Municipality-level Panel Data and Municipal Mergers in Japan

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Abstract

This paper explains a method of constructing municipality-level panel data for Japan for the period of 1980–2020. Municipal mergers conducted in the mid-2000s, which are collectively known as "the Great Mergers in the Heisei era," resulted in a reduction of almost half of the number of Japanese municipalities. The significant changes in administrative borders resulting from these municipal merges cause difficulties in constructing municipality-level panel data. To address this problem, this paper proposes a method of aggregating municipalities as a collective geographical unit that remains identical over decades.

JEL classification: Y10
Keywords: Municipality-level Panel Data, Municipal mergers

1 Introduction

Municipal mergers took place nationwide in the mid-2000s in Japan, known as "the Great Mergers in the Heisei era," and the number of municipalities decreased to nearly half of the total between 1980 and 2020. As shown in Table 1, there were 3,278 municipalities in 1980, and 1,741 in 2020. Table 1 also shows a breakdown of the municipalities, indicating that while the number of towns and villages has declined significantly through municipal mergers, the number of ordinance-designated cities and standard cities has increased.[1]

In recent years, with the promotion of evidence-based policy making (EBPM), the demand for statistical analysis using municipality-level panel data has increased. However, the creation of long-term municipality-level panel data needs an extremely complicated process in Japan because municipal mergers have changed the administrative borders. As a result, a great deal of time must be spent to create the panel dataset before the start of the statistical analysis. To address this problem, this paper describes a method for creating a municipality converter that covers historical changes of municipality codes considering municipal mergers from 1980 to 2020.

The term "converter" used in this paper means a correspondence table for connecting two or more pieces of data. Figure 1 shows a conceptual scheme of how the municipality converter connects municipal data. Here, we consider a situation where we have municipal data aggregated at the 1980 and 2015 administrative unit, respectively. Because municipalities were merged between 1980 and 2015, it is not possible to simply connect the two sets of data using the municipality codes at the time of the survey. The role of the municipality converter is to unify the municipality codes between both years.

Municipal mergers mean that a municipality as it exists in 2015 is a combination of several municipalities that used to be separate in the past. Therefore, if municipalities from 1980 are grouped based on the municipality codes from 2015, comparisons between 1980 and 2015 can be made for 2015 municipal units in a unified manner. This means that the municipality converter creates a 1980–2015 municipality-level panel data based on the 2015 geographical definitions of municipalities.

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[1] The ordinance-designated cities are cities with populations greater than 500,000 and are officially designated by the government. In December 2022, there are 20 cities (Sapporo, Sendai, Saitama, Chiba, Yokohama, Kawasaki, Sagamihara, Niigata, Shizuoka, Hamamatsu, Nagoya, Kyoto, Osaka, Sakai, Kobe, Okayama, Hiroshima, Fukuoka, Kitakyushu, and Kumamoto) in Japan. Cities are administrative areas with a population of at least 50,000. The Local Autonomy Law stipulates the conditions for each type of municipality: city (*shi*), town (*cho/machi*), and village (*son/mura*).

The use of the municipality converter is not limited to the creation of municipality-level panel data. For example, regional fixed effect at the municipality level should be often controlled for in an empirical analysis using individual data or firm-level data in Japan. However, this is difficult as the municipality code changes over time. The use of the municipality converter alleviates this issue as it can assign a consistent municipality code for a unified geographical unit over time. The municipality converter may also be expected for empirical studies that make use of municipal border changes as a natural experiment.

The municipality converter created in this paper is also useful in policy making and education. Unlike the microdata of households and firms, the municipal data is publicly available. To promote EBPM in Japan, Office for Promotion of Regional Revitalization, Cabinet Office (2023) developed the the Regional Economy Society Analyzing System (RESAS), which is a web application that visualizes regional data. Beyond the visualization of the regional data, policymakers are required to conduct data analysis using the long-term municipality panel data. Although Cabinet Office (2015) provides long-term municipality-level data for some variables, other variables are also needed in many situations. Currently, researchers need to download municipal data from the e-Stat Statistics Bureau, Ministry of Internal Affairs and Communications (2023) and recalculate them by aligning the municipality codes over years. The municipality converter simplifies this complicated process and allows researchers to conduct data analysis smoothly. It is expected that the municipality converter will increase empirical research that stimulate policy discussion of regional economic issues.

The rest of this paper is organized as follows. Section 2 provides an overview of the municipality code specification and a detailed explanation of the converter concept. Section 3 describes how to create the municipality converter and the layout of the data file. Section 4 provides a simple example for constructing the municipality-level panel data using the municipality converter. Section 5 verifies the accuracy of the municipality converter developed in this paper. Finally, Section 6 presents conclusions and recommendations.
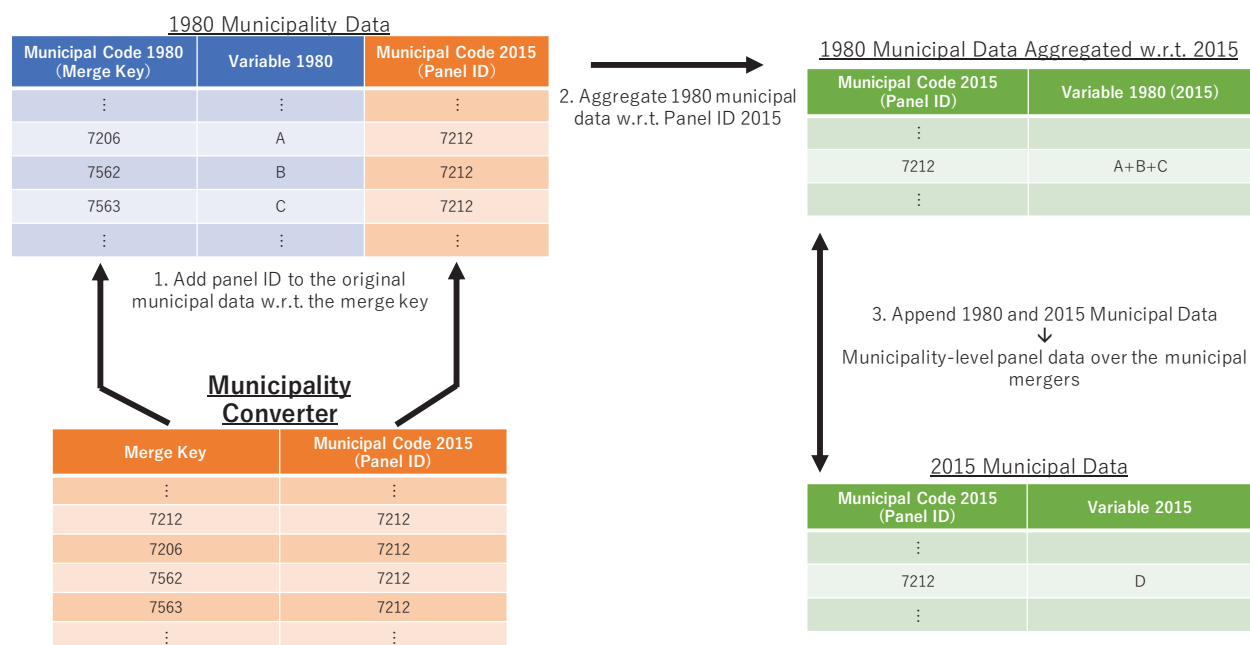
1980 Municipality Data

Municipal Code 1980 （Merge Key）	Variable 1980	Municipal Code 2015 (Panel ID)
⋮	⋮	⋮
7206	A	7212
7562	B	7212
7563	C	7212
⋮	⋮	⋮

2. Aggregate 1980 municipal data w.r.t. Panel ID 2015

1980 Municipal Data Aggregated w.r.t. 2015

Municipal Code 2015 (Panel ID)	Variable 1980 (2015)
⋮	
7212	A+B+C
⋮	

1. Add panel ID to the original municipal data w.r.t. the merge key

3. Append 1980 and 2015 Municipal Data
↓
Municipality-level panel data over the municipal mergers

Municipality Converter

Merge Key	Municipal Code 2015 (Panel ID)
⋮	⋮
7212	7212
7206	7212
7562	7212
7563	7212
⋮	⋮

2015 Municipal Data

Municipal Code 2015 (Panel ID)	Variable 2015
⋮	
7212	D
⋮	

Figure 1 Conceptual Schema of Municipality Converter

Notes: Author's creation. By applying the Municipality Converter to historical municipal data, it is possible to recompile data in the same geographic unit through time, even before and after municipal mergers.

2 Specification of Municipality Code and Municipality Converter

In Japan, municipality codes are assigned to uniquely identify each municipality.[2] Questionnaires for statistical surveys also include a field for entering the municipality code, and when survey results are published at the municipality level on the e-Stat (Statistics Bureau, Ministry of Internal Affairs and Communications, 2023), the municipality code is generally assigned.

As shown in Figure 2, a municipality code consists of five digits.[3] The first two digits represent prefecture code, ranging from 01 for Hokkaido to 47 for Okinawa. The remaining three digits represent the city/town/village code within the prefecture. The 3-digit municipality codes with the 100s are assigned for government-designated cities, 201–299 for cities, and 301–799 for towns/villages.

When municipalities merge, the municipality codes are often newly created or changed. Sometimes, the previous municipality codes become unused. Even in the absence of mergers, there are

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[2]"In order to contribute to the efficiency and facilitation of information processing, as part of code standardization, the Ministry of Internal Affairs and Communications (then: Ministry of Home Affairs) established codes for all prefectures and municipalities in 1968."
URL: http://www.soumu.go.jp/denshijiti/code.html (accessed on January 19, 2023)

[3]For details on municipality codes, see the Ministry of Internal Affairs and Communications (2007). In some cases, the municipality code is provided as a six-digit code instead of the five-digit. The sixth digit is considered an inspection code and is not required to be used in data analysis.

Table 1 Number of Municipalities from 1980 to 2020

Classification of Municipalities	1980	1985	1990	1995	2000	2005	2010	2015	2020
Special Wards of Tokyo	23	23	23	23	23	23	23	23	23
Ordinance-designated City	10	10	11	12	12	14	19	20	20
City	636	641	644	652	659	736	767	770	772
Town	1993	2001	2003	1992	1991	1178	757	745	743
Village	616	601	587	576	570	288	184	183	183
Total Number of Municipalities	3278	3276	3268	3255	3252	2239	1750	1741	1741

Notes: Prepared by the author based on the information from Statistics Bureau, Ministry of Internal Affairs and Communications (2023). The base date of the annual data is as of October 1 of the census. Six villages in the Northern Four Islands are not included in the above figures because population censuses are not conducted there.

Municipal Code (5 digit)

13101

Prefecture Code (2 digit)   Municipal Code (3 digit)

Municipal Code (5 digit): **13101**
↓
Chiyoda-ku, Tokyo

Figure 2 Structure of Municipality Code (5 digit)

Notes: Author's creation. Prefecture codes (2-digit) range from 01 for Hokkaido to 47 for Okinawa. For municipality codes (3-digit), the 100s are ordinance-designated cities, 201 to 299 are cities, and 301 to 799 are towns and villages. For details, see Ministry of Internal Affairs and Communications (2007). The correspondence table between municipality codes and names of municipalities can be obtained from e-Stat (Statistics Bureau, Ministry of Internal Affairs and Communications, 2023).

some situations in which the municipality code changes (e.g., establishment of city from town). The municipality converter was created by organizing all information on changes in municipality codes. The details of the criteria for changing municipality codes are described in Ministry of Internal Affairs and Communications (2007), and this paper describes only the points necessary for understanding the creation of the converter.

Table 2 lists the classification of the municipality code change. The symbols ● under "Municipality Code Change" in Table 2 correspond to cases where the municipality code is always changed, ▲ to cases where some municipalities do not change their municipality code, and ✖ to cases where the municipality code is unchanged.

There are two types of mergers: consolidation and incorporation. In both cases, at least one or more municipalities change their municipality codes. In a consolidation-type merger, all merging municipality codes are generally replaced by a new one when a new municipality is created

Table 2 Modification Rule of Municipality Code

Classification	Change of Municipality Code	Explanation
Consolidation-type Merger	▲	The code is changed to the newly established municipality code. However, the municipality code is not changed for the municipality that inherits the existing municipality name even if it is newly established.
Incorporation-type Merger	▲	The annexed municipality changes its municipality code to that of the annexing municipality. The municipality accepting the annexation does not change its municipality code.
Enactment of Ordinance-designated City	●	Municipality code (3-digit) changes to the 100s.
Establishment of City	●	Due to the change from town to city, the municipality code (3-digit) changed from 301–799 to 201–299.
Establishment of Town	✖	There is no change in municipality code.
Name Change	✖	There is no change in municipality code.
Zone Change	●	In case of new establishment or change of county area, there is a change of municipality code (3-digit).

Notes: The symbols for "Change of Municipality Code" are ● for cases where the municipality code is always changed, ▲ for cases where some municipalities do not change their municipality code, and ✖ for cases where the municipality code is unchanged. The division, separation, abolition, etc. are omitted here. For details, refer to Ministry of Internal Affairs and Communications (2007). In the case of a merger by incorporation, where the name of an existing municipality is taken over, it is indistinguishable from a merger by incorporation in terms of a change in the municipality code. However, because mergers by incorporation and mergers by incorporation are completely different in terms of administrative procedures, care should be taken to distinguish the difference between the two.

with a new name. However, even in the case of the consolidation-type merger, if the existing name of the merging municipalities is taken over, its municipality code will continue to be used for all merging municipalities. In an incorporation-type merger, one or more municipalities are incorporated into one other municipality, resulting in the annexed municipalities' codes being changed to match the annexing municipality's code. The municipality code of the municipality accepting the annexation does not change.

Figure 3 shows the changes in administrative districts due to municipal mergers in Miyagi prefecture. Figure 3(a) and 3(b) show the same map, but the administrative names are shown different between 1980 and 2015. Here, we focus on the municipal merger of Sendai city. As shown

(a) Municipal Names as of 1980

(b) Municipal Names as of 2015

Figure 3 Change of Administrative Borders in Miyagi Prefecture

Notes: Author's creation. The solid and dashed lines indicate the administrative borders as of 1980 and 2015, respectively. The map of each prefecture is provided in the Online Appendix.

in Figure 3, Sendai city (04100) as of 2015 consists of four previously separate municipalities in 1980: Sendai city (04201), Izumi city (04210), Akiu town (04382), and Miyagi town (04405). Sendai city (04201) experienced incorporation-type merger in 1987 and 1988. The municipality code of Sendai city remains as 04201 after the incorporation-type merger, while the municipality codes of Miyagi town, Izumi city, and Akiu town are changed to 04201.

As shown in Table 1, the number of ordinance-designated cities rose from 10 to 20 between 1980 and 2020. In this case, the municipality code is always changed, and the last three digits are changed from city numbers 201–299 to the 100s. In the previous example of Sendai city (04201), the municipality code was changed from 04201 to 04100 because Sendai city became an ordinance-designated city on April 1, 1989 after an incorporation-type merger in 1988.

In the case of a town being redesignated as a city, the municipality code is always changed in the same way, with the last three digits of the municipality code being changed from 301–799 to 201–299. However, in the case of a village being redesignated as a town, the municipality code is not changed and the same code is used.

In towns and villages, the municipality code is changed when the county area is newly established or changed. In this case, the name of the town/village is not changed. If only the municipal name is changed, the municipality code is not changed.

The information contained in the municipality converter is the historical record of how municipality codes have been changed along with municipal mergers in the past.[4] As the converter is described as "a correspondence table for connecting two or more data," a consistent municipality code can be added to municipal data over years, even between and after municipal mergers. By using a consistent municipality code as a panel ID, two or more municipal data can be connected.

3 Creating the Municipality Converter

The municipality converter includes a "merge key" and a "panel ID." The merge key was created to satisfy the following two conditions: (1) the merge key must be a unique code within the converter, and (2) the merge key can connect municipal data in any point in time from 1980 to 2020. The merge key that satisfies the above two conditions is the set of all municipality codes

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[4]The list of historical changes of municipality codes can be found in e-Stat Statistics Bureau, Ministry of Internal Affairs and Communications (2023). The municipality converter created in this paper is based on the historical change information on the e-Stat.

that exist or existed from 1980 to 2020, including obsolete cities, towns, and villages. Note that obsolete municipality codes are treated as missing after the municipal merger, and not reused thereafter. The municipality converter has 3,627 merge keys in total.

The next step is to describe the historical changes of the municipality code. In this paper, because the population census is used as the basis for the municipality converter, the changes of municipality code are described for each five-year period from 1980 to 2020.

One record in the converter's merge key corresponds to a municipality that exists or existed from 1980 to 2020. This record includes a historical change of municipality codes during the period. For example, if a city has never experienced a change of municipality code from 1980 to 2020, this record includes the same municipality code throughout the period. Next, consider a situation in which a city experienced a change of municipality code in 2006 due to an incorporation-type merger. In this case, the municipality code transition consists of two records. The first record contains the existing municipality code from 1980 to 2005 and is blank from 2010 to 2020, while the second record is blank from 1980 to 2005 and contains the newly created municipality code from 2010 to 2020.

In addition to the municipality codes, the municipality converter includes the historical information of the municipal names. Given that it is also important to know reasons why the municipality code was changed, the municipality converter also includes such information based on the classification in Table 2.

Table 3 lists the variables included in the municipality converter. The merge key variable is merge_id_muni, which can be connected to the municipality codes from 1980 to 2020. The panel ID is id_muni[yyyy], where [yyyy] indicates the year of the survey. For example, if researchers wish to aggregate the 1980 municipal data by the municipal unit as of 2015, researchers should assign id_muni2015 to the source data using the merge key. The variable name_muni[yyyy] indicates the municipal names.

To demonstrate how the converter works, we introduce municipal mergers in Gifu prefecture. Figure 4 shows the transition of administrative districts through municipal mergers in Gifu prefecture. The solid line shows the administrative borders as of 2015, and the dotted line shows the administrative borders as of 1980. Figure 4 visualizes that the municipalities as of 2015 are composed of multiple municipalities as of 1980.

Table 4 shows a layout of the municipality converter for the case of Nakatsugawa city, Gifu

Table 3   Variables in the Municipality Converter

Variable Name	Explanation
merge_id_muni	Merge key, which is unique in the Municipality Converter
id_muni1980	Municipality code (5 digit) as of October 1, 1980
id_muni1985	Municipality code (5 digit) as of October 1, 1985
id_muni1990	Municipality code (5 digit) as of October 1, 1990
id_muni1995	Municipality code (5 digit) as of October 1, 1995
id_muni2000	Municipality code (5 digit) as of October 1, 2000
id_muni2005	Municipality code (5 digit) as of October 1, 2005
id_muni2010	Municipality code (5 digit) as of October 1, 2010
id_muni2015	Municipality code (5 digit) as of October 1, 2015
id_muni2020	Municipality code (5 digit) as of October 1, 2020
name_muni1980	Municipal name as of October 1, 1980
name_muni1985	Municipal name as of October 1, 1985
name_muni1990	Municipal name as of October 1, 1990
name_muni1995	Municipal name as of October 1, 1995
name_muni2000	Municipal name as of October 1, 2000
name_muni2005	Municipal name as of October 1, 2005
name_muni2010	Municipal name as of October 1, 2010
name_muni2015	Municipal name as of October 1, 2015
name_muni2020	Municipal name as of October 1, 2020
flag_merge_consol	Indicator variable for consolidation-type merger
flag_merge_incorp	Indicator variable for incorporation-type merger
flag_seirei	Indicator variable for enactment of ordinance-designated city
flag_city	Indicator variable for establishment of city
flag_town	Indicator variable for establishment of town
flag_change_name	Indicator variable for name change
flag_change_zone	Indicator variable for zone change

Notes: The municipality converter supports for constructing the municipality-level panel data from the 1980 to the 2020 Population Censuses. The variable flag takes the value of 1 if the municipality experiences the corresponding category, and 0 otherwise.

prefecture, which experienced the municipal merger on February 13, 2005. As shown in Figure 4, Nakatsugawa city (21206) as of 2015 consists of Nakatsugawa city (21206), Sakashita town (21561), Kawakami village (21562), Kashimo village (21563), Tsukechi town (21564), Fukuoka town (21565), Hirukawa village (21566), and Yamaguchi village (20431) in Nagano prefecture from 1980. Nakatsugawa city experienced a cross-prefecture merger with Nagano prefecture. Because of the municipal merger on February 13, 2005, the municipality codes and names were changed before and after 2005 in Table 4.

The merge key can be used to connect between municipal data. A merger literally means that a current municipality is composed of multiple municipalities in the past. Therefore, when creating

the municipality-level panel data, we must use the municipality codes after the last year of the dataset. For example, if researchers want to create a panel of municipalities from 1980 to 2000, the municipality codes from either 2000, 2005, 2010, 2015, or 2020 are used. If researchers want to create a municipal panel data from 1980 to 2020, the municipality codes as of 2020 are used.[5]

4 Creating Municipality-level Panel Data with Municipality Converter

As shown in Figure 1, we summarize the procedure for creating the municipality-level panel data using the municipality converter. Suppose that we have municipal data for each year from 1980 to 2020, but the municipal data include the municipality code at the time of the survey. Then, we want to construct the municipality-level panel data from 1980 to 2020 based on the geographic units of the municipalities as of 2020. The procedure for using the municipality converter is summarized as follows:

1. Assign a municipality code `id_muni2020` to the municipality data using the converter's merge key (`merge_id_muni`).

2. Aggregate the past municipality data based on the municipality code `id_muni2020`.

3. Delete duplicates in the past municipality data with respect to the municipality code `id_muni2020` and delete the municipality codes and original data of the past municipal data.

4. Save the aggregated data with the municipality code `id_muni2020`.

5. Repeat the above procedure for each year in the past.

6. Integrate aggregated data of each year to create the municipality-level panel data based on the municipality unit as of 2020.

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[5]There is a small caveat when creating municipal panel data. The problem is that municipality converters cannot simply deal with cases where a split of municipality occurs. There is only one case in which Kamikuishiki village (19341), Yamanashi prefecture was split and merged into Kofu city (19201) and Fujikawaguchiko town (19430) in Yamanashi prefecture on March 1, 2006. If this merge is added for both Kofe city and Fujikawaguchiko town in the converter, the merge key for Kamikyuuichiki-Mura, Yamanashi prefecture is duplicated, resulting in a double-counting issue in the panel data. Note that this converter treats this case as a merger only into Kofu city. If this processing is problematic, a simple solution is to redefine Kofu city and Fujikawaguchiko town as a single geographic unit, and then we can recalculate municipal data from 1980 to 2020.
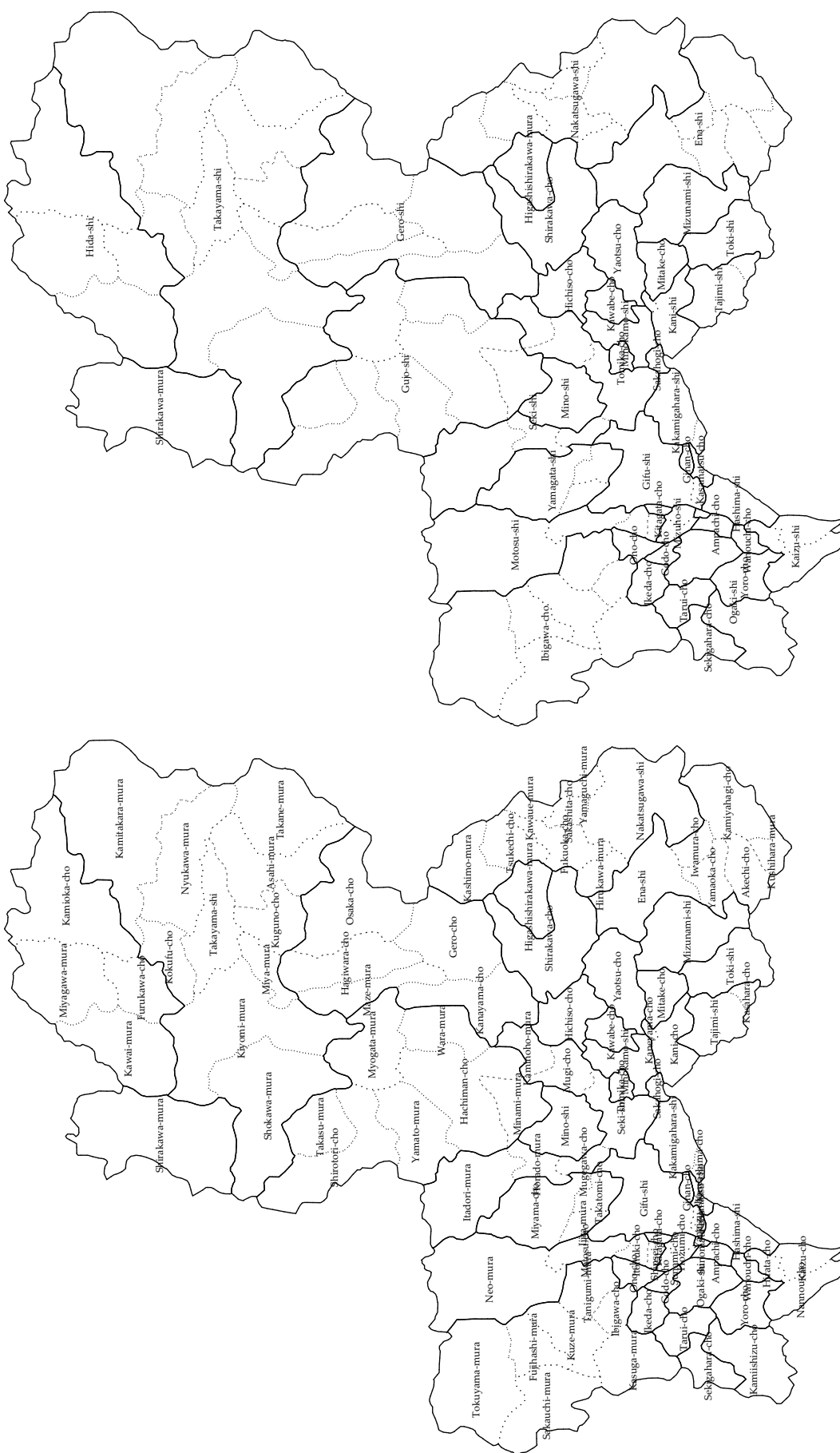
(a) Municipal Names as of 1980

(b) Municipal Names as of 2015

Figure 4 Change of Administrative Borders in Gifu Prefecture

Notes: Author's creation. The solid and dashed lines indicate the administrative borders as of 1980 and 2015, respectively. Note that Yamaguchi-mura, Nagano prefecture (20431) was merged into Nakatsugawa-shi, Gifu prefecture (21206) beyond the prefectural border on February 13, 2015. The map of each prefecture is provided in the Online Appendix.

Table 4 Layout of the Municipality Converter (Example of Nakatsugawa-shi, Gifu Prefecture) between 1990 and 2015

merge_id_muni	id_muni1990	id_muni1995	id_muni2000	id_muni2005	id_muni2010	id_muni2015
21206	21206	21206	21206	21206	21206	21206
21561	21561	21561	21561	21206	21206	21206
21562	21562	21562	21562	21206	21206	21206
21563	21563	21563	21563	21206	21206	21206
21564	21564	21564	21564	21206	21206	21206
21565	21565	21565	21565	21206	21206	21206
21566	21566	21566	21566	21206	21206	21206
20431	20431	20431	20431	21206	21206	21206

merge_id_muni	name_muni1990	name_muni1995	name_muni2000	name_muni2005	name_muni2010	name_muni2015
21206	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu
21561	Sakashita-cho, Gifu	Sakashita-cho, Gifu	Sakashita-cho, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu
21562	Kawaue-mura, Gifu	Kawaue-mura, Gifu	Kawaue-mura, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu
21563	Kashimo-mura, Gifu	Kashimo-mura, Gifu	Kashimo-mura, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu
21564	Tsukechi-cho, Gifu	Tsukechi-cho, Gifu	Tsukechi-cho, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu
21565	Fukuoka-cho, Gifu	Fukuoka-cho, Gifu	Fukuoka-cho, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu
21566	Hirukawa-mura, Gifu	Hirukawa-mura, Gifu	Hirukawa-mura, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu
20431	Yamaguchi-mura, Nagano	Yamaguchi-mura, Nagano	Yamaguchi-mura, Nagano	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu	Nakatsugawa-shi, Gifu

Notes: The variable merge_id_muni is the key code that merges the municipality converter with the municipality codes of original data. The municipality code is based as of October 1 of the survey year, which is the survey date of the population census. Nakatsugawa-shi, Gifu prefecture experienced the cross-prefecture merger with Yamaguchi-mura, Nagano prefecture on February 13, 2005. The municipalities merged to Nakatsugawa-shi, Gifu prefecture changed the municipality codes (5-digit) to that of Nakatsugawa-shi, Gifu prefecture (21206). The name of the prefecture and the name of the municipality are separated by a comma and single-byte space. In the case of a town/village, the county name is also added (omitted in Table 4 due to the space limitation).

```
**************************************************************************
** [Coding Example of Stata]
** Names of Data Files: muni_pop[yyyy].dta ([yyyy]: Year)
** (Municipal Data from 1980 to 2020)
** Variables year id_muni pop
** year: Survey Year
** id_muni: Municipality Code at the Time of the Survey
** pop: Total Population
**************************************************************************


**==============================================
** Reaggregation of Past Municipal Data
**==============================================
** Loop
forvalues i = 1980(1)2020 {

    ** Load Municipal Data
    use "muni_pop`i´.dta", clear

    ** Make Key Variable to Connect with the Municipality Converter
    gen merge_id_muni = id_muni

    ** Add Municipal Codes and Names as of 2020 using the Key Variable
    merge 1:1 merge_id_muni using "Converter.dta", keepusing(id_muni2020 name_muni2020)

    ** Delete Unused Data in the Data
    drop if _merge == 1

    ** Delete Unused Data in the Municipality Converter File
    drop if id_muni2020 == .

    ** Reaggregate Past Data using the 2020 Municipal Code
    by id_muni2015, sort: egen totalpop = total(pop)

    ** Delete Duplicated Records
    duplicates drop id_muni2020, force

    ** Keep Variables to be Used
    keep year id_muni2020 name_muni2020 totalpop

    ** Data Formatting
    replace year = `i´
    sort id_muni2020
    order year id_muni2020 name_muni2020 totalpop

    ** Store Past Data with Municipality Code as of 2020
    save "muni_pop`i´_base2020.dta", replace
}

**==============================================
** Creat Long-style Panel Data
**==============================================
** Delete Data on Memory
clear

** Append Data by Loop
forvalues i = 1980(1)2020 {
    append using "muni_pop`i´_base2020.dta.dta"
}

** Save Panel Data
save "muni_pop_panel1980-2020.dta", replace
```

Figure 5   Stata Code Example for Constructing Municipality-level Panel Data Using the Municipality Converter

Notes: Author's creation. This is an example of Stata code to construct a municipality-level panel data.

Figure 5 shows an example of a Stata code to give an intuitive idea of the creation process. When working with Stata, it is necessary to change the names of data and variables as appropriate for each user's situation.

5   Verifying Accuracy of Municipality Converter

In this section, we verify the accuracy of the created municipality converter. This is done by comparing whether the results are the same as the municipality-level panel data independently constructed by a highly reliable third party. Assuming that the panel data prepared by a third party is correct, we refer to it as the answer data. As the answer data, we use the municipality-level panel data provided by Japan's Future Committee of the Cabinet Office (Cabinet Office, 2015). We use this data for the validation. If the results are the same as the answer data, the municipality converter of this paper is judged to have been created correctly. The variables used in the validation are the total population from the Population Census and the value of manufactured goods shipments from the Census of Manufacture. Table 5 summarizes the verification results.

First, the verification results of the total population in the Population Census show that all municipalities had the same figures between 1980 and 2010, except for Kofu city, Yamanashi prefecture, which had a different population in 2010. As discussed in footnote 5, Kamikuishiki village, Yamanashi prefecture (19341) was incorporated and merged into Kofu city (19201) on March 1, 2006, while "Oaza Kakehasi and Furuseki" was divided and incorporated into Kofu city (19201) and "Oaza Shoji, Motosu, and Fujigane" into Fujikawaguchiko town (19430). In the municipality converter, Kamikuishiki village in Yamanashi prefecture is simply added to the Kofu city side because the municipality converter cannot handle cases where a municipality is split.[6]

Next, we discuss the verification results of the value of manufactured goods shipments in the Census of Manufacture. The only major difference was the treatment of Oamishirasato city, Chiba prefecture. The Cabinet Office data do not include data for Oamishirasato city, Chiba prefecture in 2012, but the 2012 Census of Manufacture includes data for Oamishirasato town, Chiba prefecture. The difference arises from the fact that Oamishirasato town experienced the establishment of city in January 1, 2013, and then the municipality code changed. The municipality converter correctly

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[6]In the currently available version of the Cabinet Office data (updated January 22, 2015), the population of Kamikuishiki village, Yamanashi prefecture is not included in Kofu city nor Fujikawaguchiko town, and may have been excluded during the tabulation.

Table 5   Verification Results for Accuracy of Municipality Converter

Case 1	Variable to be verified: Total Population, Population Census
Period	1980, 1985, 1990, 1995, 2000, 2005, 2010
Source of Answer Data	The municipality-level panel data on the total population is constructed by Japan's Feature Committee, Cabinet Office (Cabinet Office, 2015).
Source of Original Data	The total population of each municipality is taken from the Population Census, which is available on the e-Stat Statistics Bureau, Ministry of Internal Affairs and Communications (2023).
Verification Results	Differences are observed between the Cabinet Office data and the converter recalculation due to the treatment of the merger of Kamikuishiki-mura, Yamanashi prefecture. Otherwise, the data are consistent for all years.

Case 2	Variable to be verified: Value of manufactured goods shipments, Census of Manufacture
Period	2001–2012 (each year)
Source of Answer Data	The municipality-level panel data on the value of manufactured goods shipments is constructed by Japan's Feature Committee, Cabinet Office (Cabinet Office, 2015).
Source of Original Data	The municipal data are provided from the Ministry of Economy, Trade and Industry (2023).
Verification Results	While Oamishirasato-cho, Chiba prefecture has null data in the Cabinet Office data, the converter includes the information on the municipal establishment of Oamishirasato-cho, Chiba prefecture (January 1, 2013), thus succeeding the data for Oamishirasato-cho, Chiba prefecture from 2001 to 2012 Censuses of Manufacture. Other differences may be due to rounding errors in the monetary units. The unit of the Cabinet Office data is million yen, while the unit of the original data is ten thousand yen.

Notes: The upper side shows the verification result of Population Census. The lower side shows the verification results of the Census of Manufacture. The code and data for replication are available online.

reflects the change of municipality code for Oamishirasato town. Other small differences in the value of manufactured goods shipments may be due to rounding errors in the monetary units. The Cabinet Office data are rounded to the nearest million yen, while the original data are rounded to the nearest ten thousand yen.[7]

Both results suggest that the municipality converter developed in this paper is reliable and can be used to create municipality-level panel data. It is expected that the municipality converter helps researchers easily construct municipality-level panel data for their empirical research.

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[7]The same problem as the total population does not occur in the value of manufactured goods shipments, because Kamikuishiki village in Yamanashi prefecture was not included in the original data of the Census of Manufacture.

6 Concluding Remarks

This study developed a municipality converter that tabulates historical changes of municipality codes through the municipal mergers in Japan. Due to geographical changes in administrative borders caused by the municipal mergers, it had been difficult to make municipality-level panel data over a long period of time. By applying the municipality converter developed in this study to municipal data, it is possible to easily construct municipality-level panel data based on unified geographic units of municipalities from 1980 to 2020. It can also be applied in empirical analyses using household and firm-level data to controls for regional fixed effects. The municipality converter makes a significant contribution to the future development of regional economic analysis in Japan by helping researchers save significant time in their empirical research projects.

References

Cabinet Office (2015) "Population and Economic Data by Municipality, Committee for Japan's Future."
https://www5.cao.go.jp/keizai-shimon/kaigi/special/future/keizai-jinkou_data.html (accessed on January 19, 2023).

Ministry of Economy, Trade and Industry (2023) "Census of Manufacture."
https://www.meti.go.jp/english/statistics/tyo/kougyo/index.html (accessed on January 19, 2023).

Ministry of Internal Affairs and Communications (2007) "Code Specifications of National and Local Governments."
http://www.soumu.go.jp/main_content/000137948.pdf (accessed on January 19, 2023).

Office for Promotion of Regional Revitalization, Cabinet Office (2023) "Regional Economy Society Analyzing System (RESAS)."
https://resas.go.jp/ (accessed on January 19, 2023).

Statistics Bureau, Ministry of Internal Affairs and Communications (2023) "Portal Site of Official Statistics of Japan, e-Stat."
https://www.e-stat.go.jp/ (accessed on January 19, 2023).