Various Aspects of Japan's Rural Automotive Industry

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1. Introduction

The purpose of this paper is to compare automobile industry clusters outside of the major regions of Chubu and Kanto and illuminate issues and differences between them. Specifically, this paper looks at the six prefectures of the Tohoku region, the five prefectures of the Chugoku region, and the three prefectures of northern Kyushu. The Tohoku region is home to auto-plants of Toyota Motor East Japan (a direct subsidiary of Toyota, herein referred to as "TMEJ"), located in Iwate Prefecture and Miyagi Prefecture. Meanwhile, Nissan has an engine factory in Fukushima Prefecture. Mazda's auto-plants are located in the Chugoku region prefectures of Hiroshima and Yamaguchi, while Mitsubishi Motors (herein referred to as "Mitsubishi") has an auto-plant in Okayama Prefecture. In neighboring northern Kyushu, Fukuoka Prefecture is home to auto-plants belonging to Toyota Motor Kyushu (a direct subsidiary of Toyota, herein referred to as "TMK") and Nissan Shatai Kyushu (established by direct Nissan subsidiary Nissan Shatai and separate entity Nissan Motor Kyushu Co., Ltd.). Finally, Daihatsu Motor Kyushu Co., Ltd. has an auto-plant in Oita Prefecture, and a Honda motorcycle-plant is located in Kumamoto Prefecture.

According to 2014 calculations by the Tohoku Bureau of Economy, Trade and Industry's automotive industry office, automotive production by region is as follows: 3,360,000 vehicles were produced in the Chubu region; 2,900,000 vehicles were produced in the Kanto region; 1,420,000 were vehicles produced in the Kyushu region, 1,150,000 were vehicles produced in the Chugoku region, and 520,000 vehicles were produced in the Tohoku region. In terms of vehicle unit production numbers in Japan, the rural automotive industry clusters in the Kyushu, Chubu, and Tohoku region place third, fourth, and fifth and fifth respectively. However, these areas are very different when compared to the Chubu region

(home to Toyota and Mitsubishi) and the Kanto region (home to Nissan, Honda, Subaru, etc.). This paper will focus on illuminating these differences. With Toyota, production bases in the Tohoku and Kyushu region developed in the early 1990s. The major goal of these developments was to eliminate labor and land shortages experienced during the bubble period. Since Toyota claims that the Tohoku region is its third domestic base, it is essential to compare the region with its second base in Kyushu.

2. Classifying the Rural Automotive Industry

This paper will attempt to develop a "theory of the rural automotive industry," dynamically studying industry clusters by combining strategic management theories to analyze the automobile industry (corporate groups overseen by automobile manufacturers) and regional economic theories (that maintain an awareness of the uniqueness of industry clusters). In order to compare the characteristics of the automobile industry clusters of each region, we will explain the criteria for classifying these industrial regions nationwide.

Automotive industrial clusters are organized like top-down corporate towns. In examining whether the demand for the corporation's industrial goods (capital goods such as equipment, jigs, tools, etc., and intermediate goods such as materials and parts) can be met within each cluster, we must further categorize and understand their characteristics. We can break down regions into three categories[1]. This paper uses three classifications: Type X, Type Y, and Type Z.

Classification 1 is Type X, a self-contained cluster that is able to meet over 50% of the central corporation's demands within the cluster. Specifically, with Toyota, this covers wide areas of the Tokai region centering in the Nishi Mikawa area of Aichi Prefecture, including company auto-plants (Motomachi, Takaoka, Tsutsumi, Tahara), and auto-plants belonging to its manufacturing subsidiaries (Fujimatsu, Yoshiwara, Inabe〔located in a remote area of Mie Prefecture〕, and Gifu Auto Body Co., Ltd., the subsidiary). With Nissan, this includes company auto-plants (Oppama, Tochigi) and those of its manufacturing subsidiaries (Shonan) centered in the Kanto region prefectures of Kanagawa and Tochigi. Meanwhile, Honda's center is located in the northern Kanto region, home to its east Japan auto-plant

1) There are large differences in classifications of clusters indicated. For instance, Type X explained later, the maturity of the cluster surrounding Toyota is overwhelming that it is superior to that of Nissan or Honda. Please note that the classification of the clusters' characteristics used here is differentiated for convenience.

and Saitama plant (Sayama and Yorii)

Classification 2 is Type Y, an immature cluster that is similar to the aforementioned Type X, but only able to meet a fixed portion of the central corporation's demands within the cluster. Specifically, this includes a wide swath of the Hiroshima area, (including the Mazda Ujina Factory (adjacent to Mazda's headquarters) and the Houfu plant in Yamaguchi Prefecture), areas around Mie Prefecture (home to Honda's Suzuka Factory (the company's automobile manufacturing plant for west Japan), and the automobile manufacturing plant of its subsidiary Honda Auto Body Co., Ltd.), western Shizuoka Prefecture (home to Suzuki's automobile manufacturing plants in Kosai and Iwata), the Kansai region of Osaka, Kyoto, and Shiga Prefecture (home to automobile manufacturing plants in Ikeda, Kyoto, and Shiga Ryuo near Daihatsu's headquarters), and Gunma and Tochigi Prefectures (Yajima, and Subaru's main Gunma automobile manufacturing plant).

Classification 3 is Type Z, a cluster dependent on other regions, which only produces a portion of parts, and is unable to meet the central corporation's demands on its own. Typically, this refers to large-scale industrial type clusters developed by the automobile company. These includes the Tohoku region (home to the aforementioned TMEJ), the northern Kyushu region, which is home to TMK, Nissan Motor Kyushu Co., Ltd. (including manufacturing subsidiary Nissan Shatai Kyushu), and Daihatsu Kyushu, and the Kurashiki and Soja area in Okayama Prefecture, which is home to Mitsubishi's Mizushima Plant.

The main reason for establishing these three categories has to do with whether the core companies within the cluster and their adjacent partner companies have procurement rights or development capabilities. Type Z regions such as Tohoku and northern Kyushu typically only possess large scale production capabilities, and internal decision-making abilities within the cluster are limited. It is not unusual for parts manufacturers to expand in a region by dealing with company headquarters rather than with local companies in the area. As such, Type Z can be understood as clusters (excluding local companies) made up of large economic zones of branch factories.

3. Previous Research Into Industry Clusters

Research into industry clusters first began with foundational studies by Marshall (1890) and Weber (1922). Marshall pointed out that external economies develop as a result of numerous companies forming in concentrated areas. Meanwhile, Weber explained the logic behind how the formation of companies in the same area helps minimize costs. Reviewing

the development of cluster theory, Matsubara (1999) conducted new comparative research on industrial clusters in Europe. Scott's cluster theory (1988) addressed the writings of Williamson (1975), while Stoper's writings (1997) addressed those of Asanuma (1985a, 1985b), with each building on the other to outline the cluster's characteristics. Williamson's transaction cost approach and subsequent research by Asanuma that was built upon this theory provide a theoretical basis for research into today's supplier systems. However, using these theories in industrial cluster research is still relatively new. Doing so illuminates the contours of the trading system for industrial clusters.

Later, Ito (2000) reviewed the new-industrial-cluster theories developed by Krugman (1991), Piore and Sabel (1984) and Porter (1999), asserting that there were core differences in how clusters formed in Japan and how they formed in the US and Europe. He states that while in Europe and the US, branch factories are established to produce intermediate goods, in Japan, these factories are converted to Keiretsu transactions and subcontracting systems that keep them separate and independent. Not all of Japan's industrial clusters are entirely independent of the central corporation. A certain percentage are organized as detached units sharing capital relationships. This is consistent with the approach of this paper (as it deals with theories of the rural automotive industry), which treats the main corporation and outside companies located within the cluster as a connected corporate group.

In considering specific regions, this paper is directly preceded by the research of Orihashi, Mokudai, and Murayama ed. (2013), which looks at the history of development and growth of the automotive industry, and provides a comprehensive look at existential issues facing the rural automotive industry from a corporate and administrative perspective. Orihashi et al. (2013) examine in detail the conditions and issues of the rural automotive industry in the Tohoku and northern Kyushu region, where enormous branch plants belonging to Toyota, Nissan, and other major automobile companies are located. With their research also incidentally including the Chugoku region, their scope of research essentially matches that of this paper. The Tohoku and northern Kyushu region both face identical problems, such as the lack of development capabilities and procurement rights from the central corporation, low local content ratio (from local companies), competition with domestic plants, and other issues. Finally, regardless of how large the sub-factory economy is, its growth is limited to domestic markets and exports (which are likely to decline as free trade areas grow). This presents an essential weakness. As such, unless Type Z clusters can advance in the region by improving their local procurement rate, development capabilities, and obtaining procurement rights, their importance to the company will be

negligible, merely serving as a buffer between core factories (those adjacent to the headquarters) and production fluctuations in overseas factories. Their ability to survive will depend on how the domestic market declines or contracts over the long term.

4. Statistical Implications

This section will use various statistics to quantitatively analyze the business environment of the automobile industry in each region. The following is a summary of information from the 2018 Regional Population Projections for Japan published by the IPSS (National Institute of Population and Social Security Research), the 2018 Census of Manufacturers published by METI (Ministry of Economy, Trade and Industry) and the 2011 Input-Output Table published by the MIC (Ministry of Internal Affairs and Communications).

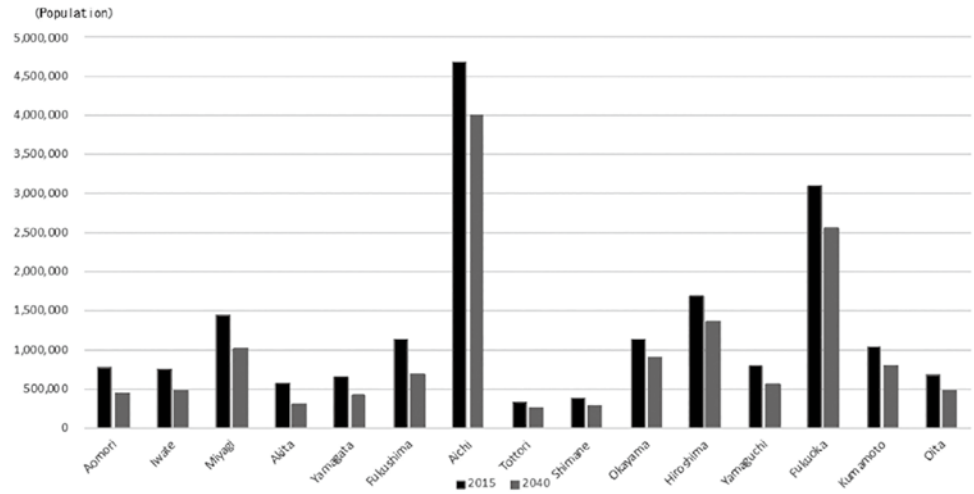
(1) Implications From "Future Regional Population Estimates in Japan"

Figure 1 shows the productive age population in 2015 and 2040 (estimate), comparing figures in Aichi Prefecture (where Toyota is headquartered) with six prefectures in the Tohoku region, five prefectures in the Chugoku region, and three prefectures in the northern Kyushu region. The productive age population in each municipality is an important indicator of supply capabilities, and is an essential factor in considering the reproduction of industrial clusters.

Looking at an overview of the demographics, there is a limited productive age population in every prefecture without cities (as designated by government ordinance). As of 2015, areas with over 1,000,000 people include the prefectures of Miyagi and Fukushima in the Tohoku region, the prefectures of Okayama and Hiroshima in the Chugoku region, the prefectures of Fukuoka and Kumamoto in northern Kyushu, and Aichi Prefecture (shown for comparison). However, by 2040, only Miyagi Prefecture (Tohoku), Hiroshima Prefecture (Chugoku), Fukuoka Prefecture (northern Kyushu), and Aichi Prefecture will be able to retain a population of more than 1,000,000 people. As of 2015, the productive age population in the six prefectures of the Tohoku region is approximately 5,300,000 people. By 2040, the total is estimated to decline to approximately 3,310,000. The five prefectures of the Chugoku region have a population of approximately 4,300,000 as of 2015. By 2040, the total is estimated to decline to approximately 3,340,000. Likewise, the 2015 population of the three prefectures in northern Kyushu, which is approximately 4,800,000 people, is estimated to

decline to approximately 3,810,000 people. Finally, the population of Aichi Prefecture, which boasts Japan's largest manufacturing industry, will fall from a 2015 figure of approximately 4,680,000 people to an estimated 4,000,000 people by 2040. All three regions will thus suffer larger declines than Aichi Prefecture. Among these, the Tohoku region will experience the most significant decline. As such, it is necessary to consider how automobile industry clusters in this region can function given the approaching rapid drop in the productive age population. The region faces the most severe conditions when compared to other clusters.

Figure 1. Comparison of productive age population



Source: National Institute of Population and Social Security Research [2018], "Future Regional Population Estimates in Japan"

(2) Implications from the "Industrial Statistics Table"

Tables 1 and 2 are based on the Industrial Statistics Table. They show manufacturing conditions in the Tohoku region (six prefectures), Chugoku region (five prefectures), northern Kyushu (three prefectures) and Aichi Prefecture (shown for comparison). Table 1 compares the makeup of major industries in each prefecture, while Table 2 shows various conditions relating to the transportation machinery industry in each prefecture.

Looking at industrial shipments in Table 1, automobile-related fields hold the largest share of the transportation machinery industry in Iwate Prefecture, Fukushima Prefecture, Aichi Prefecture, Hiroshima Prefecture, and Fukuoka Prefecture. Automobile-related fields rank second in Miyagi Prefecture, Kumamoto Prefecture, and Oita Prefecture. Yamaguchi Prefecture is the only prefecture where they rank third. All of these regions are home to

Table 1. Major industries in each prefecture

		1st		2nd		3rd	
Prefecture	Industrial shipment: Million JPY	Industry	Percentage	Industry	Percentage	Industry	Percentage
Aomori	1,428,926	Electronic Parts, Devices and Electronic Curcuits	24.0%	Food	23.7%	Business Oriented Machinery	8.4%
Iwate	2,298,714	Transportation Equipment	26.7%	Food	15.2%	Production Machinery	8.3%
Miyagi	4,130,383	Food	13.2%	Transportation Equipment	12.9%	Electronic Parts, Devices and Electronic Curcuits	11.1%
Akita	1,193,759	Electronic Parts, Devices and Electronic Curcuits	30.4%	Food	9.1%	Production Machinery	8.3%
Yamagata	2,624,509	Electronic Parts, Devices and Electronic Curcuits	18.7%	Food	12.3%	Production Machinery	9.0%
Fukushima	4,436,870	Transportation Equipment	11.2%	Chemical Products	10.3%	Electronic Parts, Devices and Electronic Curcuits	9.1%
Aichi	36,126,929	Transportation Equipment	49.0%	Iron and Steel	6.2%	Electrical Machinery	5.9%
Tottori	681,689	Food	20.5%	Electronic Parts, Devices and Electronic Curcuits	18.8%	Pulp and Paper	13.5%
Shimane	1,076,716	Electronic Parts, Devices and Electronic Curcuits	19.1%	Iron and Steel	14.6%	Information and Communication Electronics Equipment	11.9%
Okayama	7,099,218	Chemical Products	15.2%	Petroleum and Coal Products	15.1%	Iron and Steel	12.9%
Hiroshima	9,011,195	Transportation Equipment	34.5%	Iron and Steel	14.7%	Production Machinery	8.3%
Yamaguchi	5,761,446	Chemical Products	28.6%	Petroleum and Coal Products	16.5%	Transportation Equipment	16.3%
Fukuoka	9,114,146	Transportation Equipment	36.6%	Food	9.8%	Iron and Steel	9.5%
Kumamoto	2,559,843	Production Machinery	16.5%	Transportation Equipment	14.7%	Food	13.0%
Oita	3,931,306	Chemical Products	16.3%	Transportation Equipment	15.2%	Iron and Steel	12.5%

Source: METI [2018], "Census of Manufactures"

automobile manufacturing plants (including for motorcycles) and power train plants, with numerous partnered materials and parts companies concentrated nearby.

Several prefectures are also developing transportation machinery industries outside of the automobile field. For example, in addition to automotive industry clusters, Fukuoka Prefecture also has clusters of aeronautics businesses organized around the IHI Group. Likewise, Hiroshima Prefecture has developed a shipbuilding industry in the city of Kure. Surprisingly, the transportation machinery industry in Okayama Prefecture, which is home to Mitsubishi's Mizushima Plant (an automobile manufacturing plant), is not large enough for it to rank third. In fact, the three prefectures of the Sanyo region (Okayama Prefecture, Hiroshima Prefecture, Yamaguchi Prefecture) are more focused on process industries such as petroleum, chemicals, and steel. The Setouchi industry cluster is comprised of the three

prefectures of the Sanyo region, and the northern part of Shikoku along the Seto Inland sea. Over many years, the area has developed large scale industrial complexes for the petroleum, chemical, and steel industries due to the high degree of convenience of maritime transport and relative simplicity of acquiring land through land reclamation. Likewise, the Mizushima seaside complex, where Mitsubishi's Mizushima Plant is located, is a similar industrial complex.

Aichi Prefecture has the highest proportion of industrial shipments (25%), followed by Fukuoka Prefecture, Hiroshima Prefecture, and Hiroshima Prefecture. Excluding Hiroshima Prefecture, where Mazda is headquartered, Toyota Group's automobile manufacturing is shown. Looking at the six prefectures in the Tohoku region, electronic components, devices and circuits are a major industry outside of the transportation machinery industry. This is the largest industry in Aomori Prefecture, Akita Prefecture, and Yamagata Prefecture, and is the third-largest in Miyagi Prefecture. This industrial makeup tells us about present conditions in the Tohoku region. The region has a history of industrial development around the Kitakami River basin, with major electronics companies entering the area in the 1970s. Later in the 1990s, the automobile industry (particularly parts companies), began to gradually move into the area. Meanwhile, in the Chugoku region prefectures of Shimane and Tottori, electronic components, devices, and circuits rank first and second respectively, showing an industrial makeup similar to that of the Tohoku region.

Now we will look at Table 2, which specifically examines the transportation machinery industry. Looking at the absolute values gathered on the left half of the table, it is clear that Aichi Prefecture has an overwhelming presence. The number of businesses and employees

Table 2. Manufacture of transportation equipment in each prefecture

Prefecture	Number of establishments (a)	Number of employees (b)	Total amount of cash earnings (c)	Total raw material costs	Industrial shipment (d)	Added value (e)				
			(Million JPY)	(Million JPY)	(Million JPY)	(Million JPY)	d/a	d/b	c/b	e/a	e/b
All Over Japan	9,884	1,083,760	5,969,954	48,017,570	68,263,488	18,767,026	6,906.5	63.0	5.5	1,898.7	17.3
Aomori	28	1,408	5,297	26,449	54,168	24,242	1,934.6	38.5	3.8	865.8	17.2
Iwate	58	7,536	38,188	536,621	644,673	89,144	11,115.1	85.5	5.1	1,537.0	11.8
Miyagi	102	10,211	51,127	406,455	547,699	125,395	5,369.6	53.6	5.0	1,229.4	12.3
Akita	29	2,755	11,788	44,744	67,406	19,944	2,324.3	24.5	4.3	687.7	7.2
Yamagata	97	6,731	27,998	70,805	133,911	53,463	1,380.5	19.9	4.2	551.2	7.9
Fukushima	114	11,184	52,176	272,722	510,014	218,880	4,473.8	45.6	4.7	1,920.0	19.6
Aichi	1,741	327,581	2,033,659	18,978,711	26,473,101	7,021,804	15,205.7	80.8	6.2	4,033.2	21.4
Tottori	22	1,476	4,844	15,840	26,282	8,340	1,194.6	17.8	3.3	379.1	5.7
Shimane	35	2,877	11,865	51,380	87,332	31,708	2,495.2	30.4	4.1	905.9	11.0
Okayama	225	19,096	98,828	552,097	915,849	334,665	4,070.4	48.0	5.2	1,487.4	17.5
Hiroshima	493	52,122	292,875	2,594,171	3,612,383	1,084,008	7,327.3	69.3	5.6	2,198.8	20.8
Yamaguchi	112	14,217	72,096	661,781	979,681	314,832	8,747.2	68.9	5.1	2,811.0	22.1
Fukuoka	157	31,260	180,019	2,925,043	3,379,768	432,247	21,527.2	108.1	5.8	2,753.2	13.8
Kumamoto	94	11,702	59,369	317,560	416,444	97,358	4,430.3	35.6	5.1	1,035.7	8.3
Oita	98	8,944	42,349	531,398	616,072	71,803	6,286.4	68.9	4.7	732.7	8.0

Source: METI [2018], "Census of Manufactures"

is significantly higher than in other prefectures. The area is home to Toyota's headquarters, numerous automobile manufacturing plants, Toyota group companies, and a large concentration of related partner companies. This configuration is typical of a Type X cluster. Limiting the scope to the six prefectures in the Tohoku region, surprisingly, Iwate Prefecture does not have a very large number of businesses or employees despite having the most mass production plants in the region. It ranks lower than Miyagi Prefecture or Fukushima Prefecture. Despite the added value of Iwate Prefecture, it ranks lower than Miyagi or Fukushima Prefecture.

It is more important to compare indicators for a unit of production, which are calculated on the right half of the table. We will now look at automobile manufacturing plants in the Tohoku region prefectures of Iwate and Miyagi, and compare their shipment amounts with Toyota Group's automobile manufacturing plants in Aichi Prefecture and Fukuoka Prefecture. Fukuoka Prefecture ranks highest in terms of shipment amount per plant, followed by Aichi Prefecture, Iwate Prefecture, and Miyagi Prefecture respectively. In terms of shipping volume per employee, Fukuoka Prefecture ranks first, followed by Iwate Prefecture, Aichi Prefecture, and Miyagi Prefecture. Fukuoka Prefecture leads the way in both categories, which likely due to differences in vehicle model production breakdown. In short, TMK in Fukuoka Prefecture manufacturers Lexus vehicles, and has a high export rate. Likewise, Nissan Motor Kyushu Co., Ltd. and Nissan Shatai Kyushu mainly produce SUV models, which have a high export rate and a comparatively high-profit margin. In contrast, Aichi Prefecture produces a wide range of models, including Lexus vehicles, mass production vehicles, and commercial vehicles. The two prefectures in the Tohoku region produce small vehicles, which have low domestic demand for their price range. However, given the low number of employees in proportion to the number of businesses, Iwate Prefecture has higher shipment amounts per employee than Aichi Prefecture. Aichi Prefecture has a massive automobile production cluster. Within the prefecture, this cluster includes top-class global corporations such as Toyota and Denso, along with tier 3 and tier 4 SMEs, and micro-sized subcontractors. This makeup affects production numbers. In Iwate Prefecture, the cluster is comprised of the TMEJ Iwate Plant along with tier 1 companies such as Toyota Group and major independent parts companies. The proportion of labor-intensive tasks performed here is considered to be relatively low (in other words, the capital equipment ratio is high). In fact, the difference in the automation rate is likely an explanatory variable, but such a factor cannot be determined through this table. On the

contrary, it may simply be that the required number of man-hours in Iwate Prefecture is low since the majority of critical parts are procured from the Chubu region.

Next is an added value. In terms of added value per plant in the aforementioned prefectures, Aichi Prefecture ranks highest, followed by Fukuoka Prefecture, Iwate Prefecture, and Miyagi Prefecture. Looking at an added value per employee, Aichi Prefecture ranks highest, followed by Fukuoka Prefecture, Miyagi Prefecture, and Iwate Prefecture. In contrast with shipment value, Aichi Prefecture leads in both categories of added value. This difference is explained by the hierarchy of automobile industry clusters in Fukuoka Prefecture and Aichi Prefecture. In fact, in Fukuoka Prefecture, the shipment value is high as a result of exclusively producing relatively high priced vehicles. However, as a result, there are many component parts, with core parts shipped from headquarters in the Chubu and Kanto region. As such, work in Fukuoka Prefecture generally begins with sub-assembly. As a result of this, the added value is centered around the assembly process. Meanwhile, in Aichi Prefecture, the entire process can essentially be completed within the prefecture, from sourcing materials, general industrial goods and performing final assembly. The large industrial cluster is structured, so that added value accumulates each step up the transaction hierarchy. Fukuoka Prefecture surpasses Aichi Prefecture in terms of shipping volume per production unit while maintaining the same added value. The biggest reason for this is that all of Fukuoka Prefecture's automobile manufacturing plants are specialized for production capabilities, and the prefecture's automobile industry clusters are structured as typical branch factory economic zones. With virtually no development capabilities or procurement rights, the prefecture's sole responsibility is production. As such, it is hard to surpass headquarters (where there is a design, development, and a purchasing department) when it comes to added value. While there are automobile manufacturing plants belonging to Toyota and Nissan in Fukuoka Prefecture, the two are essentially the same. The branch factory economic zones in Iwate Prefecture and Miyagi Prefecture (Tohoku region) are even more vulnerable. Table 2 shows the salary per employee in each prefecture. While Tohoku has a relatively high level, it is lower than the headquarters in Aichi Prefecture and Fukuoka Prefecture, and does not reach the national average. Conversely, one could argue that this low wage system is what allows for small vehicle production businesses to exist in Japan.

Next, we will compare the five prefectures of the Chugoku region (including Hiroshima Prefecture, which is home to headquarters and development bases for an automobile company) with Aichi Prefecture. Aichi Prefecture has more industrial shipments, businesses,

employees, and greater added value than all prefectures in the Chugoku region combined. The gap in employee numbers is easily explained by the difference in the productive age population. Likewise, this also partially explains the difference in the number of businesses. Aichi Prefecture has approximately twice the number of businesses, 3.6 times the number of employees, and 3.9 times the added value. Looking at the comparison of indicators for production unit calculated on the right half of the table, while it is clear that the five prefectures in the Chugoku region have a less added value per plant than Aichi Prefecture, Yamaguchi Prefecture has a higher added value per employee, and Hiroshima Prefecture's values are nearly the same[2].

Comparing Aichi Prefecture with Hiroshima Prefecture, two production areas that are crucial to the automobile industry, Aichi Prefecture leads all production unit indicators. This is due to differences in productivity between the automobile companies in the prefectures, and because of the generally small size of Mazda's local business partners. In contrast to Toyota's numerous publicly traded, global-scale business partners such as Denso and Aisin Seiki in Aichi Prefecture, virtually no Mazda-affiliated local businesses in Hiroshima Prefecture are publicly traded. In addition, the range of parts that these companies can supply to Mazda is limited. Specifically, these parts are centered around pressed components, machined components, and internal and external parts. Though the scale of the company does not necessarily affect productivity and the creation of added value, there is no doubt that large companies have the advantage in regard to equipment modernization, the introduction of advanced production methods, and investment capabilities in R&D. While both prefectures are home to automobile companies, Aichi Prefecture is classified as Type X, while Hiroshima is classified as Type Y, which explains the differences between the two. Despite this, compared to Mitsubishi's Mizushima Plant in Okayama, Hiroshima Prefecture's automobile industry cluster is highly matured. Like Iwate Prefecture and Miyagi Prefecture in the Tohoku region, and Fukuoka Prefecture in the northern Kyushu region, Okayama Prefecture is organized in a typical Type Z structure (branch factory economic zone).

Comparing indicators per production unit in the Tohoku, Chugoku, and northern Kyushu region, Iwate Prefecture and Fukuoka Prefecture (which are home to Toyota Group's automobile manufacturing plants) surpass Hiroshima Prefecture and Yamaguchi Prefecture in terms of shipment value. However, this is reversed when looking at added value. As previously mentioned, both the Tohoku and northern Kyushu region are branch

2) Perhaps Mazda and other local partner companies allow the creation of added value with lower numbers of employees by high mixed-flow production line (Flexible Manufacturing System).

factory economic zones. As such, creating added value on site is difficult. This is why Hiroshima Prefecture, which is a relatively highly mature cluster, has higher added value. Shipment value is higher in Iwate Prefecture and Fukuoka Prefecture because the industrial industry cluster is limited primarily to a Toyota Group automobile manufacturing plant and numerous major parts companies. As a result, the shipment value incidentally appears higher. Even though there are differences in productivity at Toyota and Mazda, it is best to regard this as a characteristic of the branch factory economic zone.

Analyzing the above Census of Manufacturers reveals the fragility of branch factory economic zones. Though they have a fixed scale in terms of volume, these zones are essentially specialized production bases. Since the zones are not given development capabilities or procurement rights, they are unable to discover and nurture local companies, approve parts transactions, and perform other related functions. They merely serve to perpetually respond to the demands of a distant headquarters. This structure poses a major hurdle when it comes to increasing transactions with local companies and increasing local procurement rates. Core decisions such as which branch plant to delegate authority to, and what vehicle model to produce, are ultimately made by headquarters. To be specific, the configuration of branch factories leaves them powerless to achieve quantitative growth or make qualitative reforms. The Tohoku and northern Kyushu regions (which have developed as Japanese branch factory economic zones), and the Chugoku region (which has an automobile industry cluster in Okayama Prefecture) function like overseas local production plants (the only difference being that Japanese can be used to communicate). Considering that domestic demand is not expected to grow in the future, conditions in these areas will likely be worse than overseas plants due simply to the lack of quantitative growth.

(3) Implications from the "Input-Output Model (Basic Transaction Table)

To conclude the statistical overview, we will examine Table 3, looking at the input-output table (basic transaction table) of the five prefectures that are the focus of this paper. Key figures displayed in the input-output table are the exportation, importation, and self-sufficiency rate for the automotive industry in each prefecture.

First, automobile-related fields comprise a high proportion of industry as a whole in Aichi Prefecture, both in regard to completed vehicles and vehicle parts. This shows the large size of the automobile industry cluster. Fukuoka Prefecture slightly surpasses Aichi Prefecture when it comes to the proportion of completed vehicles. This is likely due to having multiple automobile manufacturing plants belonging to both Toyota and Nissan. The

Tabel 3. Imput-Output table of the five prefectures

	Iwate	Miyagi	Aichi	Hiroshima	Fukuoka
Ratio of automobile sector to total production value in the prefecture					
Passenger cars	3.23%	0.79%	5.03%	3.00%	5.60%
Truck, Bus and other cars	0.02%	–	0.91%	-	0.09%
Auto parts and accessories	1.61%	1.11%	11.33%	4.43%	1.17%
Shipment and export rate					
Passenger cars	99.86%	63.59%	94.73%	97.06%	98.92%
Truck, Bus and other cars	0.00%	–	93.41%	-	98.74%
Auto parts and accessories	54.96%	90.27%	49.87%	74.36%	63.70%
Introduction and import rate					
Passenger cars	99.41%	64.88%	64.95%	89.67%	97.32%
Truck, Bus and other cars	94.91%	–	81.66%	-	99.40%
Auto parts and accessories	73.49%	90.82%	30.96%	66.78%	89.08%
Self-sufficiency rate					
Passenger cars	0.59%	35.12%	35.05%	10.33%	2.68%
Truck, Bus and other cars	5.09%	–	18.34%	-	0.60%
Auto parts and accessories	26.51%	9.18%	69.04%	33.22%	10.92%

Source: MIC [2011], "Imput-Output table(basic transaction table)"

proportion of completed vehicles in Hiroshima Prefecture is surprisingly smaller, ranking lower than Iwate Prefecture. Moving on, the export rate for passenger vehicles is extremely high, above 90% for all prefectures except Miyagi Prefecture. This is because the majority of manufactured vehicles are shipped across Japan and overseas. While there are slight variations in automobile parts across all prefectures, Aichi Prefecture ranks lowest, followed by Iwate Prefecture, Fukuoka Prefecture, Hiroshima Prefecture, and Miyagi Prefecture. Half of the automobile parts manufactured in Aichi Prefecture are used in final assembly plants within the prefecture. The other half are shipped to the Tohoku region, northern Kyushu region, or overseas. Compared with Fukuoka Prefecture, the export rate in Iwate Prefecture is approximately 8.74points lower. Hiroshima Prefecture has a high rate exceeding 70%. One factor contributing to this is the considerable number of automobile parts that are shipped to Mazda's other automobile manufacturing plant in Yamaguchi Prefecture. Looking at the import rate for passenger cars, Aichi Prefecture and Miyagi Prefecture sit at approximately 65%, which is low compared to the over 97% level of Iwate Prefecture and Fukuoka Prefecture. This is likely because the proportion of Toyota vehicles sold in Aichi Prefecture and Miyagi Prefecture is relatively high. Hiroshima Prefecture has a high value of nearly 90%. Though the prefecture serves Mazda, other companies have high sales. For automotive

parts, Aichi Prefecture has the lowest figure, at approximately 30%, followed by Hiroshima Prefecture at approximately 67%, Iwate Prefecture at approximately 73%, Fukuoka Prefecture at approximately 89%, and Miyagi Prefecture at approximately 91%. These figures are easily understood by looking at the self-sufficiency rate. Aichi Prefecture has an overwhelming self-sufficiency rate of approximately 70% for automobile parts, the highest among the prefectures. This is followed by Hiroshima Prefecture at approximately 33%, Iwate Prefecture at approximately 27%, and Fukuoka and Miyagi Prefecture at a low of approximately 10%.

When considering an automobile industry cluster's ability to sustain and grow in a given region, its self-sufficiency rate for automobile parts is one important indicator. Though both are branch factory economic zones, Iwate Prefecture has a significantly higher self-sufficiency rate than Fukuoka Prefecture. Branch factories in Fukuoka Prefecture are highly reliant on typical automobile parts from headquarters, with Nissan-related companies particularly reliant on vital parts from nearby East Asia. This may explain the differences between the two prefectures. Unlike the clear difference in the quantitative scale shown in the prior Census of Manufacturers, Iwate Prefecture has stronger inter-industrial ties within the prefecture than Fukuoka Prefecture does. This can be considered one of the prefecture's strengths. However, we should note that it is unclear whether the Tohoku region can maintain quantitative growth as it now does through inter-industrial relationships, given that there is a three-fold difference between the Tohoku and Kyushu regions when it comes to the number of vehicles produced. It should also be noted that the trends in Iwate Prefecture Miyagi Prefecture differ considerably. When considering the reproduction of the automobile industry cluster in the Tohoku region, the differences in the two prefectures demonstrate that an overly uniform approach will not work.

Another point of debate is how to evaluate Hiroshima Prefecture, which serves as a development base and headquarters for an automobile company. Certainly, when comparing prefectures in the Tohoku and northern Kyushu region (where Toyota Group's automobile manufacturing plants are located), Hiroshima Prefecture has a high self-sufficiency rate for automobile parts. However, this figure is only seven points above Iwate Prefecture, and it is less than half the level of Toyota's headquarters and development base in Aichi Prefecture. In this regard, despite both prefectures being major industrial players in the automobile industry, Hiroshima Prefecture cannot be classified as a Type X cluster like Aichi Prefecture. Rather, it resembles a Type Z cluster.

5. Conclusion

The purpose of this paper is to illuminate differences and issues between major automobile industry clusters in Japan, excluding those in the Chubu and Kanto region. The purpose of analyzing these three regions is to show the conditions of so-called minor industry clusters in Japan, and see how they differ from Toyota and Nissan's headquarters in the Chubu and Kanto region.

Prior studies have already indicated the limits of growth for branch factory economic zones in the Tohoku and northern Kyushu regions. Further statistical analysis allows one to better understand these limits in a quantitative manner. Although the three regions of Tohoku, Chugoku and northern Kyushu are each home to cities (as designated by government ordinance) such as Sendai, Hiroshima, and Fukuoka, they are still ahead of the curve when it comes to population decline in Japan. In addition to structural limits on market growth, in order to reproduce the regions' automobile industry clusters, it will be necessary to take a unique approach that differs from that of the Chubu and Kanto region. In other words, there needs to be a methodology that clearly distinguishes them from other regions. As a prerequisite to the analysis in this paper, we acknowledge that population decline of productive-age population is occurring quicker than in metropolitan areas, that there are differences in the creation due to the degree of maturation in the cluster and vehicle production breakdown, and various conditions related to prefecture's inter-industry relationships.

Looking at the three regions covered in this paper, it is clear that Type Z (branch factory economic zones) automobile industry clusters in the Tohoku and northern Kyushu region face both qualitative and quantitative challenges. Without appropriate measures, not only will it be substantially difficult for these clusters to reproduce and grow, their very existence over the long term is being threatened. Further, despite serving as a development base and headquarters for an automobile company, Hiroshima Prefecture's automobile industry cluster lacks maturity when compared to Aichi Prefecture, and can hardly be classified as a Type Y cluster. To be a sustainable automobile industry cluster, it is not sufficient to merely have a headquarters and development base. In this sense, despite having varying conditions, the three regions covered in this paper face many of the same challenges. Going forward, it will be necessary to use the conclusions of this paper to consider a methodology to reproduce clusters in a way that is specially tailored to each

region.

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