, China emerged as a major exporter of certain labor-intensive goods. NIES also continued to expand their manufacturing bases. The Japanese economy stumbled, but its trade surplus continued to be significant. America made a comeback as a center of digital network goods and software. How can we explain these dynamics of manufacturing competitiveness? The best way to understand them is to go back to the basics of comparative advantage theory.

When there is a good fit between a nation's characteristics and an industry's characteristics, the industry tends to enjoy competitive advantages in that country. The Ricardian Theory of Comparative Advantage implied that "good fit" translated into relatively high labor productivity vis-à-vis other countries (Ricardo, 1971). Neoclassical economists such as Heckscher, Ohlin, and Samuelson maintained that countries having a large endowment of a certain

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factor of production (for example, labor-rich countries) would have a better fit with industries that heavily use that particular resource (for example, labor-intensive industries), assuming that technology is identical across the countries (Hecksher, 1949; Samuelson, 1948). A recent version of competitive advantages (e.g., Porter, 1990; Cho & Moon, 2000) also follows this tradition of fit between industry and country characteristics.

In more recent years, however, various phenomena have emerged that existing theoretical frameworks have difficulty explaining. These phenomena include Japan apparently being 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.

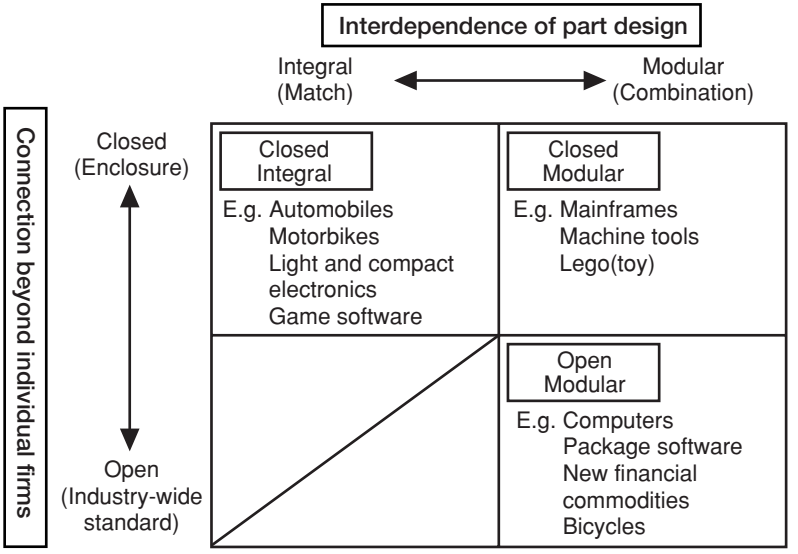
2. Export competitiveness of Japan's integral architecture products

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

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

There are two basic types of product-process architecture: (1) "*integral architecture*," with complex interdependence between product functions and product structures (such as automobiles), and (2) "*modular architecture*," in which the relationship between a product's functional and structural elements has a simple and clear one-to-one correspondence (such as personal computers) (Ulrich, 1995).

Figure 1. Products Categorized by Architecture Type of Design Information



It is then thought that Japan, which is a country with a large 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 advantage*" hypothesis. In other words, Japan, where coordination-oriented organizational capability is concentrated due to its historical trajectory in the late 20th century, tends to export *coordination-intensive goods*, or products with integral architecture.

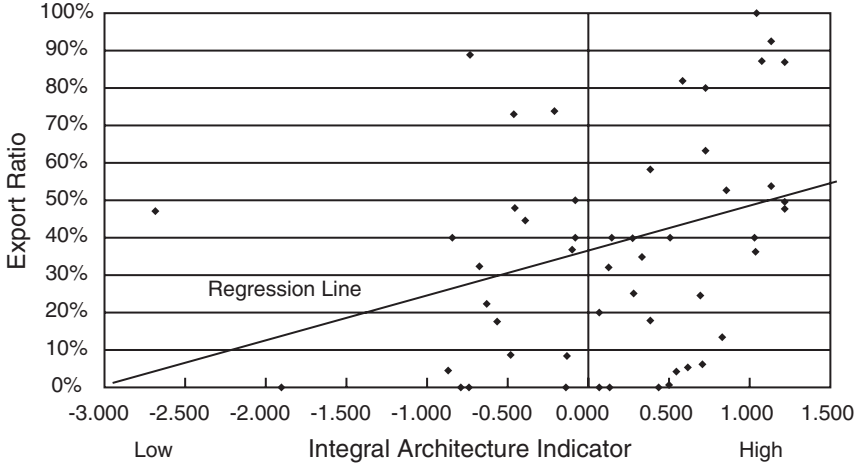
3. Preliminary empirical results

Can this new approach to industrial competitiveness, featuring capability-architecture matching, demonstrate additional explanatory power on the reality of Japan's industrial competitiveness? Although the research is still at an 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, including automobiles, household appliances, electronics, and parts, industrial machines, chemicals, iron and steel, textiles, and food and beverages (Fujimoto & Oshika, 2006).

The results revealed that our "integral architecture index," constructed from about a dozen questions regarding architectural characteristics of each product surveyed, has a statistically significant and positive correlation with the export ratio of the product in question (export value/domestic production value) (Figure 2). The positive correlation is observed in both fabrication-assembly goods (e.g., machinery) and processed goods (e.g., chemicals). The integral architecture index is also positively correlated with not only the export ratio, but also the foreign activity ratio (export plus overseas production/domestic production), indicating that Japanese multinational firms tend to do well with integral architecture products wherever they are produced.

Figure 2. Ratio of Export and Integral Architecture Index (assembly products: 52 samples)

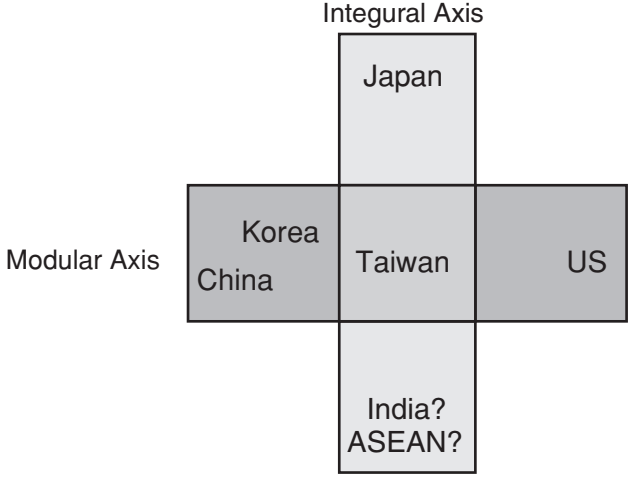


4. Hypotheses on architectural advantages in the Asia-Pacific Area

Let us turn to architecture-based comparative advantages outside Japan. The following hypotheses are very preliminary and impressionistic, and are based mostly on *ad hoc* empirical and historical observations of each geographical area (Figure 3).

The basic logic is the same across regions and can be described as follows. 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 an initial capability-building process, which generates region-specific capability. Products with a certain type of product-process architecture tend to match better with a certain type of organizational capability, which results in relatively high productive performance in terms of, for example, productivity, lead time, and quality.

Figure 3. Architectural Geopolitics: A Prediction in the Pacific Region



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

As a result, American industries have emphasized division of labor, specialization, standardization of work, clear job demarcation, and use of the market mechanism, while minimizing coordination efforts. Thus, the American System of Manufacturing throughout the 19th century emphasized interchangeable parts and specialized equipment while minimizing coordination on the shop floor (e.g., fitter). The 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 through the Silicon Valley model of designing and producing digital network goods.

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

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

To quickly catch up on product design, many Chinese firms, both state-owned and private, opted to buy 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 motorcy-

cles, trucks, air conditioners, TVs, and other digital consumer goods, were supplied by more than one hundred assembly makers. Copied 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 on the Pacific Rim. This contrasts sharply 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 terms 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 had advantages in standard capital-intensive goods, where mix-and-match of the latest production equipment resulted in competitive products, such as general-purpose steel, DRAM, and crystal liquid display. 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 manufactured goods. The Taiwanese economy may be characterized as a "competitive small country" on a par with the Netherlands. Taiwan, because of its complicated history in the 20th century, and because of its geographical location at 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 specialized producers tend to create networks with American firms. Where the products are integral (e.g., the automobile),

Taiwanese firms tend to link with Japanese production networks. Thus, their strength resides in the *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 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 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. Although China possesses a huge supply of low-wage single-skilled workers, the wage level tends to be high and rising for multi-skilled workers because of the volatile nature of the Chinese labor market.

Training multi-skilled workers is thus the key for this possible path of ASEAN countries toward strength in producing integral goods. In order for ASEAN economies to avoid direct competition against China, which is overwhelmingly strong in labor-intensive modular products, they 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

Historically, Japan's ODA to ASEAN nations has been significant in terms of 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 the training of multi-skilled workers. Large scale systems and high-tech equipment may look spectacular, but with only these it is difficult to differentiate ASEAN to create distinctive manufacturing competence *vis-à-vis* China, a giant in modular manufacturing. The main players of such capability-building should be Japanese and ASEAN manufacturing firms, but policy makers can assist their strategic linkage.

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

Because the Asia-Pacific region is highly competitive in manufacturing, its policy makers and industrialists need to have a keen sense of comparative advantage. The architecture-based framework of comparative advantage may give them some additional insights. As Ricardo advocated, a country cannot be a major exporter of all goods. This principle holds true in the case of product architectures as well.

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