

# **Chapter 3**

## **Quantitative Analysis of the Procurement Structure of Supporting Industries in ASEAN 4, Republic of Korea, and Japan**

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### **1. Introduction**

The aim of this paper is to describe quantitatively the procurement structure of supporting industries for key manufacturing categories in Asia. The term “supporting industry” refers to a group of industries that supply the diverse parts and materials used in the production of industrial products, such as automobiles and electronic and electrical products. In this paper, “supporting industries” is defined as a general term for all industries that supply parts and materials for the production of final products, such as automobiles and consumer electronics products. In the automotive industry, for example, a few ten thousands of parts and materials that are ultimately assembled by car manufacturers are manufactured by a variety of companies, including first-tier, second-tier, and third-tier suppliers. Various materials (metals, plastics, rubber, glass, fibers, etc.) and processing technologies are therefore needed to produce a complete automobile. Thus, to produce an automobile, it is necessary to have cooperation not only within the automotive parts industry, but with a large number of other industries as well.

Regarding industrial development in Asia, there has been much discussion about the need to strengthen the supporting industries in order to boost industrial competitiveness. Indeed, countries in Asia have already spent a few decades developing their supporting industries, not only for automobiles but in other areas as well. To what extent have Asia’s supporting industries developed

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as a result of these efforts? In this paper we conduct a quantitative analysis of the procurement structures for the manufacturing industries for cars, trucks and motorcycles (hereafter automotive/motorcycle industry in this paper) as well as electrical and electronics products (ranging from air conditioners and washing machines to televisions, CD and DVD players, and computers, etc.; hereafter electrical/electronics industry in this paper) in the Association of Southeast Asian Nations 4 (ASEAN 4: Thailand, Malaysia, Indonesia, and Philippines), Republic of Korea (hereafter Korea in this paper), and Japan, and make inferences about the procurement structures from their supporting industries.

The procurement activities associated with supporting industries are complex and have certain special features. For example, (1) materials are procured from a large number of industries; (2) supplier relationships are intricate, with suppliers often supplying each other, and supplier-customer roles sometimes being reversed; and (3) in many cases, first- and second-tier suppliers and others import from other countries the materials they need for their own production, even though these materials may be available within their own country. Trade and industrial statistics alone are insufficient to analyze these complex industrial linkages and trade structures; it is necessary to use industrial input-output tables. The Asian International Input-Output Tables used in this paper reveal the industrial structures that are composed of the industries in each country (Figure 1). By using these tables, it is possible to accurately analyze the inputs from supporting industries into the industries targeted by our analysis. In addition, by using back-linkage analysis, it is also possible to conduct analysis converging on infinity of the linkages in each industry that provides inputs into the industries targeted by this analysis. In this paper, by using the Asian International Input-Output Tables, we attempt a quantitative analysis of the structure of industries that support the automotive/motorcycle and electrical/electronics industries, which Asian countries have selectively encouraged from among a wide range of supporting industries. Many studies have already conducted input-output analyses for Asia, but many of these have focused on the analysis of industrial structures at the national level. Analysis that pays attention to their supporting industries is difficult to find.

**Figure 1. Concept structure of Asian International Input-Output Table**

		Intermediate transaction					Final demand		Export			Statistical discrepancy	Total	
		ASEAN 4	Korea	Japan	USA	Singapore	China	Taiwan	ASEAN 4	..	Taiwan			Hong Kong
	ASEAN 4 Korea Japan USA Singapore China Taiwan	A					F		L			Q	X	
F&I		BA					BF							
Imp.	Hong Kong	HA					HF							
	ROW	WA					WF							
	Wages and salary	VV001												
	Operating surplus	VV002												
	Depreciation of fixed capital	VV003												
	Indirect taxes less subsidies	VV004												
	Total	X												

Note: F&I is the acronym of International Freight and Insurance.  
ROW is short for Rest of the World.

## 2. Methodology

### 2.1. Industrial input-output tables and target of analysis

The input-output tables used in this paper include the tables for the year 1975 (8 countries, 56 industrial sectors), 1990 (10 countries, 78 industrial sectors), and 1995 (10 countries, 78 industrial sectors) of the Asian International Input-Output Tables from the Institute of Developing Economies (IDE, 1982, 1998 and 2001). The analysis in this paper compares ASEAN 4, Korea, and Japan. The selection of the industries for this analysis is based on the general thinking model of Asian economic development that placed Japan as the leader; in this paper, under a similar development model, Japan and Korea are seen as advanced countries compared to ASEAN 4 in terms of the automotive, electrical and electronic industries. The subjects of analysis in this paper are the automotive/motorcycle and electrical/electronics industries. The reasons for their selection are that they are typical examples of industries that require extensive supporting industries, and governments have strategically fostered both of them in ASEAN 4 and Korea.

## 2.2. Terminology and Analytical Methodology

In this paper we conduct the analysis with an emphasis on input structures, paying attention to the procurement of materials required for production. First, the domestic linkage effects in each country are measured for the automotive/motorcycle and electrical/electronics industries. In addition, to facilitate a detailed analysis, the terms “direct procurement” and “indirect procurement” are introduced, as well as their related indicators.

“Direct procurement” is defined here as first procurement activities from various industries by industry  $j$  when industry  $j$  carries out production. Column  $j$  in the intermediate transaction segment of the international input-output tables shows the “amount procured” from which “country,” of the raw materials needed for the production of a product in industry  $j$ . The raw materials needed for that production are indicated under the “intermediate inputs” category. Using these features of the tables, it is possible to analyze to what extent industry  $j$  is procuring materials from which industries in which country. “Domestic direct procurement rate” (DDPR) is defined here as the proportion of direct procurement done domestically as a portion of all direct procurement, as shown in Equation 1.

$$DDPR = \frac{\sum_{i=1}^m c_{ij}^a}{\sum_{a=1}^g \sum_{i=1}^m c_{ij}^a} \times 100, \quad (1)$$

in which DDPR: Domestic direct procurement rate,

$c_{ij}^a$ : Intermediate input coefficient of industry  $j$  in country  $a$ ,

$m$ : Total number of industries in each country, and

$g$ : Total number of countries.

Procurement activities in supporting industries cannot be expressed, however, only in terms of direct procurement. The production linkage effect associated with production in the supporting industries themselves brings a variety of indirect linkage effects both inside and outside the country, and generates new procurement activities. For example, let us consider the case of industry  $i$ , and industry  $j$ , which provides inputs to it. An expansion of production in industry  $i$  will naturally stimulate an expansion of production in industry

$j$  as well. At this point, if industry  $j$  is highly dependent on foreign sources, the more industry  $j$  expands production to meet demand in industry  $i$ , the more imports from other countries will increase. In other words, newly-generated procurement activity is dependent on other countries, but the concept of direct procurement does not include the impacts of this indirect type of foreign dependency. In order to explain the production dependence structure caused by this kind of indirect production linkage effects, it is necessary to introduce a separate concept from direct procurement. We define “indirect procurement” as the procurement conducted in the processes of continuous chain production caused by indirect linkage effects. The “domestic indirect procurement rate” (DIPR) is defined as the proportion of indirect procurement done domestically, as shown in Equation 2.

$$DIPR = \frac{\sum_{i=1}^m {}^a b_{ij} - 1}{{}^a B_j - 1} \times 100, \quad (2)$$

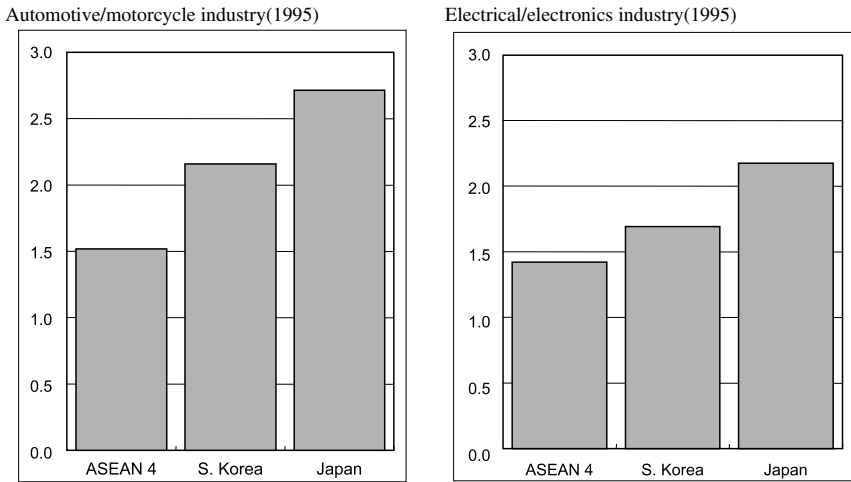
in which DIPR: Domestic indirect procurement rate,

${}^a b_{ij}$ : Each elements of Leontief inverse matrix of industry  $j$  in country  $a$ ,

${}^a B_j$ : The sum of row elements of Leontief inverse matrix of industry  $j$  in country  $a$ , and

$m$ : Total number of industries in each country.

Direct procurement is based on roughly the same concept as the domestic production ratio used in the automotive industry policies of ASEAN and other countries. It must be noted that even if, at first glance, the domestic production ratio seems high, in many cases in reality the supply of parts or sub-parts and materials may depend on imports from other countries. By examining indirect procurement, we wish to quantify the structure of foreign dependency for the materials needed to manufacture those parts.

**Figure 2. Linkage effect of automotive/motorcycle industry and electrical/electronics industry**

### 3. Results

#### 3.1. Domestic production linkage effects

The automotive/motorcycle and electrical/electronics industries are supported by an extensive range of other industries, so their linkage effects are large. This is one of the reasons that Asian countries have made it a priority to foster these two industries. How large has their domestic linkage effect become after many years of nurturing for these industries? Figure 2 shows the domestic linkage effect of both industries in each country as of 1995. The value of the domestic linkage effect shows the multiple of production generated in each related industry for every unit of production in each of the core industries.

The figure shows that in Japan, this value is 2.7 for the automotive/motorcycle industry and 2.2 for the electrical/electronics industry. Notably, the value is above 2 for both industries in Japan. This indicates that the indirect linkage effects are greater than the direct effects, and that both industries exert a large influence on the Japanese economy. In the case of Korea, the values are 2.2 and 1.7 for the automotive/motorcycle and electrical/electronics industries, respectively. In ASEAN 4, they are 1.5 and 1.4, respectively. From the perspective of the linkage effect, Korea is at about 80% the level of Japan, and ASEAN

is only at about 60%. This result suggests that ASEAN 4 in particular has a lower domestic linkage effect compared to Japan. This may suggest that the domestic linkage effect is lower due to the low level of domestic procurement, which may be due to inadequate development in their supporting industries.

### **3.2. Direct and indirect procurement in automotive/motorcycle industries**

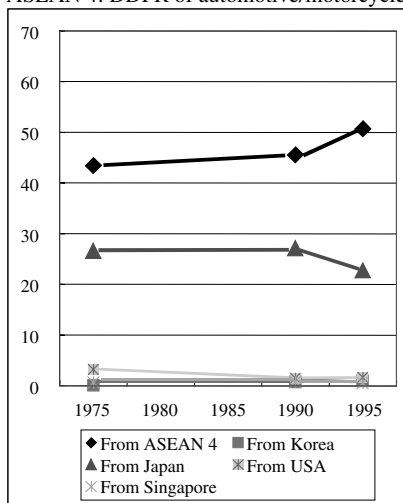
Figure 3 shows the trends for DDPR and DIPR for the automotive/motorcycle industries in ASEAN 4 and Korea. Characteristics of each country could be summarized as described below. In ASEAN 4, the direct and indirect procurement rates from their own countries were stagnant in the 40% range from 1975 until 1990. Overseas dependency on Japan was strong, but particularly for indirect procurement, the dependency on Japan was stronger than that on domestic sources. Later, from 1990 until 1995, procurement from the domestic supporting industries expanded. In ASEAN 4, it appears that supporting industries were stagnant from 1975 until 1990, but that they developed from 1990 through 1995. This period of their expansion coincided with a period of major economic expansion in ASEAN 4. Meanwhile, in Korea, domestic direct and indirect procurement expanded from 1975 through 1990, to the point that more than 80% of procurement was done domestically. From 1990 through 1995 this composition continued at roughly the same level. During this twenty-year period, Korea's dependency on its most important procurement source, Japan, steadily declined. One could conclude that supporting industries in Korea expanded from 1975 through 1990, and thereafter maintained the same structure. There is a clear tendency in both ASEAN 4 and Korea for the proportion of domestic direct procurement to be lower than the proportion of indirect procurement, and one could say that their supporting industries depend on procurement of materials from overseas, particularly from Japan. Even for indirect procurement, however, by 1990 Korea shifted to a structure with about 80% domestic procurement. As for Japan, over the twenty years from 1975 through 1995, there was almost no change, with almost 100% domestic sources being used for both direct and indirect procurement.

### **3.3. Direct and indirect procurement in electrical/electronics industries**

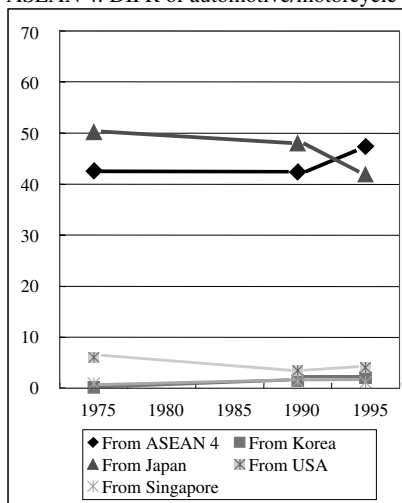
Figure 4 shows the trends of DDPR and DIPR for the electrical/elec-

*Figure 3. DDPR and DIPR of automotive/motorcycle industry*

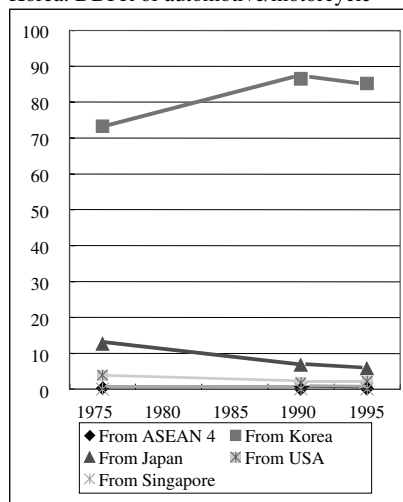
ASEAN 4: DDPR of automotive/motorcycle



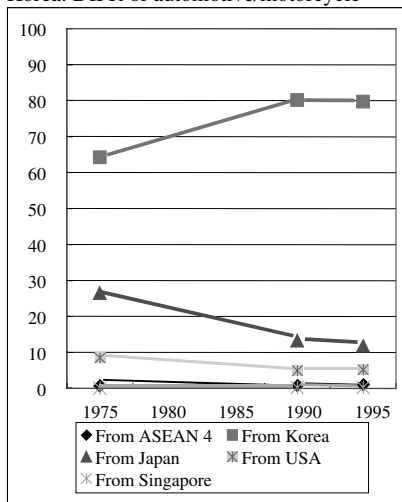
ASEAN 4: DIPR of automotive/motorcycle



Korea: DDPR of automotive/motorcycle



Korea: DIPR of automotive/motorcycle

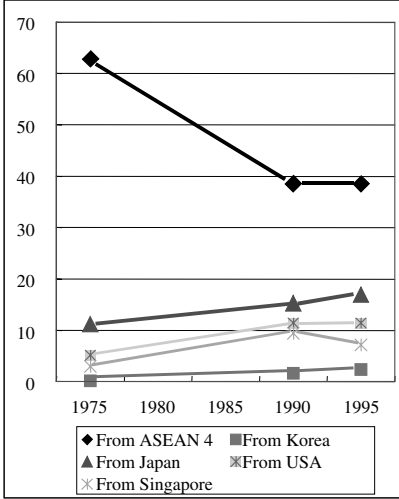


tronics industries in ASEAN 4 and Korea. The characteristics of these countries could be summarized as described below. In ASEAN 4, the direct and indirect procurement rates from their own countries declined significantly from 1975 through 1990, as dependency shifted from domestic to foreign sources. This foreign dependence continued during the 1990s. Of the foreign sources,

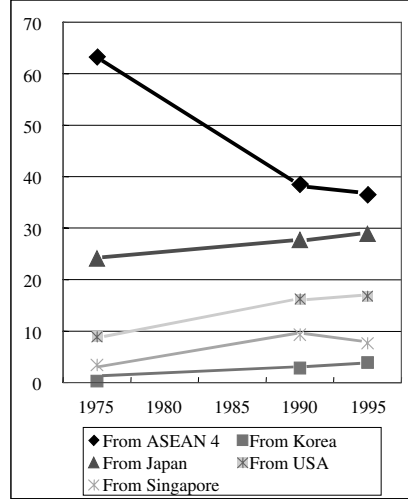


Figure 4. DDPR and DIPR of electrical/electronics industry

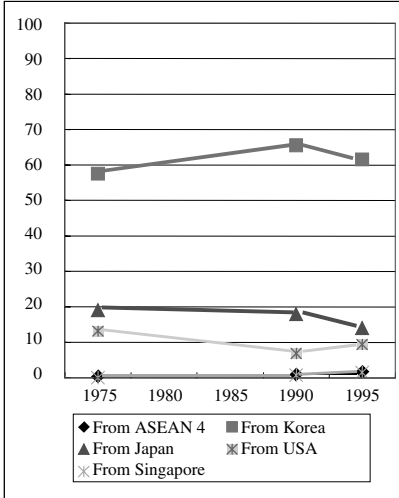
ASEAN 4: DDPR of electrical/electronics



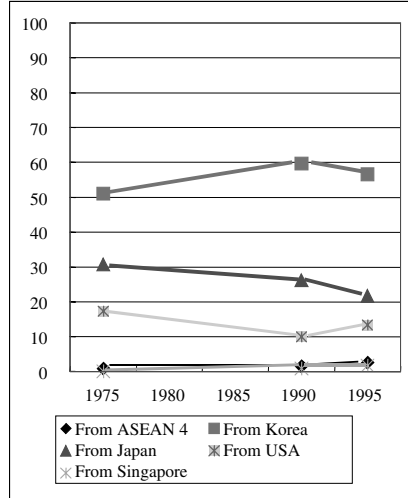
ASEAN 4: DIPR of electrical/electronics



Korea: DDPR of electrical/electronics



Korea: DIPR of electrical/electronics



dependence on Japan and the United States steadily increased over these twenty years. In ASEAN 4, between 1975 and 1990, for both direct and indirect procurement there was a shift from domestic supporting industries towards choosing more foreign procurement. This structure has continued since then. Meanwhile, in Korea, domestic direct and indirect procurement expanded during the

period from 1975 through 1990, to the point that about 60% of procurement was sourced domestically. From 1990 until 1995, the foreign proportion of procurement increased. In Korea, direct and indirect procurement from domestic supporting industries expanded from 1975 through 1990, but after 1990 this trend was reversed, and it appears that in many cases procurement from overseas increased. In those cases, the main sources were Japan and the United States. As for Japan, over the period from 1975 through 1995, the composition of domestic procurement stayed above 90%, for both direct and indirect procurement. During this twenty-year period, however, the procurement ratio from foreign sources has steadily increased, with the largest foreign supplier being the United States.

#### **4. Review**

The above discussion has been on a country basis, but because this analysis revealed that there were differences between the automotive/motorcycle and electrical/electronics industries with regard to changes in direct and indirect procurement, the author would like to proceed now by focusing the analysis on industries. First the author summarizes the results of analysis to this point. For the automotive/motorcycle industry (with the exception of Japan, which procured almost 100% domestically), between 1975 and 1995, Korea shifted to an industrial structure with over 80% domestic procurement, followed by ASEAN 4, which also increased its domestic procurement rate. The changes in procurement for both ASEAN 4 and Korea were similar in that they generally experienced a steady expansion of domestic procurement. Meanwhile, in the electrical/electronics industry, from 1975 through 1995, in Korea the domestic procurement expanded temporarily, but then foreign procurement increased again.

ASEAN 4 shifted towards an industrial structure with foreign dependence, with foreign exceeding domestic procurement, and this structure persisted. As shown above, the automotive/motorcycle industry emphasizes domestic procurement, while the electrical/electronics industry is structurally foreign dependent.

#### 4.1. Differences in characteristics of parts

How did this difference arise between the automotive/motorcycle and electrical/electronics industries? To begin with, one could consider the differences in characteristics of the parts being handled. The characteristics of automotive and electronic parts differ greatly. The first aspect is the nature of those parts. Many automotive parts are large and heavy, while many electronic parts are small and light; thus, one could say that automotive parts are not as easily transported as electronic parts. In interviews with car manufacturers, procurement managers state that one of the reasons they have encouraged local production and procurement is the nature of automotive parts, and their transport-related characteristics.

Conversely, electronic parts are light. Thanks to this, they are easy to transport by air. Interviews with Japanese electronic parts makers indicated that many of these exports are carried by air transport. In addition, due to their small size and light weight, electronic parts are likely to be high in value per gram. In studies on procurement of electronic parts in developing countries, Kodama and Kiba (1994), Letchumanan and Kodama (2000) and others have shown quantitatively that the higher a part's value per gram, the more likely is the dependency on foreign production. Based on such differences in the nature of parts, compared to automotive parts, electronic parts could be characterized as being easier to import.

The second aspect relates to design and standardization. It is common for automotive parts to be custom-designed for each car model. Electronic parts are more commonly composed of standardized components. Kokuryo (1999) presented the concept of "open architecture." Fujimoto (2001) and Shibata (2001) assert that automobiles are composed of non-standardized parts in a closed architecture, while products such as consumer electronics products and personal computers are composed of standardized parts in an open architecture. In addition, Shibata gave the label of "black box" parts to automotive parts designed through cooperation between car makers and parts makers, and pointed out that many automotive parts consist of these parts. Substitution of such specialized "black box" parts is not easy, making it difficult to purchase them from just any source in the world. In contrast, electronic parts are standardized and can be easily substituted thanks to their modular design, making it possible

to procure them from anywhere in the world, depending on cost and performance. These differences in the physical features and standardization of parts are thought to be among the factors affecting differences between the procurement situations for automotive and electronic parts.

#### **4.2. Differences in quality required by the market**

Next, one could also consider differences in the quality required by the market. If we calculate each country's domestic demand ratio in the automotive/motorcycle and electrical/electronics industries from each year's figures from the Asian International Input-Output Tables, we see for 1975 through 1995 that in ASEAN 4, the automotive/motorcycle industry was almost completely oriented toward satisfying domestic demand. The automotive/motorcycle industry in Korea was also mainly focused on domestic demand. Meanwhile, in the electrical/electronics industry, from 1975 through 1990, in ASEAN 4 the industrial structure was focused on exports, and this tendency became stronger after 1990. In Korea as well, the export ratio of the electrical/electronics industry was high, compared to that of the automotive/motorcycle industry, and production for overseas exports rose steadily. Aoki (1993) states that one issue regarding Malaysia's electronics and electrical equipment is that its industrial structure requires the import of more than 50% of the intermediate materials needed to produce manufactured goods for export. He indicates that the reason for this is that procurement cannot be done from the domestic supporting industries, so the raw materials and parts must be imported. A number of inferences can be made from these points. Specifically, the automotive/motorcycle industry was oriented toward satisfying domestic demand, and products were acceptable at a level that was competitive domestically. For this purpose, it was not necessary for procured parts to be of high quality. In contrast, because the electrical/electronics industry was export-oriented, it was necessary to manufacture products that were internationally competitive. One could infer that in cases where domestically procured parts could not achieve the required quality, it was necessary to procure high-quality parts from overseas.

### **4.3. Differences in policies**

One final aspect is differences in policies. ASEAN countries either banned imports or placed high import duties on automotive parts in line with policies to promote the domestic production of these parts. Meanwhile, ASEAN countries poured their efforts into encouraging exports and gave preferential treatment to exporting industries, using, for example, import duties and import surcharges on the parts and raw materials necessary for production of export products. Because the electrical/electronics industry was export-oriented, as shown above, it was possible to import electronic parts duty-free or with very favorable import duties. The differences between the automotive/motorcycle industry compared to the electrical/electronics industry (in both direct and indirect procurement) are probably also due to such factors.

## **5. Conclusion**

We have conducted an analysis of the procurement structure of the automotive/motorcycle and electrical/electronics industries in the Association of Southeast Asian Nations 4 (ASEAN 4), the Republic of Korea, and Japan, and made some inferences about the state of development of their supporting industries. It was not possible to draw conclusions on a country basis regarding their supporting industries, so it was necessary to examine things by industry. In the automotive/motorcycle industry, each country increased its domestic direct and indirect procurement year by year, and supporting industries expanded. In the electrical/electronics industry, however, the opposite results were found. We could conclude that the automotive/motorcycle industry emphasizes domestic procurement, while the electrical/electronics industry is structurally foreign-dependent. Reasons for these differences include such factors as differences in the nature of parts, differences in the quality required by the demand markets, and differences in government policies.

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