Recent Trends and Issues in Geographical Studies on Modern Transportation in Japan

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Abstract: The purpose of this paper is to review the achievements and issues in transportation geography in Japan since 1990, focusing on modern transportation. Although the number of studies in transportation geography has decreased, the studies that have been conducted can be classified into four types, namely, studies on (1) transportation enterprises, (2) the effects of transportation developments on given areas, (3) nodal structures, and (4) airports and harbors and their hinterland. Most of the studies focus on the former two themes, while some papers have been presented on the latter two themes in the 2000s. Finally, the author points out the issues that need to be addressed—in the study of transportation geography—against the backdrop of the trend of deregulation and globalization. It is necessary to examine the significance of deregulation in a region by considering the transportation in and orientation of the city as well as its public transportation. Meanwhile, the transportation geographers in Japan should conduct studies on air liberalization and the hub airport competition in Asia.

Key words: transportation geography, modern transportation, public transportation, socioeconomic method, quantitative method, political approach

Introduction

Ever since the quantitative revolution came about in the academic field of geography in Japan, the number of studies in transportation geography has increased. Transportation geography based on the quantitative method developed in Japan mainly in the 1970s and 1980s, and Okuno (1991) called this period the “newly developed period,” while Aoki (1987) termed it “period of the rise of the quantitative method.” In the late 1980s and early 1990s, many review papers on transportation geography were presented. Aoki (1987), Okuno (1991), and Aoki and Murayama (1991) have reviewed the achievements and issues in the field of transportation geography as a whole in the past decades1. Thus, while the issues in transportation geography were summarized once in around 1990, in recent years, the trends in transportation geography have been changing. Due to the economic recession, the socioeconomic situation surrounding transportation has also changed. These socioeconomic changes have aggravated the existing transportation problems.

Therefore, the purpose of this paper is to review the achievements and issues in transportation geography in Japan since 1990, focusing on modern transportation. This purpose will be achieved through the following steps. First, in the next section, the viewpoints and issues in the above mentioned review papers will be summarized. Second, studies in transportation geography since 1990 will be categorized by theme, after which the trends and achievements of each theme will be reviewed. Finally, the author will clarify the issues that should be addressed in transportation geography in Japan.

Survey Overview

According to Aoki (1997), studies in transportation geography can be classified into two types: (1) those that interpret a transportation phenomenon based on the relationship with the regional environment and (2) those that interpret other phenomena on the basis of trans-
portation, for example, those that consider modes of transportation as a factor or given condition. In the former type of studies, transportation phenomena are considered to be impacted by regional socioeconomic components. In the latter type of studies, modes of transportation are considered to have an impact on regional socioeconomic activity. However, modes of transportation and regional socioeconomic activities mutually affect each other and are therefore not exclusive. It has often been mentioned that the boundary between transportation geography and other academic fields was not clear. Concerning a case of type (2), some studies take transportation as the main factor to interpret phenomena, and others take it as one factor among many other factors. It is difficult and also makes little sense to draw a clear distinction between transportation geography and others. The main studies are quoted from those which primarily focused on transportation phenomenon and are reviewed in this paper.

There are two types of methods used to conduct studies in transportation geography: (1) the socioeconomic method and (2) the quantitative method (Aoki and Murayama 1991). The former method involves explaining transportation phenomena descriptively. It started developing in the 1960s as a geographical approach to solve transportation problems and address the functional change caused by the rapid economic growth since the mid-1950s. It necessitates the consideration of the traffic system, politics, and techniques because the viewpoint of study differs according to the mode of transportation.

Aoki and Murayama (1991) classified the socioeconomic study of transportation geography into the following six types: (1) studies focusing on the restoration of former transportation routes and circulation; (2) studies focusing on marine traffic, ports, and harbors; (4) studies focusing on commodity transportation and interregional flow; (5) studies focusing on the modes of transportation and firms; (6) studies focusing on urban transportation; and (7) studies that analyze the impact of traffic on a given area.

On the other hand, since quantitative methods were popular among the Japanese transportation geographers in the 1960s, the number of studies based on quantitative methods increased. Beginning with network analysis in the late 1960s, in the 1970s and 1980s, the scope of quantitative transportation geography expanded to many areas. In the late 1980s, owing to the systematic experimental studies that were conducted, the field of quantitative transportation geography reached a stage where its achievements were on par with those of adjacent academic fields.

To examine the methodological development of transportation geography, Okui (1985) classified the achievements of the field into those pertaining to the study of transportation networks and those pertaining to the study of traffic flow. This classification was made based on the methodology/object of the study. While the study of transportation networks involves focusing on accessibility, areal division, connectivity, simulation, and the development model, the study of traffic flow involves focusing on pattern descriptions, general field theory, distance decay function, and the transportation problem model. On the other hand, Aoki and Murayama (1991) classified studies in quantitative transportation geography into the following seven types, based on Okui (1985) and Konagaya (1990): (1) studies that involve the application of multivariable analysis, (2) studies that utilize network analysis, (3) studies that focus on traffic regions and nodal structures, (4) traffic impact studies, (5) studies that utilize spatial interaction and flow analysis, (6) studies that adopt the behavioral approach, and (7) studies that adopt other approaches.

In this paper, studies in modern transportation geography will be classified by referring to the classification mentioned earlier. Studies were classified based on the method due to the difference of analysis approach in most of former review papers; for example, studies were divided into two types, namely descriptive or quantitative, moreover the quantitative studies were classified based on methodology. However, the method should be decided depending on the purpose of each study. In this paper, therefore, studies in modern transportation geography will be classified into the following four types, based on the purpose of the study and the subject of focus: (1) studies focusing on transportation enterprises, (2) studies focusing on the effects of transportation developments on a given area, (3)
studies that utilize nodal structure analysis, and (4) studies that focus on airports and harbors and their hinterland.

All studies in transportation geography including both descriptive and quantitative studies might be classified into these four types. Actually, a study which used to be classified into "multivariable analysis" based on the methodology will also be classified based on the purpose of the study. Since the type of each study is nonexclusive, some studies can be referred to several types of studies. Unfortunately, it is not adequate to classify such studies more meticulously due to the scattering of the studies in Japan after the 1990s, although it is possible to classify them more closely.

The types of study are interdependent; therefore, some studies can be referred to in the context of several types of studies. In the next chapter, the trends of studies based on this classification will be reviewed.

**Recent Achievements in Transportation Geography**

**Transportation enterprises**

Since the 1990s, most of the research concerning transportation facilities and transportation operators has focused on bus transit operations.

The number of studies on bus transit operators has increased since 1980 and themes such as changes in the routes of bus networks, conversion of railway routes into bus routes, and the process through which highway buses were developed have been studied. In particular, there are two themes that have been studied since the 1990s, namely, the operational problems of route bus networks and the process through which the highway bus network developed.

However, attention should be paid to the fact that the management situation surrounding bus transit operations has been worsening due to the changes in the socioeconomic situation, for example, the development of motorization, increase in the number of elderly people, worsening of recession, and deregulation. While before the 1990s, the development of bus routes in urban areas was often studied in transportation geography, after the 1990s, considerable attention was paid to the bus management problem in mountainous areas.

Nakamaki (2002) clarified the process of change in a village in the mountainous area of Gunma Prefecture caused by the modernization of transportation since the 1940s. The residents in the village persuaded the local government to upgrade roads and set up route buses, which improved accessibility to the urban areas. As a result of the increase of motorization, private route buses were discontinued in the beginning of the 1990s. However, after that, alternate bus services for elderly people began to operate. The management of unremunerative route buses, which is an essential service for elderly people, was examined by Hamasato (1995) and Fukutome (1996). Hamasato (1995) examined the bus service in the mountainous areas and noted that the loosening of regulations on the operation of buses as well as the flexible application of the subsidy system for alternate buses is required. Fukutome (1996) pointed out the problem, namely, that residents did not understand the financial difficulties encountered in the case of buses operated by the local government.

On the other hand, due to financial difficulties in the urban areas, the efficient management of buses is required. Ro (2000) clarified the process and factors in the development of the bus network from 1948 to 1995 in the northern part of Kanagawa Prefecture. Imai (2005) examined the restructuring process of the bus network resulting from the extent of subway line and the transfer of bus operations from a municipal enterprise to a private firm. Nevertheless, the areas in the case study, such as Kanagawa and Sapporo, are in urban area, while the financial condition of bus firms in provincial town or farming and mountain villages is worse than in urban areas. Since the financial condition of small bus companies is not favorable, in recent years, the importance of public bus services has been increasing.

According to Inoue (2005), who clarified the regional characteristics of municipal bus services, municipal bus services have been provided in almost half the municipalities in six prefectures in the Kansai region. In Inoue's paper, municipal buses are classified into two types—al-
ternate buses and community buses—in order to clarify the effect of the subsidy system and deregulation during the process through which each type of bus came into being. Inoue (2006) focused on the influence of deregulation and clarified the competition in the bus transportation market in Kyoto City by analyzing the municipality bus firms’ behavior against the entry of new private bus firms. However, this is an example of a successful case because Kyoto is a large city. The concern in the case of deregulation is that it entails mobility degradation for vulnerable road users due to the abolition of unprofitable bus routes—an issue on which transportation geographers should focus.

Today, the long distance intercity bus service is the only growing bus service wherein profits can be expected. With regard to long distance buses, Han examined the process through which intercity buses developed in Japan and Korea. Han (1992) comprehended the bus network according to firm in Chungchong-bukto Prefecture in Korea and clarified the intercity connection in the prefecture and the characteristics of entrant firms in relation to those of other prefectures. Han (1995) described the process through which long distance highway buses in Japan developed, and examined the factors influencing the choice of bus route. He pointed out that in addition to other factors, the most significant factor is the development of highway networks. Ishizawa (2001) clarified the relationship between the expansion of the highway network and the long distance intercity bus operation in the Hokuriku region. Additionally, Adachi (2005) clarified the factors influencing the expansion of the bus network that connects Haneda Airport to important cities in the Kanto region.

Long distance bus operators have also been affected by deregulation. Many routes are profitable in highway bus networks while only limited routes are profitable in route bus networks. Therefore, the routes of the intermetropolitan or inter-large city highway bus services are increasing in light of the excessive competition due to the entry of new bus companies. Although the significance of deregulation is not discussed in this paper, deregulation has definitely influenced bus companies and their networks as well as the connectivity among areas. It is expected that the field of transportation geography will provide insights with regard to the influence of easing regulation on bus operation.

Although there are only a few papers on the modern railway in transportation geography, Tsuchitani has addressed the issues encountered in sustaining local railways in Japan. He studied local railways in cities such as Matsumoto (Tsuchitani 1997), Ueda (Tsuchitani 1999), Choshi (Tsuchitani et al. 2004), and Kumamoto (Tsuchitani 2005). In addition to examining data such as the number of passengers, Tsuchitani also conducted questionnaire surveys in order to take into account residents’ evaluation in his research. He emphasized the need for an integrated transportation policy encompassing all transportation systems because it is impossible for local railway companies to run on a stand-alone basis. However, as mentioned above, it may be difficult to formulate an integrated transportation policy to control some transportation firms, given the trend of deregulation. Alternatively, even if integrated transportation policy is adopted, it is still possible to substitute a route bus for the railway, from the aspect of management. The study of transportation geography necessitates the examination of the regional transportation system while taking into account the interrelation with regard to management among the multiple modes of transportation and the resultant effects on the residents.

**Effects of development in transportation on given areas**

The study of the impact of transportation on a given area involves the analysis of how changes in infrastructure such as the improvement of transportation networks or building of transportation facilities affect the socioeconomic structure of a region. It involves focusing on the economic influences on an area caused by transportation, and the objects of study in traffic engineering and economics of transportation are phenomena that can be converted into monetary value. On the other hand, in transportation geography, the effects of development including sociocultural effects are analyzed by laying emphasis on the spatial aspects (Yokoyama 1979).

In socioeconomic transportation geography, methods such as the interview survey, fieldwork,
and landscape observation are used, while in quantitative transportation geography, the effects on an area are quantitatively measured by using multivariate analysis and the accessibility model (Aoki and Murayama 1991).

Many studies on the effect of construction and the extension of highways on areas have been reported in Japan since the 1980s. Since highway networks are still being expanded, many transportation geographers may be interested in their effects on given areas. In studies in transportation geography since 1990, the effect of the expansion of highway networks on various areas have been quantitatively measured on the basis of accessibility, using macroscale techniques (e.g., Tanaka (1998, 2001) and Fujime (1999)). Tanaka measured changes in accessibility in light of the expansion of the highway network in Tohoku region and Nagano Prefecture. In a case study of the Chogoku and Shikoku regions, Fujime emphasized the importance of analyzing the effect of transportation on areas with respect to not just time-effectiveness but also cost-effectiveness.

Mesoscale and microscale studies are classified into two types: studies that focus on regional economic activity and those that focus on the livelihood activities of residents. The former group includes studies on the relationship between the opening of highways and overall office activity (Teraya 1993), the change in location of the logistic center through the opening of the Seto-ohashi bridge (Kawakubo 1996), and the suburbanization of office locations due to the increase in motorization (Kikuchi 2005). Abe (2003) reevaluated the influence of highways from the perspective of industrial location and clarified that the existence of highways is an essential condition for a firm to consider when it is deciding the location of its factory. Fujime (1991, 1992) developed the trunk traffic axis, which is closely related to industrial development.

Nodal structures

Studies on traffic zones and nodal regions are essential in transportation geography. Due to the introduction of the quantitative method and development of Origin and Destination data, many experimental studies were conducted in the 1970s and 1980s. Although the number of studies has decreased since 1990, some studies on nodal structures have been reported. First, some studies on urban systems were conducted, for example, Murayama (1994), Park (1995), Ono (1997), and Suyama (2005). Murayama examined the change in the urban system in Japan by measuring accessibility, based on time and distance in terms of the railway.
Park focused on the significance of local cities in East Asia in order to clarify the international urban system on the basis of air traffic. Ono and Suyama clarified the urban system in Korea by focusing on intercity bus flow. Although Ono used data of 1993 and Suyama used that of 2004, the urban system for which Seoul provided the nucleus had been reinforced and the superiority of Seoul increased in Korea. Suyama highlighted the inconsistency in the national policy, which promotes decentralization. Additionally, Nojiri (1993) clarified the spatial structure in Japan, based on the flow of railway containers and route trucks, using the direct connect method of maximum flow and factor analysis. He examined the application of factor analysis to the study of freight and orientation of logistics.

On the other hand, the nodal structure at the prefecture or city level has been investigated in some studies. Hashimoto (1991, 1992, 1993) clarified the change in the nodal structure of public buses due to the growth of motorization. He used the quasi three-mode factor analysis, based on the accessibility which had been measured in the number of transfer opportunities. Hashimoto and Hamasato (1995) clarified the change in the nodal structure in Koriyama from 1977 to 1987 using MDS (multidimensional scaling). Momose (2005) elucidated the nodal structure of the public transportation network in Nagano from 1990 to 2000. He examined the influence of decision-making by the local government or the public transportation enterprise in changing the nodal structure.

As mentioned above, since 1990, the number of studies on nodal structures has been decreasing. This may imply that the phase of examining the methods to elucidate nodal structures has passed. Momose attempted to combine quantitative and socioeconomic methods, the two approaches being methodologically diverse. In the future, studies on such an approach are expected.

Airports and harbors and their hinterland

Harbors, which are the connecting points between land and marine transportation, are one of the objects of study in transportation geography. In Japan, the number of studies on harbors has increased due to their drastic development following the high economic growth from the latter 1950s onwards. Some studies concerning harbors or their hinterland were reported in the 1990s. First, Sakai (1993, 1996) focused on the function of individual harbors and their hinterland. He clarified the development process of Kushiro harbor in Hokkaido and the transportation network in its hinterland from a historical perspective. On the other hand, other studies elucidated the relation between ports and the properties that were located in their hinterland, based on the commodity flow of several ports. For example, Azumi (1990) focused on container transportation operated by foreign capital, Mine (1995, 1996) examined the relationship between harbors and office location, and Park (1997) determined the factors that influenced Korean companies' choice regarding the port from which to export commodities to Japan. The findings of these studies further elucidated the hierarchy of ports and the complexity of the ports' hinterland. These studies reveal that it is not necessary for cargo owners to select the nearest harbor, owing to the development of land transportation, in light of the expansion of the highway network. Harbors chosen by cargo owners depend on the priorities of the cargo owners, such as time- and cost effectiveness (Park 1997).

In the studies on airports during the 1990s, the issues of the development of the airports' hinterland and the distribution of passengers were addressed (Inada 1990; Yokoyama 1992; Fujime 1995). Ida (1991, 1993a,b) clarified the hinterland of certain airports in Japan and the areal attributes that account for passenger distribution. Meanwhile, Fujime (1995) focused on the relationship between passenger distribution and accessibility of airports, and elucidated the effect of the extension of highways on the expansion of the airport hinterland. Similarly, Tsukada and Takada (2000) measured the accessibility of Haneda airport in the Kanto region from the time-space perspective, using the geographic information system (GIS).

In Japan, few studies on airports and harbors have been conducted in the field of transportation geography. Does this imply that the discussion on the issues of airports and harbors has come to an end? Not in the opinion of this author. Although import and export largely depend
on marine transportation in Japan, the relative importance of the role played by harbors has decreased, particularly in comparison to other harbors in Asia. Meanwhile, the importance of airports has not decreased to as low as that of harbors. However, since a number of large airports that serve as hub airports have started operating in Asia, it will not be easy to maintain the status of Japan's international hub airports in the near future. In such a situation, it is a matter of concern that only a few studies on airports and harbors have been conducted in recent years. Issues relating to airports and harbors should be dealt with and discussed in transportation geography.

**Conclusions and Perspectives**

In this paper, the trends and issues in the geography of modern transportation since 1990 were reviewed. The number of studies on the geography of modern transportation has decreased; these studies can be classified into four types, namely, studies on (a) transportation enterprises, (b) effects of transportation developments with respect to area, (c) nodal structure, and (d) airports and harbors and their hinterland. Most of the studies can be categorized into the former two types, while only a few studies have been done on the latter two themes in the 2000s.

Most of the research on transportation enterprises has focused on bus companies. The studies on buses are related to the crisis of maintaining bus operations in mountainous areas or local cities. Moreover, the management situation of bus companies has changed due to the deregulation carried out in 2002. Since deregulation considerably affects the operator of the bus entity and its network, an approach based on policy discussion is required in order to examine bus companies. Some effects of deregulation have been regarded with caution, for example, the decrease in mobility owing to transportation vulnerability, caused by the abolishing of unprofitable routes by private bus services and excessive competition on profitable routes. Themes such as these should be dealt with in transportation geography.

With regard to the effects of transportation development, many studies have focused on the expansion of highway networks. Studies in transportation geography have contributed in terms of clarifying the influence of highways on regional society and the regional economy. However, no study in transportation geography has discussed the merits and demerits of constructing new highways from the perspective of cost-efficiency. In the future, cost-efficiency should be taken into account when emphasizing the contribution and significance of transportation geography to society and in other academic spheres.

Transportation geographers may be afraid that the division between transportation geography and traffic economics will blur if too much importance is attached to economics when dealing with transportation geography. However, regional properties that cannot be converted to monetary values are eliminated in traffic economics, while the approach of transportation geography can take regional properties into consideration. Moreover, the originality of transportation geography will further improve by focusing on the changes not only in the regional economy but also in regional society.

Finally, the author would like to point out the issues that should be addressed in transportation geography based on the above discussion. The first issue that needs to be focused on is that of urban public transportation. Numerous studies on urban structure have been presented by urban geographers in Japan. In these studies, commuting flow has been used as an indicator to help explain urban structure, while studies in urban transportation geography examine the relationship between urban structure and transportation (Konagaya 1990). In recent years, the concept of a compact city has drawn attention in the context of sustainable urban development. One of the features of a compact city is its dependence on public transportation instead of private automobiles. The merits of this type of city are that it results in the reduction of environmental loads, revitalization of the inner city, and redresses the problem of transportation vulnerability. The most serious obstacle in introducing the compact city system in the local cities of Japan is that public transportation is inconvenient for the residents. As Tsuchitani (2005)
pointed out, intermodal coordination between the railway and bus networks should be enhanced. Moreover, government initiative for the coordination of regional transportation networks is required. However, as mentioned earlier, the level of discretion that bus service operators enjoy with regard to their operations has increased due to the deregulation carried out in this sector. Since it is very difficult to control public transportation in local cities, the public transportation network is poor.

For these reasons, transportation geographers should address the significance of deregulation for a region by considering transportation and the orientation of the city and the public transportation operating there.

The second issue that should be focused on is the orientation of Japanese air transportation at the global level. Accelerating globalization has resulted in the transportation of passengers and commodities all over the world. Since globalization is sustained by air transportation, studying the flow of passengers and commodities via air should be the objective of future studies in transportation geography. As discussed above, however, few studies on airports and harbors have been conducted in the field of transportation geography in Japan. While liberalization has been revolutionizing the air transportation industry in the EU and other parts of the world, it is still very difficult for the air transportation industry in Japan to enjoy the benefits, such as the Open Sky Accord. Additionally, in Japan, the future status of international airports is uncertain, because the competition between hub airports is likely to increase. Although Narita airport has been a hub airport against the backdrop of the Tokyo metropolitan area, it faces serious problems such as low capacity and poor accessibility to the central parts of Tokyo. We have to prevent airports in Japan from losing their status as main hub airports in Asia in the same way as harbors such as Kobe and Yokohama lost their earlier status in Asia and were replaced by Busan, Shanghai, and Hong Kong. Although this critical theme of transportation has been exclusively addressed in the research on traffic economics in Japan, this is the very theme that should be discussed in transportation geography in the environment of accelerating globalization.

Notes

1. Moreover, there were several papers that reviewed specific aspects such as quantitative methods (Okui 1985), commodity flow (Murayama 1989), domestic air transportation flow (Inada 1990), urban transportation (Konagaya 1990), logistics (Nojiri 1995), and automobile transportation (Okui 1996).

2. With the increase in motorization, the number of bus passengers has shown a downward trend since around 1970. Many route buses encountered a crisis with regard to their existence in mountainous areas. There were several studies, such as Hayakawa (2002), Kakimoto and Tsuji (2006) and Takahashi (2006), on the subsidy system for route buses and the possibility of their sustenance in mountainous areas in the transportation economics.

3. Deregulation, here, refers to the abolishing of “the supply-demand adjustment regulations” that took effect in February 2002. In principle, any bus service company can enter and exit the market.

4. The drastic deregulation of bus services was implemented under the Thatcher administration in the United Kingdom. It resulted in the decrease of public transportation users through a decline in public transportation services (Okamoto 2000).

References


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