

2

The Relationship between Toyota and Its Parts Suppliers in the Age of Information and Globalization: Concentration vs. Dispersion

*Masatsugu Tsuji**

1. INTRODUCTION

The automobile industry, a main force in economic development during the twentieth century, is examined here, with a focus on the economic basis of the Toyota production structure. The automobile industry has many related industries, such as automotive parts and machine tools, and also has the most advanced social division of labor. In particular, it is said that 30,000 to 40,000 parts are required to produce one automobile and this means that a vast number of firms are involved to some degree. Therefore, it is essential for the automobile assembler to integrate and efficiently manage these manufacturers who supply its parts. On this point, the Japanese automobile assemblers have established their own world-renowned production system. An analysis of how their method of production reached such a level of efficiency and how this industry developed interdependently with other firms, especially small- and medium-sized firms, will be made in this paper. We also make an attempt to explain how the Toyota production structure is based on Japanese production culture. Based on this analysis, the heavy concentration or localization of the automobile industry in Aichi Prefec-

ture, particularly the Nishi-Mikawa district, will be discussed. Since the 1990s, the Japanese economy has undergone transformation resulting from the development of an information society and globalization, and this paper analyzes how Toyota and its parts suppliers have been coping with these changes by making use of IT and international collaboration, so as to maintain vitality.

2. PRODUCTION SYSTEM OF THE AUTOMOBILE INDUSTRY

The production systems of Japanese automobile manufacturers are fundamentally the same. Described here are the general features of the production system, with a subsequent examination of Toyota's. Automobile manufacturers such as Honda, Nissan, and Toyota assemble parts only, and do not produce all the required parts themselves. In contrast to American automobile manufacturers which produce about 60% of their parts themselves, Japanese assemblers produce only 40% of their parts within their own firms. This implies that most of their parts are supplied by related firms. Another aspect of the Japanese automobile industry is that these firms which are connected to the manufacturing of automobiles, such as those for automotive parts, are organized in a hierarchical structure. The flow of automobile parts and the hierarchical structure of firms engaged in the production of automobiles are as shown in Figure 2.1 below.

According to Figure 2.1, related firms of the automobile industry may be classified as follows: (a) Primary parts suppliers (Primary subcontractors); (b) Secondary parts suppliers (Secondary subcontractors); and (c) Tertiary parts manufacturers (Tertiary subcontractors). This is examined in more detail in what follows.

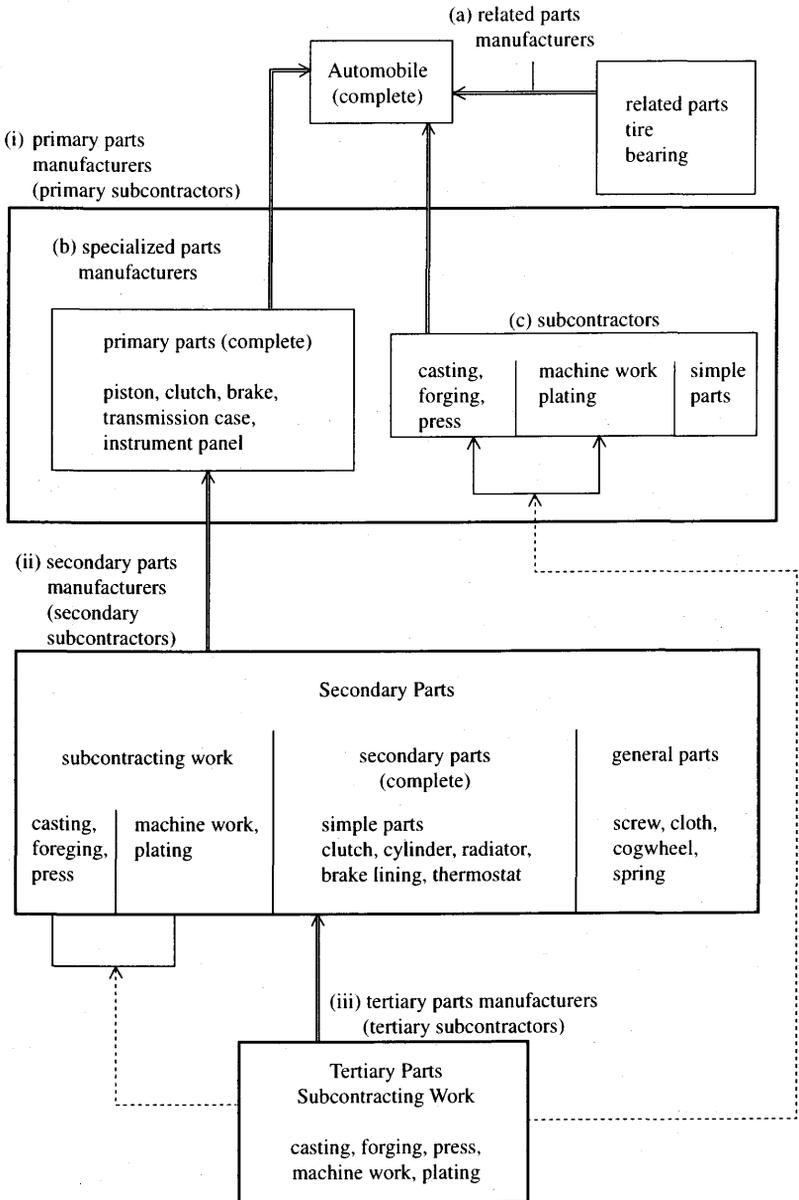
2.1. Primary Parts Suppliers (Primary Subcontractors)

The firms in this category supply parts directly to automobile assemblers. They comprise the following three types of firms:

(i) Related parts manufacturers

These firms supply complete parts such as tires, batteries, or glass to the automobile assemblers. The sizes of such firms are as large as the automobile assemblers. The ratio of their products supplied to automobile assemblers is, generally speaking, less than 50%. They are not dominated or controlled by the automobile assemblers. They are therefore sometimes omitted from the category of automotive parts

Figure. 2.1: Hierarchical Structure of the Automobile Industry



manufacturers.

(ii) Specialized parts manufacturers

Firms in this category are also labeled primary parts manufacturers, and they supply complete parts such as pistons, clutches, brakes, and shock absorbers which are often called primary parts. They are characterized by specializing in the production of automotive parts, including high-tech parts such as those used in advanced electronics. They are medium to large in size, and they are at the core of Japanese automotive parts manufacturers.

There are two classes among them; namely, subsidiary and independent. The former supplies only certain automobile assemblers, and the latter deals with non-specific assemblers. Since it is crucial to the quality of their automobiles that assemblers have subsidiary parts suppliers of superior technical ability, assemblers maintain close ties with them by the ownership of stocks or interlocking directorate. Moreover, this is accomplished by interrelation through the synchronization of the production process, as well as joint R&D activities. Their firms thus expanded as the automobile assemblers grew. Among them, some became enterprises of worldwide scale in their specific field of parts or level of technology.

(iii) Subcontractors

They are subcontractors that supply simple and standard parts directly to the assemblers. They are engaged in labor-intensive processing, such as casting, forging, plating, and press. They are relatively small in size. Firms that supply their products directly to the assemblers as primary parts suppliers or primary subcontractors are thus defined. Since the most important firms in this category are specialized parts manufacturers, they have been labeled as primary parts suppliers.

2.2. Secondary Parts Suppliers (Secondary Subcontractors)

Manufacturers of this type supply secondary parts such as clutches, cylinders, brake lining, and thermostats, to primary parts manufacturers. They supply the above parts in the form of a unit. They also produce screws cogwheels, and springs. The size of these firms is generally medium to small. Secondary parts manufacturers have strong ties with primary parts manufacturers. Though they are positioned below the primary parts manufacturers, secondary parts manufacturers stand on top of their own hierarchical structure.

2.3. Tertiary Parts Manufacturers (Tertiary Subcontractors)

Firms in this category are of small size, and depend on family labor. As subcontractors of secondary parts manufacturers, their main business is of a processing nature such as that of casting and forging. These are labor intensive; thus their productivity is also low. The number of firms in this category is largest. It is said that they are competitive in the market for obtaining orders from secondary parts manufacturers.

Characteristics of the Japanese automobile industry have been focused upon, in particular by pointing out that its structure has a hierarchical nature with the assemblers positioned at the top, and the primary and secondary subcontractors below, on down to the very bottom where the tertiary parts manufacturers are situated. The higher the hierarchical structure, the stronger the connection between the contractors and the subcontractors in terms of technology, equity, and directorate. In other words, the complementary relationship between these two becomes even stronger and such a relationship tends to include a long-term, implicit contract. On the other hand, the lower the position is in the hierarchy, the stronger its relation is through the market mechanism. In order to analyze the Japanese automobile industry, it is also important to grasp the qualitative difference between the upper and lower realms of the hierarchy.

3. PRODUCTION STRUCTURE OF TOYOTA

Let us now examine Toyota in the abovementioned context. First, the primary parts manufacturers that have a direct relationship with Toyota shall be examined. They can be roughly classified into two types — the first type includes firms that belong to the 'Toyota Group.' These are the following fourteen companies: Toyota Tsusho, Aichi Seiko, Toyota Koki, Toyota Boshoku, Toyota Gosei, Toyota Shatai, Aishin Seiki, Nippon Denso, Toyota Jido Shokki, Toyota Central Research Institute, Towa Real Estate, Daihatsu, Kanto Jidosha, and Hino Motors. The first eleven companies are similar in origin for they spun off from Toyota Jido Shokki. The last three companies tied up with Toyota and joined the Toyota Group. Since they are assemblers of automobiles and their production plants are located in regions other than Tokai, they have been omitted from this analysis. Toyota Central Research Institute and Towa Real Estate are not involved in the automobile industry; thus they have also been omitted here. Companies of the Toyota Group have very strong ties with Toyota either traditionally or as a result of the

synchronization of production called the '*Kanban* method' which shall be explained later in more detail. Moreover, in regards to the interrelationship achieved through holding stocks and interlocking directorate, it is important for Toyota to hold stocks of companies in the group or assign a director to a given company, though not necessarily vice versa. They also conducted joint research for the development of new products or technology.

Another group of firms in this category is called cooperative companies by Toyota. They form cooperative organizations such as 'Kyohokai' and 'Kyoekikai' and have ties with Toyota that are as strong as those of the Toyota Group.¹ Certain companies such as related parts manufacturers belong to Kyohokai and as has been explained earlier, these firms are not necessarily considered Toyota's subcontractors. There were sixty-seven member companies whose headquarters were located in Aichi Prefecture. Among them are forty-one companies whose shares are owned 10% or more by Toyota. In order to synchronize the production process, they successively adopted the *Kanban* method around the late 1970s. The size of the member firms varies from medium to large. Most of the member companies in Kyohokai also organize their own hierarchy of subcontractors and form cooperative systems.

Secondary parts manufacturers of Toyota are mainly those which belong to this cooperative system. They are engaged in the production of simple parts or processing work. There is no data available, however, of the exact number of such secondary or tertiary parts manufacturers, except for those that are outdated provided by the "Survey of the Structure of Division of Labor" conducted by the Medium and Small Business Agency in 1977. According to this data, Toyota had 168 primary subcontractors, 5,437 secondary subcontractors, and 41,703 tertiary subcontractors. This therefore implies that there were a total of 36,000 (non-overlapping) subcontractors involved in the manufacturing of Toyota automobiles.

On the other hand, the production structure of GM is non-hierarchical, and it has only 12,000 parts suppliers. This implies that the ratio of domestic production is much higher than that of Toyota. That is, in the US, automobile assemblers produce a higher ratio of their parts within their own factories, and the number of parts supplied from outside firms is small. A comparison of the two systems is summarized in Table 2.1.

As stated above, a large number of firms make up this social division of labor. Hereafter, let us consider the reason for the formation of this hierarchy of production.

Table 2.1: Comparison of Toyota's and GM's Systems

Toyota	GM
Low domestic production: 20%-25%	High: 40%-50%
200 trade partners	Much larger
Toyota dominates parts suppliers	Equal partner
Long-term commitment on quality and price	Market-based relationship
Parts suppliers invest in specific equipment	General equipment

4. HIERARCHICAL SYSTEM VS. NON-HIERARCHICAL SYSTEM

It is vitally important for assemblers, which have a huge number of subcontractors, to organize them in a manner that overall production efficiency is achieved. In the following section, a comparison shall be made between the two production systems of the Japanese and US assemblers in view of efficiency. The production system of the former is labeled hierarchical, and that of the latter non-hierarchical.

4.1. Economic Basis of the Hierarchical Production System

The relationship of parts suppliers with Toyota can be explained by the long-term implicit contract. Once Toyota begins a business relationship with a certain parts supplier, it implies that Toyota will make purchases from that parts supplier over an extended period. Again, this long-term relationship can save the costs of transaction and information. Parts suppliers can invest in specific equipment for the production of Toyota parts only. In addition to this, efficiency of the hierarchical production structure can be explained by the 'principal-agent model.' Toyota is the principal and the parts suppliers are agents. It is not necessarily efficient for Toyota to produce various types of parts by itself. It is more efficient to hire certain firms as agents and to contract for parts production, since those firms have more information on manufacturing-related parts than the principal. Subcontracting is commonly adopted in industries such as construction, since subcontracting improves the efficiency of a large organization.

The Toyota production system is a multiplayer principal-agent relationship. In the Toyota system, Toyota is the single and ultimate principal of the whole system, but the primary parts suppliers are principals and the secondary parts suppliers are agents at the second stage; and secondary parts

suppliers are the principal and tertiary parts suppliers are agents at the third stage. According to Coase [1937] and Williamson [1989], the optimal length of the stages in this context is determined by either the transaction costs or information structure of the system to prevent opportunism and bounded rationality. Toyota can determine the optimal length of layers.

4.2. Amount of Required Information

Let us examine the merits and demerits of the hierarchical system and non-hierarchical system in more detail. From the viewpoint of contractors or assemblers, the amount of information necessary for the management of their subcontractors is less in the hierarchical system than the non-hierarchical. The production system of the latter is so centralized that the assemblers require much more information, especially since the number of parts suppliers is large. This increases the expenses of assemblers used for the management and organization of subcontractors. If there is any limitation of information flow, the system fails to be organized efficiently. On the other hand, when the hierarchical system is highly decentralized, less information on the subcontractors is required.

A disadvantage of the hierarchical system, however, is that since more agents take part in decision making, the assemblers' wishes might not be successfully transmitted to the very bottom of the hierarchy. This implies that the general consistency of decision making may not be adequately maintained throughout the system.

Pertaining to this point, the theory of principal-agent in economic theory can be applied. According to this theory, an optimal contract exists between the principal and agent such that the best decision for the agent is optimal to the principal as well. Thus, for the latter, it is preferable to refrain from direct management of the company and more beneficial to select one firm as an agent and allow it to manage the remainder of the subcontractors. By so doing, the amount of information required by the principal decreases even further on the one hand, and efficiency is improved on the other.

In the theory of principal-agent lies the essence of how incentives should be given to the agent whose best decision is also considered the best decision for the principal. In the case of Toyota, the incentive for subcontractors to work as an agent is said to include the following: (i) Toyota guarantees a certain amount of profits to the agent (primary subcontractors). Price negotiations between Toyota and its parts manufacturers are recognized as being particularly stringent, but the margins of profit for parts manufacturers are

not subject to this negotiation and they have already been traditionally provided; (ii) Long-term implicit contract relationship (once an agent joins the system, the transaction is secure over a long period); (iii) Guarantee of growth (the agent can grow in step with Toyota); and (iv) Feeling of solidarity with Toyota. All of these are important factors of so-called Japanese Management.

4.3. Production Efficiency

Another characteristic of the hierarchical system of production is improved efficiency through the division of labor, since subcontractors specialize in their own specific production process by means of rationalization. An automobile consists of several tens of thousands of parts. There are great numbers of simple and tiny parts which are required in small numbers. The assemblers decrease their cost of production by allowing subcontractors to produce these parts rather than doing so themselves. Due to diversification of consumers' taste in recent years, assemblers have had to produce an increased variety of cars in decreased number for each type. This resulted in increasing the number of parts even further.

Even if the efficiency of individual firms in the hierarchy is improved through specialization by the division of the production process, the efficiency of the entire system is not necessarily achieved. In the case of Toyota, it is the synchronization of production by the 'Just-in-Time system' or *Kanban* method that makes this possible. Each subcontractor has to supply automotive parts of a certain quantity, at a certain time, and at a certain place, as decided beforehand by the assemblers. A single mistake by those suppliers would cause mass confusion in the production process. Each subcontractor is thus required to act in consideration of the entire system.

4.4. Risk Sharing

The Japanese industrial group is sometimes defined by the diversification of risk; that is, if various kinds of companies make up the industrial group, the total risk of the group is decreased. The same can be said of an industry with subcontractors, such as the automobile industry. Contractors can avoid investing in equipment if they consign production to subcontractors, or subcontractors can lessen their risk in long-term investment by making implicit contracts with the assemblers. Thus, both sides benefit by lessening the risk factor.

4.5. Growth Sharing

Another reason why nearly 36,000 subcontractors support the hierarchical production system of Toyota is 'growth-sharing,' that is, when Toyota grows, the parts suppliers also grow. As a matter of fact, parts suppliers grow in step with Toyota, and most Toyota Group firms are now world-scale enterprises.

Toyota, as illustrated above, has adopted a system of production making full use of the merits of the hierarchical structure. The core of its production system is found in the Just-in-Time system or *Kanban* method. This means that parts are supplied at a specific time and in a specified quantity. Moreover, this implies not only that the speed of each process in production at the assemblers' factory has been synchronized to the speed of the assembling line, but also that the production process of all subcontractors situated even at the very bottom of the hierarchy has been synchronized. Furthermore, Quality Management (QM) or Total Quality Management (TQM) which works to improve the quality of automobiles are being practiced systematically throughout the hierarchy from the assemblers at the top to the lowest level of subcontractors.²

5. LOCALIZATION OF THE AUTOMOBILE INDUSTRY IN AICHI PREFECTURE

Following the previous discussion on the general characteristics of the automobile industry, let us now examine the localization or concentration of the automobile industry in Aichi Prefecture.

5.1. Location of the Automobile Industry and Its Concentration

To begin with, let us study the location of the headquarters and factories of the Toyota Group and those of the major member companies of Kyohokai whose headquarters are located in Aichi Prefecture. According to Table 2.2, most of the headquarters as well as factories are located in Aichi Prefecture. Specifically speaking, for the most part they are located in the Nishi-Mikawa district, the eastern sector of Aichi Prefecture.

At the period of the bubble economy, Toyota faced a severe labor shortage. Because of this, Toyota established three assembling factories outside the Mikawa region for the first time. The locations of the new factories are Hokkaido, Tohoku, and Kyushu, far away from Toyota City. Those plants

Table 2.2: Location of Factories of Toyota and Its Parts Suppliers

(Unit: Firms)

	Toyota Motor Co.	Toyota Group	Factories of Member Firms of Kyohokai (%)
Aichi Prefecture	11	47	16 (79.5)
Owari District		11	33 (22.6)
Nagoya City		1	14 (9.6)
Ohbu		3	1 (0.7)
Inazawa		3	
Tokai		1	
Others	3	18 (12.3)	
Nishi-Mikawa District		34	80 (54.8)
Toyota City	6	7	33 (22.6)
Kariya		8	5 (3.4)
Anjo		4	7 (4.8)
Nishio		4	5 (3.4)
Hekinan	1		33 (2.1)
Takahama		2	
Okazaki		1	4 (2.7)
Miyoshi-Cho	3	2	6 (4.1)
Kohda		2	
Others		1	17 (11.6)
Higashi-Mikawa Distance	1	2	3 (3.4)
Gifu Prefecture	1		10 (6.8)
Mie Prefecture		1	
Others	3		20 (13.7)

Note 1: Kanto Motors, Hino Motors, Daihatsu, Toyota Central Research Institute, and Towa Real Estate have been omitted.

2: The Toyota Group has been omitted from Kyohokai.

Source: Calculated from I.R.C. [2002] and Japan Auto Parts Industries Association and Auto Trade Journal [2000].

started operations in 1992 and 1993. Some of the parts suppliers constructed their factories close to Toyota's. Nearly 70% of the parts are shipped from Nagoya Port to those factories by ship.

As for the location of factories of the member companies of Kyohokai whose headquarters are situated in Aichi Prefecture, 80% are in Aichi Prefecture and 55% are located in the Nishi-Mikawa district, in particular. Moreover, nearly half are found in Toyota City. This contrasts greatly with the fact that factories of the Toyota Group are dispersed in the cities of Toyota and Kariya. The reason for this is that the members of Kyohokai are directly tied up with Toyota and have located themselves close to its factories in Toyota.

Little can be said regarding secondary subcontractors due to insufficiency of data. From Table 2.3, it can be concluded that factories are located close to primary parts manufacturers.

It is therefore apparent that a heavy concentration of factories connected with Toyota exists in Aichi Prefecture, and this is crucial to Toyota's efficiency. The reason behind the largest concentration of automobile industries in Aichi Prefecture is path dependency, that is, Toyota based its headquarters there, and the *Kanban* method influenced subcontractors to locate themselves close to Toyota plants so as to save cost and time for

Table 2.3: Location of Factories of Major Secondary Subcontractors of Toyota

(Unit: Firms)

a	Denso	Toyota-Gosei	Toyota-Shatai	Aichi-Seiko	Tokai Rika Denki
b	Kariya	Haruhi	Kariya	Tokai	Ogichi
c	Hishoukai	Kyowakai	Shatai Kyorokukai	Hokokai	Kyorokukai
d	84	74	102	129	52
Aichi Prefecture	⑨ 67	⑥ 54	③ 75	② 74	⑤ 34
Owari	22	⑥ 45	39	① 52	① 30
Nagoya	18	① 13	26	20	12
Other	4	⑤ 32	① 13	① 32	① 18
Nishi-Mikawa	⑧ 42	7	② 36	① 22	④ 4
Toyota	2	1	11	4	① 4
Kariya	② 11	1	② 10	① 7	
Chiryu	② 7	1	4	1	
Anjo	② 3	1	3	2	
Nishio	5		1	1	
Hekinan	5		1		
Takahama	① 2		1	1	
Others	① 7	3	5	6	③ 4
Higashi-Mikawa	① 3	2			3
Gifu Prefecture	2	7	3	3	8
Mie Prefecture	① 5	5		4	1
Shizuoka Prefecture	3	① 1	4		3
Others	① 8	4	22	22	4

Note 1: a: name of primary contractor, b: location of headquarters, c: name of cooperative association, d: number of members.

2: Circled numbers in the circle are the number of factories of contractors, i.e., company at the top of each column.

Source: As Table 2.

delivering parts to Toyota factories. Another reason for Toyota's decision to locate there is that the region has a long tradition of machinery for textiles and tools.

It can be furthermore pointed out that the concentration of contractors and subcontractors of the assembling industry in one particular region led to even more efficiency through the *Kanban* method or joint investment in R&D.³ Moreover, even at the bottom of the hierarchy, or among the tertiary subcontractors, a specialized economy was created through outside orders for parts. It has been reported that even among factories employing less than five workers, which engaged in the manufacturing of simple parts or in simple tasks, an interdependence of production existed through outside orders.

5.2. Growth of the Automotive Parts Industry in Aichi Prefecture

We now focus on the parts manufacturers of Kyohokai located in Aichi Prefecture, which began to supply parts to Toyota before the Second World War and have maintained a long and rewarding relationship with Toyota since then. Though the growth of these parts manufacturers is partially due to their special relationship with Toyota, it cannot be denied that it was accomplished through their mutual efforts with Toyota. During the early stages of the automobile industry, Toyota worked toward nurturing the parts manufacturers; that is, Toyota supported them in borrowing funds from banks which allowed them to purchase production equipment, provided instruction on new technology, and supplied materials. Later when they began to introduce the Just-in-Time system, Toyota sent specialists to make adjustments to their production system by redesigning the process and improving the assembly line. Moreover, they completely adopted QM and TQM following the example of Toyota.

While lending support to the parts manufacturers, Toyota also requested estimates for new parts from more than one parts manufacturer in order to decide which was best for purchasing parts; thus, this meant that competitive forces were working among those parts manufacturers. When the prices of parts are negotiated, instead of calling for bids, discussions based on the estimates are conducted until an agreement can be reached. Toyota does not force subcontractors to accept any particular price, and instead engages in discussions with them to the point where a price can be agreed upon spontaneously by both parties.

After going through such a process, primary parts manufacturers of

Toyota have since achieved a fairly high level of technology of their own. They are presently trying to diversify the assemblers so that their parts may be supplied by them and expand their business into new areas in preparation for the post-automobile society.

5.3. Medium- and Small-Sized Firms of the Automobile Industry

Regarding the role of small- and medium-sized firms in Japanese industries, it suffices to state that the coexistence of large firms on one hand, and small- and medium-sized firms on the other, has been accepted as the dual characteristics of the Japanese economy. However, focus shall be made here on the interdependence of these two types of firms in the context of the production structure hierarchy, especially the role of small- and medium-sized firms in Aichi Prefecture.

It is said that there are two types of small- and medium-sized firms in Aichi Prefecture; namely, one is labeled the 'Owari tribe' and the other the 'Kariya tribe.' The former are those involved in the textile and machine tools industries located in the Owari district in the western sector of Aichi Prefecture. The latter are those of the automotive parts industry, particularly specializing in manufacturing parts. The biggest difference between them is that the former must diversify their business because the textile industry is in the midst of structural shifts, but the latter is enjoying the prosperity brought about by the automobile industry.

Small- and medium-sized firms in the automobile industry are mainly engaged in the production of simple parts or labor-intensive processes. They do not possess any specialized technology or management and are therefore strongly influenced by their contractors. They manufacture parts by using parts designs rented from contractors. In the case of Toyota subcontractors, a similar system of production, wages, training, and even management as Toyota's was adopted. It is said that their level of technology is superior to that of other subcontractors. To determine the price of parts, on the other hand, they are asked to submit their data on cost and even their finances, and it is then that the appropriate price is negotiated with the contractors. It is also said that they are guaranteed a certain ratio of profit margin, and wage levels are advantageous as they are tied up with Toyota.

Small- and medium-sized firms in Aichi Prefecture have matured into the backbone of the regional economy because of the regional concentration of parts manufacturers; that is, the excellent management of small- and medium-sized firms was given birth to by themselves from which they had

spun off. Companies with 'firm backbone' are founded on others of the same foundation. Nowadays, however, technological innovation is taking place so rapidly that it seems almost impossible for such first-rate companies to be reproduced just by the accumulation of small-sized firms. Now that automobile assemblers have begun to shift their production overseas, small- and medium-sized firms should heighten their technological level and develop their products for survival.

6. TOYOTA PARTS SUPPLIERS FACING GLOBALIZATION

The Japanese economy has been faced with globalization. An increase in imports of foreign goods has forced local industries to face competition for the first time. In addition, firms have been shifting toward production abroad, and Toyota and its parts suppliers are not the exception. Here, let us examine how globalization has affected the location of Toyota and its parts suppliers.

6.1. Foreign Direct Investment by Toyota and Its Parts Suppliers

Motivation for foreign direct investment is explained as being either natural resources-oriented or market-oriented. The aim of the former is to make use of relatively inexpensive natural resources, and that of the latter is to promote the sale of products in the local markets.⁴ The automobile industry has chosen overseas locations according to the latter. In East Asia, including China, Asian NIEs, and ASEAN countries, the ratio of products sold in the local market has been increasing in accordance with the increase of income level. Recently, in addition to an abundance of natural resources, raising the technology level of the above regions has been intensively promoted. As a result, there has been a tendency for these regions to serve as the base of manufacturing for export to Japan or other countries; that is, the processing and assembling industry has been conforming widely to the network of the international division of labor in such a way that firms decide on the location of their plants by comprehensively taking the following points into account; namely, the cost of manufacturing parts, as well as that for assembling final products, such as the exchange rate, wage rate, cost of materials, and level of technology in all international regions.

6.1.1. Overseas production

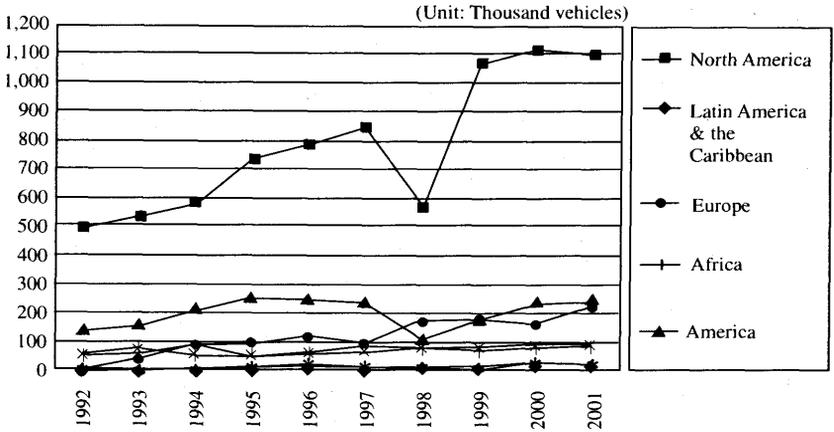
The reason why Toyota decided to commence production in the US was trade friction involving Japanese automobiles in the US in the late 1970s and early 1980s. In 1982, Honda began manufacturing automobiles in the US, followed by Nissan, Toyota and others who began operating production plants there. In 1984, Toyota established NUMMI in California in the form of a joint venture with GM, and later started production in Kentucky (TMMK), and in Indiana (TMMI) in 1998. In Europe, Toyota has factories in England (established 1992), France (2001), and Portugal (1968), and plans to establish a plant in Czech with Peugeot in 2005. In Asia, Toyota has plants in Thailand (1964), Malaysia (1968), Indonesia (1970), Taiwan (1986), the Philippines (1989), Vietnam (1996), India (1999), and so on. Toyota also announced start of production in China in 2002. Thus, Toyota has twenty-eight overseas plants in twenty-four countries. The recent trend of overseas production and sales are summarized in Figures 2.2 and 2.3. According to these figures, North America dominates the world market, but the increase in Asia is remarkable. In 2001, Toyota produced more than 40 million vehicles, which is the largest amount of overseas production. Thus, overseas production of Japanese automobiles is projected to expand greatly in future years as long as the prevailing international competitiveness and environment in the international economy continues.

With an increase of overseas production, parts suppliers also established plants. Table 2.4 indicates the number of plants of Toyota's parts suppliers in North America.

6.1.2. Local parts content

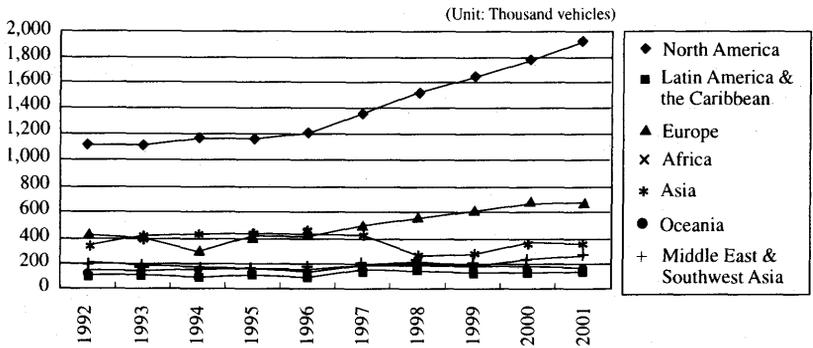
As overseas production increases, so does the purchase of local parts by Japanese automobile manufacturers. In factories in North America, nearly 50 percent of the parts are purchased locally. An increase in this figure is always required in negotiations between Japan and the US, and Toyota has decided to produce engines and transmissions in Alabama. This will make the ratio of local parts in the US reach more than 50% of the total. Toyota has been purchasing parts from overseas, which include among major items tires, lamps, glass, catalysts, leather, carpet fabric, and large electronic equipment. They are all of standard quality or differ little from the quality of Japanese products, excluding large equipment.

Figure 2.2: Overseas Production of Toyota



Source: Toyota Motor Corporation.

Figure 2.3: Overseas Sales of Toyota



Source: Toyota Motor Corporation.

6.2. Foreign Direct Investment by Parts Manufacturers

As stated above, overseas production by Japanese auto manufacturers has continued to increase; thus, automotive parts manufacturers have intensified their activities in foreign countries. By the end of 2001, 304 automotive parts manufacturers in Aichi Prefecture were involved in foreign investment, particularly eighty-six in North America, 130 in Asia such as Taiwan, China and Thailand, and fifty-nine in Europe.⁵

The current situation of foreign investment in North America by automotive parts manufacturers located in Aichi Prefecture is as shown in Table 2.4. It is reported that twelve manufacturers have invested in seventeen plants by this time. Their investments mainly aim to supply parts to Toyota's Kentucky plant (TMMU) and Indiana plant (TMMI). Therefore, they are located in such neighboring states as Kentucky, Indiana, and Ohio. Due to the dispersion of these parts plants and the location of local parts manufacturers, the *Kanban* method has been practiced quite irregularly by the collection of the necessary parts at the required time by trucks. Thus, production is not synchronized with the assembler as it is in Japan, so the assembler retains two days' worth of parts in its inventory.⁶

The characteristics of parts manufactured in those plants are as follows; (i) Quality of Japanese parts is superior; (ii) High freight fee compared to the price of parts such as air conditioners for automobiles, floor mats, weather-strips, and body parts; (iii) Specification of parts differ from those American; and (iv) Parts produced by American automobile manufacturers for themselves are difficult to purchase on the market.

Table 2.4: Toyota Plants and Its Parts Suppliers in North America (as of 2001)

(Unit: Firms)

	California	Indiana	Kentucky	Missouri	Ohio	Illinois	Tennessee	Canada	Others
Toyota	1	1	1					1	
Toyota Group	5	3	6	3		1	2	2	5
Kyohokai	1	2	6	2	2	1	1		1

Source: Aichi Prefecture [2002].

6.3. Foreign Direct Investment and Dispersion of Location

Foreign investment by parts manufacturers has thus been reviewed. Let us now consider its effect on the hierarchical production structure.

First, in general terms, the strength of the connection between contractors and subcontractors in the processing and assembling industry must be taken into consideration. For assemblers, the merit of using subcontractors is to be able to purchase cheaper parts of high quality. Their interest lies in how they can obtain cheaper and better parts. Basically, there is no marked difference whether they are made in Japan or not. This is the economic foundation of the international division of labor in the production process.

The same can be said of automotive manufacturers, as well as assemblers. They can substitute domestic parts with foreign parts as long as the latter satisfies their requirements in price and quality.

Then the issue is whether this expansion of the international division of labor will change the hierarchical production structure or not. One of the fundamental bases of the Japanese hierarchical structure is the long-term successive relationship between the contractors and subcontractors. The closeness of the relationship comes from more specific Japanese traits rather than economic reasons. In the case of Toyota, the relationship between Toyota and its subcontractors began prior to the Second World War and the historical cohesion of being a member of Toyota seems to be even stronger today.

On the other hand, decision making by firms is based on economic law. Contractors and subcontractors cannot continue their relationship without consideration of their benefits. Whether they can continue it or not depends upon the delicate balance of the centripetal and centrifugal forces in the hierarchy. The structure might lose its balance at any time when a substitution of subcontractors with foreign products or foreign subcontractors occurs. This is also true if parts manufacturers conform to their own hierarchical structure with foreign agents and formulate their own management strategy.

From the current situation of the automobile and parts industries, it does not appear that such a time will arrive soon. The automobile industry is still expected to grow and the parts industry has not matured enough to establish its own production structure.

7. CONCLUSION

The hierarchical production structure which is crystallized in the form of the Japanese automobile industry, particularly in the Toyota production system, is as thus analyzed here. One reason why this structure is widely found in other assembling and processing industries is that when these industries were first introduced to Japan, the parts manufacturing industry had not yet been developed; therefore, it was the assemblers who fostered the growth of those industries. Despite such a history, in effect, the Japanese hierarchical production structure (or Japanese Management) promoted the growth of these industries into those of world-renowned stature within a short period of time, since this was based upon not only economic theory but also Japanese production culture.

In addition to the hierarchical production structure which has these char-

acteristics, the nature of the automobile such that it requires thousands of parts led the automobile industry, particularly the Toyota Group, to heavily concentrate in a particular, rather small region. The distribution of parts cannot be substituted with IT, but the SCM (Supply Chain Management) applied by IT can reduce the time and cost of shipment. In this sense, the Just-in-Time system is essential for the heavy concentration of Toyota parts suppliers in locations close to Toyota plants. Another rationale for the heavy concentration lies in the economies of scale. The Toyota Group as a whole can exploit scale economies by concentrating production within a limited number companies.

(a) IT

Since the 1990s, the transformation of the Japanese economy has resulted in IT and globalization penetrating into all Japanese industries, to the extent that the Japanese automotive industry may not exploit the above economies by concentration any longer. The above transformation is quite new to the Japanese economy, and may not suit the Japanese economic system with its long-term contractual relationship among firms. IT, for instance, is a key technology for collecting real-time information, and it can reduce the time and cost for searching for the best partner in trade. In this sense, IT helps the market mechanism to work better. One example of this is ANX (American Automobile Network Exchange), which interconnects all automobile assemblers and parts suppliers. This network functions like an e-marketplace, and helps to find the best partner for trade instantly according to the price as well as quality desired. Toyota also makes the effort to use IT in all segments of its activities, and the new *Kanban* method is referred to as *e-Kanban*. This is still at an experimental stage.

Now Toyota is constructing "WARP" (Worldwide Automotive Realtime Purchasing System), which is a global database for sharing information on the quality of parts, production plan, and transactions related to all nodes of Toyota. This system is aimed to be open to all suppliers including non-Toyota ones.

Another new application of IT is 'concurrent engineering,' which is the system of sharing information with different sections of the automobile assembler. Chrysler made use of this information system in the development of Neon in the early 1990s by connecting all sections related to its development, especially the design, R&D, and prototype sections. This made the period and cost of development shorter and smaller. Chrysler's development period was approximately 31 months, which is said to be shorter than

that of Toyota at that time. Toyota and its group companies still proceed with the development of new models in the traditional way.

(b) Globalization

We analyzed the globalization of Toyota and its parts suppliers. At the early stage of globalization in the 1980s, the general outlook was pessimistic, that is, it was believed that all Japanese automobile assemblers and parts

Table 2.5: Automobile Assemblers Supplied by Toyota Group Parts Manufacturers

(Unit: %)

	Toyota		Nissan		Daihatsu		Mazda	
	1988	2001	1988	2001	1988	2001	1988	2001
Aishin AW	82.0	64.1				0.3		0.2
Aishin Seiki	64.0	11.0						
Denso	55.4							
Toyota Gosei	58.7	55.1			4.2	4.1	1.3	
Futaba Industrial	46.4	55.0			4.3	4.2		
Takashimaya Nippatsu	81.2	81.4						
Tsuda Industries	53.7					1.0		
Sango	66.5	75.4			3.9	6.1		
Chuo Spring	46.4	40.0	1.9	1.0	4.2	4.0	8.1	5.0
Hosei Brake	83.0	86.7			6.0	3.7		
Aisan Industry	66.6	77.0			7.4	7.4		3.9
Arakawa Auto Body	98.6				0.5			
Kyosan Denki	15.1	8.0	0.8	0.7	1.2		2.1	1.3
	Mitsubishi		Honda		Suzuki		Others	
	1988	2001	1988	2001	1988	2001	1988	2001
Aishin AW	3.0		3.3			0.3		
Aishin Seiki			2.9					
Denso								
Toyota Gosei							8.8	
Futaba Industrial	13.5	7.4	1.7	8.5		6.0		
Takashimaya Nippatsu								
Tsuda Industries						0.5	33.1	
Sango							18.3	
Chuo Spring	2.5	3.0	9.7	11.8	3.4		8.0	
Hosei Brake								
Aisan Industry	4.0	2.1			3.7		7.1	
Arakawa Auto Body								
Kyosan Denki	0.8						69.5	

Source: I.R.C. [2002] and Japan Auto Parts Industries Association and Auto Trade Journal [2000].

suppliers would not be able to survive severe international competition. This expectation is partly true, since Nissan and Mazda encountered difficulties and they restructured nearly one-third of their parts suppliers. On the other hand, Toyota still maintains its hierarchical structure almost intact. One big change is found in its 'wide extension,' which means Toyota recommends its parts suppliers to supply parts to other automobile assemblers. Toyota used to be reluctant to have its parts suppliers supply to other assemblers, since there would be a drain of technology and know-how. These days, this helps its parts suppliers to secure sales and to decrease costs due to the larger amount of production. These ultimately are beneficial to Toyota. Table 2.5 indicates the comparison of destinations of parts in 1988 and 2001, namely automobile assemblers, which are supplied by Toyota's typical parts suppliers. From this limited data, it is difficult to note the above general trend.

Toyota has been proceeding with 'CCC21' (Continuance Costs Competitiveness 21), which aims to reduce costs by 30 percent for three years starting 2001. This is based on an entirely different philosophy such that the costs were required to reduce a certain percentage from the previous model. Whereas this traditional philosophy is based on relative price, CCC21 pays attention to rather absolute costs. That is, Toyota chooses 173 core parts and sets the absolute costs by considering those of global markets and parts suppliers, and the design, purchase, and production sections are asked to collaborate from the early stage of development to the final stage of production so as to meet the desired reduction of costs. This also aims to nurture its parts suppliers with global competitiveness.⁷

Notes

* The author is indebted to the officials of Aichi Prefectural Government, and to those of the Toyota Motor Corporation and its parts suppliers for their collaboration during the survey interview.

¹ Kyohokai consists of 211 parts supply companies (as of 2002), and there are also sub-groups such as those for unit parts and body parts. The member companies of Kyoeikai are mainly related to tools and machine tools; it has four sub-groups comprising body equipment, unit equipment, construction, and distribution. The total number of member companies is 123 (as of 2002).

² Those were referred to as Quality Control (QC) or Total Quality Control (TQC), respectively.

³ Recently, joint R&D activities with Toyota and other firms of the Toyota Group

are no longer common. They tend to seek their own innovative management. In addition, sometimes they do not share the same aims and objectives. One such example can be found in the development of the car navigation system. Toyota opposed the R&D of Aishin A&W, which ultimately succeeded, since Toyota preferred Denso to proceed with R&D. Aishin A&W did not comply.

⁴ In North America, investment in the form of setting up offices to promote sales used to be the largest due to that country's great purchasing power. In addition, investment in plants related to R&D aimed to collect information on innovation as well as new technology has been on the increase.

⁵ These figures are calculated from Aichi Prefecture [2002].

⁶ This is the same as the Honda plant in Guangzhou, China.

⁷ See I.R.C. [2002], pp. 170-1.

References

- Aichi Prefecture [2002]. *Overseas Activities of Aichi Firms* (in Japanese), Nagoya: Aichi Prefectural Government.
- Asanuma, B. [1989]. "Structure of Transactions of Japanese Industry: The Case of Automobile Industry (in Japanese)," *Economic Review* (Kyoto University), 133 (3): 1-30.
- Coase, R. H. [1937]. "The Nature of the Firm," *Economica*, 4: 386-405.
- I.R.C. [2002]. *Reality of the Toyota Group* (in Japanese), Tokyo: I.R.C.
- Japan Auto Parts Industries Association and Auto Trade Journal [2000] *Japanese Automotive Parts Industry* (in Japanese), Tokyo: Auto Trade Journal Co., Inc.
- Monden, Y. [1998]. *Toyota Production System: Integrated Approach to Just-in-Time*, 3rd ed., Norcross (GA): Engineering & Management Press.
- Ohno, T. [1978]. *Toyota Production System* (in Japanese), Tokyo: Diamond Publication.
- Toyota Motor Corporation [1985]. *Endless Creation: 50-Year History of Toyota Motor Corporation* (in Japanese), Tokyo: Toyota Motor Corporation.
- Tsuji, M. [2000]. "Envisioning the Japanese Economic System in the 21st Century in Relation to Economies of Network," in F. Schober *et al.* (eds.) *Restructuring the Economy of the 21st Century in Japan and Germany*, Berlin: Duker & Humbolt.
- Tsuji, M. [2003]. "Transformation of the Japanese system towards a network economy" in E. Giovannetti, M. Kagami, and M. Tsuji (eds.) *The Internet Revolution: A Global Perspective*, Cambridge: Cambridge University Press, forthcoming.
- Tsuji, M. and T. Nishiwaki [1996]. *Nettowa-ku Mirai (Future of Networking)* (in Japanese), Tokyo: Nihonhyoronsha.
- Williamson, O. E. [1989]. "Transaction Cost Economics," in R. Schmlensee and R. Willig (eds.) *Handbook of Industrial Organization*, Vol. 1, New York (NY): North-Holland.