Ports, regions and manufacturing systems: Automobile manufacturing in Kyushu, Japan

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Abstract

The locations of seaports and manufacturing activities in Japan have changed considerably since World War II. Despite the geographic spread of economic activities over decades and the uneven development of ports, the cores of both systems have long remained in the same metropolitan areas. While co-location does not provide necessary or causal connection, strong a priori grounds can be offered to posit that a necessary relationship exists between the Japanese manufacturing system's geographic expansion and changes in the maritime transport network. A case study of automobile industry's recent development in the peripheral region of Kyushu identifies some drivers of these evolutions at manufacturing level. This demonstrates that, despite the development of high capacity transport infrastructure and manufacturing facilities in the Japanese periphery, the current manufacturing core is not yet threatened.

Keywords: Port, Manufacturing, Automobile industry, Core-periphery model

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1. Introduction

This paper explores the relationships between regional manufacturing systems and seaports; the core/periphery approach is used to conceptualize their interactions.

Despite the potential understanding the driving forces of globalization, few works have analyzed the nexus between regional manufacturing and maritime transport systems [7, 19]. However, transport improvements have played a major role in the historical extension of manufacturing systems. The Roman Empire's completion of a road network system or the development of steam engine's development in the nineteenth century are examples of advances in transportation that have set the pace of capitalist expansion, driving major shifts in both production and trade. The increase in transportation efficiency notably allowed large-scale manufacturing, implying further economic specialization in countries and regions, and favoring economies of agglomeration. Consequently, territories became increasingly interdependent. Among the different transport modes involved in the economic interaction between cities and regions, maritime has historically played a major role, enabling the emergence and development of a network of cities in the Mediterranean as early as the first millenium B.C. The region's success layed in such manufacturing activities as the production of textiles and olive oil, which were heavily dependent on overseas inputs [31]. Today, 80% per cent of international merchandise trade, measured in tons-kilometers, is carried by sea and handled by seaports worldwide [35]. Maritime transport's dominance is not limited to long-distance trade, as it also plays an important role in medium -and short- distance connections. Markets can only expand overseas if they benefit from frequent and reliable maritime transport services.

This paper aims to contribute to a better understanding of the interplay between maritime transport and regional manufacturing. Japan has been selected because its status as an insular country, providing relevant grounds to observe port-manufacturing interactions with less ground transport interference. Moreover, it is a rare country in which where detailed port traffic and employment data are available over several decades. The study focuses on the automobile industry in a peripheral Japanese region as an example to understand how the core and periphery interact. This industry is strongly reliant on frequent maritime transport services between its historical centers and new manufacturing areas. Specifically, we propose the case study of

northern Kyushu because it has two important specificities: first, its location in southwestern Japan allows for the daily deliveries of automotive parts by either ship or truck from central Japan as well as low-cost suppliers in South Korea and China. Second, a relatively dense network of local suppliers has been progressively developed.

This research studies these interactions by building on the frameworks of the core-periphery model and global commodity chains, which are presented and criticized in Section 2. The area of study is defined in Section 3, and long term (1945-1990) locational manufacturing and seaport trends are presented in section 4. We investigate the recent changes in manufacturing and port systems (1990-2010) and their geographical expansion in Section 5 and in section 6 we rely on a case of automobile manufacturing in northern Kyushu to explain the evolving relationships between port and manufacturing systems. Finally, Section 7 presents a discussion of our results and conclusions.

2. Core-periphery and commodity chains: Conceptualizing the regional shifts in manufacturing and seaports

Wallerstein's world-systems analysis provides a compelling framework to analyze the evolving locations of ports and manufacturing activities, as it aims to understand how the dynamic of capital accumulation contributes to shape the world as a core-periphery structure that relies on two basic dichotomies [37]. The first is a class dichotomy, in which ruling groups' control depends on their capacity to make decisions regarding the nature and quantity of the production of goods- via property rights, accumulated capital, control over technology and so on. The second dichotomy, which is particularly relevant to our study, is the spatial hierarchy of economic specialization, or core versus periphery. This involves an appropriation of surplus from the producers of low-profit goods, by the producers of high-profit goods in a purported "unequal exchange". Spatial hierarchies change to respond to the pressures of cyclical economic crises within the system, but without significantly changing class hierarchies [37]. The core and periphery can then be considered as only temporary outcomes of the capitalist system. Core processes imply high wages, high technology and high profit input; periphery processes imply the opposite. A transnational firm's managing of a commodity chain is an example of a core mechanism. These processes tend to spatially concentrate and segregate over time, reflecting the evolution of market power, entry barriers, and forms of chain governance [5]. This dy-

namic produces places in which core processes are dominant and places where periphery processes are dominant, or the "core" and "periphery" places, respectively. Naturally, core places also host peripheral processes; some core processes could eventually occur in a periphery.

Wallerstein's model [38, 39] provides a rather sophisticated approach to the relationships between core and periphery, rather than suggesting a dual world. This offers valuable insight to understand the hierarchical relationships within urban systems [9, 4], and explains the concentration of decision-making activities in a few large urban areas. This configuration leads to income disparities between the core (some large urban areas) and the periphery (the rest)[1]. The commodity chain concept is used to explain how value is transferred from the periphery to the core, maintaining or deepening the differences between both. Hopkins & Wallerstein [20] define it as a "*network of labor and production processes whose end result is a finished commodity*". Further developed by Gereffi & Korzeniewicz [16], the (global) commodity chain is considered a system of value creation employed by firms and other agents, in which market power asymmetries lead to unequal value distributions. Participants along the chain are unequally able to appropriate rents and barriers to entry exist. Lead firms act as chain drivers, commanding the coordination of the whole commodity chain, by controlling the other firms in the chain [15]. The lead firms' superior profitability is a result of their capacity to generate different types of rents, using scarce assets (i.e. infrastructure, machinery, brands, marketing, etc.). These assets lead to the creation of barriers to entry and result in different types of high rents [15], which allow the firms ensuring core processes to be relatively insulated from capitalist competition. Conversely, firms realizing peripheral processes would not have the power to contest the organizational leadership, and are more exposed to competitive pressures [16]. Despite its utility in describing the relationships between firms, the global commodity chain approach has been criticized for simply assuming the power differential between firms implied in a chain, without providing a more general explanation of how these differences have been created [34, 33]. According to these critics, chains should be further conceived as moments in a global circuit of capital [34]. The connection between commodity chains and the general dynamics of capitalism would be partially reached using the Marxian law of value [33]. Indeed,

> the formation of commodity chains is therefore the concrete form taken by the competition among normal or average capitals

> over extra surplus value that escapes the hands of small capitals. (Starosta, 2010:451)

The trend of outsourcing manufacturing activities can then be regarded as a method for large firms to multiply the sources of extra surplus value released by small capitals. The lead firm is in the best position to coordinate the entire chain and exert control on the other firms to capture the *"extraordinary profits flowing out of small capitals"*[33].

The automobile industry is one of the most extensively researched commodity chain [14, 3, 27, 22], and illustrates how profits freed by small capitals are captured by normal capitals. Three main players exist within this particular chain: car manufacturers, first-tier suppliers, and lower-tier suppliers. Automobile chain is controlled by automobile manufacturers, which typically play a central role. They are large firms with highly automated labor processes. The chain is highly hierarchical with multilayered production systems involving thousands of firms.

The automobile value chain's situation has changed in the 1990s; the hierarchical restructuring into tiers became even more pronounced [14], following a decrease in the number of suppliers at all levels, with each manufacturer relying on a small group of first-tier suppliers. These large suppliers not only operate large plants, but they have also assumed over many of the functions previously centralized by car manufacturers, and are often responsible for the design, manufacturing, and delivery of complete modules to automobile assembly plants. The latter have become responsible for selecting lower-tier suppliers and coordinating the automobile supply chain's core segments at a global level. According to Gereffi, top first-tier suppliers are "challenging the assemblers to control over the key high value activities in automobile production" [14] (p.5). As many of the leading auto suppliers manufacture parts in the periphery, this could provide a chance for its firms to move up in the industry. However, not all the major first-tier suppliers succeed in capturing higher value in the chain, and some are experiencing difficulties [11]. Further, some lower-tier suppliers can eventually capture higher value from the chain. One example involves steel producers, where the invention of new processes generates opportunities for product innovation and the creation of higher value steels through forming and shaping new and existing materials[21]. Finally the core/periphery structures can vary considerably between regions, despite the general principles of commodity chains' organization. Maritime transport plays an important role in accessibility in remote

or insular areas, and its improvement can eventually accelarete the rearrangement of core/periphery structures.

3. Area of study and data collection

Japan presents a noteworthy geographical context to study the links between seaports and manufacturing. The country's manufacturing system is highly reliant on seaports due to both its insularity and a lack of natural resources. Moreover, the latter handles the bulk of Japanese international trade (99% in tons, and 75% in value in 2010). Many studies have been devoted to the regional shifts of manufacturing [12, 2, 32] and to the evolution of its seaports [24, 30] in such a context, but few of the former analyze both dimensions simultaneously.

We identify where core and peripheral processes are dominant by using the typology of Japanese prefectures established by Fujita & Tabuchi [12] (Table 1). Decision-making functions, such as those associated to headquarters (HQs), and such knowledge intensive activities as research and development (R&D), have been considered as core processes. These often imply high wages, technology and profit inputs and are located at the top of the urban hierarchy. Manufacturing functions (MNF) and regional branches have been associated with peripheral processes, which are located in the rest of the country and overseas (Table 2).

Level	**Name of the Urban Area**	**Functions***
1	Tokyo MA	HQs, R&D, MNF
1.5	Osaka MA	HQs, R&D, MNF
2	Nago., Fuku., Sapp., Hiro., Send.	MNF, HQs, R&D, Branches
3	Other provincial centers	MNF, Branches
Others	Rest of Japan	MNF

Table 1: Organization of Japanese manufacturing firms by urban hierarchy level. Source: Authors (2016), based on the categories of Fujita & Tabuchi [12] *Mentioned in order of importance.

We analyze the changes in ports and manufacturing systems by considering the three largest metropolitan areas (MAs) located along the Japanese manufacturing belt (as defined by the Japanese Ministry of Economy, Trade

and Industry, Figure 1). Additionally, this research focuses on northern Kyushu, as it is an emerging manufacturing region. The Tokyo MA is constructed by the Saitama, Chiba, Tokyo, and Kanagawa prefectures; the Nagoya MA is constructed by the Gifu, Aichi and Mie prefectures; the Osaka MA is constructed by the Kyoto, Osaka, Hyogo and Nara prefectures; and finally, the Kyushu MA is constructed by the Fukuoka, Saga, Nagasaki, Kumamoto and Oita prefectures.

A combination of data analysis, literature review, and case study research was used in this work. The study of the joint evolution of manufacturing and ports at the prefecture level has been permitted bu a comparison of employment data (as per the Census conducted by the Statistics bureau of Japan every five years) and port throughput (Port Statistics Yearbook, published annually by the Ministry of Land, Infrastructure, Transport, and Tourism). systems at the level of prefectures has been allowed by the comparison of data on employment (Census, carried out by the Statistics bureau of Japan every five years) and port throughput (Port Statistics Yearbook, published every year by the Ministry of Land, Infrastructure, Transport and Tourism). As our focus is on manufacturing activities, we only considered flows of manufacturing products and employment in manufacturing firms. Unfortunately, the level of data aggregation did not allow us to distinguish the employment and cargo flows related to core and peripheral processes. This obstacle has been partially overcome by a case study based on automobile manufacturing. Given the specificity topic's specificity and the lack of data, a series of 20 semi-structured, in-depth interviews were conducted with automobile manufacturers and logistics providers in primary manufacturing regions (the Nagoya, Tokyo, and Kyushu MAs) between May and September 2015. The interviewees essentially held senior positions at logistics or production management departments.

Urban Level	HQ	R&D	Branch	Factory
1 Tokyo MA	***	***	*	*
1.5 Osaka MA	**	*	*	*
2 (ex. Fukuoka)	*	*	**	**
3 (ex. Okayama)	*		***	**
Others			**	***
Overseas 1	**	*	**	*
Overseas Others				***

Table 2: Detailed organization of Japanese manufacturing firms by urban hierarchy level. Source: Authors (2016), based on the categories of Fujita & Tabuchi [12]

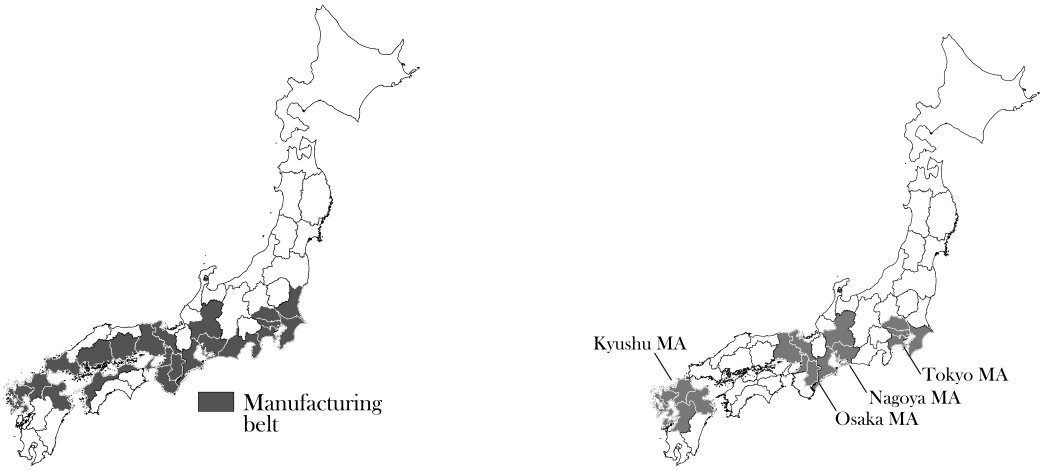

Figure 1: Composition of the Japanese manufacturing belt (left) and of the main metropolitan areas (MAs) used in this study (right). Source: Authors (2016), based on the categories of Fujita & Tabuchi [12]

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4. Regional growth in Post-War Japan (1945-1990)

The manufacturing and seaport systems' current core/periphery structures cannot be understood without referencing the historical process that produced them. The Japanese manufacturing core prior to World War II (WWII) was essentially structured around the Tokyo and Osaka Metropolitan Areas (MAs), and the textile industry was its most prominent (Figure 2). Osaka was slightly more important than Tokyo at the time as a manufacturing center: its success was built on textile and the related trade. Local merchants and traders ensured the link between domestic manufacturers and foreign suppliers and buyers. Further, the domestic industry's inputs and outputs were handled bu ports in the Osaka and Tokyo MAs. The need for proximity between trade, manufacturing, and transport functions led to the use of ports directly located at the core (Figure 3).

The Korean War (1950-1953) in the aftermath of WWII, acted as a catalyst for Japanese economic revitalization, and aroused manufacturing activities specializing in military and consumable goods. Shortly thereafter (1960), an ambitious infrastructure investment policy was implemented: the "double-income plan". This aimed to support the manufacturing growth by ensuring production by ensuring high-capacity transport connections between Osaka, Tokyo, and the primary peripheral MAs. The manufacturing system's core was still shared by Osaka and Tokyo MAs during this rapid economic growth period, but large manufacturing centers emerged at the periphery: Nagoya, Hiroshima, Okayama, and Fukuoka. Heavy industry, such as shipbuilding, became increasingly important. The seaport hierarchy remained unchanged despite peripheral port expansion with Osaka and Tokyo MAs at the forefront.

The rapid growth period abruptly ended with the first oil shock in 1973. The foreign currency exchange system's transition around the same time, from fixed to floating rates, induced the appreciation of the Japanese yen against the United States' dollar. The combination of high oil prices, the yen's higher value and an intensified competition with newly industrialized economies in East Asia provoked the Japanese economy's second major structural change. This involved a change from heavy industry to knowledge-intensive activities, such as automobile and electronic manufacturing. Japanese manufacturing firms then created overseas production facilities to remain competitive in international markets. This shift involved the emergence of a new regional system, the center of which is exclusively the Tokyo MA, which

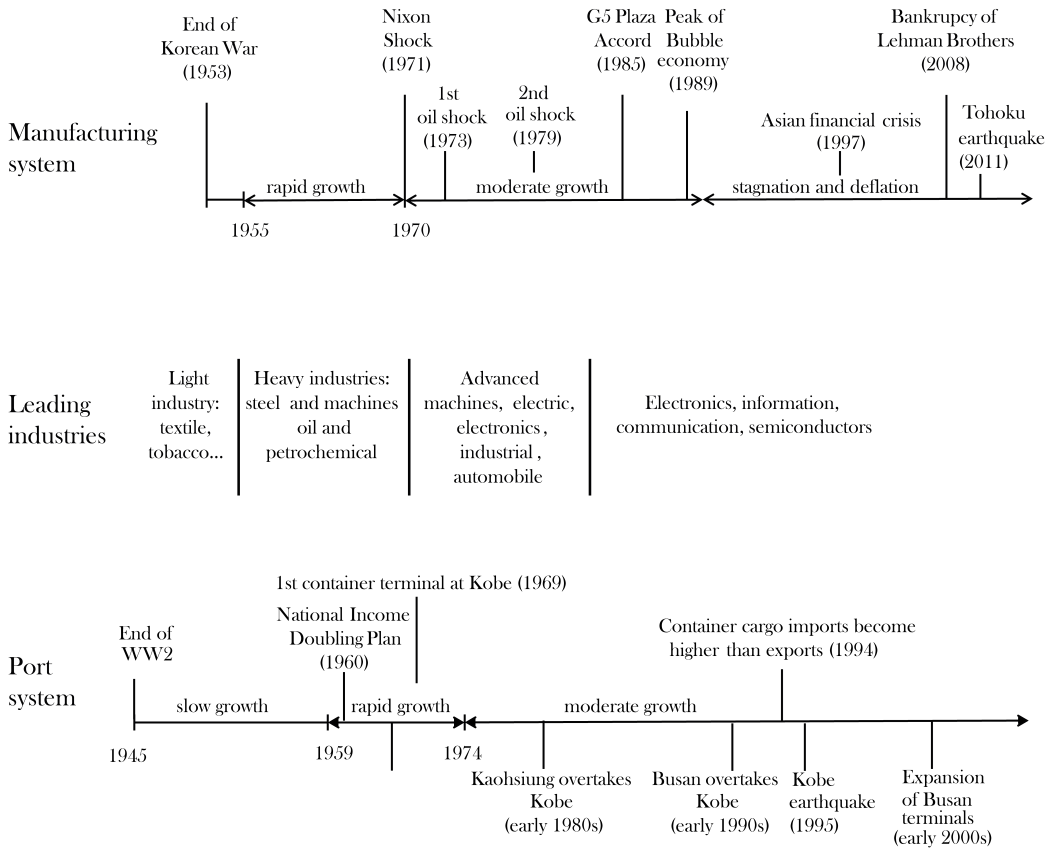


Figure 2: Leading industries and main events in manufacturing and port systems. Source: Authors (2016), based on Fujita & Tabuchi [12].

concentrated most emerging multinational firms' headquarters. The port system became increasingly dominated by the Osaka MA (Kobe), a pioneer of containerization in Asia [18], that still concentrates most of its functions on trade and shipping companies. The manufacturing system's international expansion decreased the need for proximity between manufacturing, trade and seaport functions. The most labor-intensive processes, such as large-scale manufacturing, are increasingly transferred to the periphery with the manufacturing system's core specializing in advanced services.

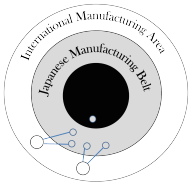
	Phase I	Phase II	Phase III	Phase IV
Period	Before 1950	Mid 1950s -Early 1970s	Mid 1970s - Early 1990s	Since Mid 1990s
Leading industry	Light industry	Light to heavy industry	Heavy industry to electric, high-tech and services	Services High value added manufacturing
Manufacturing system	Manufacturing is largely located at landlocked regions.	Geographical shift of manufacturing to coastal regions	Massive investment from Japan to East and South-East Asia	Bubble burst.
Maritime trade	Low level of internationalization of the economy.	Increasing dependence on overseas supply of raw materials	Containerization and development of hub and spokes networks.	
Port system	The ports at Osaka MA and Tokyo MA are the main gateways.	The ports at Osaka MA and Tokyo MA are the main gateways.	Osaka MA (Kobe port) become the main gateway.	Port hierarchy is dominated by foreign ports. The ports of Tokyo MA are the japanese gateways.
Core/periphery scheme				
Core National periphery International periphery Dominant seaport Regional seaport				

Figure 3: Scheme representing the changes in manufacturing and seaport systems since WWII. Source: Authors (2016).

5. The post-bubble context (1990-2010)

The Japanese economy was substantially transformed in the 1980s and 1990s. A new wave of internationalization of manufacturing occurred, primarily in Southeast Asia, South Korea, and China. Large container hubs emerged in neighboring countries (South Korea, Taiwan, and Hong-Kong), diverting many deep-sea container services from Japanese ports, which were increasingly feederized, and became peripheral in a regional hierarchy dominated by foreign ports [6, 8, 10]. Although not the main cause of the port's decline, the 1995 Kobe earthquake acted as a catalyst for a collapse [24]. The port function became increasingly disconnected from the manufacturing system's core.

The impacts of these transformations have been particularly dramatic within the manufacturing sector, as between 1990 and 2010 employment decreased from 14.5 to 9.5 million. Aside from the economic factors at work (i.e., increased productivity, manufacturing firms' outsourcing of services, internationalization, etc.) which are not on the within this paper's scope, it is important to underline the uneven geographical impact of these transformations. Manufacturing employment decreased everywhere, but the periphery (the Nagoya MA and the rest of the periphery) resisted better than the manufacturing core (the Tokyo and Osaka MAs) (Figure 4[2]).

The observation of port traffic during the same period provides an alternative perspective on the geographical shifts in manufacturing. The volumes of manufactured goods handled by seaports increased both for imports (+51%, from 51.4 Mt to 104.8 Mt) and exports (+23%, from 134.3 Mt to 174.3Mt), between 1990 and 2010. However the geographical dynamics of imports and exports significantly differ. Regarding imports, the seaports of Tokyo, and to a lesser extent Kyushu MAs, increase their shares on import flows to the detriment of the Osaka and Nagoya MAs, and especially after 2005. Fostered by its large local consumer market's demand, the Tokyo MA strengthened its gateway position for imports. The opposite occurred in the Osaka MA, where the local demand for imports weakened (Figure 5).

The geographical distribution of export flows approximates that of manufacturing employment, as a substantial share of the manufacturing outputs

[2]Detailed data on seaports and employment was not available at an international level. Graphic schemes have been elaborated as complements to clarify the geographical shifts of port and manufacturing systems in the international periphery.

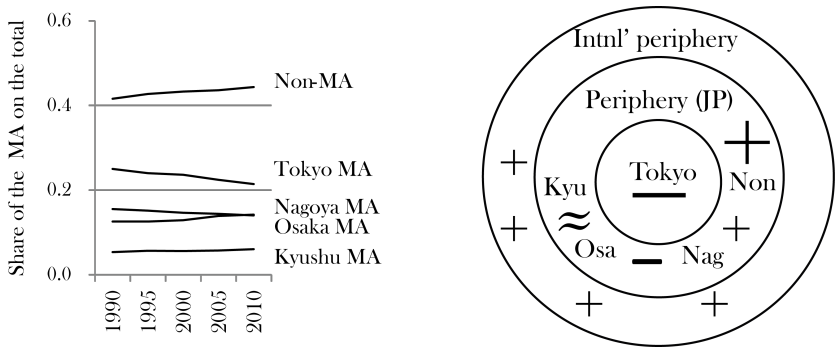


Figure 4: Graph (left) representing the evolution of Japanese MAs' contribution to total manufacturing employment (shares for the national total, noted in number of employees). The scheme (right) represents the evolution of manufacturing employments in Japanese firms at the international level. Source: Authors (2016); Data: JP Census.

is shipped overseas. The Tokyo and Osaka MAs lost ground during the 1990-2005 in favor of the rest of the country, and particularly of Nagoya and Kyushu MAs (Figure 6). The ties between decision-making and manufacturing activities loosened as production moved from the core to peripheral areas, including overseas.

Overall, most labor-intensive activities moved to the periphery, either overseas or within Japan. The Tokyo MA remains a national gateway, as is the largest Japanese consumer market, but only plays a minor role in eastern-Asia. Most regional hubs[3] are located overseas, mainly in South Korea (Busan) and Taiwan (Kaohsiung). Outbound international trade has been directly shipped from manufacturing regions (e.g., the Nagoya and Kyushu MAs) (Figure 7).

[3]In the context of the rapid increase in container ships' sizes, the major Japanese ports are increasingly served via foreign hubs, and particularly in the connections with Europe and the Middle-East. Comparatively, Japanese ports are well-positioned for trade with North America, as transshipment in South Korea or Taiwan implies considerably longer transit times.

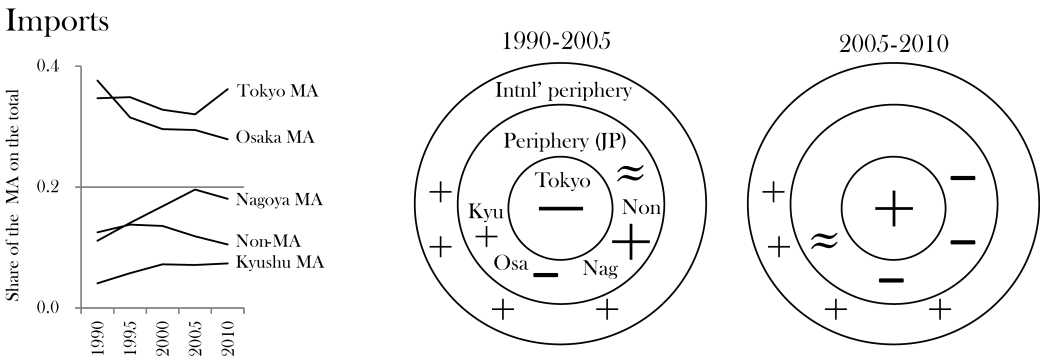


Figure 5: Graph (left) representing the evolution of Japanese MAs' contribution to total manufacturing cargo imports (in tons). The schemes (right) represent the evolution of manufacturing cargo imports on an international level. Source: Authors (2016); Data: MLIT.

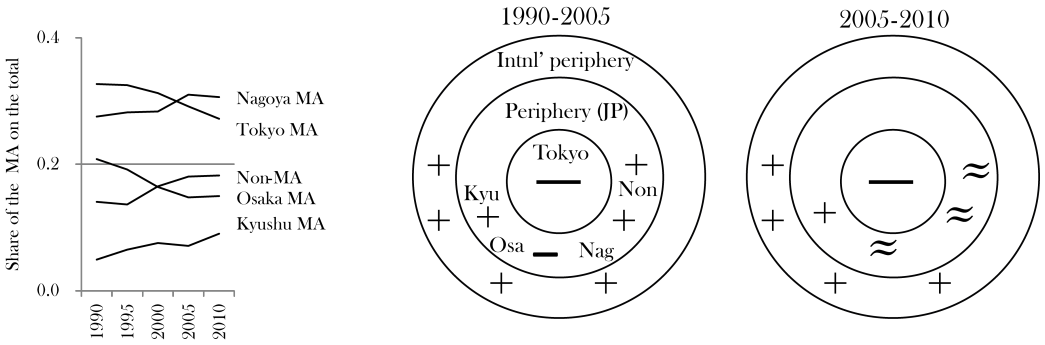


Figure 6: Graph (left) representing the evolution of Japanese MAs' contribution to total manufacturing cargo exports (in tons). The scheme (right) represent the evolution of Japanese firms' manufacturing cargo exports on an international level. Source: Authors (2016); Data: MLIT.

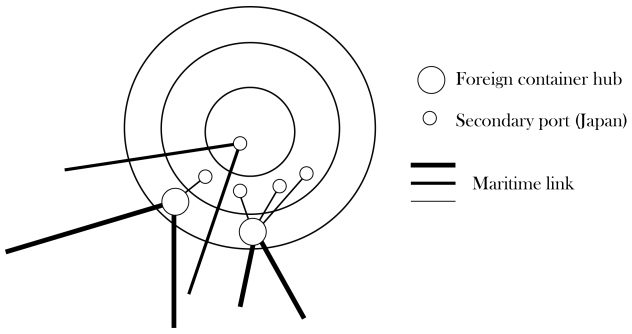


Figure 7: Scheme representing the current organization of the Japanese seaport and manufacturing system. Source: Authors (2016).

6. An exploration of the links between seaport and manufacturing systems: The case of the automobile industry in Kyushu

The recent development of automobile manufacturing in Japan's peripheral regions suitably illustrates the interdependence between the seaport and manufacturing systems. The automobile industry is doubly noteworthy for our study. On the one hand, it is by far Japan's most important industry, accounting for 3.6% of total employment[4][25], and generating substantial transport volumes. On the other hand, its organization, implies frequent deliveries between suppliers and assemblers, and makes it particularly sensitive to the quality of both transport services and infrastructure. This is particularly true for maritime transport within Japan, which is used for daily part deliveries from suppliers located in the historical cores of automobile industry in the Nagoya and Tokyo MAs, to assembly plants located in the peripheral regions.

As aforementioned (Figure 2), the Japanese manufacturing system's international expansion began in the early 1970s, after the Nixon shock. Automobile manufacturers followed the same trend, creating overseas assembly plants to supply their foreign markets. Twenty years later, in the early 1990s, Japanese car manufacturers' overseas production is higher than the domestic production. Currently, three out of five Japanese cars sold worldwide are produced outside Japan (Table 3). However, despite its high internationalization, domestic production remains crucial, with almost 10 million cars, nearly half of which is exported (4.85 million).

Long before the Japanese automobile firms' internationalization, most of them built *keiretsu* systems, in which very tight supplier relationships are developed. This form of vertical integration particularly common in Japan, involves capital partnership, the inclusion of representatives on the board, technical guidance, and financing, from a parent company to its subsidiary companies. Some suppliers in this context, usually located close to assembly plants, provide parts requested by car manufacturers on a just-in-time (JIT) basis. However, this is far from the case for every component, and different sourcing strategies are adopted depending on such factors as the minimum efficiency scale required for production, part diversity, and bulkiness among others [26]. Moreover, car manufacturers in the recent decades have largely

[4]Including automobile production, materials and equipment supply, and sales and services.

Region (Million units)	**Cars locally assembled**	**Cars imported from Japan**	**Total cars made by Japanese firms**
US & Canada	3.40 (15%)	1.73 (8%)	5.13 (22%)
Latin America	0.98 (4%)	0.40(2%)	1.38 (6%)
Asia	7.11 (31%)	0.58 (3%)	7.69 (33%)
Oceania	0.12 (1%)	0.43 (2%)	0.55 (2%)
Europe	1.57 (7%)	0.94 (4%)	2.51 (11%)
Middle East	-	0.58 (3%)	0.58 (3%)
Africa	0.21 (1%)	0.19(1%)	0.40 (2%)
Japan	4.79 (21%)	-	4.79 (21%)
Total	**18.18 (79%)**	**4.85 (21%)**	**23.03 (100%)**

Table 3: Finished car production (in million units) by Japanese firms, by region. Source: Authors (2016); Data: Nissan (2012)

adopted global purchasing strategies to save costs, often implementing long distance sourcing and substantial stocks [17].

Northern Kyushu provides a noteworthy illustration on how car manufacturers use ports to build more resilient supply chains. Japanese car manufacturers considerably expanded their production capacities outside their traditional core in the early 1990s. The reasons for this shift are threefold. The first reason is cost-related, labor costs in norther Kyushu are about 20% lower than in the traditional automobile industry cores in the Nagoya and Tokyo MAs. Moreover, land acquisition costs for industrial activities have increased considerably in the traditional cores. Second, northern Kyushu has higher accessibility to rapidly growing Asian consumer markets for new vehicles. Finally, frequent parts deliveries can be organized from low cost suppliers in South Korea and China to the northern Kyushu's assembly plants. For example, Nissan, uses high-speed ferry services between Busan (South Korea), Shimonoseki and Hakata (Japan) [13]. Semi-trailers with both South Korean and Japanese license plates are used to convey the parts daily between suppliers and assembling plants at the northern Kyushu (Figure 8).

Sea, rail, and air transport are used to source parts from other regions of Japan, in addition to overseas services. Kitakyushu's container terminal expansion in 2005 and airport creation in 2006 were strongly motivated by the needs of automobile manufacturers. The air terminal, which is the

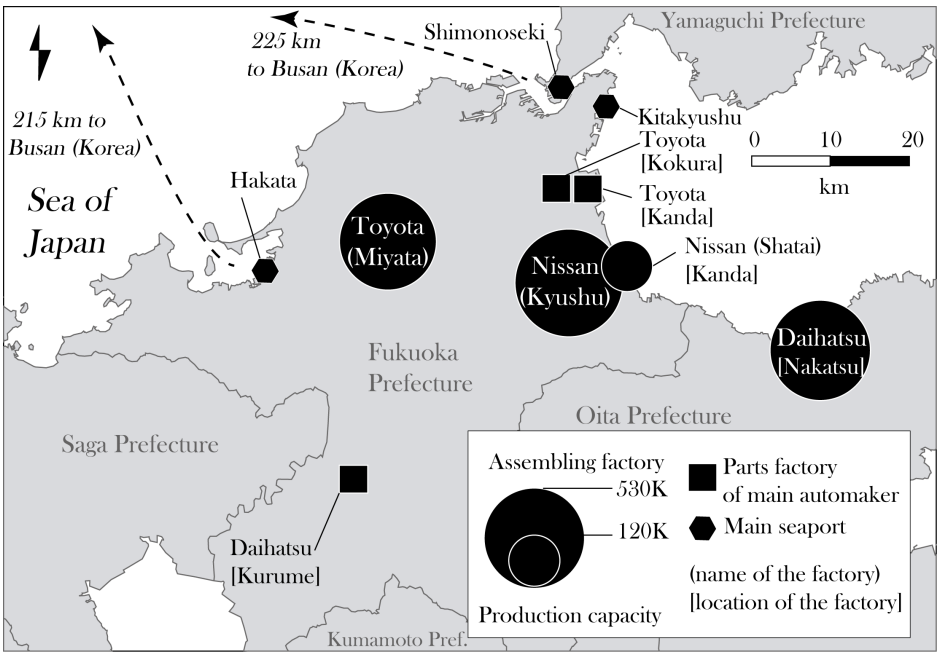


Figure 8: Automobile industry in northern Kyushu. Source: Authors (2016)

first to be open 24 hours a day in northern Kyushu, is connected through a large-capacity highway to the manufacturing plants in Kokura (Toyota) and Kanda (Toyota and Nissan). Automobile manufacturers require both lean and robust supply chain networks to quickly respond to shifts in new vehicle demand, and to reduce their exposure to exchange rate fluctuations. This need for robust and resilient supply chain networks increases in northern Kyushu, as most production is destined to foreign markets, which often implies less stable demand than in domestic markets.

Although the automobile industry has existed in northern Kyushu since the 1970s, production substantially increased in quantity and importance after the 1990s, with the creation many manufacturing and parts supply plants (Table 4). However, local content ratios for the relatively recent northern Kyushu plants are lower (51% in 2006) than those from the traditional regions in the Nagoya and Tokyo MAs (about 84% in 2006) [40]. This is because a majority of part suppliers have remained located in the automobile industry's traditional cores. Moreover, Kyushu's local content ratio could be overestimated, as approximately 50% of the parts delivered by local suppliers are manufactured in other regions of Japan[23, 28].

Group	**Nissan**		**Toyota**			**Daihatsu**	
Plant	Kyushu	Shatai	Miyata	Kanda	Kokura	Nakatsu	Kurume
Start of Production	1976	2009	1992	2005	2008	2004	2008
Employment	3,760	1,000	6,800	900		3,300	300
Production Capacity	0.53M	0.12M	0.43M	0.22M*	-	0.46M	0.22M*
Export Ratio	74%		82.6%	-	-	4.9%	-
Local Cont. Ratio**	70%	-	60%	-	-	65%	-

Table 4: Characteristics of Japanese car manufacturers' plants in northern Kyushu. Source: Fukuoka Prefecture, Ishiro & Mokudai (2013). *Number of parts. **Share of the vehicle's value produced in northern Kyushu.

Northern Kyushu's production growth has outstripped the national production of new vehicles since the 1990s; the region accounted for 14.9% of domestic production in 2012 (Figure 9), and is the third largest automobile manufacturing region after the Nagoya and Tokyo MAs. The northern Kyushu's growth is particularly striking when considering the national automobile industry's sluggish development over the last two decades. These differences can be captured by comparing the employment trends in the transport and machinery sector, which is a slightly larger category than the singular automobile industry. Employment in northern Kyushu increased between 1990 and 2010 by 37% (from 39,000 to 63,000), but decreased at national level by 9% (from 1.11 to 1.02 million).

The automobile industry in northern Kyushu strongly relies on maritime transport, both for inbound and outbound logistics. Inbound transport machinery volumes in 2010 represented 18% (10.2 Mt) of domestic inbound volumes and 9% (1.0 Mt) internationally. Substantial domestic inbound flows involve parts from suppliers located in the Nagoya and Tokyo MAs. The transport machinery sector accounts for 19% (12.5 Mt) of domestic outbound volumes, and 6% (5.4 Mt) internationally. The main domestic destination of the northern Kyushu's shipments is the Nagoya MA, as finished cars and auto parts sent there are eventually redistributed overseas.

The ports in northern Kyushu handle most of the inbound flows of parts

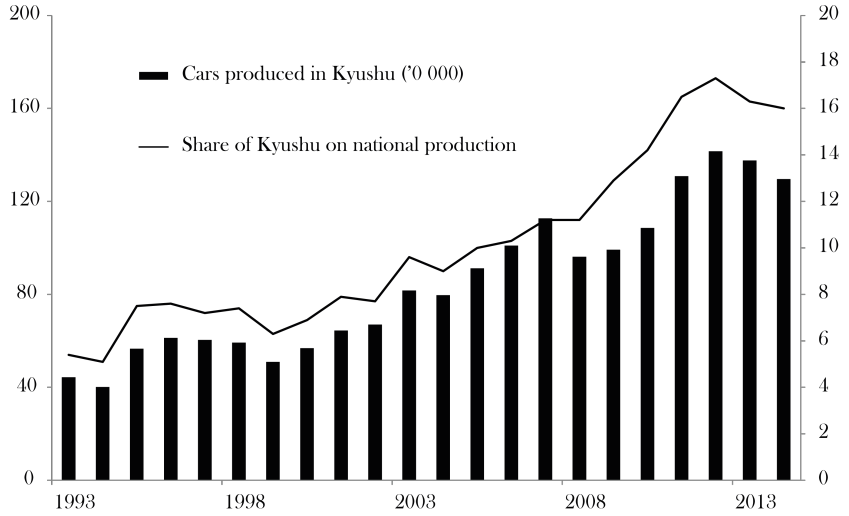


Figure 9: Trends in the production of finished cars in northern Kyushu. Source: Fukuoka Prefecture

conveyed in container or ro-ro[5] ships from Japan or abroad. The vehicles assembled in northern Kyushu plants are shipped from the same ports to the rest of Japan and overseas, but manufacturers' maritime routes partially differ (Table 5 and Figure 10). For example, most of Nissan's cars are directly shipped overseas from the port of Kanda (northern Kyushu), but those produced by Toyota are usually consolidated at the port of Mikawa (Nagoya MA) to optimize the last-generation car carrier ships'[6] capacity.Further, only 20% of Toyota's cars exported from Kyushu are shipped directly to North America, or 60% in Nissan's case. Improvements in transport infrastructure and car manufacturers' efforts have drastically reduced logistics costs in the recent years. A survey carried out by the Japanese Institute of Logistics Systems indicates that between 2005 and 2012, logistics costs have considerably diminished for finished transport machinery products, such as automobiles.

This research raises the question that, in an advanced economic context in which transport infrastructure is well-developed, can manufacturing firms

[5]Roll-on/roll-off (ro-ro) ships are vessels designed to carry wheeled cargo, such as automobiles or trucks, driven on and off the ship on their own wheels.

[6]Most of these mega-ships were ordered in the mid 2000s when global car sales were booming and shipping companies raced to keep up with the demand from car manufacturers.

from the peripheral areas improve their positions in the automobile value chain? Local suppliers in northern Kyushu, supported by universities and the local government, seem to be struggling to upgrade their positions. For instance, only a few local firms have succeeded in becoming first-tier suppliers for several models built in northern Kyushu. According to different works in this field, suppliers located close to headquarters and R&D centers, where the new models are designed, would have a significant advantage over suppliers located elsewhere [40, 22]. The latter are hindered in their quest to improve their positions, as the first stages of development of new models requires frequent exchanges between car manufacturers and first-tier suppliers. Despite first-class transport connections to the Japanese automobile industry's core in the Nagoya and Tokyo MAs, suppliers of northern Kyushu would travel too far to compete with them. Another major challenge for part suppliers in northern Kyushu will be to address the increasing competition with low cost suppliers in South Korea and China. Nissan's CEO, Carlos Ghosn, has recently expressed his willingness to reduce Kyushu plants' sourcing cost by increasing the share of imported parts from low-cost suppliers in South Korea and China [36]. Paradoxically, improving the northern Kyushu's maritime transport connections, heavily funded by the public sector, could imply the decline of local suppliers.

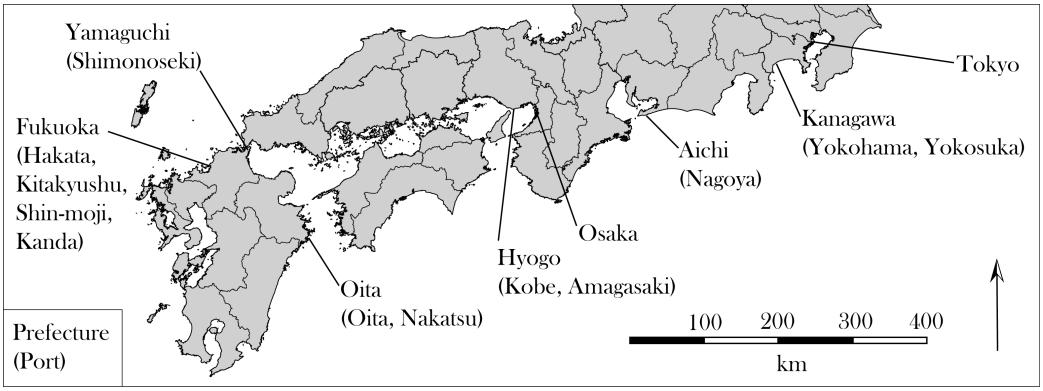


Figure 10: Ports mentioned in Table 5

Cargo	Direction & Scope	Toyota	Nissan	Daihatsu
Parts	*Domestic outbound*	–	–	–
	Domestic inbound	Nagoya → Shin-moji → Miyata factory	Tochigi, Yokohama factories→ Yokosuka → Kanda → Kanda factory	Osaka → Oita, Nagoya → Shin-moji
	Intl. outbound	–	Kanda factory → Kitakyushu, Hakata → 10 countries	–
	Intl. inbound	–	CN, KR → Kitakyushu → Kanda factory	–
Finished vehicles	*Domestic outbound*	Miyata factory→ Shin-moji → Nagoya	Kanda factory → Kanda → Yokosuka	(1) Oita factory → Nakatsu → Amagasaki, (2) to northern Kyushu by road (3) to South Kyushu and Shikoku regions by ship
	Domestic inbound	Nagoya → Shin-Moji → northern Kyushu	Yokosuka → Kanda → northern Kyushu	Amagasaki → Nakatsu → northern Kyushu
	Intl. outbound	(1) Miyata factory→ Shin-moji → Nagoya → EU USA, (2) Miyata factory→ Hakata → CN, (3) Miyata factory→ Shimonoseki Hakata → KR	Kanda factory → Kanda → USA	Oita factory → Nakatsu → Kobe → EU
	Intl. inbound	–	–	–

Table 5: Maritime transport services used by car manufacturers in Kyushu. Source: Ozawa (2011); Interviews. CN: China, KR: South Korea, EU: European Union

7. Conclusion

This paper presented an overview of the evolution of Japanese manufacturing and seaport systems since World War II, with a special focus on the post-bubble era (1990-2010). First, we illustrated that until the mid-1990s primary seaports have always been located in core regions. Japanese seaports have since been downgraded, primarily because of container hub development in neighboring countries, such as Busan in South Korea, Kaohsiung in Taiwan and Hong-Kong, and a substantial shift in Japanese manufacturing to emerging economies in east and southeast Asia. We then demonstrated that while decision-making functions have been increasingly concentrated in the core (Tokyo MA during the post-bubble era [1990-2010]), manufacturing functions have trickled down the urban hierarchy in Japan and overseas.

We have concluded that unlike the previous periods, when decision-making in manufacturing and seaport functions were concentrated at the core, a growing disconnect exists between both: decision-making remains at the core, but primary seaports have been located in neighboring countries since the mid-1990s. However, even if the seaports at the core (e.g., the Tokyo MA) are not the container network's primary nodes, they still dominate the national hierarchy and non-containerized shipping networks, and particularly in the case of imports. We have also concluded that the development of containerized hub-and-spokes networks has contributed to the marginalization of Japanese ports. However it is unclear if this is a real obstacle to the manufacturing system's development. Recent works indicate that most cargo carried by sea container is not particularly time-sensitive [29]. Therefore, a few days' lengthening of the maritime transport induced by the transshipment of cargo in foreign countries does not seem to be critical for most Japanese-based firms. This is particularly the case when we know that when order and door-to-door lead times are considered.

The transport machinery industry follows a slightly different pattern than other manufacturing industries: the centrifugal movement of assembling plants is less powerful than in other such sectors as electronics, and many manufacturing plants remain at the traditional manufacturing regions. The core still plays an important role in this case, not only in decision-making functions but also in the mass production of parts and vehicles. However, efficient maritime transport has allowed for the relocation of non-negligible automobile production to peripheral areas, in which production costs are generally lower and car manufacturers can benefit from an existing supplier

network, primarily inherited from electronic industry.

Improvements in ports and maritime transportation surely do not comprehensively capture changes in the manufacturing system, but are strongly suggestive of the type of explanation needed. Our study also indicated it is necessary to conduct a detailed activity-based analysis (in contrast to the traditional industrial sector-based analysis) combined with urban and transport systems approaches in the seaport/manufacturing systems, which are being experienced in both developed and developing countries worldwide. Although this paper has focused only on Japan, we hope to conduct a more comprehensive study of regional transformations in comparison with several closely related countries (including both developed and developing countries) using a similar approach in the future.

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