

Regional Economies and Keiretsu Groups in Japan

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Abstract:

This research investigates industrial accumulation in Japan's regional economies with a focus on corporate groups (*keiretsu*). The input-output analysis identifies the linkage effects in four selected prefectures with respect to their principal industries (automobile and electronics). We then examine the relationship between industrial linkages and characteristics of major *keiretsu* groups located in each prefecture. The paper demonstrates that the presence of *keiretsu* groups has profound impacts, through multiple layers of transactions, on the performance of regional economies. It also shows that diverse economic activities in the regional economy offer an opportunity to exploit the industrial concentration provided by *keiretsu* operations.

Keywords: Regional Economies, Corporate Groups, Industrial Accumulation, Input-Output Analysis

JEL codes: R11 Regional Economic Activity
R15 Econometric and Input-Output Models

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1. Introduction

Promotion of industrial activities in a region is an important issue for its policymakers as it creates employment and generates income. This is the reason for intense interests in the idea of the industrial “cluster” detailed by Porter (1990). Geographical concentration of industrial activities takes various forms. Firms in the same industry often locate in the same area, European examples of which include watch-making in the Jura Mountains in Switzerland and biotechnology industry in Cambridge, England. In the U.S., automobile manufacturers are clustered in Detroit, insurance business in Boston and software industry in Silicon Valley. In Japan, many large manufacturers develop a network of affiliate subcontracting corporations (keiretsu), and the keiretsu relationship can also emerge as industrial accumulation in a regional economy.¹

There has been a rich array of research into keiretsu groups in the disciplines of management science and economics. Ahmadjian and Lincoln (2001) document changes in the supplier-assembler relation in the automobile keiretsu. Weinstein and Yafeh (1995) investigate behavior of Japanese keiretsu member firms, and find that they produce at levels beyond those dictated by profit maximization. Miwa and Ramseyer (2002) cast doubt on relevance of keiretsu in the explanation of Japanese corporate structure. The focus of past studies, however, has generally been on individual groups and companies, and analysis of keiretsu in the context of regional economy is limited. This is the gap that this paper attempts to fill through an inquiry into the impact of keiretsu presence in Japanese regional economies.

The principal analytical tool in this study is the input-output (I-O) approach. The I-O analysis was pioneered in such works as Rasmussen (1956) and Leontief (1966), and offers valuable information for economic policymaking since it can illustrate the structure of sectoral interdependence existing in an economic unit. It helps to identify “strategic” or “key” sectors of an economy in measures such as backward and forward linkages: the former captures the economy-wide repercussion from an increase in the final demand of a sector, and the latter establishes the size of output expansion an increase in a sector’s output permits as inputs to other sectors.²

The rest of the paper is organized as follows. The next Section introduces Japanese prefectures selected for study as well as keiretsu groups located in each of them. This is followed by identification, through the I-O analysis, of the linkage effect that an output expansion in the industry where region's major keiretsu group operates gives rise to individual economies. This linkage is then examined in the context of characteristics of keiretsu in each region. The concluding Section summarizes the findings and offers themes for further research in the context of industrial activities and regional economies.

2. Regions for Investigation and their *Keiretsu* Groups

Japan has 47 prefectures as the administrative unit under the central government, and prefecture governments prepare their own I-O tables with technical assistance from the Ministry of Economy, Trade and Industry. The I-O tables for all 47 prefectures are available from the year 1990 (with revisions every five years), and some prefectures had organized I-O tables from earlier years for their policy analysis. This paper examines regional economies of four prefectures, Aichi, Hiroshima, Ibaraki, and Osaka, which had begun using their I-O tables before 1990. These four prefectures are characterized by accumulation of industrial activities. As presented in Table 1, they

Table 1: Prefecture Economy Summary Data

	GDP (billion yen)	Population (thousand)	GDP p.c. (thousand yen)	Area (thousand km ²)
Japan (47 prefectures)	495,772	127,619	3,885	377.8
Aichi	33,696	7,158	4,707 (2nd)	5.2
Hiroshima	10,961	2,878	3,809 (10th)	8.5
Ibaraki	11,150	2,991	3,727 (12th)	6.1
Osaka	38,324 (19.0 %)	8,816 (17.1%)	4,347 (3rd)	1.9 (5.7%)

Note: GDP, population, and GDP per capita are for the year 2003. In the bottom parentheses are percentage shares of four prefectures combined.

account for 19.0% of the nation's economic activities in terms of gross domestic products (GDP) in 2003. In terms of per capita GDP of the same year, they rank 2nd (Aichi), 3rd (Osaka), 10th (Hiroshima), and 12th (Ibaraki) in Japan. Among the prefecture's principal industries is the transportation machinery manufacturing in Aichi and Hiroshima, with its share in prefecture GDP at 14.0% and 5.0% respectively in 2003, and the electric industry in Ibaraki and Osaka with its GDP share of 4.1% and 2.5%.

Keiretsu groups play a large role in these industries. While Aichi and Hiroshima have automobile *keiretsu*, i.e., Toyota and Mazda, Ibaraki and Osaka are home to large electronics manufacturers, Hitachi and Matsushita-Panasonic. These prefectures are the birthplace of respective *keiretsu* groups. Toyota Motor Corporation was established in 1937 as a spin-off from Toyota Industries Corporation with its first automobile factory in Koromo, Aichi Prefecture. As its factories and offices accumulated in Koromo, the city was renamed to Toyota in 1959. Toyota itself has 20 automobile factories in Aichi as of 2000, and many of its group corporations are also based in the prefecture. Mazda Motor Corporation started its operation in 1920 in Hiroshima. It chose to stay in the area even after the destruction of Hiroshima City by the atomic bomb in 1945. Mazda is now part of the Ford Group, with 25% of its shares purchased by Ford in 1979, which was raised to more than 33% in 1996. In spite of its affiliation with Ford, Mazda continues to maintain close ties with Hiroshima, which is symbolized by its ownership of a professional baseball team (Hiroshima Toyo Carp) and a professional football team (Sanfrecce Hiroshima). Hitachi, Ltd. was incorporated in 1920 in Hitachi City, Ibaraki Prefecture, as an independent electric manufacturer with two factories, growing out of an electrical repair shop for a lead mine. Hitachi has grown to be a comprehensive electric machinery maker that produces such diverse items as nuclear power generators, railroad equipment, mainframe computer, and consumer electronics. Konosuke Matsushita, the founder of Matsushita Electric Industrial Co., Ltd. began producing insulation plates, original sockets, and electric attachments plug in 1918 in Osaka.⁴ Unlike Hitachi, Matsushita-Panasonic remains specialized in consumer electronics.

These groups survived World War II, and expanded their operations during the period of rapid economic growth of Japan. Toyota, Hitachi and Matsushita-Panasonic have grown to be multinational corporations with extensive networks of subsidiaries in many countries, while Mazda plays an important role as a strategic partner in the Ford Group. In spite of this development, they have maintained large presence in their home prefectures. In terms of the number of employees in the region's manufacturing sector

in 2000, for example, the share of Toyota and Mazda groups in Aichi and Hiroshima was 24.4% and 16.6%. The same share for Hitachi and Matsushita-Panasonic was 10.4% and 14.8% in Ibaraki and Osaka.⁵

Figure 1. Keiretsu Concentration in Home-Prefecture (employment, % of group total)

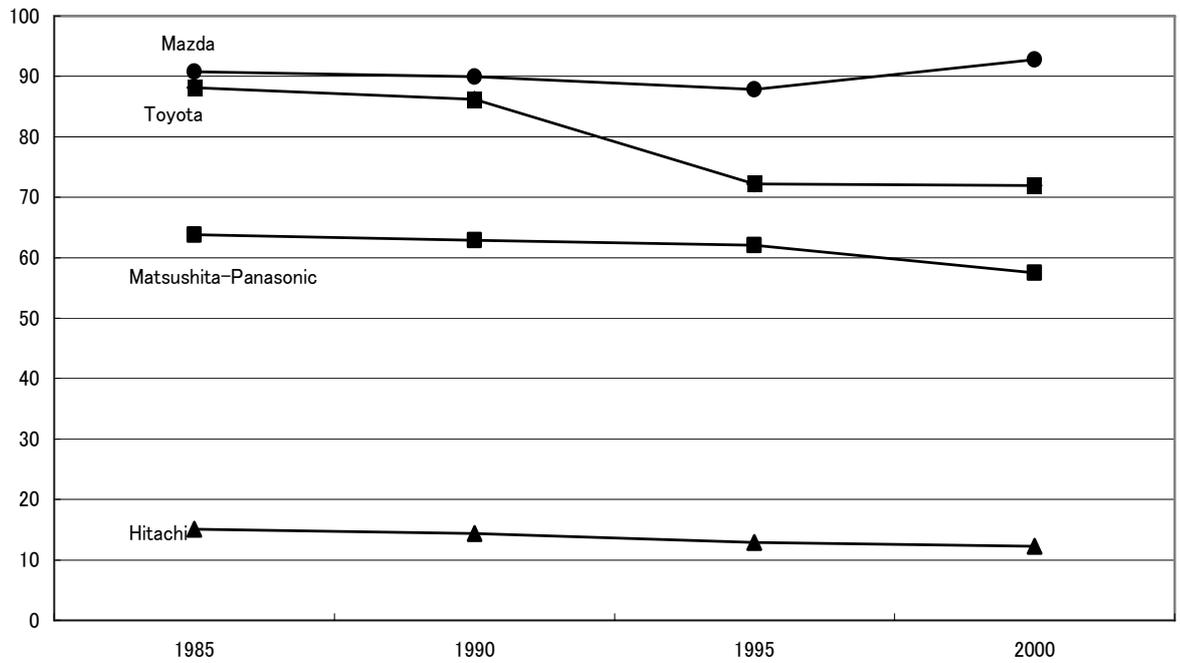


Figure 2. Keiretsu Concentration in Home-Prefecture (sales, % of group total)

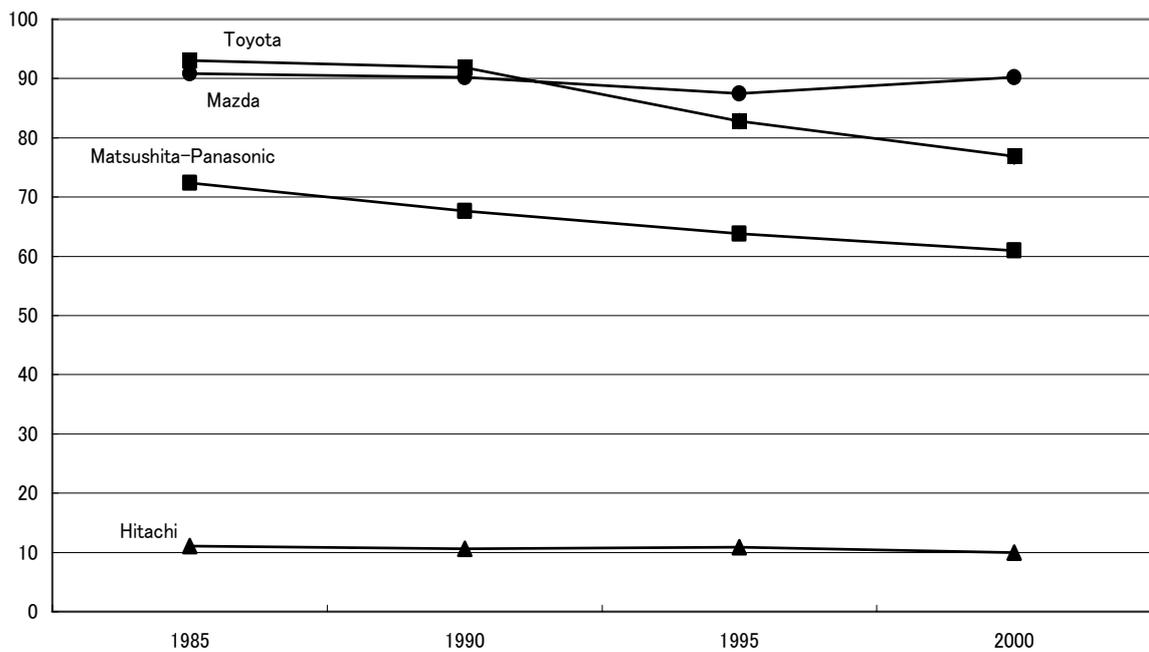


Figure 1 and 2 demonstrate concentration of *keiretsu* activities that takes place within respective home prefectures. Figure 1 represents proportions of home prefecture group employment that accounts for the core company's employees in the home prefecture as well as employees of group firms headquartered in the same prefecture. Figure 2 shows sales concentration, which includes sales recorded by subsidiary companies located in the home prefecture as well as the sales of the group's principal corporation (classified as home-proportion from locational information on capital outlay and employment). It is notable from Figure 1 and 2 that, between automobiles and electronics, it is the former that has a higher degree of home prefecture concentration. This must be due to the different degrees of product diversity among two industries. Toyota and Mazda produce transportation machinery, the structure of which is similar regardless of the type of vehicles such as trucks and passenger cars of various sizes. This industry characteristic makes a greater degree of concentration in geographical proximity an advantage. The Japanese automobile industry is also the pioneer of the lean production system that requires prompt delivery of parts and components when required by the downstream production line, which also encourages locational concentration. Contrary, the product line of electric *keiretsu* contains a wide variety of manufactured goods including radio, television, washing machine, refrigerators and computers. Operation efficiency may not require as much physical concentration across separate divisions producing various items for Hitachi and Matsushita-Panasonic as is the case for automobile *keiretsu*. A comparison between Hitachi and Matsushita-Panasonic further highlights the point. Matsushita-Panasonic is more focused on consumer electronics, and Hitachi production portfolio is far more diverse, which is reflected on the lower level of concentration in Ibaraki Prefecture for Hitachi.

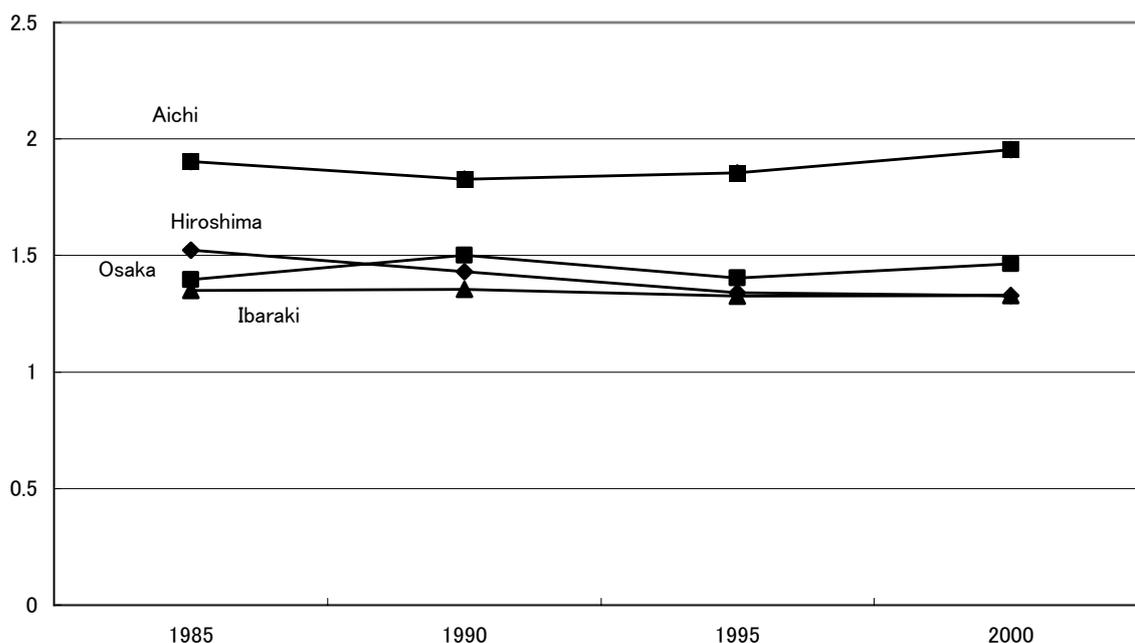
3. Linkages in Regional Economies and Keiretsu Groups

This Section discusses regional economy's sectoral interdependence in the context of *keiretsu* groups. First, the size of repercussions that arise from an output increase in automobile and electric industries will be identified as an output multiplier. The multiplier represents the extent to which an expansion in a sector's output leads to production increases in various sectors through the supply of intermediate goods such as parts and components.⁶ For example, an increase in automobile production directly leads to extra purchase of steel and tyres as inputs, which indirectly creates demands for items such as iron ore, coke, and rubber. When this chain of intermediate goods flow

takes place within a region, the region has a large output multiplier from the automobile production and the total production expansion could be substantial. If the region does not have industries supplying these goods to the automobile sector, however, the additional production will “leak” from the region and materialize elsewhere. The output multiplier takes a small value in this case. In order to derive the output multiplier, it is necessary to use the I-O approach. Detailed information on the flow of goods among various industries is provided in the I-O table, which allows calculation of the overall linkage effect that arises from a sector’s output increase. Although the multiplier could be designed to incorporate effects of income changes that take place as a result of induced output expansion, this research limits itself to production effects.

Figure 3 demonstrates output multipliers for the automobile sector (for Aichi and Hiroshima) and for the electronics sector (for Ibaraki and Osaka). They represent the magnitude of economy-wide output expansion that takes place in individual prefectures responding to a unit production increase in automobile and electronics sectors. Between two prefectures with automobile keiretsu, Aichi showed a greater degree of repercussions from the sector: its multiplier of 1.955 in 2000, for example, implies that Aichi prefecture economy was characterized by the sectoral interdependence in which a unit production increase in its automobile industry results in an extra 0.955 unit expansion of total output through direct and indirect linkages. The comparable number

Figure 3. Output Multipliers



for Hiroshima in 2000 was 1.328. In both prefectures, the multiplier declined from 1985 to 1990. While Aichi showed a rebound in the value in 1995 and 2000, Hiroshima saw the multiplier continue to dip further in those years. Among Ibaraki and Osaka, it is the latter that shows larger multipliers, albeit with a small margin. The pattern of changes from 1985 through 2000 is the same: an initial rise in 1990 is followed by a slump in 1995, which is reversed in 2000 (although to the level below that of 1990).

The factor behind the linkage shifts, depicted as changes in multipliers originating from automobile and electric sectors, can be discussed in the context of individual economies' structural characteristics and their keiretsu groups. For this purpose, correlation coefficients between output multipliers and keiretsu home concentration indices are obtained for respective prefectures (Table 2). Aichi and Osaka show negative coefficients for both sales and employment, which means that the changes in multipliers and concentration indices are in the opposite directions for these prefectures. Declining keiretsu concentration by Toyota and Matsushita-Panasonic does not necessarily lead to smaller output multipliers there. Positive correlation coefficients for Hiroshima and Ibaraki, on the contrary, imply that the direction of changes in the two variables is the same: inter-industry linkages become smaller as keiretsu concentration of Mazda and Hitachi declined.

Table 2. Correlation Coefficient:
Output Multiplier and *Keiretsu* Home Prefecture Concentration

	Multiplier - <i>Keiretsu</i> Employment	Multiplier - <i>Keiretsu</i> Sales
Aichi	-0.361	-0.576
Hiroshima	0.037	0.631
Ibaraki	0.899	0.324
Osaka	-0.327	-0.304

Aichi and Osaka are large economies. Their 2003 GDP figures, converted to the US dollar value with the year's average exchange rate of 115.93Yen/\$ (IMF, International Financial Statistics), are listed with economies of comparable size in Table 3, which

shows that they exceed those of countries such as Austria and Indonesia. The higher degree of industrial linkage in Aichi reflects regional accumulation of various manufacturing sectors. According to 2003 GDP statistics more than a tenth of Japan's manufacturing activities took place in Aichi, which makes it the largest supplier of manufactured goods among 47 prefectures. In addition to the transportation machinery, the share of Aichi is highest in various sectors such as textiles, ceramics, and metal products. This industrial structure allows an expansion of automobile production to give rise to substantial repercussions in other industrial sectors within the prefecture. It is notable that Aichi's industry linkage in the 1990s accelerated in the face of declining home prefecture concentration by Toyota group. This was possible as operations of Toyota as a whole generally expanded in the 1990s, and the group's home-prefecture activities did not experience contraction despite the smaller concentration in Aichi. For example, the number of group firms increased from 109 in 1985, to 138 in 1990, 315 in 1995, and 450 in 2000, among which 75, 85, 124, and 155 companies were located in Aichi in respective years.

Table 3. Comparison of Aichi and Osaka economies among major countries

GDP (billion US\$)	
Australia	527.1
Brazil	505.7
Russia	431.5
<u>Osaka</u>	<u>330.6</u>
Switzerland	322.7
Belgium	310.4
Sweden	304.1
<u>Aichi</u>	<u>290.7</u>
Austria	256.2
Turkey	239.7
Indonesia	237.4

Source: IMF, *International Financial Statistics*, May 2006.

Osaka's share in the nation's total GDP is 7.7%, which ranks it second only to Tokyo among all the prefectures (with Aichi being the third). Although its output multiplier is not as large as that of Aichi, its level in 2000 gained over the one in 1995. Similarly with Aichi, its correlation with keiretsu home concentration is negative; Osaka economy has maintained its industrial linkage in the face of falling concentration of the Matsushita-Panasonic group. The source of the linkage resilience, however, is quite different. Table 4 demonstrates that Osaka's economic structure is characterized by a large tertiary sector such as wholesale and retail, finance and insurance and services. Multiple layers of transactions that encompass non-manufacturing activities must be the source of linkage among various sectors for Osaka economy.

Table 4. Comparison of Aichi and Osaka Economy Structure: 2003

	Aichi	Osaka
GDP (billion yen)	33,696	38,324
Manufacturing	11,014 (32.7%)	6,767 (17.7%)
Construction	1,833 (5.4%)	1,532 (4.0%)
Wholesale & Retail	5,125 (15.2%)	7,766 (20.3%)
Finance & Insurance	1,763 (5.2%)	2,762 (7.2%)
Real Estate	3,614 (10.7%)	5,115 (13.3%)
Services	5,508 (16.3%)	8,952 (23.4%)

The difference in economic structures between Aichi and Osaka is also reflected in the decomposition of the multiplier effects. Table 5 shows breakdown of the repercussions between the keiretsu industry and other sectors of the economy. For example, the output multiplier of 1.903 in Aichi for the year 1985 is divided into three components: (i) the original production expansion of 1.0 in the automobile (keiretsu) industry, (ii) the multiplier effect of 0.440 in the same industry, and (iii) the multiplier effect of 0.463 in other sectors of the prefecture economy. It is notable that for Aichi (ii) takes a larger value than (iii) in three years out of four, while (iii) is several times greater than (ii) for Osaka. This demonstrates that the indirect production increase

inside the automobile industry is significant in Aichi. In Osaka, however, spillovers from the original output increase in the keiretsu industry to other sectors of the economy far exceed the repercussions within the electric industry.

Table 5. Composition of Multiplier Effects: Aichi and Osaka

	1985	1990	1995	2000
Aichi				
Total Multiplier	1.903	1.827	1.854	1.955
(i) automobile (source)	1.000	1.000	1.000	1.000
(ii) automobile (indirect)	0.440	0.431	0.476	0.530
(iii) others (indirect)	0.463	0.396	0.378	0.425
Osaka				
Total Multiplier	1.396	1.501	1.403	1.465
(i) electronics (source)	1.000	1.000	1.000	1.000
(ii) electronics (indirect)	0.054	0.073	0.085	0.079
(iii) others (indirect)	0.342	0.428	0.318	0.386

The economies of Ibaraki and Hiroshima are smaller, with their GDP less than a third of Aichi's. It implies that the buildup of industrial interdependence has not been accomplished to a degree realized in large economies. Thus the internal linkage of their regional economy is dependent on corporate groups operating in the prefecture. Table 2 shows that its regional output multiplier is positively correlated with their *keiretsu* home concentration. Hiroshima experienced a gradual reduction in its inter-industry linkage between 1985 and 2000. The linkage shrinkage proceeded as Mazda concentration in the home prefecture eroded. Since Mazda has been affiliated with Ford since 1979, its parts and component procurement must have been determined in the context of international network of Ford group. And Hiroshima did not have alternative sources of industrial linkage that compensates shrinking *keiretsu*. The situation in Ibaraki is similar. The home prefecture concentration of Hitachi has never been particularly high (due perhaps to its diverse product line), which hurts Ibaraki in the form of depressed linkage effects.

4. Conclusion

This paper has examined inter-industry linkages for four regional economies in Japan, and discussed them with a focus on their *keiretsu* corporate groups. Aichi and Osaka demonstrate advantages of large economies, which can supplement the *keiretsu* network with substantial accumulation of various economic activities. While they can capitalize on in-group transaction linkages that arise within *keiretsu*, they enjoy multiplier effects that take place even outside the *keiretsu* transactions. The source of linkages is the heavy concentration of manufacturing in Aichi and non-manufacturing sectors such as commerce, finance, and services in Osaka. Hiroshima and Ibaraki, on the other hand, were more dependent on their *keiretsu* group for economic linkages. They suffered when *keiretsu* reduced their home-prefecture presence.

It benefits a region to promote corporate groups such as *keiretsu*, as it will bring substantial economic activities to the local economy. If economic policy of the local authorities stops there, however, the region will become dependent on corporate groups and vulnerable to shocks that stem from changes in their locational strategy. Corporate groups make their locational choice based on various factors, some of which are beyond the control of the local policy-makers. A virtuous cycle is accomplished when a web of solid industrial foundation of the regional economy supports group operations, as that will make the region not only more attractive as the investment destination of corporate groups, while resilient at a time of groups' phase-out from the region.

Notes:

1. Miyashita and Russell (1994) distinguish *keiretsu* between horizontal and vertical. The horizontal *keiretsu*, such as Mitsubishi and Sumitomo, comprises firms operating in diverse industries and develops around a commercial bank or a trading company. The vertical *keiretsu*, on the other hand, is more hierarchical, and its member firms have close business relations with a single end-product manufacturer. This paper investigates *keiretsu* in the latter category.
2. For a concise explanation of the use of the I-O model to evaluate the economy-wide impacts from a change in final demand for a sector, see Miller and Blair (1985), pp. 100-148. Cai and Leung (2004) discuss methodologies and technical issues to measure the impacts with the I-O analysis. Ciobanu, Mattas and Psaltopoulos (2004) is an example of a regional study that uses the I-O approach.
3. Toyota Motor Corporation was formerly Toyota Motor Company Ltd. at the time of establishment, and the original name of Toyota Industries Corporation was Toyoda Automatic Looms Works. Toyoda (1987) gives a detailed account of birth of Toyota as a motor vehicle producer.
4. Kotter (1997) gives a detailed account of professional career of Konosuke Matsushita from the leadership perspective. Although Matsushita is the official name of the company, this paper uses Matsushita-Panasonic to refer to the company, as we presume that its Panasonic brand name is more widely recognized in the international markets.
5. The source of corporate group data is *Japanese Corporate Groups (Nippon-no Kigyo Gurupu)* by Toyo-Keizai Shimposha from various years. A detailed account of calculating method of *keiretsu* activities within each home prefecture is in the Appendix.
6. Miller and Blair (1985) define the output multiplier for sector j as “the total value of production in all sectors of the economy that is necessary in order to satisfy a dollar’s worth of final demand for sector j ’s output” (page 102).

APPENDIX: Derivation of *keiretsu* activity size within home prefectures

The source of corporate group data is *Japanese Corporate Groups (Nihon-no Kigyou Gurupu)*. Toyo-Keizai Shimposha, a Japanese publishing company specialized in business, finance and economics, annually collects data from all Japanese listed companies through questionnaire survey on their “group corporations”. The 2005 issue, for example, provides data on 2,835 parent companies and 30,558 group firms. In case “group corporations” include listed companies, “group corporations” of individual listed companies are also included, as the secondary group companies, in the group of the original end-product corporation (Toyota, Mazda, Hitachi and Matsushita-Panasonic).

Keiretsu concentration for four groups is calculated regarding employment and sales. The former represents the percentage share of in-prefecture employment out of the group total. In-prefecture employment includes employees of subsidiary companies that are headquartered in the prefecture as well as employees of the principal firm stationed in the prefecture. The sales concentration is the share of sales recorded by the group companies headquartered in the prefecture and the core firm’s sales classified as in-prefecture. The core firm’s sales’ classification is based on the average ratio of (i) its home-prefecture employment ratio, and (ii) its home-prefecture capital outlays ratio.

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