

Quantitative consideration of spatio-temporal information on education and culture in Japan using telephone directory archive data

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Abstract In this study, an attempt was made to quantitatively understand the spatio-temporal situation with respect to the prosperity of educational and cultural facilities in municipalities nationwide. For this, Japanese telephone directory data, taken from the digital archive containing geospatial information (address and industry) of all the facilities/institutions in a given area, were used to analyze the time series changes and obtain the latest industrial trends. Multiple patterns were observed in the growth and decline of educational, cultural, and business fields, and a detailed understanding of the regional characteristics that lead to future trends, the growth of cities, and future tourism strategies in times of disaster, was achieved.

Keywords Telepoint Data · Digital Archives · Spatio-Temporal Information

1 Introduction

At present, available geographic information is diverse, such as data sent from mobile base stations and information with real-time characteristics to grasp our behavior patterns. In the past, location information and travel directions were generally found by referring to symbolic information such as a route map using booklets and signs in the city. As for automobiles, car navigation systems have appeared since the 1980s, and research focused on the usage of such location information are in progress [1-3]. Furthermore, it is possible for a user to

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easily refer to real-time location information through personalized tools such as smartphone applications. There are a lot of various data that collected those data. There are several factors regarding these phenomena that require attention, such as leakage of personal information when referring to or transmitting personal location information within an application (locations can be disclosed via services such as SNS). Therefore, there is a need for self-management and literacy when using smartphones to link personal and location information. However, despite these disadvantages, they allow for several tools that can improve quality of life, such as a map application displaying unrestricted (socially inclusive) facilities or information on evacuation shelter maps, public halls, welfare facilities, etc. that are installed voluntarily and registered and controlled by volunteers [4-6]. In addition to the map function, SNS and other communication tools can also be implemented, and game elements have been introduced to actively share information not only in Japan but around the world. In the future, the demand for such important information will continue to grow, and the circle of sharing will expand. Access to spatial information will be available under equal conditions in places where various adverse situations occur. Using such information, various methods of cartographic communication can be addressed by language, map symbols, signs, and road signs [6], changing each year in line with technological innovations. While various forms of spatio-temporal information are available, the telephone directory contains point data as geographical information that are regularly updated. These data include those registered for corporations in each industry that are periodically updated in units of latitude and longitude. Until now, the Ministry of Economy, Trade and Industry has led a wide range of research on “commercial statistics” regarding changes in shopping streets and commercial areas [7-9]. Approaches for surveying declining areas, such as a vacant house in a municipality, are also being investigated. In addition, a variety of other approaches such as questionnaire surveys and fieldwork have been adopted as survey methods [10].

2 Purpose

Using the directory data, it is possible to identify the changes in the number of contractors in each region and industry from 2012 to 2018. In this paper, the above-mentioned data will be used to present a preliminary report on the changes and general conditions of education and culture throughout Japan. Notably, the data in this study considers trends within the range registered in the directory. However, in the case of education, there are several cases where corporations are registered with information such as compliance, cooperation with local governments, and so on. From this perspective, we believe that by analyzing these data, we can obtain important information that can help us in quantitatively and comprehensively understanding spatio-temporal features relevant to educational and cultural backgrounds.

3 Dataset

In this study, telephone directory data were used to obtain the latest industrial trends in municipalities nationwide. The analysis was carried out using the Japanese version of phonebook data containing industry information (22 data points from June 2012 to October 2018). The phonebook data contains geospatial information (address and industry) of all stores, institutions, and facilities, such as business establishments, hospitals, schools, parks, welfare facilities, and medical facilities. Therefore, it is possible to analyze detailed time-series changes of stores and facilities on a nationwide scale. Not only does the phonebook contain a wide range of data, from that of large corporations to individual, small-business owners, but the data are updated every four months, and therefore, detailed information about every store/facility can be obtained. The phonebook is essentially a large-scale digital archive with temporally high frequency and spatially accurate features. Each store/facility is classified into 25 major categories and 332 minor categories based on the type of industry. Previous studies have observed that these datasets can be scaled from the relationship between population and the number of stores and facilities in units of municipalities. The number of medical-related facilities is $\beta-1$, and the number of facilities appears to increase linearly as the population increases. On the contrary, the facilities related to the real estate industry have $\beta \leq 1$, and the number of facilities increases beyond the population increase, and the accumulation progresses. In addition, facilities related to public institutions have $\beta \leq 1$ and the increase is lower than the rate of drought increase, although it is expected that efficiency will increase [1-2].

4 Overall trends

First, in order to grasp detailed trends over the entire fiscal year, we analyzed the general situation regarding educational and cultural facilities from 2012 to 2017, when all the data for the fiscal year were obtained.

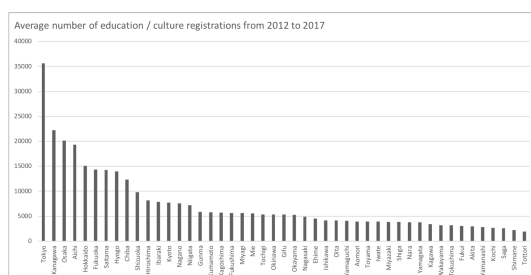


Fig. 1 Average number of educational and cultural facilities from 2012 to 2017

Looking at the average overall trend, as shown in Fig. 1, it can be seen that contractors are registered in densely populated areas such as Tokyo and Kanagawa, followed by major government-designated cities and the Kanto region.

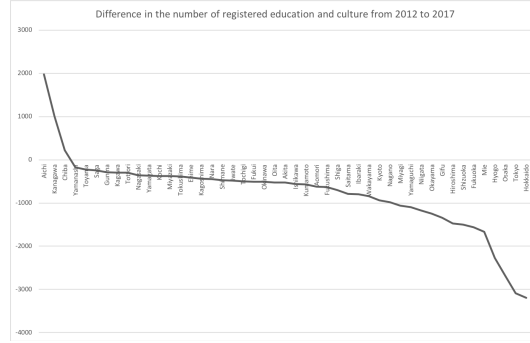


Fig. 2 Difference in the number of registered education and cultural facilities from 2012 to 2017

As seen in Fig. 2, on average, there is a tendency for the number of educational and cultural facilities in prefectures (Tokyo and Osaka), which existed at the top, to decrease significantly, whereas in Aichi and Kanagawa, it is observed to generally increase.

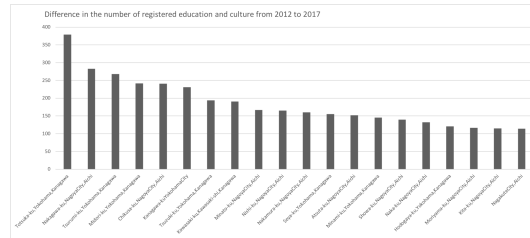


Fig. 3 Difference in the number of registered education and cultural facilities from 2012 to 2017 (by municipality top 20)

As can be observed in Fig. 3, the central areas in Aichi and Kanagawa are increasing.

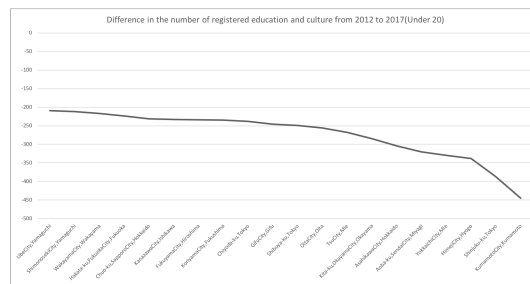


Fig. 4 Difference in the number of registered education and cultural facilities from 2012 to 2017 (by municipality under 20)

Fig. 4 depicts regions with a significantly decreasing trend from 2012 to 2017. Some cities in Yamaguchi tended to decrease significantly; however, new educational measures such as a scholarship system have been implemented since 2019, a point that should be observed to track the types of changes that have been observed continuously. In areas such as Fukuoka City (Fukuoka), Sapporo City (Hokkaido), and Shibuya-ku (Tokyo), where commercial development and other forms of urban development are progressing, there is a decline in the educational and cultural facilities. In addition, areas such as Kumamoto, Fukushima, and Miyagi, that once suffered major catastrophes, can also be observed to be on the decline. Once again, factors that should be considered regarding educational and cultural facilities and educational infrastructure after a major disaster were observed.

5 Discussion

Here, spatiotemporal archive data from 22 points from 2012–2018 were used in order to obtain a more detailed understanding.

5.1 Detailed classification

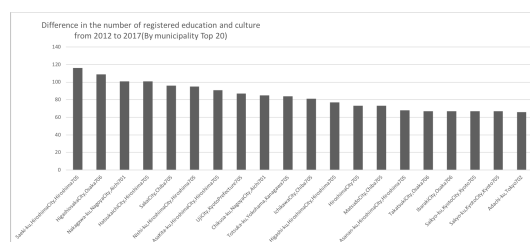


Fig. 5 Detailed classification of difference in the number of registered education and cultural facilities from 2012 to 2018 (by municipality top 20)

Industry numbering in Fig. 5

- (A1) 701: Cram School/Preparatory School/Teacher
- (B1) 702: Nursery/Kindergarten
- (C1) 705: Business School/Classroom
- (D1) 706: Musical Instruments Sales and Repair

As can be seen in Fig. 5, business-school-related trends are increasing in cities far from the center such as Hiroshima City (Hiroshima), Yokohama City (Yokohama), Uji City (Kyoto), Sakai City, and Matsudo City (Chiba). In addition, Nakagawa-ku (Nagoya) has shown the largest increase in nurseries since 2012, a sector of childcare and education whose insufficiency and operational failures have been condemned by the Japanese public in recent years [12]. Even when the conditions were narrowed down to only “(A1) 701,” it was found that nursery schools in the six wards of Nagoya city (Nagoya) were on the rise in the top ranks nationwide, indicating that they have been actively working on countermeasures against the current situation.

In addition, it was observed that the number of corporations related to the sale and repair of musical instruments increased in areas far from the center of Higashi Osaka City, Takatsuki City, and Ibaraki City (Osaka). In addition, 17 cities in Osaka corresponded to the top 20 districts when the condition was extracted only for “(D1) 706” in the increase/decrease list of each industry in the municipalities nationwide. We tend to occupy more than a majority of the total, and we would like to continue to consider the types of trends that can be expected the future from the perspective of tourism and cultural beliefs for major events related to Japanese history such as the Olympics(2020) and Expo(2025).

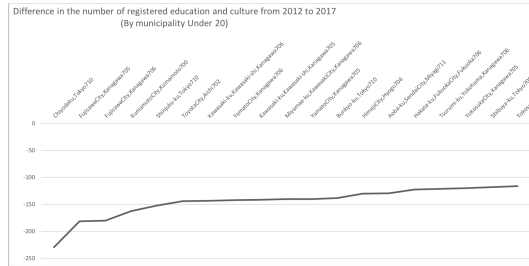


Fig. 6 Detailed classification of difference in the number of registered education and cultural facilities from 2012 to 2018 (by municipality under 20)

Industry numbering in Fig.6

- (A2) 700: Culture School
- (B2) 702: Nursery/Kindergarten
- (C2) 704: Elementary School
- (D2) 705: Business School/Classroom

(E2) 706: Musical Instruments Sales and Repair
 (F2) 710: Book Publishing
 (G2) 711: University, Junior College, Graduate School

Fig. 6 shows that the number of publishing-related businesses in the Tokyo metropolitan area in Chiyoda-ku, Shinjuku-ku, and Bunkyo-ku (Tokyo) has declined significantly. A tendency to be observed was observed. It was observed that these trends gradually decreased every 4 months since 2013. Furthermore, the number of cases has decreased by about 70 from January to April 2018. In addition, the number of business schools in Fujisawa City, Kawasaki City, Yamato City, Yokosuka City, and Yokohama City (Kanagawa) has been decreasing since 2013, while the number in Hakata-ku (Fukuoka) has been decreasing rapidly, particularly in 2015 and 2017 (an excessive trend was seen, such as one where there were over 100 cases in 4 months). In addition, the number of corporations related to musical instrument sales and repairs also showed a sharp decline after January 2015. The culture school in Shibuya-ku (Tokyo) has been on the decline since 2016.

6 Summary

In this study, an attempt was made to quantitatively grasp the spatio-temporal situation with respect to the prosperity of educational and cultural facilities in municipalities nationwide. In order to grasp the detailed trends, the overall trends were considered, and a detailed consideration was obtained to understand future tendencies.

- (1) Certain areas such as Hakata Ward (Fukuoka), Sapporo Chuo Ward (Hokkaido), Shibuya Ward (Tokyo) were found to have excessive flow rates. However, it was observed that in such areas, where urban development was progressing in terms of commercial facilities, a downward trend was seen in terms of educational and cultural facilities.
- (2) Kumamoto City, Fukushima Prefecture, Miyagi Prefecture and other areas where major disasters once occurred showed a declining trend in educational and cultural facilities.
- (3) In 2013, the number of business schools in Fujisawa City, Kawasaki City, Yamato City, and Yokosuka City (around Kanagawa) also demonstrated a declining trend. There was a tendency to infer changes and globalization (transfer to overseas bases) in the Internet business area. In addition, the culture school in Shibuya-ku (Tokyo) has been on the decline since 2016, and it is speculated that the development of a public network that allows online learning and the distribution of devices contributed to this. Overall, (3) has been presumed to reflect phenomena that are unique to areas that are sensitive to trends such as online business.
- (4) While Japan's lack of sufficient nursery schools has previously been condemned by the public [12], and it was found that Nagoya City (Aichi) has significantly increased its number of nursery schools since 2012. When similar

conditions were narrowed down, it was found that nursery schools in the six wards of Nagoya City were on the rise in the top ranks across the country, indicating that they are actively working to address the aforementioned insufficiency.

(5) As an interesting consideration, a marked increase in musical instrument sales and repair in Osaka Prefecture was observed. In 2019, Hundred Birds and Furuichi Burial Mounds in Sakai City (Osaka) were registered as UNESCO World Heritage Sites, and the Osaka Expo has been scheduled for 2025.

In order to gain insight into how such patterns develop in history, education, and culture, we hope to continue this study using the digital archive data in the phonebook.

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