Strategic Interaction among Japanese Municipalities Regarding Public Servant Salary Levels

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Abstract

It remains unclear whether local jurisdictions consider their neighbors' salary levels when making changes to their public sector salaries. Following the Great East Japan Earthquake and its aftermath, the Japanese central government introduced several policies aimed at reducing public sector salaries at the local government level, and local governments responded by reducing their employees' salaries. This study empirically tests the existence of strategic interaction in relation to public sector salary setting among municipal governments in response to central government policies. Using a sample of Japanese municipalities from 2010 to 2016, we developed a spatial model that incorporates both spatial autoregressive disturbances and spatial dependencies. We found that changes in salary levels in Japanese municipalities are dependent on the salaries in neighboring municipalities. Several estimation methods were used, and produced consistent results. Our study also suggested that yardstick competition could drive strategic interaction in relation to decision making regarding salaries. Moreover,

when the central government's top-down policy appears to be effective, the strategic interactions in public salary settings among neighboring municipalities are strong.

Keywords: Laspeyres index, public sector salary, strategic interaction, yardstick competition

1. Introduction

Appropriate salary levels in the public sector are crucial for ensuring the quality and efficiency of public services (Morikawa 2016). However, it remains unclear whether local jurisdictions consider their neighboring jurisdictions' salary levels when making decisions regarding changes to their public sector salaries. Earlier empirical studies on this topic can be divided into two groups: one dealing with local public sector salary determination and the other addressing interdependence among jurisdictions in regard to local public expenditures.

Early studies in the former group found that local public sector salaries were determined by local fiscal conditions, demographic characteristics, and labor unions. Besides, the presence of labor unions in other cities within a standard metropolitan statistical area can have an impact on local public sector salaries (Ehrenberg and Goldstein 1975), while Mehay and Gonzalez (1986) argued that inter-jurisdictional competition under monopsony market conditions such as "state legal barriers to incorporation," "the rate of annexation," and "the number of municipalities competing in a given county" (p. 83) also play an important role in public sector salary determination. Brueckner and Neumark (2014) found that local features, such as the weather and population density, might contribute to public sector salary differentials among US states. However, the abovementioned studies did not present any evidence of strategic spatial interaction in relation to determining local public sector salaries.

Regarding the second group of studies, a jurisdiction's spending is dependent not only on its income, grants from other levels of government, and demographic and/or political characteristics, but also on external factors such as expenditure by its neighboring jurisdictions. This has been confirmed by a large body of literature (e.g., Case et al. 1993; Caldeira 2012; Yang and Lee 2018). Nevertheless, the influence of external factors such as the level of salaries paid by neighboring jurisdictions on a local jurisdiction's salaries – one of the core subcategories of government spending – has largely been ignored. There is little evidence of strategic interaction among neighboring jurisdictions in setting local public sector salaries, in particular evidence derived from a spatial econometrics approach. The most relevant previous study is Mehay and Gonzalez (1986). They examined how interjurisdictional competition in municipal service markets affects municipal wages and found that local competition may be a crucial determinant of local wages. To the best of our knowledge, for more than 30 years since their study, there has been no empirical research that attempts to address interjurisdictional dependence in the setting of local public salaries.

Accordingly, this study aims to fill this research gap by providing evidence of strategic interaction among Japanese municipalities when determining public sector salaries. Using a sample of 1704 Japanese municipalities from 2010 to 2016, we empirically examined whether municipalities change their salary levels in response to changes in other municipalities. We paid close attention to the influence of central government policies on public sector salaries following the Great East Japan Earthquake (GEJE) and its aftermath. We developed a spatial model incorporating both spatial lag and error dependence and use a generalized spatial two-stage least squares (GS2SLS) approach to obtain estimates (Kelejian and Prucha 1998, 2010).

The results suggested that municipalities do pay attention to other municipalities when making decisions on their public sector salaries. In the periods following intervention by the central government, there were significant positive impacts of changes in neighboring municipalities' public sector salary levels on changes in a given municipality. The results were consistent across various specifications used as robustness checks, including the use of different spatial weighting matrices, additional control variables, and spatial panel models. Another finding is that strategic interaction is significantly stronger while a top-down policy approach by the central government is implemented than a bottom-up approach is done.

The contributions of this study are twofold. First, it provides evidence of strategic interaction regarding public sector salaries among governments at the local level. The results indicate that Japanese municipalities take neighboring municipalities' decisions into consideration when they are determining their public sector salary levels, which follows the logic of the yardstick competition mechanism. Second, it investigates how the central government's policies affect the interrelationships among municipalities by observing how the strength of strategic interaction among neighboring municipalities vary in response to changes in the central government's policies. By comparing the strategic interaction among municipalities prior to and following the intervention of the central government, we show that the central government's policies are successful in shaping the behavior of local governments, especially under a top-down policy approach.

The rest of the paper is organized as follows. Section 2 provides an literature review, Section 3 introduces the institutional background, Section 4 describes the data used and Section 5 discusses the empirical strategy. Section 6 presents the main results together with results of robustness tests, and Section 7 concludes.

2. Literature review

Few previous studies have examined strategic interaction among local governments in relation to public sector salaries, and therefore we provide an overview of previous studies on strategic interaction among local governments regarding public expenditures. Previous empirical studies have found some evidence supporting the hypothesis that local jurisdictions do not make spending decisions in isolation. However, the sources of strategic interactions vary among cases, categories, and sectors. Strategic interaction among local governments regarding public spending is theoretically explained by two main factors: expenditure spillovers and yardstick competition.

Expenditure spillovers are found in many categories of public spending, including total expenditure (Case et al. 1993; Javier et al. 2008; Ferraresi et al. 2018) and expenditure on culture (Lundburg 2006; Werck et al. 2008; Akai and Suhara 2013), public safety (Yang and Lee 2018), the environment (Deng et al. 2012), health (Yu et al. 2013; Langer 2019), education (Gu 2012), and industrial infrastructure (Lenka 2009). The estimates of spatial autocorrelation parameters are mostly negative in relation to the environment, health, public safety, infrastructure, and education, meaning that expenditure by neighboring municipalities is strategically substitutable, that is, greater spending in one municipality is associated with less spending among its neighbors. Conversely, the corresponding estimates are mostly positive in relation to total and current expenditure, implying that fiscal spending is strategically complementary. In other words, additional spending in one municipality is accompanied by additional spending in neighboring municipalities.

Yardstick competition occurs when politicians mimic neighboring jurisdictions' fiscal policies to increase their chances of being re-elected because residents use the policies of neighboring jurisdictions as a yardstick, against which they compare their local jurisdiction's policies. Yardstick competition is commonly found to be a source of strategic interaction in relation to total municipal expenditure (e.g., Hayashi and Yamamoto 2017; Kim and Park 2019) and current expenditure (Bartolini and Santolini 2012). It can also be found in subcategories such as expenditure on welfare (Revelli 2006; Elhorst and Freret 2009) and education (Gu 2012), and in other subcategories including capital construction, enterprise innovation, agricultural support, and government administration (Caldeira 2012). The estimates of the coefficients of interest are predominantly positive, as evidenced by the fact that local jurisdictions tend to mimic each other when it comes to making fiscal spending decisions.

Conversely, some studies such as those of Gebremariam et al. (2012) and Fossen et al. (2017) found no significant strategic interaction in relation to local public expenditure. Gebremariam (2012) found that positive interdependence in relation to local public expenditure in Appalachia was a result of the spatial error process, rather than strategic interaction. Similarly, using an exogenous variable in the form of the level of exposure of Columbian municipalities to oil price shocks, Fossen et al. (2017) found that the estimates of spatial interactions for total expenditure and most spending categories were small and not significantly different.

As stated earlier, previous studies have attempted to find evidence of strategic interaction among local governments regarding overall expenditure and expenditure on subcategories other than salaries. Although salaries are one component of local government expenditure, little previous research have paid attention to strategic interaction in relation to public sector salary setting.

3. Institutional background

3.1 Post-Great East Japan Earthquake policies regarding public sector salaries

In March 2011, the GEJE struck northeastern Japan, resulting in a devastating tsunami followed by a nuclear accident. The compound disaster "caused a large number of human casualties and devastated properties" (Parwanto and Oyama 2015). Damages were estimated at ¥16.9 trillion (US$210 billion), or approximately 4% of Japan's gross domestic product (The World Bank 2014). Despite the relatively small amount of economic activity in the affected region, the GEJE had a severe and widespread economic impact, partly because of the nuclear accident, which disrupted energy networks and supply chains. In a concerted effort to revive the economy and repair damaged infrastructure, the Japanese government implemented various fiscal policies including a reduction in government expenditure, which involved a reduction in the cost of public servants (Japanese National Diet 2011).

3.1.1 Bottom-up approach

In 2012, national public sector salaries were reduced by an average of 7.8% for 2 years to display solidarity with other cost-cutting efforts and to generate the financial resources required for reconstruction of the ravaged Tohoku region (Nikkei 2013a). This was included in legislation introduced by Prime Minister Yoshihiko Noda. In 2012, the central government also asked local governments to reduce employee salaries in line with the national reduction.

It can thus be seen that the decision to reduce employees' salaries was left to the various municipalities' discretion; in other words, it is a bottom-up approach, focusing on the actors who devise and implement policies and public services at the local level (Matland 1995). This approach allows the local actors to adopt flexible strategies in response to specific local challenges and contextual factors (Cerna 2013).

3.1.2 Top-down approach

In Japan, the Local Allocation Taxes, known as unconditional grants, are aimed at correcting inequalities among local governments to ensure a consistent standard of public services in all regions. Nikkei (2013b) noted that the Local Allocation Taxes distributed in FY2013 were reduced by 400 billion yen (US$3.7 billion[1]), which represented 7.8% of the salaries of local government employees. In 2013, local governments that voluntarily reduced their salaries would receive total grants of 300 billion yen (US$2.77 billion) under the Region-Energizing Project (*Chiiki no Genki Dukuri Jigyohi*, in Japanese) (Ministry of Internal Affairs and Communications 2013). These grants were awarded on the condition that local salaries were below the national level as of 2013 and that the number of personnel had been significantly reduced. The Local Allocation Taxes accounted for one-fourth of the national budget, and the government had to issue annual deficit-financing bonds to offset the shortage of local financial resources.

In response to this policy, municipalities were required to reduce their salary levels by the reduction of Local Allocation Tax, otherwise they would have to either

[1] The conversion rate is based on data from Morningstar for Currency and Coinbase for Cryptocurrency as at 21 April 2021.

reduce or discontinue the provision of some public services, which would be harmful to the welfare and security of their communities. In this sense, a series of the policies on local salaries are in line with the top-down approach. The top-down policy approach is that central government policymakers regard them as central actors and focus their attention on factors that they can control (Matland, cited in Cerna 2013). This approach enables the central government to apply consistent implementation across different policy areas, in this case, all local municipalities.

3.2. Local public servant salaries

Salaries of local public servants follow the principle of equilibrium.[2] In other words, compensation paid to local personnel must take into account the duties, responsibilities, cost of living, and salaries of personnel in the national government, other local governments, and private enterprises (Ishida 2015). The salaries for local public sector personnel should be set based on the standard for national public sector personnel,[3] which was established after considering private sector salaries and the cost of living. In this manner, a balance among local governments is maintained by ensuring that all local government salary decisions are based on the salary schedule for national public sector personnel.

To compare local civil service salaries with those of the national civil service, the Laspeyres index is used. This index is calculated using a weighted aggregate method,

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[2] Regarding the principle of equilibrium, see https://jica-net-library.jica.go.jp/lib2/08PRDM003/en/pdf/4_3_1.pdf.

[3] Japan International Cooperation Agency (2008) provides a comprehensive overview of Japan's local government system.

in which the national civil service standard is set at 100 points. Before the GEJE, the Ministry of Internal Affairs and Communications had used monetary measures, such as placing restrictions on bond issues, to stabilize the Laspeyres index values for various local governments (Japan International Cooperation Agency, 2008).

4. Data

Our sample consisted of annual data for 1704 municipalities over 7 fiscal years (FY2010–FY2016). This period was chosen for two reasons. First, municipal mergers had almost finished by the end of 2009, and so there was no change in the number of municipalities during the period selected, enabling us to construct a balanced panel of municipalities. This was important for maintaining the exogeneity of the weighting matrix. Second, the overall period covered subperiods before and after the central government's policy intervention.

The data were collected from official government websites controlled by the Ministry of Internal Affairs and Communications. Table 1 presents summary statistics of the variables in 2010 and 2014, which were used to construct the baseline model in this study. In regression analysis, the dependent variable was the Laspeyres index, while various sets of control variables were used to capture municipal variations in demographic and socioeconomic characteristics, fiscal capacity, and collective bargaining.

Table 1. Summary statistics of variables in 2010 and 2014

	Mean	Std. Dev	Min	Max

	2010	2014	2010	2014	2010	2014	2010	2014
Dependent variable								
Laspeyres index	96.056	96.572	4.022	3.498	71.4	74.9	105.1	105.8
Independent variables								
Total population	69661.6	69093.0	182170.0	183836.5	201	182	3688773	3717601
Population density	864.26	861.079	1775.8	1785.5	1.629	1.588	14020	14111.2
Share of population < 15	12.653	12.05	2.236	2.314	4.251	3.154	21.807	21.069
Share of population > 64	27.945	31.039	6.981	7.056	9.192	11.84	57.243	59.825
Taxable income per taxpayer	2.74	2.746	0.391	0.423	1.926	1.939	5.736	6.317
Cumulative debt rate	100.309	95.918	27.488	28.328	1.042	.302	411.607	311.204
Unemployment rate	6.307	4.374	2.184	1.456	0	0	22.718	14.858
Grant ratio	42.499	40.094	16.25	14.175	2.567	3.738	86	74.299
GEJE grant per capita	0	3.511	0	26.288	0	0	0	457.0
Labor union	.731	0.732	.444	0.443	0	0	1	1

Regarding demographic attributes, we included municipal population, population density, the proportion of the population aged under 15, and the proportion of the population aged over 64. Municipal population and population density capture the potential economies of scale and/or congestion effects, while the proportions of the population aged under 15 and over 64 influence the composition of municipal public spending, and hence indirectly affect salary levels. Regarding socioeconomic attributes, we collected data on the municipal unemployment rate and per capita taxable income as proxies for the local economic situation. Fiscal capacity can influence salary levels because it can affect the ability of local jurisdictions to pay for high-quality workers and to make independent fiscal decisions. Therefore, we collected data on the ratios of municipal cumulative debts and conditional grants from upper-tier governments to total municipal revenue.

Some evidence (e.g., Belman et al., 1987) shows that the presence of labor unions can affect the earnings of local government employees. Collective bargaining can play a critical role in the compensation levels of municipal workers. Thus, a dummy variable reflecting the presence or otherwise of a labor union in various municipalities was included. A variable representing central government grants for rebuilding the local infrastructure and economy after the GEJE was added to a robustness check model to control for variations in the impact of the disaster on different municipalities. Four variables—total population, population density, taxable income per taxpayer, and grants for GEJE reconstruction per capita—were transformed into natural logarithm form.

Figures 1–4 illustrate the Laspeyres index values of Japanese municipalities during the period 2010–2016. In Figure 1, it can be seen that the mean Laspeyres index value rose from around 96 in 2011 to more than 104 in 2012, possibly as a result of the reduction in national public sector salaries. The mean remained the same in 2013, before falling to around 96.5 in 2014, similar to the 2011 value. This fall can be explained by the restoration of national public sector salaries to their original level.

Figure 1. Average Laspeyres Index Values, 2010–2016

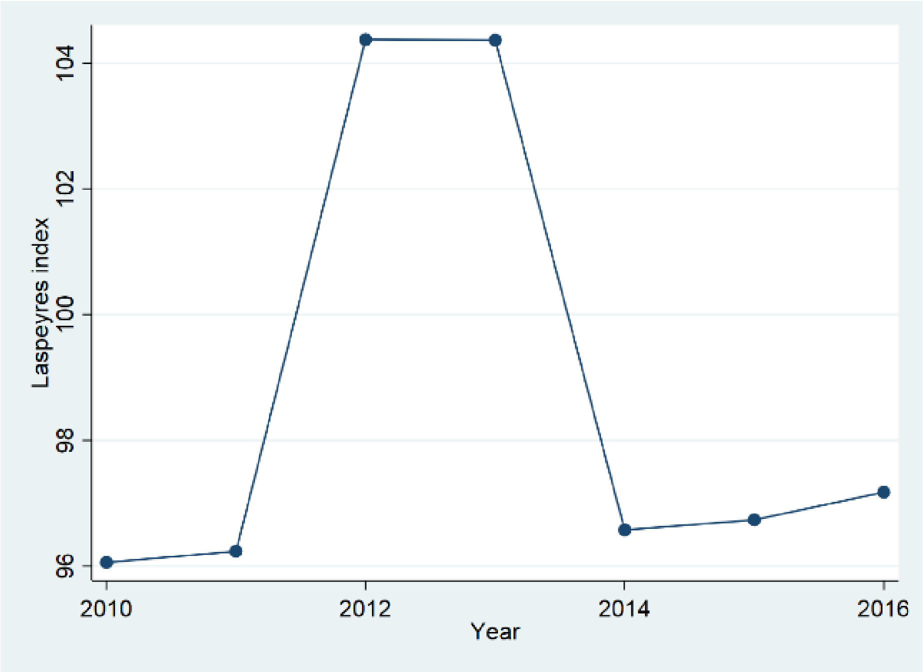
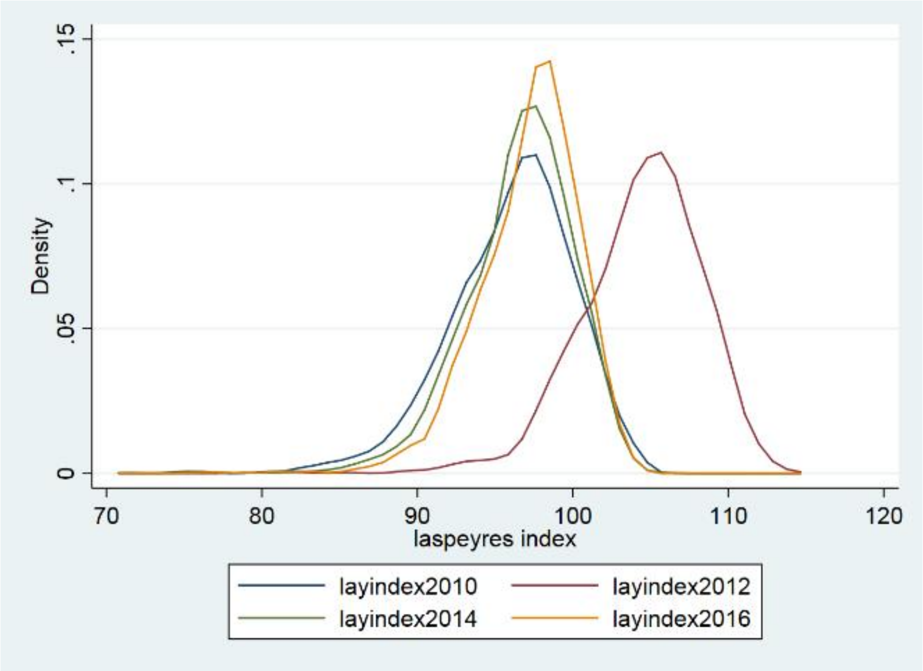
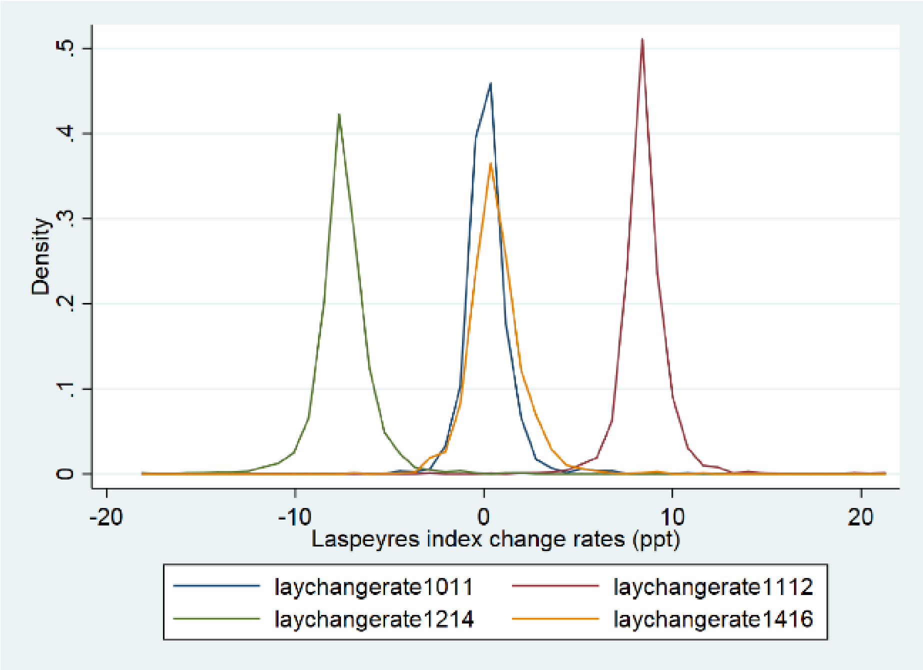


Figure 2. Kernel Distribution of Laspeyres Index Values for 2010, 2012, 2014, and 2016



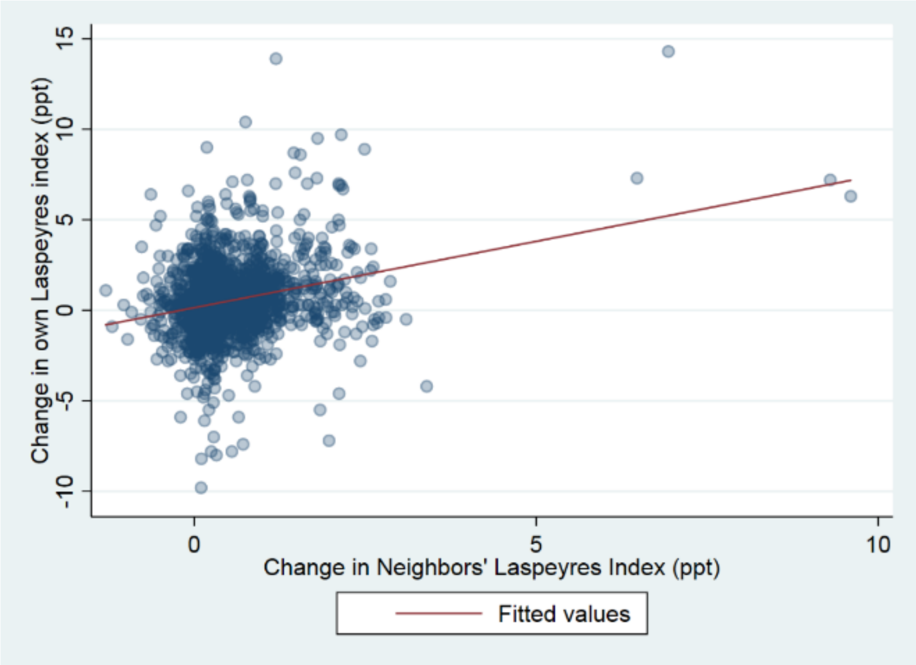
Note: "layindexYEAR" indicates the Laspeyres index values in YEAR.

Figure 3. Kernel Distributions of Change Rates in Laspeyres Index Values between 2010 and 2011, 2011 and 2012, 2012 and 2014, and 2014 and 2016



Note: "laychangerateXXYY" indicates a change rate of the Laspeyres index values from the year 20XX to 20YY. ppt = percentage point.

Figure 4. Differences between a Municipality's Own Laspeyres Index Values and those of Neighboring Municipalities' within 60 km between 2014 and 2010



Note: ppt = percentage point.

In Figure 2, the distribution of the Laspeyres index values in 2010 was similar to that in 2012, but the distributions in 2014 and 2016 are more converged. This indicates a decline in the variations among municipal salary levels after 2012, and suggests that municipalities were likely to mimic others. Figure 3 shows that Laspeyres index values increased from 2011 to 2012 but decreased to a large extent from 2012 to 2014 as a result of variations in national public sector salary levels. The index values changed only slightly from 2010 to 2011 and from 2014 to 2016. Figure 4 suggests that there is a positive relationship between changes in a municipality's own Laspeyres index values and those of neighboring municipalities. This indicates that changes in salary levels in neighboring municipalities are likely to be positively correlated with changes in the own municipality's salary levels.

5. Empirical strategy

The spatial autoregressive model with spatial error correlation (SARAR) has been widely used in previous studies of strategic interaction among local governments (Lenka, 2009; Gebremariam et al., 2012) because it enables consistent estimation by simultaneously incorporating both spatial lag and spatial error dependence. In this study, we adopt the SARAR model to deal with the coexistence of the two types of spatial correlations. The conventional equation can be written as

$$y = \lambda_0 Wy + X\beta + u, \quad u = \rho_0 Wu + \varepsilon, \qquad (1)$$

where y is an $N \times 1$ vector in which element y_i is the Laspeyres index value in municipality i, Wy is the corresponding spatially lagged dependent variable for the weighted matrix W, X is an $N \times K$ matrix of explanatory variables, λ_0 is the spatial autoregressive parameter, and β is a $K \times 1$ vector of coefficient parameters. An $N \times 1$ vector of error terms, u, is assumed to follow a spatial autoregressive process; ρ_0 is the spatial autoregressive coefficient for the error lag Wu, and ε is an $N \times 1$ vector of white noise errors.

Using a standard cross-sectional relationship risks the problem of omitted variables and makes it difficult to draw ceteris paribus conclusions. Thus, the following alternative equation explicitly considers how changes in a lagged dependent variable and controls over time affect the change in y over the same period. Differencing removes all unobserved time-invariant heterogeneity. We examined differences in various periods, namely, those between 2010 and 2012, 2013, 2014, 2015, and 2016. The equation is as follows:

$$\Delta Y = \lambda W \Delta Y + \Delta X\beta + \Delta u, \quad \Delta u = \rho W \Delta u + \varepsilon. \qquad (2)$$

Maximum likelihood estimation does not always generate consistent results because the computation of the eigenvalues becomes numerically unstable for matrices of more than 1,000 observations (Anselin, 2001). Furthermore, we cannot consistently estimate the spatial autoregressive disturbances using the maximum likelihood method when the error terms may not normally distributed. The GS2SLS estimator requires no distributional assumption regarding the error terms, and thus is more efficient. This approach also generates consistent and asymptotically efficient estimates under the assumption that the explanatory variables are exogenously related to the dependent variable (Kelejian and Prucha, 1998, 2010; Arraiz et al., 2010).

Next, we turn to the spatial weighting matrix. One advantage of specifying a spatial weighting matrix (W) based on location is that the elements are exogenous (Elhorst and Vega, 2013; LeSage, 2014). In this study, we use the inverse distance matrix as the baseline weighting matrix. Accordingly, all diagonal elements of W are zeros, while off-diagonal elements ω_{ij} are defined as $\omega_{ij} = 1/d_{ij}$, where d_{ij} is the distance between the centroids of two municipalities. The matrix is truncated at 60 km following Miyazaki and Sato (2017). If the geographic distance between the centroids of two given municipalities is less than the cut-off point of 60 km, they are considered neighbors. Each row of W is normalized. The latitudes and longitudes of the municipal locations were based on the Tokyo datum geodetic system and used to calculate the distance between a given pair of municipalities, as described in Kirimura et al. (2011).

The choice of the weighting matrix is, to a certain degree, arbitrary (Elhorst and Vega, 2013), and neighborliness does not necessarily only mean geographic proximity (Case et al., 1993), and therefore we tested the robustness of the results by applying three alternative weighting matrices. The first was the binary contiguity matrix, another popular method of determining geographical proximity, with elements $\omega_{ij} = 1$ if two municipalities shared a common border, and 0 otherwise. The second was the same-prefecture weighting matrix, whose elements $\omega_{ij} = 0$ if the two municipalities did not belong to the same prefecture, and 1 otherwise.

The third, and non-standard method of specifying W, involved a spatial municipality characteristic, namely, total revenue, that made it possible for municipalities to take into account the decisions of similar municipalities. This matrix incorporated both geographical and economic distance. The off-diagonal elements of the revenue-weighted inverse distance matrix were the products of inverse distance $1/d_{ij}$ multiplied by the element of the matrix that was the inverse of the absolute value of the difference in total revenue between municipalities i and j divided by the total revenue of municipality i. The sum of each row of the weighting matrix is normalized to one. One shortcoming of using weighting matrices based on socioeconomic distances is that the assumption of exogeneity might be invalid because the dependent variable might have an impact on total revenue. Therefore, the revenue-based inverse distance matrix was only used to check for robustness.

6. Results

6.1. Preliminary results

As shown in the lower side of Table 2, in our model Moran's I and Lagrange multiplier (LM) tests show the presence of spatial lag and error correlations. Then, spatial models should be used for empirical analysis because if we applied non-spatial models and ignored the spillover effect, our estimated parameters would be biased and inconsistent.

We run the year-by-year cross-sectional regressions as their estimates are expected to provide an idea of how spatial interaction estimates vary from year to year. It can be seen from Table 2 that the coefficients of spatial lag *Lambda* were insignificant in 2010 and 2011 (columns (1) and (2), respectively), but then increased year by year, becoming significant from 2012 onwards. It can be inferred from the result that no spatial interaction among municipal governments in the levels of public salary is seen before 2011 but such interaction has appeared since 2012. Note, however, that the estimates refer to the spatial dependence in the public salary levels, not the interaction of changes in public salary. Coefficient estimates of total population, taxable income per taxpayer, and presence of a labor union are significantly positive at the 1% level, while estimates of population density and grant ratios are negative and statistically significant for all specifications.

Table 2. Spatial model estimates from year-by-year cross-sectional regressions

Years	**2010**	**2011**	**2012**	**2013**	**2014**	**2015**	**2016**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	**(6)**	**(7)**
Total population	1.249***	1.182***	1.150***	1.060***	0.893***	0.896***	0.924***
	(0.081)	(0.076)	(0.080)	(0.081)	(0.074)	(0.068)	(0.067)
Population density	–0.292***	–0.261***	–0.270***	–0.263***	–0.211**	–0.258***	–0.184**
	(0.098)	(0.094)	(0.099)	(0.099)	(0.089)	(0.084)	(0.080)
Share of population < 15	0.005	–0.005	–0.008	0.018	–0.000	0.034	0.087
	(0.065)	(0.064)	(0.068)	(0.068)	(0.061)	(0.058)	(0.053)
Share of population > 64	–0.032	–0.029	–0.020	–0.016	–0.021	–0.004	0.022
	(0.028)	(0.027)	(0.028)	(0.028)	(0.026)	(0.024)	(0.023)
Taxable income per taxpayer	7.503***	6.043***	6.621***	7.433***	4.473***	3.730***	3.292***
	(1.363)	(1.343)	(1.353)	(1.340)	(1.082)	(1.073)	(1.013)
Unemployment rate	–0.104**	–0.111**	–0.051	–0.025	–0.002	0.019	–0.018
	(0.043)	(0.048)	(0.057)	(0.063)	(0.061)	(0.061)	(0.060)

Grant ratio	–0.025***	–0.028***	–0.027***	–0.022**	–0.034***	–0.042***	–0.029***
	(0.009)	(0.009)	(0.009)	(0.009)	(0.009)	(0.008)	(0.008)
Cumulative debt rate	–0.015***	–0.012***	–0.014***	–0.011***	–0.008***	0.000	–0.002
	(0.003)	(0.003)	(0.003)	(0.003)	(0.003)	(0.000)	(0.002)
Labor union	1.825***	1.666***	1.640***	1.708***	1.555***	1.445***	1.345***
	(0.177)	(0.169)	(0.177)	(0.178)	(0.163)	(0.156)	(0.148)
Constant	76.281***	78.860***	83.721***	81.535***	78.764***	78.911***	77.440***
	(3.012)	(2.907)	(2.965)	(2.959)	(2.526)	(2.487)	(2.388)
Lambda	0.017	0.016	0.039***	0.047***	0.059***	0.057***	0.058***
	(0.011)	(0.011)	(0.010)	(0.010)	(0.010)	(0.010)	(0.009)
Rho	0.727***	0.742***	0.706***	0.667***	0.659***	0.676***	0.730***
	(0.038)	(0.038)	(0.038)	(0.037)	(0.036)	(0.037)	(0.037)
Diagnostic tests							
Moran's I (error)	30.8282	31.5076	30.6785	28.6513	30.0535	30.7242	34.3952
P-value	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
LM lag + LM error	1560.1530	1869.8133	3380.1237	3642.7751	5402.3232	6127.2642	1.01e+04
P-value	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	1704	1704	1704	1704	1704	1704	1704

Notes: Standard errors are shown in parentheses: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. The dependent variable is Laspeyres index. Total population, population density, and taxable income per taxpayer are in natural logarithm form.

6.2. Main results

Table 3 shows the results of spatial interactions among municipalities in relation to public sector salaries under six difference-based specifications. The results of Moran's I and LM tests under all specifications suggested the presence of both spatial lags and spatial errors.

The central government introduced both bottom-up and top-down policy approaches regarding the salaries of municipal public servants during the study period. It might take some time for the central government's policies to take effect because municipalities need to consider their budget allocation. Therefore, let us assume that it takes a year for the policies to take effect. The coefficient of *Lambda* was positive but not statistically significant for changes during the period 2010–2012 (see column 1, Table 3). This indicates that, as the bottom-up approach, which encourages municipalities to voluntarily reduce salary levels to the national level, started in 2012, municipalities barely interacted with each other regarding changes in salary levels even after the bottom-up policy was introduced. Conversely, the coefficient of *Lambda* for changes in the period 2010–2013 (column 2) was significantly positive (0.576). The strategic interaction among municipalities strengthened during the period 2010–2014 (column 3), with the coefficient rising to 0.943. This could have been the result of the top-down approach that was introduced in 2013 with a cut of 7.8% to the Local Allocation Tax in an effort to financially constrain municipalities, thereby forcing them to reduce their salary levels. These two coefficients indicate that a 10% change in the Laspeyres index in neighboring municipalities resulted in a corresponding change of 5.76% to 9.43% in the Laspeyres index in the own municipality in 2010–2013 and 2010–2014, respectively. Thus, it can be seen that interaction among neighboring municipalities in relation to salary levels is strong and significant under the influence of the top-down approach.

Table 3. Spatial interactions among municipalities regarding public sector salary levels

	Δ 2010–2012	**Δ 2010–2013**	**Δ 2010–2014**	**Δ 2010–2015**	**Δ 2010–2016**	**Δ between 2010–2011 vs 2013–2016**
	(1)	**(2)**	**(3)**	**(4)**	**(5)**	(6)
Δ Total population	–5.723 *	–4.304	–3.909	–6.013 **	–4.443	–4.966
	(2.730)	(2.424)	(2.299)	(2.371)	(2.517)	(3.715)
Δ Population density	0.761	0.037	0.231	0.975	–0.097	1.178
	(1.961)	(2.156)	(2.162)	(2.212)	(2.401)	(3.669)
Δ Share of population < 15	0.022	0.113	0.243 ***	0.200 ***	0.169 ***	0.208 ***
	(0.145)	(0.101)	(0.077)	(0.067)	(0.062)	(0.065)
Δ Share of population > 64	0.134	0.108	0.181 ***	0.111 ***	0.089 ***	0.101 ***
	(0.088)	(0.056)	(0.041)	(0.036)	(0.032)	(0.033)
Δ Taxable income per taxpayer	2.740	0.566	–0.054	1.765	0.269	–0.058
	(1.939)	(1.871)	(1.227)	(1.306)	(1.403)	(0.338)
Δ Unemployment rate	–0.059	0.010	–0.047	–0.055	–0.066	–0.046
	(0.061)	(0.045)	(0.037)	(0.034)	(0.034)	(0.033)
Δ Grant ratio	–0.008	–0.009	–0.011	–0.020 *	–0.014	–0.006
	(0.007)	(0.008)	(0.008)	(0.009)	(0.009)	(0.008)
Δ Cumulative debt rate	–0.004	–0.003	–0.001	0.000	0.004	0.000
	(0.003)	(0.002)	(0.002)	(0.000)	(0.002)	(0.000)
Δ Labor union	–2.300	1.297	1.680	1.497	1.851	2.211
	(1.565)	(1.220)	(1.314)	(1.344)	(1.454)	(1.327)
Lambda	0.161	0.576 ***	0.943 ***	0.694 ***	0.761 ***	0.888 ***
	(0.147)	(0.115)	(0.095)	(0.125)	(0.131)	(0.120)
Rho	0.182	–0.351	–0.747 ***	–0.272	–0.256	–0.509 *
	(0.155)	(0.201)	(0.188)	(0.214)	(0.236)	(0.231)

Diagnostic tests						
Moran's I (error)	6.4540	10.3923	15.8245	16.8082	16.6944	16.9148
P-value	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
LM lag + LM error	105.9406	342.6542	242.2813	298.2547	311.0479	945.6674
P-value	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]	[0.000]
Observations	1704	1704	1704	1704	1704	1704

Notes: Standard errors are shown in parentheses: * $p < 0.1$; ** $p < 0.05$; *** $p < 0.01$. The dependent variable is change in the Laspeyres index. Changes in total population, population density, and taxable income per taxpayer are in natural logarithm form.

The values for *Lambda* in columns (4) and (5) in Table 3 show that there was still strategic interaction in 2010–2015 and 2010–2016. We also adopted a specification using the differences in the averages from 2010–2011 and 2013–2016 in column (6), and obtained substantially the same result. These results supported the existence of the spatial interdependence of changes in municipal public salary and hence interdependence in setting their salary levels. The estimates of the spatial error coefficient, *Rho*, are negative and insignificant in most regressions, inferring that there are no spatially correlated disturbances that significantly affect local governments' decisions regarding changes to salary levels.

Notably, the differences in the proportion of the population less than 15 years old and that over 64 years old from columns 2 to 6 had a significant impact on the differences in the Laspeyres index values. The estimates of the coefficients for changes in population density, taxable income per taxpayer, unemployment rate, grant ratio, cumulative debt rate, and presence of a labor union were not statistically significant under any specification. It follows that changes in age characteristics in a municipality play a crucial role in determining changes in salary levels but other attributes do not.

6.3. Robustness checks

We performed several robustness checks by using other specifications to establish whether the results of the main estimation could be confirmed. Column (1) in Table 4 included an independent variable representing the GEJE recovery grant from the central government to the municipalities. The coefficients for strategic interaction and disturbance interaction were both statistically significant, similar to the 2010–2014 baseline results. The results were also robust to the choice of weighting matrices. All four specifications with different weighting matrices generated significantly positive coefficients regarding neighboring municipalities' changes in salary levels at the 1% level of significance (see columns 1, 2, 3, and 4, respectively, in Table 4). All models provided consistent results regarding spatial interaction among neighboring municipalities in relation to changes to salary levels. The estimates of *Lambda* in the robustness checks were also comparable to those in the main results.

Table 4. Spatial interactions among municipalities regarding salary changes under other specifications

	Add GEJE grant	**Contiguity matrix**	**Prefecture matrix**	**Revenue inverse matrix**
	(1)	**(2)**	**(3)**	**(4)**
Δ Total population	–3.434	–5.527 *	–4.753	–3.975
	(2.257)	(2.575)	(2.482)	(2.265)

Δ Population density	0.198	0.208	0.395	0.706
	(2.144)	(2.255)	(2.231)	(2.032)
Δ Share of population < 15	0.236 ***	0.247 ***	0.240 ***	0.215 ***
	(0.077)	(0.087)	(0.088)	(0.075)
Δ Share of population > 64	0.175 ***	0.160 ***	0.150 ***	0.141 ***
	(0.039)	(0.049)	(0.049)	(0.040)
Δ Taxable income per taxpayer	0.092	0.097	-0.566	1.182
	(1.212)	(1.409)	(1.428)	(1.177)
Δ Unemployment rate	–0.052	–0.013	–0.038	–0.023
	(0.036)	(0.042)	(0.043)	(0.036)
Δ Grant ratio	–0.010	–0.021	–0.012	–0.006
	(0.008)	(0.009)	(0.009)	(0.009)
Δ Cumulative debt rate	–0.001	–0.001	–0.001	–0.001
	(0.002)	(0.002)	(0.003)	(0.002)
Δ Labor union	1.650	1.567	1.593	1.402
	(1.300)	(1.367)	(1.351)	(1.225)
Δ GEJE grant per capita	–0.003			
	(0.041)			
Lambda	0.9999 ***	0.407 ***	0.802 ***	0.855 ***
	(0.075)	(0.131)	(0.141)	(0.129)
Rho	–0.908 ***	–0.121	0.047	–0.553 ***
	(0.168)	(0.156)	(0.212)	(0.084)
Diagnostic tests				
Moran's I	15.8367	9.1777	16.8085	8.8397
P-value	[0.000]	[0.000]	[0.000]	[0.000]
LM lag + LM error	239.4679	77.7511	269.1463	97.6925

P-value	[0.000]	[0.000]	[0.000]	[0.000]
Observations	1704	1704	1704	1704

Notes: Standard errors are shown in parentheses: * p < 0.1; ** p < 0.05; *** p < 0.01. All regressions are based on the 2010–2014 differences model. The dependent variable is change in the Laspeyres index. Changes in total population, population density, taxable income per taxpayer, and GEJE grant per capita are in natural logarithm form.

The existence of strategic interaction is also examined in the spatial autoregressive panel models (see Table 5). Columns (1) and (2) show the spatial dependence among municipalities regarding salary decisions before and after the policy intervention, respectively. For the pre-policy period, data for 2010 and 2011 were used, while data for 2013–2016 were used for the post-policy period. The estimated coefficients for strategic spatial interaction *Lambda* were significantly positive in both models, but the coefficient in the post-policy model (0.958) was much greater than that in the pre-policy model (0.247). This suggests a substantial change in the way municipalities behaved in response to changes in salary levels among neighboring municipalities as a result of the introduction of the central government's policy.

Table 5. Spatial interactions among municipalities regarding salary changes under spatial panel models

Period	**Pre-policy**	**Post-policy**
	(1)	**(2)**
Total population	–7.944 ***	–0.099
	(2.894)	(4.448)

Population density	0.569	–4.811
	(0.421)	(4.253)
Share of population < 15	–0.265	0.283
	(0.246)	(0.208)
Share of population > 64	0.026	–0.050
	(0.089)	(0.043)
Taxable income per taxpayer	1.032	–0.024
	(1.926)	(0.766)
Unemployment rate	–0.011	0.104
	(0.078)	(0.068)
Grant ratio	–0.009	0.007
	(0.007)	(0.005)
Cumulative debt rate	–0.000	–0.000
	(0.003)	(0.000)
Labor union	0.255 *	0
	(0.132)	(omitted)
Lambda	0.247 ***	0.958 ***
	(0.054)	(0.004)
Spatial coef. test (Lambda)	chi2(1) =36027.37 Prob > chi2 = 0.0000	
Observations	1704	5112

Notes: Standard errors are shown in parentheses: * p < 0.1; ** p < 0.05; *** p < 0.01. Model (1) uses data from 2010 to 2011, while model (2) uses data from 2013 to 2016. The dependent variable is the Laspeyres index.

6.4. Possible sources of strategic interaction

Ishida (2015) noted that as of 1 July 2013, 997 municipalities, or around 60% of the 1719 municipalities in Japan, had already reduced their public sector salary levels. Yardstick competition may be relevant in the case of Japan because Japanese municipalities are governed by elected councils. As argued by Ohta (2013), in difficult financial situations, municipalities that set high salary levels for public sector employees may experience severe criticism from the public, and voters may call for reform of the salary scheme to restore the balance between public and private sector salaries (Ohta, 2013). Voters might also use the Laspeyres index values of other jurisdictions as a yardstick when evaluating the performance of their local government. This argument is in line with previous studies that found evidence of yardstick competition among Japanese municipalities in relation to decisions on the acceptance of disaster-related waste (Miyazaki and Sato, 2017) and municipal spending (Hayashi and Yamamoto, 2017). As interdependence regarding decision-making on public sector salaries appeared following the central government's top-down policy, it can also be implied that the central government could affect how local governments interact with each other in public salary settings.

7. Conclusion

We developed a spatial autoregressive model with spatial error correlation to empirically investigate the degree of strategic interaction among neighboring municipalities in Japan regarding changes in public sector salaries. We used annual data for 1,704 Japanese municipalities over the period 2010–2016. Moran's I and LM tests were used to check for the existence of spatial lags and/or spatial errors in local public salary decision-making, and the results suggested spatial dependence. Because the error terms were not normally distributed, GS2SLS estimation was chosen instead of maximum likelihood estimation.

We found a significantly positive impact of neighboring municipalities' changes in salary levels on a given municipality, and the results remained robust under different specifications. Another finding is that strategic interaction among municipalities was almost nonexistent prior to the introduction of the central government's policies, and was stronger in response to the top-down policy approach. This provides confirmation of the central government's ability to influence local fiscal decision-making through grant allocations (Ahmad and Brosio, 2009). We can draw from the finding a policy implication that spatial interdependence among neighboring local governments could have the potential for supporting sustainable fiscal policies and effective regional planning.

The study achieved its aim of discovering evidence of strategic interaction among neighboring local jurisdictions in relation to determining their public sector salaries. However, the results are limited to the case of municipalities in Japan, and thus we are unable to draw any general conclusions that are applicable to other countries. Results elsewhere could vary as a result of differences in political systems, the extent of decentralization, or the degree of financial autonomy of local governments. Thus, further studies using data from other countries are recommended.

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APPENDIX

Table 6. Variable units, definitions, and sources

Variable and unit	Definition	Source
Laspeyres index (%)	Ratio of municipal salary level to national salary level	1
Total population (person)	Total population in each municipality	2
Population density (person)	Population density in each municipality	2
Share of population under 15 years old (%)	Share of total population under 15 years old, calculated from the linear interpolation between 2010 and 2015 and between 2015 and 2020	2
Share of population over 64 years old (%)	Share of total population over 64 years old, calculated from the linear interpolation between 2010 and 2015 and between 2015 and 2020	2
Taxable income per taxpayer (thousand yen)	Share of local income tax per taxpayer	3
Cumulative debt rate	Cumulative debt as a proportion of total expenditure	2
Unemployment rate (%)	Percentage of the labor force that is unemployed, calculated from the linear interpolation between 2010 and 2015 and between 2015 and 2020	2
Grant ratio (%)	Sum of conditional and unconditional grants from the central government as a percentage of total revenue	2
GEJE grant (thousand yen)	The sum of grants from the central government to each municipality for recovery from the Great East Japan Earthquake	2
Labor union	This is a dummy that takes a value of 1 if there is at least one public labor union in a municipality and 0 otherwise	4

Notes: 1 = Ministry of Internal Affairs and Communication (2019a). *Status of municipal salary and capacity* (https://www.soumu.go.jp/main_sosiki/jichi_gyousei/c-gyousei/teiin-kyuuyo02.html); 2 = e-Stat (2019). *Social/ demographic system* (https://www.e-stat.go.jp/statsearch/files?page=1&toukei=00200502&result_page=1); 3 = Ministry of Internal Affairs and Communication (2019b). *Municipal taxation status* (https://www.soumu.go.jp/main_sosiki/jichi_zeisei/czaisei/czaisei_seido/ichiran09.html); 4 = All Japan Prefectural and Municipal Workers Union (2019). *Status of self-governing labor union* ((https://www.jichiro.gr.jp/aboutmap).