

CURRENT SITUATION EVALUATION OF TAKASAKI CITY BY FORMULATING MODEL OF URBAN POWER

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ABSTRACT: The aim of the present study is to indicate objective position of a local city other than the prefectural capital location by formulating model of urban power and current condition evaluation. Specific methods are as follows: 1) formulate a model of urban power; 2) evaluate the current situation of Takasaki City; and 3) clarify direction to tackle in order to improve Takasaki City in the future by formulating model of urban power and current condition evaluation. The results obtained in the present study can be summarized as follows: 1) In order to maintain urban power of local cities, it is necessary to industrial activities that create bustling communities such as commerce; 2) It is indispensable to enhance transportation system such as Shinkansen, railway and expressway, and to enhance the bases of home center and department store; and 3) The annual sales of goods value of Takasaki City is larger than that of Maebashi City, the prefectural office location in Gunma, and is considered to be contributed by department store, Shinkansen, and expressway.

Keywords: Provincial city, Urban power, Takasaki City, Current condition evaluation

1. INTRODUCTION

City data pack 2018 version is conveying movement of town of the whole country. [1] Toyo Keizai is published a livability ranking in July 2018. The purpose is to clarify urban power of each city area based on public statistics in various fields. The 16 indicators are based from 5 in terms of peace of mind degree, convenience degree, comfort, high-net-worth level. Deviation value for the 50 average values is calculated for 16 indicators. The overall rating is the calculation each average and the deviation value of the 5 point of view. The rankings of all 814 city blocks in 791 cities and 23 wards of the country are introduced on 2 pages each. For example, Inzai City is a livability ranking overall rating 1 of 2017. It is located in the northwestern Chiba, in a population of 92,000 people, accounting for more than half of the area of Chiba New Town. It is comfort third place, in the convenience of 10-position. Mori Memorial Foundation urban strategy Institute is published a "Japanese cities characterization" in October 2018. Six areas as elements that make up the city are economy, business, research and development, culture and exchange, living and living, environment, transportation and access. In each field, 26 indicator groups and 83 indicators are selected. Each index data is indexed as maximum value 100 and minimum value 0. The average value of each index group is summed up by field, and it is considered as the score of each field. The total score is calculated by adding up the six fields. For example, Kyoto City is a ranking first in culture and interaction, and second in research and development, and first in the

total score of urban characteristics in Japan.

The present study is to formulate a model of the city force, intended to evaluate and organize the current state of Takasaki City (summary will be described later).

2. PREVIOUS STUDIES

As research on urban power, Ishikawa considers urban power to be a comprehensive value of seven indicators: production rate, population growth rate, land price rate, yield rate, lighting rate, tax rate, and savings rate. [2] Sakurai focuses on milk marketed in Tokyo. There is explained urban power from the milk producing area in the metropolitan area, the amount of milk transported from the milk producing area to Tokyo, the transportation distance, transportation means, and transportation route. There is clarified that the city's milk area connecting Tokyo from milk producing area was formed in Showa era. [3] Takano defines urban power as the total number of employees of the establishment targeting 23 urban areas in Aichi. Urban area index is the ratio to the total residential population. There is high in large cities like Nagoya and in developed areas of the industry. It is low in other areas. [4] Yoshisaka et al. define a numerical value corresponding to urban power in order to quantitatively grasp the size of the city the force index. A comprehensive index is obtained by multiplying the population concentration area population (DID population) by the population

concentration area (DID area). [5] Sawada uses the total value of the six indicators of the number of shops, the number of shop workers, the number of goods sold, the number of factories, the number of plant workers, and the amount of industrial shipments as urban power. [6] Yoshisaka et al. define urban power index corresponding to urban power from the road distance in the population concentration area. [7] Yoshisaka et al. consider the composition of a block from the city power index and the area corresponding to urban power. [8] Sakurai et al. define urban power as the force produced as a result of accumulation of urban functions. It is target within a radius 5km area of central area in Yokohama City. There is defined urban power as a comprehensive value of the active force produced in 4 function of residential, commercial, business, industry. In order to simulate the situation of city change and transformation in advance, there is formulated by multiple regression analysis. Objective variable is urban power. [9] Noda defines the urban power as a state that the transform the world, the quality of life, and the economic power are achieving balanced growth. The three areas are measured by intellectual capital / innovation, technology maturity, gateway function, transportation/ infrastructure, health/ safety/ security, sustainability and natural environment, population composition/ livability, economic influence, ease of business, the cost of industrial and life. [10]

In the field of urban planning, urban power is seen to have been professionally defined as a comprehensive indicator of quantitatively competitiveness between cities.

3. PURPOSE OF PRESENT STUDY

Urban power is professionally defined as a comprehensive indicator that quantitatively indicates the competitiveness between cities from the past research in the field of urban planning. Each item of indicators makes up urban power as a comprehensive evaluation, and there are variety previous studies. Therefore, a problem from the point of view of regional policy is to formulate a model of urban power by an objective analysis technique. It is necessary to be formulated on the model of urban power, evaluate and organize the current state of the specific city by case studies.

The aim of the present study is to reveal the state objectively the position of regional cities other than prefectural office location by modeling formulation of urban power and evaluating current. It is

formulated a model of urban power by the objective analysis technique. Moreover, it is evaluated and organized the current state in Takasaki City as a case study (set reason will be described later). Based on the above-mentioned results, it reveals the direction that should be addressed in order to improve the future Takasaki City. That is, there is created a model that can be represented metrically on the scale of urban power. Based on the above-mentioned results, there is addressed the direction in order to improve the urban through case studies.

The specific method is as follows.

- (1) There is described the concept of urban power model. There is selected a multiple regression analysis from the statistical analysis technique. From this, the evaluation index X is to formulate a model of urban power to predict the impact directly to the comprehensive evaluation Y.
- (2) As a study area to expand the case studies, there is set Takasaki City, and described an overview of Takasaki City.
- (3) There is organized and evaluated the current status of Takasaki City from the model of urban power formulated by predicting that the evaluation index and the general evaluation are related.
- (4) There is revealed the direction that should be addressed in order to improve the future Takasaki City from the current state evaluation of the results.

4. URBAN POWER MODEL

4.1 Urban Power Model Concept

Model concept of urban power in this study are as follows. Urban power is able to capture and quantify the status of the city. Outlines of the analysis procedure are modeling of urban power, and prediction of urban power by simulation using model formula.

4.2 Urban Power Model Concept

A prerequisite is to the following two assumptions to model construction for expressing to meter urban power.

[Assumption 1] To make city unit city.

[Assumption 2] To quantify the situation of the city at a certain point.

4.3 Model Formulation

Among various urban activities developed in a city, the base function and the transportation system are taken up as two representative functions. The total value of activity generated by these two

Table 1 Index and Item of Urban Power
(Created by the author)

Index	Item
base function	1. number of household appliances, furniture, and home center
	2. department store association merchant number
transportation system	3. Shinkansen stop station
	4. number of railway station
	5. number of interchange

Table 2 Statistics of multiple regression analysis
(Created by the author)

Index item	Partial regression coefficient	Standard partial regression coefficient	T value	Judgment
X1	18,918.076	0.303	3.548	**
X2	206,940.793	0.248	3.463	**
X3	190,712.134	0.142	2.085	*
X4	5,455.218	0.120	1.549	
X5	32,650.959	0.166	2.366	*
Constant term	128,625.126		1.656	
F value			22.577	**
Multiple correlation			0.679	

** : the t value does satisfy the significance level for 1 %.

* : the t value does satisfy the significance level for 5 %.

functions is the annual product sales value. This is urban power. Annual sales of goods is based on 2016 economic general survey-activity investigation Table 1, the number of the establishments according to city and district, the industrial classification subdivision, the number of the employees, the annual sales of goods. There is selected the number of household appliances, furniture, and home center, and department store association merchant number for the base function. Similarly, there is selected the presence or absence of Shinkansen stop station, the number of railway station, the number of interchange for the transportation system (Table 1). Therefore, objective variable is "annual sales of goods(Y)". Explanatory variable is "the number of household appliances, furniture, and home center(X1)", "department store association merchant number(X2)", "the presence or absence of Shinkansen stop station(X3)", "the number of railway station(X4)", "the number of interchange(X5)". When formulated by multiple regression analysis, regression equation of formula (1) is obtained a precision shown in Table 2. In addition, the cities used for model creation are

Table 3 Annual sales of goods [13]
(Created by the author)

Population rank	Prefecture	Municipality	Annual sales of goods (one million yen)		
			Actual value	Estimated value	Difference
51	Nagano	Nagano	1,685,006	1,290,507	-394,499
52	Aichi	Toyohashi	1,089,863	1,162,887	73,024
53	Osaka	Suita	1,919,875	497,317	-1,422,558
54	Gunma	Takasaki	3,057,010	1,405,140	-1,651,870
55	Wakayama	Wakayama	1,133,258	1,080,768	-52,490
56	Nara	Nara	602,695	898,894	296,199
57	Osaka	Takatsuki	555,036	796,800	241,764
58	Saitama	Kawagoe	766,096	593,032	-173,064
59	Fukushima	Iwaki	869,814	841,205	-28,609
60	Shiga	Otsu	469,139	1,280,467	811,328
61	Saitama	Tokorozawa	520,941	692,807	171,866
62	Hokkaido	Asahikawa	1,063,246	708,319	-354,927
63	Saitama	Koshigaya	822,471	456,038	-366,433
64	Kochi	Kochi	972,508	1,193,206	220,698
65	Gunma	Maebashi	1,147,867	1,015,305	-132,562
66	Fukushima	Koriyama	1,402,963	1,114,169	-288,794
67	Okinawa	Naha	849,364	639,226	-210,138
68	Akita	Akita	1,147,819	1,076,333	-71,486
69	Mie	Yokkaichi	993,011	894,490	-98,521
70	Aichi	Kasugai	696,654	602,737	-93,917

population of 150,000 or more excluding all ordinance -designated along with 790 cities in Japan based on the 2015 census.

$$Y=18918.076X_1+206940.793X_2+190712.134X_3+5455.218X_4+32650.959X_5+128625.126...(1)$$

The results of the test for significance of regression equation is shown in Table 2. The results of the analysis of variance, the degree of freedom of the F value molecule is 5, and the denominator of freedom of the F value molecule is 132. F distribution of the upper side 1% is 22.577>F (5, 132, 0.01)=3.17. It is 1 % level of significance. The null hypothesis that the obtained regression equation is not useful for the estimation of Y is rejected. The F value is also large enough. Therefore, the resulting regression equation can be determined to be valid. Further, the multiple correlation coefficient between the actual observed values with the theoretical value calculated by applying the regression equation of the object variables is 0.679. Therefore, as shown in Table 3, there is a difference between actual values and estimated values in the annual sales of goods, but resulting regression equation is valid.

Table 2 is clear that the number of household appliances, furniture, and home center, department store association merchant number, the number of interchange, and the number of railway station affected annual sales of goods, the t value does satisfy the significance level. Among them, the number of railway station and the number of interchange are a significant impact on annual sales of goods can be seen. On the other hand, although



Fig.1 Takasaki Station West Exit
(Photo taken by the author)



Fig.2 Takasaki Station East Exit
(Photo taken by the author)

the t value does not satisfy the significance level for 5 %, “the number of railway station (5,455.218)” is also an important index item judging from the magnitude of the parameter (partial regression coefficient).

Based on the above-mentioned results, it is considered that the number of household appliances, furniture, and home center, department store association merchant number, the presence or absence of Shinkansen stop station, the number of railway station, and the number of interchange are important to capture urban power from the viewpoint of base function and traffic system.

5. STUDY AREA AND TAKASAKI CITY

5.1 Setting of Study Area

A city that represents the prefecture is generally prefectural office location. Even if Maebashi City is appeared in the national statistics in case of Gunma, Takasaki City is hardly found. However Takasaki City is merged with Haruna town, becomes a population of 340,000 in October 2006, exceeded Maebashi City which has been merged with the previously Seta County area, etc. Takasaki City is the city with the largest population in Gunma. April 2011 or later, Takasaki City is a core city. In recent years, Takasaki City's position has been objectively

shown throughout Japan. According to Takasaki Chamber of Commerce and Industry, Takasaki City has been posted on the city ranked by economic magazine in recent years. Happiness ranking with 42 core city nationwide of the Toyo Keizai newspaper is third across Japan, Nikkei city rankings with a vitality of the business is the 29 across Japan in 2016. According to statistical data, the urban population is 55th in the whole country (2015), the industrial scale is 31th in the national scale, commercial sales is 15th in the national scale, and the industrial shipments are 88th in the national scale. [11]

From above, the present study is set area the Takasaki City as local cities other than prefectural office location.

5.2 Summary of Takasaki City

According to Takasaki City Directory, Takasaki City is a commercial city that flourished as a strategic point of traffic. There is expanded exchange area by development of high-speed transportation network. Prefecture population in sphere that can travel in two hours from Takasaki City is said to be 46 million people. The annual 200 million 6,000 million people visit in Gunma. Visitors to Takasaki City are the most frequent in Gunma. Near Takasaki Station is accumulation of accommodation, is a base for businessmen and tourists. Headquarters of the consumer electronics retailer's largest and a broad-based sales offices nationwide company are integrated. The department stores and attractive commercial premises in the nucleus, town building has been carried out and full of bustle and vitality in the center city. Advanced use of Takasaki City center is progressed by urban redevelopment projects. Takasaki Station connects with large commercial facilities, office buildings and hotels via an air corridor called pedestrian deck. Castle district which is continuous from Takasaki Station West Exit (Fig. 1) commercial area is an integrated areas of public facilities such as the city hall and Medical Center, Gunma Music Center. Takasaki City is established a "Takasaki Cultural Arts Center (tentative name)" new music hall as the base of art and culture in Takasaki Station East Exit (Fig. 2) area, is planning a large-scale complex facility with commercial premises and industrial development function. [12]

6. CURRENT EVALUATION

Assuming the annual product sales amount as urban power, evaluation Takasaki City is formulated urban power model of formula (1).

More specifically, the current state of Takasaki City is organized from the point of view of annual sales of goods, the number of installed university, department store association merchant number, the presence or absence of Shinkansen stop station, the number of railway station, and the number of interchange. It is evaluated by comparing with Maebashi City, the prefectural office location in Gunma.

6.1 Current Situation of Takasaki City

(1) Annual sales of goods

Wholesale trade is 2 trillion 569.2 billion yen, the retail industry is 487.7 billion yen in Takasaki City, 2016. Annual sales of goods which is their total amount are 3 trillion 57 billion yen. Takasaki City ranks 15th in the national ranking and 1st in the core city. The cities in within the 20th place are all designated cities except for Takasaki City. In the city in Gunma, Maebashi City is 1 trillion 147.8 billion yen (46th) (See Table 4, the same is true for the following.).

(2) Number of home center and so on

The number of household appliances, furniture, and home center are 24 shops, in the case of Takasaki City, as of March 2019; Yamada Denki, Cainz home, Sekichu, Nitri, Super Viva Home, Tokyo interior furniture, Bic camera, and so on.

(3) Department store association merchant number

Department store association merchant number are 2 shops, in the case of Takasaki City, as of March 2019; Takasaki Takashimaya, Suzuran Takasaki store.

(4) Shinkansen stop station

The presence or absence of Shinkansen stop station is Takasaki Station, in the case of Takasaki City, as of March 2019. Takasaki Station gets into Joetsu Shinkansen and Hokuriku Shinkansen of JR East that have served.

(5) Number of railway station

The number of railway station are 16 stations, the case of Takasaki City, as of March 2019, JR Takasaki Line Takasaki Station, Kuragano Station, Shinmachi Station, JR Joetsu Line of Takasaki-tonyamachi Station, Ino Station.

(6) Number of interchange

The number of interchange are 4 places, in the case of Takasaki City, as of March 2019; Takasaki Tamamura SIC, Takasaki IC, Maebashi IC of Kanetsu expressway, Yoshii IC of Joshinetsu expressway.

6.2 Comparative Study of Maebashi City

In order to show the position of regional cities other than the prefectural capital objectively, as

compared with Maebashi City, there is evaluated the estimated value of annual sales of goods of Takasaki City.

Substituting a numerical value into urban power model of formula (1); the number of household appliances, furniture, home center of $X1=24$, department store association merchant number of $X2=2$, the presence or absence of Shinkansen stop station of $X3=1$ (Yes), the number of railway station of $X4=16$, and the number of interchange of $X5=4$, the estimated value of annual sales of goods of Takasaki City is 1 trillion 405.1 billion yen.

Substituting the estimated value into urban power model of formula (1); the number of installed university of $X1=12$, department store association merchant number of $X2=1$, the presence or absence of Shinkansen stop station of $X3=0$ (no), the number of railway station of $X4=19$, and the number of interchange of $X5=2$, the estimated value of annual sales of goods of Maebashi City is 1 trillion 15.3 billion yen.

Compared to Maebashi City, there are 3 shops less than the number of household appliances, furniture, and home center, there are 3 stations less than the number of railway station, and there are acting on the negative. However, there is a Shinkansen stop station, there is 1 shop more department store association merchant, there are 2 places more than the number of interchange, and there are acting on the plus.

Based on the above-mentioned results, it is considered that the number of interchange, Shinkansen stop station, and department store association merchant number of Takasaki City contribute to the results above the estimated value of annual sales of goods of Maebashi City, the prefectural office location in Gunma.

7. CONCLUSION

The aim of the present study is to reveal the direction to be addressed in order to improve the future Takasaki City by urban power model formulation and present situation evaluation. The results obtained in the present study can be summarized as follows:

- (1) It is considered that the number of household appliances, furniture, home center, department store association merchant number, the presence or absence of Shinkansen stop station, the number of railway station, and the number of interchange are important to capture urban power from the viewpoint of base function and traffic system.
- (2) It is considered that the number of interchange, Shinkansen stop station, and department store association merchant number of Takasaki City contribute to the results above the estimated value of annual sales of goods of Maebashi

- City, the prefectural office location in Gunma.
- (3) From (1) and (2), it is possible to show objectively indicate the position of a local city other than the prefectural capital location by formulating model of urban power and current condition evaluation. In order to maintain urban power of local cities, it is necessary to industrial activities that create bustling communities such as commerce. For that reason, it is considered that it is indispensable to enhance transportation system such as Shinkansen, railway and expressway, and to enhance the bases of home center and department store. The annual sales of goods value of Takasaki City is larger than that of Maebashi City, the prefectural office location in Gunma, and is considered to be contributed by department store, Shinkansen, and expressway.

8. SUBJECT FOR NEXT STUDY

- (1) Our future goal is creation of time consumption type sightseeing to create bustle of town. Tourism resources such as landmarks, sightseeing spots, and hot springs are indispensable to increase the residence time of tourists. It is difficult to make tourists stay for more than half a day with tourist resources such as historic sites and city parks, and invite them to local consumption. Therefore, it is considered that experience-type tourism such as farming experience, and making of daruma at a tourist farm, and leisure tourism by eating and drinking utilizing special products such as Takasaki pasta.
- (2) Maebashi City is the 12th largest agricultural city in the country according to the 2016 agricultural production estimate. Therefore, in the future, it is necessary in Maebashi City to put emphasis on the sixth industrialization of agriculture which is processing and sales of agricultural products.

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