Intergovernmental Competition for Donations
: The Case of the *Furusato Nozei* Program in Japan

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Abstract

This paper shows that municipalities compete excessively for donations under a unique program called *Furusato Nozei* (Tax payment to hometown) in Japan. Under the program, people make donations to their favorite municipalities and municipalities that have received donations give "reciprocal" gifts in return. Our estimates show that municipalities facing competition to attract donations provide excessive gifts to donors, and net revenue from the program is 10.4% to 12.1% lower than in a scenario without competition.

JEL Classification. H77, R28, R51.

Keywords. Interregional fiscal competition, donation, efficiency.

1   Introduction

The Japanese government launched a new program called *Furusato Nozei* (Tax payment to hometown) in 2008, in which an individual makes a charitable donation to municipalities that they believe have been helped in the past. These donations can be regarded as ordinary tax revenues collected by municipal governments. Donors paying income tax in their region of residence receive an income tax deduction approximately equal to the amount donated. That is, individuals can allocate a proportion of their income tax payments to any of their favorite municipalities. In addition to tax credits, under this program, donors also benefit by receiving the "reciprocal" or "thank you" gifts from the donating municipality. Typical gifts include local products and specialties, which can either be consumed or resold. This study focuses on such pecuniary benefits offered by municipalities and quantitatively evaluates the *Furusato Nozei* program, based on tax and fiscal competition theory (Zodrow and Miezskowski, 1986; Wilson, 1986; Wildasin, 1988).

The fact that municipalities can send "reciprocal" gifts to donors implies the inevitable generation of competition among municipal governments in the acquisition of donations via the "return rate"— the percentage of gifts' value returned to the donation received.[1] In fact, in addition to local specialties, municipalities also gifted items such as an *iPad*, *Apple Watch*, *Amazon* gift card, and e-money to interest donors. Specifically, it has been pointed out that due to intense intergovernmental competition in a bid to attract donations, municipalities engage in wasteful competition. There are municipalities with negative fiscal balances because of the *Furusato Nozei* program (Suzuki and Hashimoto, 2017). This is a typical negative aspect of so-called fiscal competition, which results in excessive competition among municipalities. Faced with these situations, the central government in 2017 issued a notice to ease competition. However, since this notification did not impose penalties, many municipal governments did not abide by it. In 2019, the central government finally revised the local tax law and decided to exclude from this program municipalities that offer excessive "reciprocal" gifts. Accordingly, four municipalities were identified and excluded. However, the regulation of intergovernmental competition is just beginning, and a solid framework is yet to be established.

The main purpose of this study is to construct a simple model of the *Furusato Nozei* program, and thereby elucidate quantitatively the inefficient loss in revenue that accompanies excessive intergovernmental competition for donations under the program. Because only two years of data on donations are available, it is difficult to conduct a long-run panel data analysis. However, for all 1,741 municipalities including 23 special wards of Tokyo, we construct a panel data set for the available time periods and quantify the competition for donations among municipal governments.

The findings of our paper indicate that there is excessive competition among municipalities that participate in the program in the sense that the absence of competition between municipalities results in higher net revenues. Specifically, our quantitative analysis depicts the following empirical findings: Firstly, a municipality raises its return rate to the extent of 2.5 to 4.1% points, if other municipalities raise their return rates to donations by 10% points. In cases where the actual data can be reproduced the most, these values range from 2.5 to 2.7% points. Secondly, in comparison to a hypothetical scenario with no competition, competition among municipalities raises donations by 22.5% to 24.9%. Thirdly, due to intergovernmental competition through rising return rates for donations, the extent of the decline in net revenue ranges from 10.4% to 12.1% in comparison to a scenario without competition. This is because the cost

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[1]Suppose an individual donated ¥150,000 to *Yukuhashi*, a typical local city with a population of 70,000. In return, she receives an income tax deduction of ¥148,000 from the government of the municipality in which she resides. In addition, she receives a 32GB *iPad* with Wi-Fi as a "reciprocal" gift from *Yukuhashi* city. Since the price of the item is ¥63,800, the return rate in this case is calculated as 42.5% (=63,800/150,000).

of procuring gifts for collected donations increases by raising return rates. These results imply that municipalities engage in excessive competition for attracting donations, and thus support the central government's policy of restricting the upper limit of the return rate.

The remainder of the paper is organized as follows. In section 2, we briefly introduce the *Furusato Nozei* program. In section 3, we set up the basic model that characterizes the program. In section 4, we explain the data and empirically test the model. Based on the estimation results, we quantitatively depict a distortion in non-cooperative competition for donations among municipalities. Section 5 concludes the paper.

2 The *Furusato Nozei* program

2.1 Description of the program

In this subsection, we briefly describe the essence of the program.[2] Under this program, individuals donate to municipalities where they feel they have been helped in the past. A typical example is the region where they were born and raised. In addition, they can designate the places where their parents or partner came from or places they visited for sightseeing as the places where they indebted to. In fact, people can donate to any municipality that they regard as their hometown. When people donate to a certain municipality, their income tax to be paid to the government of the municipality where they reside is deducted. This is explained in detail later with an example.
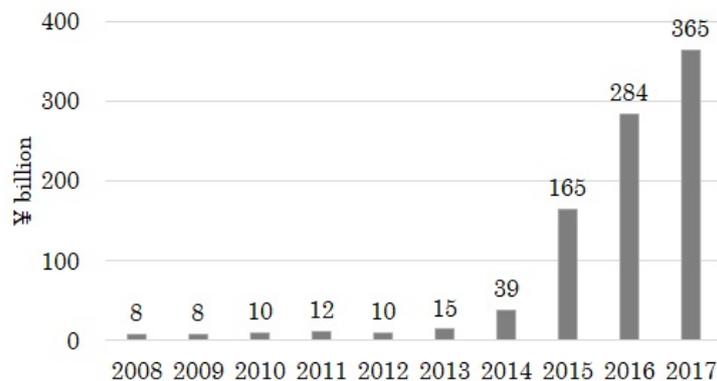

Figure 1 Changes in donation

The *Furusato Nozei* program began in 2008, but initially, it did not induce many donations. The reasons for few donations in the beginning are as follows: Firstly, unlike today, it was purely a donation program, with no municipality providing a "reciprocal" gift. Secondly, the procedure for donations and tax deductions was complicated, and the transaction costs incurred for making donations were high. Since the mid-2010s, the number and amount of donations have greatly increased (see Figure 1). This is due to, first, the doubling of the income tax credit limit in 2015, which in turn, raised the incentive to make donations with tax-related motives. Second, municipalities have begun competing for donations by offering "reciprocal" gifts in return, which is the focal point of the paper. Apart from gifts that typically include local specialties such as rice, beef and seafood, other kinds of goods such as electrical appliances, e-money, gift cards, hotel accommodation tickets, and air tickets have been provided to attract donations. Third, a system that eliminates the need for tax returns was in place, which simplified the tax deductions process. At the same time, private firms set up a portal site on the internet for this program.

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[2]See also Japan Times (2017) and Rausch (2017) for more details about of the program.

Table 1: Donation and tax deduction (¥1,000)

Annual taxable income	5000.0	5000.0	
National tax payment	572.5	560.9	▲11.6
Local tax payment	500.0	453.6	▲46.4
Donation	0.0	60.0	60.0
Consumption	3927.5	3925.5	▲2.0
Gifts received	0.0	25.2	25.2
Total consumption	3927.5	3950.7	23.2

Note. This is an example of a household with an annual taxable income of ¥5,000 thousand. The rightmost column shows the difference between the values with and without a donation.

The launch of the website helped match municipalities to donors and lowered transaction costs by facilitating credit card payments.

Based on Table 1, we explain the workings of *Furusato Nozei* program. Assume that an individual earns an annual taxable income of ¥5,000 thousand. He pays ¥572.5 thousand as income tax to the national government and ¥500.0 thousand to the governments of the municipality in which he resides. If he does not donate to any municipality, the amount of money remaining in hand for consumption is ¥3927.5 thousand. There is a limit on the amount that can be donated, depending upon the taxable income. For example, a single individual (or a working couple with no children) with an annual taxable income of ¥5,000 thousand can donate up to about ¥60,000 under this program. So, assume that an individual donates the upper limit of ¥60,000 to some municipality. In this case, tax payments to the national and municipal governments are reduced to ¥560.9 thousand and ¥453.6 thousand, respectively. Therefore, the amount of money remaining in hand is ¥3,925.5 thousand. Instead of losing ¥2,000 (=3,927.5−3,925.5), he receives gifts worth ¥25,200, which is approximately 42% of the donation.[3] Thus, the amount he can ultimately utilize for personal consumption will be ¥3,950.7 thousand, an increase of 0.6% in comparison to the amount in hand prior to making the donation, ¥3927.5 thousand. If "0.6%" is referred to as the yield in terms of the donation, this will be larger for higher income earners. For example, if a single individual with an annual taxable income of ¥18,000 thousand donates ¥500,000, which is the maximum that can be donated, it is about 1.8%. High-income earners can hence claim more benefits under this program, an aspect that has been criticized and deemed as one of its disadvantages (Bessho, 2017).

Table 2 depicts the impact on the fiscal balances of municipalities when an individual donates ¥60,000 to some municipality. If an individual donates ¥60,000, he receives a gift worth ¥25,200, which is equivalent to 42% of the donation, from the concerned municipality. When he donates ¥60,000, the tax credit that he receives is ¥58,000, implying that he loses ¥2,000. The difference between the value of the gift, ¥25,200, and the loss of ¥2,000 constitutes the individual's net benefit from the donation. For the municipality where the individual who donated ¥60,000 resides, this implies a decline in tax revenue to the tune of ¥46,400 (see the third row in Table 1). However, 75% of them are covered by transfers from the central government, meaning that the net loss of revenue is ¥11,600, or 25% of the ¥46,400. The municipality that receives the donation of ¥60,000 sends a gift worth 42% of the donation amount. Hence, the increase in net revenue is ¥34,800. As we can see from the second row of Table 1, the central government loses ¥11,600 due to tax deductions. In addition, since it covers 75% of the loss in tax revenue for municipalities that participate in the program, the balance will be ¥46,400 (11,600+34,800) minus.

As seen from Table 2, this program redistributes tax revenues among municipalities. Since

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[3]The figure of 42% is an illustration in the context of the city of *Yukuhashi* introduced in footnote 1.

Table 2: Benefit and burden (¥1,000)

	Revenue increase	Revenue loss	Net revenue
Donor	25.2	2.0	23.2
Municipality the donor lives	34.8	46.4	▲11.6
Municipality that received the donation	60.0	25.2	34.8
Central government	0.0	46.4	▲46.4
Total	120.0	120.0	0

Note. A case example when a donation of ¥60,000 is made.

it is common for individuals to donate to municipalities other than those in which they reside, the net revenue tends to be negative in the case of municipalities especially in the urban areas, where there are a large number of residents having incentives to receive tax deductions due to high income.

2.2 Literature review

Research interest in this program is fairly recent. Although there are few studies that have analyzed the program, four are noteworthy.

Hashimoto and Suzuki (2016) analyzed the correlation (not causality) between the donations that municipalities receive and the fiscal conditions of those municipalities. Their results depict a weak but positive correlation between donations and population size. However, there is no evidence to suggest that the donations that municipalities receive and the index of the fiscal conditions of municipalities are related. Yamamura et al. (2018) revealed that the amount of donations received by municipalities changed after the occurrence of a large-scale natural disaster. This demonstrated that the motivation for making donations may have become more altruistic. They also estimated the elasticity of donations with respect to the return rate, and revealed that the donations made to municipalities increase by 0.61% if municipalities increase their spending on "reciprocal" gifts by 1%. Based on the results of an original survey, Nishimura et al. (2017) analyzed the motivation for making donations by dividing the motive into two categories. First, the donations to those municipalities characterized by weak financial conditions, a reliance on the agricultural sector, and high unemployment rates, are regarded as donations based on altruistic intentions. Second, donations to those municipalities that provide a large number of reciprocal gifts and high rates of return are regarded as donations based on selfish intentions. Their estimation results indicate that donations made under the *Furusato Nozei* program are generally governed by selfish intentions. Fukasawa (2019) conducted a single regression, using data from 791 cities in 2017, to ascertain whether the return rate for donations for a specific municipality depends on that of other rival municipalities. His findings indicated that when the return rate increased by 1%, rival municipalities increase their rate of return to donations by 0.24% to 0.33%.

All the above studies analyze the positive aspects of the program, but they do not provide a theoretical model that forms the basis of the analysis. The normative analysis of the current program is hence neglected. This study carries out a normative evaluation on the interregional competition for donations using the return rate to donations as a strategic policy instrument. Regarding this aspect, as depicted in the next section, we develop a simple model of donations in the context of tax competition framework. This is utilized in the estimation of the reaction functions of municipalities that participate in the *Furusato Nozei* program.

3 Model

3.1 Non-cooperative equilibrium

Donors. There are symmetric $n(>1)$ municipalities competing for *Furusato Nozei*, which is essentially a donation made by individuals. In the program, individuals can reduce their income tax payments in accordance with their donations. To analyze an individual's decision on donation, we assume that the utility function of a representative donor is given by:

$$U = x_0 + u(x_1, .., x_n),$$

where

$$u(x_1, .., x_n) \equiv a \sum_{i=1}^{n} x_i - \frac{c}{2} \left[\sum_{i=1}^{n} x_i^2 + 2b \sum_{i=1}^{n} \left(x_i \cdot \sum_{j=i+1}^{n} x_j \right) \right].$$

x_0 is the numeraire private goods and x_i is the donation to municipality i. a represents the magnitude of the benefit from making a donation to a certain municipality, regardless of income tax deductions or gifts received. The substitutability of the donations between any two municipalities is measured by $b \in (0, 1)$, where the donations to different municipalities are perfectly substitutable for $b \to 1$. For linear regression in the next section, the form of utility function has a nice feature of providing a linear demand function and a linear response function.

Let us set up an individual's budget constraint that explains the two benefits that the individual receives under the program. Assume that the income tax rate for individuals with income y is $t \in (0, 1)$, and that this individual donated x_i to municipality i. Under the *Furusato Nozei* program, the amount obtained by subtracting ¥2,000 from total donation is subject to a tax deduction. Therefore, when donating to n municipalities, the total donation is $\sum_{i=1}^{n} x_i$, and the remainder after deducting ¥2,000 will be subject to a tax deduction. This is the first benefit that donors receive under the program. The second benefit is provided by the municipal governments. When an individual donates x_i to municipality i, he/she receives "reciprocal" gifts equivalent to $p_i x_i$ from municipal government i. Here, $p_i \in [0, 1]$ is called the return rate, which is determined by each municipal government. In 2017, the central government has issued guidelines to make p_i lower than 0.3. However, since it does not involve strong penalties, in fact, there are many municipalities that set the value to more than 0.3. The budget constraint in terms of the individual earning income y is given by:

$$y - \left[ty - \left(\sum_{i=1}^{n} x_i - 2,000 \right) \right] + \sum_{i=1}^{n} p_i x_i = x_0 + \sum_{i=1}^{n} x_i.$$

The angle bracket in the second term on the left-hand side represents the tax payment after applying a tax deduction to the donation. If an individual donates $\sum_{i=1}^{n} x_i$ in a certain year, an amount of $\sum_{i=1}^{n} x_i$ minus ¥2,000 is refunded. The third term is the total value of the reciprocal gifts provided by the municipal governments. The first term on the right-hand side represents private consumption. The second term represents the total amount of donation. The budget constraint can be simply rewritten as follows:

$$Y = x_0 - \sum_{i=1}^{n} p_i x_i,$$

where $Y \equiv (1 - t)y - 2,000$. Given the budget constraint, individuals choose x_i to maximize utility. Utility maximization yields the first-order condition for x_i as:

$$a + p_i - cx_i(1 - b) - cb\sum_{i=1}^{n} x_i = 0. \tag{1}$$

By summing the first-order condition for all i, we get:

$$\sum_{i=1}^{n} x_i = \frac{na + \sum_{i=1}^{n} p_i}{c(1 - b + bn)},$$

which demonstrates that the total donation increases with an increase in p_i. Substituting this into (1), the demand function of x_i is:

$$x_i^* = \frac{a}{c(1 - b + bn)} + \frac{(1 - 2b + bn)p_i}{c(1 - b)(1 - b + bn)} - \frac{b\sum_{j\neq i} p_j}{c(1 - b)(1 - b + bn)}. \tag{2}$$

Municipalities. We assume that the municipal government aims to maximize the net revenue from donations. The net revenue of municipality i is given by $R_i = x_i^* - p_i x_i^*$, which is maximized with respect to p_i. The first-order condition gives the reaction function as:

$$p_i = \left[\frac{b(n - 1)}{2(1 - 2b + bn)} + \frac{(1 - a)(1 - b)}{2(1 - 2b + bn)}\right] + \frac{b(n - 1)}{2(1 - 2b + bn)}\frac{\sum_{j\neq i} p_j}{n - 1}, \tag{3}$$

where $1 - 2b + bn = (1 - b) + b(n - 1) > 0$. $\sum_{j\neq i} p_j/(n - 1)$ denotes the average return rate to donations in rival municipalities, suggesting that the games played by the municipalities are strategic complements. It is obvious that the slope of the reaction function becomes steep as n and b become larger. In (3), the competition among the 1,741 municipalities can be depicted as a scenario where municipality i competes with one rival municipality, which summarized the other municipalities except for oneself.

Solving (3) for $\forall i$, we get the return rate in the non-cooperative Nash equilibrium:

$$p^N = \frac{b(n - 1) + (a - 1)(1 - b)}{2(1 - b) + b(n - 1)}. \tag{4}$$

The superscript N denotes the non-cooperative equilibrium. The intensity of competition among municipalities can be measured by the number of municipalities n, and by the substitutability of donations among municipalities b. It can be deduced from (4) that the return rate for donations is high as n and b are large, $\partial p^N/\partial n > 0$ and $\partial p^N/\partial b > 0$.

(4) is used to derive the donation level and net revenue for each municipality as:

$$x^N = \frac{(a + 1)(1 - 2b + bn)}{c(1 - b + bn)(2 - 3b + bn)}, \tag{5}$$

$$R^N = \frac{(a + 1)^2(1 - b)(1 - 2b + bn)}{c(2 - 3b + bn)^2(1 - b + bn)}. \tag{6}$$

3.2 Cooperative outcome

Our study aims to quantify the extent of the occurrence of inefficiency in comparison to when the government does not compete for donations. Such a non-competitive scenario can be considered either in terms of the collaboration of municipalities to bring the return rate to zero, or in terms of the central government regulating the return rate. Concerning this, we derive the amount of donation and the net revenue of each municipality when the return rate is zero, that is, $p^C = 0$:

$$x^C = \frac{a}{c(1 - b + bn)}, \tag{7}$$

$$R^C = \frac{a}{c(1 - b + bn)}, \tag{8}$$

where the superscript C denotes the cooperative equilibrium. The comparison of non-cooperative and cooperative equilibria using (5)-(8) yields the following result:

$$\frac{x^N}{x^C} = 1 + \frac{b(n - 1) - (1 - b)(a - 1)}{a(2 - 3b + bn)}, \tag{9}$$

$$\frac{R^N}{R^C} = 1 + \frac{[(1 - b)(a - 1) - b(n - 1)][(1 - b)(a - 1) + b(n - 1)a]}{a(2 - 3b + bn)^2}. \tag{10}$$

The advantage of our simple model is that we can quantitatively compare the equilibrium of a cooperative outcome with that of an outcome characterized by a zero return rate, if we have data on the two parameters representing the preference for donations, a and b. It is especially important to obtain data on the parameter b as it represents the degree of substitutability for donations among municipalities, which can be obtained by estimating the slope of the reaction curve as depicted in (3).

4 Empirical analysis

4.1 Specification

Upon testing the theory presented in Section 3, we follow the specification pursued in a large body of empirical studies that test tax competition theory.[4] Specifically, p_i is regressed by p_j as shown in (3). However, it is well-known in tax competition literature that an endogeneity problem is encountered in the estimation, since p_i and p_j are simultaneously determined, and that the estimates are neither unbiased nor consistent with a simple OLS regression. To avoid this, our estimation basically follows the *generalized spatial-two stage least squares* (GS2SLS) estimation procedure proposed by Kelejian and Prucha (1998), since it is a method that can address both the issues of endogeneity and spatial autocorrelation.[5] However, GS2SLS is a method developed specifically for cross-sectional analysis. Therefore, our estimation method is specifically based on a spatial random effect panel model, which extends the scope of GS2SLS to panel data analysis by including a spatial lag term and a spatial error term (Mudit et al., 2007; Mutl and Pfaffermayr, 2011).

More specifically, the equations of the estimation are:

$$p_{it} = \beta \sum_{j \neq i} w_{ij} p_{jt} + \sum_k b_k X_{it}^k + \delta_t + u_{it}, \tag{11}$$

$$u_{it} = \rho \sum_{j \neq i} w_{ij} u_{jt} + \epsilon_{it}, \text{ where } \epsilon_{it} = \mu_i + \nu_{it}. \tag{12}$$

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[4]See Brueckner (2003) and Devereux and Loretz (2013) for a review on the empirics of tax competition.

[5]In the case of this estimation, the maximum likelihood method may be sometimes applied. However, it was not adopted in this study, as it requires additional assumptions about the distribution of error terms, and has the disadvantage of calculated load.

Table 3: Descriptive statistics

	Variables	Mean	Std. Dev.	Min	Max
Return rate of own municipality	p_i	0.281	0.175	0.000	3.065
Return rate of other municipalities	p_j	0.275	0.110	0.000	1.482
Population (log)	POP	10.082	1.499	5.075	15.134
Real debt service ratio	$DEBT$	7.470	4.488	-6.400	76.800
Taxable income per capita (log)	$INCOME$	7.939	0.157	7.586	9.319
Dependency ratio on LAT grant	LAT	0.508	0.272	0.000	0.956
Financial capability indicator	FCI	0.506	0.286	0.053	2.153
Agricultural income ratio	$AGRI$	0.017	0.024	0.000	0.235
Dependency ratio on NGD	NGD	0.116	0.049	0.007	0.494
Disaster dummy	$DISASTER$	0.140	0.347	0.000	1.000
Tokyo 23 wards dummy	$TOKYO$	0.013	0.114	0.000	1.000
Population under 15 years old	$15UNDER$	0.116	0.025	0.022	0.234
Population over 65 years old	$65OVER$	0.324	0.071	0.148	0.615
Net balance ratio	$NBALANCE$	6.287	5.598	-10.800	96.700
Ordinary balance ratio	$OBALANCE$	89.140	6.716	42.200	128.400

Note: These descriptive statistics have been computed from the full sample of our data for 2016–2017. NGT denotes national government disbursements and LAT denotes *local allocation tax* grant. The return rate of other municipalities is a weighted average. $DEBT$, $NBALANCE$, and $OBALANCE$ are specified in percentages.

Here, i denotes the concerned municipality and t denotes the year. p_{it} is the rate of return to donations and X_{it}^k denotes the control variable k. When we regress p_{it} in p_{jt} in the spatial error lag model, there may be regional characteristics that cannot be completely absorbed only by the explanatory variables used in the estimation. In this case, the spatial error term, u_{it} can be correlated between different municipalities, which causes the estimate to be inefficient. (12) is set to avoid this. A specific estimation method for the spatial random effect estimator is outlined in Appendix A.

In (11), w_{it} is the spatial weights matrix defined by

$$w_{ij} = \frac{d_{ij}}{\sum_j d_{ij}},$$

where d_{ij} is a dummy variable, which takes a value of 1, if municipalities i and j share a boundary and 0 otherwise. There are several ways to define the spatial weight w_{ij}, to reflect the spatial influence of municipality i on j. The first standard approach is based on the distances between municipalities. The advantage of this approach is easy computation. Typically, the intergovernmental competition for donations closely resembles the degree of competition among neighboring municipalities, however. In such cases, the boundaries shared between municipalities play an important role in determining the degree of spatial influences. The simplest way to capture how close the municipalities are is indicated by whether such spatial units share a boundary, an aspect employed in our study.

4.2 Descriptive statistics

The key variable in our estimation of (3) is the return rate for donations, p_{it}, which is calculated as the ratio of gift procurement costs to the donations received by municipality i in year t. The followings are the control variables considered: POP denotes the population and $DEBT$ is the real debt–service ratio, an index to assess the financial burden of debt service expenditure, and is hence used as a criterion to permit the raising of local loans. $INCOME$ is the Logarithmic taxable income per capita. LAT is the ratio of *local-allocation-tax* grant receipt to revenue resources, which represents how much a municipality's finance depends on grants from the central

government. LAT grant has no limitations regarding usage. FCI is the financial capability indicator, which indicates the financial strength of municipalities. It is calculated as a three-year average of past values derived from dividing basic financial revenues by basic financial needs. A higher value indicates that the municipality has a greater margin for revenue sources. $AGRI$ depicts the ratio of primary industry, such as agriculture and fisheries. It is measured by the ratio of agriculture workers to taxpayers. NGD is the ratio of national government disbursements to the total expenditure, which is provided to municipalities to either promote specific policies or for financial aid. $DISASTER$ is a dummy variable which takes a value of 1 if the municipalities are designated as a specific stricken area under the Disaster Relief Act, after having suffered an earthquake. $TOKYO$ is also a dummy variable which takes a value of 1 for Tokyo's 23 special wards. $15UNDER$ and $65OVER$ are the ratios of the population under 15 years of age and 65 years of age and over, respectively. $NBALANCE$ and $OBALANCE$ are the net fiscal balance and ordinary fiscal balance ratios in each municipality. Finally, we use the year dummy denoted by $YEAR$.

Table 3 reports the descriptive statistics computed for the full sample.[6] The variable which we focus on is the return rate on donations. The simple average of the return rate for donations was 27.4% for 2016 and 29.0% for 2017, respectively. However, there was a non-negligible number of municipalities that did not send gifts in return for donations—these are municipalities with a return rate of zero. In 2016, 127 municipalities did not send gifts in return for donations and that number declined to 98 in 2017. Such municipalities constitute 7.3% and 5.0% of all municipalities. Since donations to these municipalities are either zero or negligible, it may be interpreted that such municipalities with zero return rates do not compete for donations. Therefore, when the return rate is weighted by the share of the donation in each municipality to the total donation amount in order to account for municipalities with zero return rates, the weighted average of return rates in 2016 and 2017 will be 38.7% and 38.8%, respectively. That is, the return rate for donations will be close to 40%, if the calculation of return rates is limited to those municipalities that compete for donations by sending gifts.

4.3 Estimation results

Estimates. In our study, we utilize a random effects model for the estimation. This is mainly because a large number of variables that represent the characteristics of municipalities are included as explanatory variables. Such variables are characterized by a lower degree of fluctuations year-on-year. This tendency is particularly remarkable, since our sample period is short with only two years of data. In general, a fixed effect model is estimated under the assumption that there is sufficient short-term variation in the data. However, critical information may be lost during estimation with only two years of data available, thereby implying less fluctuation. For instance, Barro (1998) criticizes fixed-effects panel data methods that rely purely on time series information, since conditioning variables often vary gradually over time, such that critical information is lost. In fact, the coefficient representing the slope of the reaction function estimated by a fixed effects model did not produce meaningful estimation results in our estimation. One of the reasons is that there is the issue of missing information specific to fixed effects models. Therefore, following Baltagi et al. (2013), we use the random effects model, which has the advantage of a relatively lower degree of information loss.

The baseline estimates are depicted in Table 4. Of particular interest is the estimates of p_j, specified in the second row, which suggest that the slope of the reaction function is between 0.373 and 0.412. This implies that if rival municipalities raise the return rate by 10% points on an average, the municipality raises it by 3.73 to 4.12% points. However, this estimation result

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[6]See Appendix B for the data sources.

Table 4: Estimation results: Baseline

| | Model 1 | | | | Model 2 | | | |
	coef.	s.d.	t value		coef.	s.d.	t value	
p_j	0.373	0.053	7.073	***	0.412	0.052	7.931	***
POP	0.005	0.003	1.700	*	0.004	0.003	1.204	
$DEBT$	0.002	0.001	2.599	***	0.001	0.001	1.961	**
$INCOME$	-0.148	0.026	-5.596	***	-0.150	0.027	-5.534	***
$LATG$	-0.085	0.038	-2.251	**	-0.062	0.040	-1.552	*
FCI	-0.061	0.033	-1.843	**	-0.050	0.034	-1.451	*
$AGRI$	0.388	0.121	3.210	***	0.350	0.122	2.871	***
NGD	-0.190	0.066	-2.863	***	-0.215	0.068	-3.148	***
$DISASTER$	-0.033	0.007	-4.662	***	-0.031	0.007	-4.404	***
$TOKYO$	-0.110	0.029	-3.838	***	-0.087	0.031	-2.847	***
$15UNDER$					0.194	0.213	0.910	
$65OVER$					-0.034	0.096	-0.355	
$NBALANCE$					-0.000	0.001	-0.378	
$OBALANCE$					0.000	0.001	0.669	
$YEAR$	0.010	0.004	2.354	***	0.010	0.004	2.285	***
const	-19.211				-18.591			
Rho	-0.251				-0.272			
Var nu	0.024				0.024			
Var 1	0.027				0.026			
pseudo R^2	0.128				0.129			
intercept	0.178				0.168			

Note. Obs., 3,482. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

will have too much bias to be deemed reliable, since the model does not fully account for those municipalities with zero return rates. As explained in Section 4.2, upon comparing the simple average with the weighted average, there is a difference of 10% points or more in the return rate, so it is necessary to control for those municipalities with zero return rates. In addition, there were some municipalities that were considered outliers, with the return rate exceeding 300%. To deal with these municipalities, we introduce two dummy variables. First, we include an outlier dummy to account for municipalities with return rates exceeding 100%. There were five such municipalities in the two years of data for 2016 and 2017. Second, we add a dummy variable, which takes the value 1 for municipalities with zero return rates.

The results estimated based on these treatments are depicted in Table 5, where OUT and $ZERO$ are dummy variables that represent municipalities with return rates of above 100% and municipalities with zero return rates, respectively. The estimated values for p_j when adding new dummy variables range from 0.247 to 0.267, suggesting that a 10%-point increase in the return rate raises the return rates of other municipalities by 2.47% to 2.67%. Since the pseudo R^2 increased from approximately 0.13 in Table 4 to approximately 0.45 in Table 5, the estimation results in consideration of the presence of the outlier municipalities and municipalities with a zero return rate improve significantly.

The results of cases where only one of OUT and $ZERO$ is considered are depicted as Models 5 to 8 in Table 8 of Appendix C. In all of these cases, it can be confirmed that the estimates of p_j assume values that range between the results of Table 4 and Table 5.

Quantification. From the estimation results in Tables 4, 5, and 8, the slopes of the reaction functions obtained across eight different models of estimation are in the range of 0.247 to 0.412. In addition, by using the estimates of the control variables, we can calculate the values of y-intercepts of (3). As depicted in the last line of each table, this value ranges between 0.168 and

Table 5: Estimation results: With OUT and $ZERO$ dummy variables

| | Model 3 | | | | Model 4 | | | |
	coef.	s.d.	t value		coef.	s.d.	t value	
p_j	0.247	0.031	8.010	***	0.267	0.031	8.706	***
POP	0.001	0.002	0.557		0.001	0.003	0.335	
$DEBT$	0.001	0.001	1.640		0.001	0.001	1.305	
$INCOME$	-0.104	0.021	-4.994	***	-0.110	0.021	-5.127	***
$LATG$	0.009	0.031	0.279		0.030	0.032	0.919	
FCI	0.035	0.027	1.287		0.040	0.028	1.420	
$AGRI$	0.355	0.099	3.582	***	0.300	0.101	2.984	***
NGD	-0.150	0.053	-2.284	***	-0.175	0.055	-3.183	***
$DISASTER$	-0.039	0.006	-6.684	***	-0.038	0.006	-6.305	***
$TOKYO$	0.016	0.024	0.659		0.032	0.026	1.226	
$15UNDER$					0.279	0.177	1.576	
$65OVER$					-0.030	0.080	-0.375	
$NBALANCE$					-0.000	0.000	-0.962	
$OBALANCE$					-0.000	0.000	0.269	
OUT	2.093	0.057	36.504	***	2.094	0.057	36.598	***
$ZERO$	-0.261	0.010	-27.213	***	-0.261	0.010	-27.225	***
$YEAR$	0.010	0.004	2.616	***	0.010	0.004	2.744	***
const	-18.800				-19.767			
Rho	-0.516				-0.169			
Var nu	0.016				0.016			
Var 1	0.017				0.017			
pseudo R^2	0.448				0.451			
intercept	0.213				0.207			

Note. Obs., 3,482. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

0.213, across eight different models of estimation. Utilizing this information, we can estimate the two preference parameters, a and b, and can thus obtain the predicted return rate for the Nash equilibrium. Table 6 shows the estimated return rate in the row written p^N.

Of course, since Models 1 and 2 utilize estimates that do not adequately control for outlier municipalities and those municipalities with a zero return rate, it is reasonable that predicted return rates are not close to the actual values of return rate. As mentioned in Section 4.2, the weighted average return rate was 38.7%. Since models 3 and 4 control for outliers and municipalities with zero return rates by utilizing two dummy variables, they are able to produce predicted values that are close to the actual weighted average. This implies that the preference parameters a and b, determined from the estimated values in Models 3 and 4, are rather consistent with the observed return rates. Upon inserting the estimates of a and b into (7) and (8), we obtain the amount of donation and net revenue in the counterfactual scenario in which municipalities do not compete for donations by providing reciprocal gifts, and therefore set the return rate to zero. Using these values, the two rows from the bottom of Table 6 depict the difference between the Nash equilibrium and the cooperative outcome for each donation and net revenue.

Models 3 and 4 that best replicate the weighted average value for the actual return rate depict that the provision of "reciprocal" gifts to attract donations leads to an increase in the donation across municipalities in the range of 22.5% to 24.9%, in comparison to the case where municipalities do not send gifts. On the one hand, this contributes to an increase in the revenue of the municipality. On the other hand, the cost of procuring gifts is high since the estimated return rate to donations is at a high level of 37.3% to 44.6%. This implies a decline in net revenue. The last row of Models 3 and 4 in Table 6 shows that the net revenue is 10.4% to 12.1% lower when the municipalities compete in sending "reciprocal" gift than in the absence

Table 6: Nash equilibrium and cooperative outcome

Slope	Model 1 0.373	Model 2 0.412	Model 3 0.247	Model 4 0.267	Model 5 0.307	Model 6 0.332	Model 7 0.267	Model 8 0.295
a	2.535	3.773	1.134	1.258	1.575	1.708	1.258	1.463
b	0.746	0.824	0.494	0.534	0.614	0.664	0.534	0.590
p^N	0.906	1.116	0.373	0.446	0.603	0.675	0.446	0.553
x^N/x^C	1.112	1.076	1.249	1.225	1.180	1.187	1.225	1.194
R^N/R^C	0.796	0.768	0.896	0.879	0.846	0.808	0.879	0.855

Note. p^N is the estimated rate of return. x^N and R^N are the donations received and the net revenue in each municipality, when the return rate is p^N. x^C and R^C are the donations received and the net revenue in each municipality, when the return rate is zero.

of competition. A similar trend is seen for results based on Models 5 to 8, where coordinated reduction of return rates from the Nash equilibrium levels toward zero will increase the net revenue of each municipality. This supports the regulation in which the central government sets an upper limit on return rates.

5 Conclusion

The current study is the first to estimate the loss from intergovernmental competition for donations under Japan's unique donation system known as the *Furusato Nozei* (Tax payment to hometown) program. As mentioned in the introduction, this program is controversial regarding its merits and demerits. One main criticism was that it allows individuals to choose which municipality they pay their taxes to. This deviates from the principles of local taxation that stipulates the payment of tax for receiving local public services. The program's pros and cons have further been clearly identified (Sato, 2017). Among the several issues, excessive return gifts competition has become so serious that the central government was forced to introduce new regulations involving legal reform. However, the basis for the regulation is weak, since we see no quantitative explanation so far. To study the extent of excess intergovernmental competition, we develop a model for interregional municipal competition for donations and estimate the degree of response by municipalities to the policies of others. We then used estimates to quantify the loss of net revenue caused by intergovernmental competition in the program.

The quantitative results obtained by this study are as follows.

Firstly, there is evidence of competition between municipalities. Specifically, when rival municipalities raise the return rate for donations by 10% points, the concerned municipality, in turn, raises it from 2.5% to 4.1% points. In the best case scenario that involves reproducing the actual weighted averages, these are 2.5 to 2.7% points. Secondly, based on the model that best reproduces the observation, the competition among municipalities increases donations by 22.5% to 24.9%, in comparison to a hypothetical scenario with no competition in return rates. Third, since a municipality competes to attract donations by raising return rates, the cost of procuring gifts for the collected donations increases. As a result, the net revenue is smaller than without competition in return rates. Specifically, our estimation depicts that due to intergovernmental competition through increasing return rates for donations, the net revenue will decline by 10.4%

to 12.1% in comparison to a scenario without competition. This suggests that the municipality has provided an excessive amount of "reciprocal" gifts, thereby leading to an excessive cost of gift procurement, in terms of the ability of municipalities in securing a larger net revenue.

In conclusion, we list three issues left unaddressed in this study. First, since we utilized samples where the number of municipalities with a zero return rate accounted for 5-7% of the total, we use dummy variables to account for such municipalities. An alternative approach is to use other methods such as spatial autoregressive Tobit model, which may be useful to verify the robustness of the results. Second, we used a spatial weight matrix based on whether municipalities share the boundaries. However, given that the individuals decide where to donate on the web, it would be useful to develop a new indicator that shows the proximity of municipalities in electronic space. Third, we set the outcome with zero return rates as a comparison target in the attainment of Nash equilibrium. In other words, we clarified the extent of the reduction in net revenue that intergovernmental competition brings, in comparison to the case where municipalities do not compete for donations using reciprocal gifts. Other cases that can be compared concerns the cooperation in setting the return rate so as to maximize their total net revenue. In this case, it is expected that the return rate will be negative, implying that taxing donations results in maximizing the total net revenue. This is not a realistic scenario under the framework of the *Furusato Nozei* program in practice, however. Still, there is room to discuss the formulation of a cooperative (or optimal) solution under this unique donation program.

Appendices

Appendix A. Here, we explain the estimation method of spatial random effect estimator. The spatial random effect estimator we estimated is based on Mutl and Pfaffermayr (2011). Using matrix notation, the model for a single period t can be rewritten as

$$
\begin{aligned}
\mathbf{y}_{t,N} &= \lambda \mathbf{W}_N \mathbf{y}_{t,N} + \mathbf{X}_{t,N}\boldsymbol{\beta} + \alpha \iota_N + \mathbf{u}_{t,N}, & (13)\\
\mathbf{u}_{t,N} &= \rho \mathbf{W}_N \mathbf{u}_{t,N} + \varepsilon_{t,N}, & (14)\\
\varepsilon_{t,N} &= \boldsymbol{\mu}_N + \boldsymbol{\nu}_{t,N}, & (15)\\
E(\mu_N) &= 0, \; E(\mu_{N^2}) = \sigma_\mu^2, & (16)\\
E(\nu_{t,N}) &= 0, \; E(\nu_{t,N}^2) = \sigma_\nu^2, & (17)
\end{aligned}
$$

where

$$
\mathbf{y}_{t,N} = \begin{pmatrix} y_{t1,N} \\ \vdots \\ y_{tN,N} \end{pmatrix}, \quad
\mathbf{X}_{t,N} = \begin{pmatrix} \mathbf{x}_{t1,N} \\ \vdots \\ \mathbf{x}_{tN,N} \end{pmatrix}, \quad
\mathbf{u}_{t,N} = \begin{pmatrix} u_{t1,N} \\ \vdots \\ u_{tN,N} \end{pmatrix},
$$

$$
\varepsilon_{t,N} = \begin{pmatrix} \varepsilon_{t1,N} \\ \vdots \\ \varepsilon_{tN,N} \end{pmatrix}, \quad
\nu_{t,N} = \begin{pmatrix} \nu_{t1,N} \\ \vdots \\ \nu_{tN,N} \end{pmatrix}, \quad
\mu_N = \begin{pmatrix} \mu_{1,N} \\ \vdots \\ \mu_{N,N} \end{pmatrix},
$$

$$
\mathbf{W}_N = \begin{pmatrix} w_{11,N} & \cdots & w_{1N,N} \\ \vdots & \ddots & \vdots \\ w_{N1,N} & \cdots & w_{NN,N} \end{pmatrix}.
$$

We estimate the parameters in three steps:

Step1 (2SLS estimation). We estimated the parameters of (13) using 2SLS and obtained the residuals. Here, we used $W_N X_{t,N}$ (the average of adjacent municipalities' explanatory variables) as instruments.

Step 2 (Estimation of non-linear parameters). For convenience, we use the notation $\sigma_1^2 = T\sigma_\mu^2 + \sigma_\nu^2$ and define the matrices

$$
\begin{aligned}
\mathbf{Q}_{0,N} &= \left(\mathrm{I}_T - \frac{1}{T}\mathbf{J}_T\right) \otimes \mathrm{I}_N, \\
\mathbf{Q}_{1,N} &= \frac{1}{T}\mathbf{J}_T \otimes \mathrm{I}_N,
\end{aligned}
$$

where $\mathbf{J}_T$ is a $T \times T$ matrix of unit elements.

First, using the residuals u in Step 1, we estimated the parameters ρ and σ_ν based on the three moment conditions given in Kapoor et al. (2007):

$$
E \left[\begin{array}{c}
\frac{1}{N(T-1)}\mathbf{u}'_N\mathbf{Q}_{0,N}\left(\mathbf{I}_{NT} - \rho\mathrm{W}'_{NT}\right)\left(\mathbf{I}_{NT} - \rho\mathrm{W}_{NT}\right)\mathbf{Q}_{0,N}\mathbf{u}_N \\
\frac{1}{N(T-1)}\mathbf{u}'_N\mathbf{Q}_{0,N}\left(\mathbf{I}_{NT} - \rho\mathrm{W}'_{NT}\right)\mathrm{M}'_N\mathrm{M}_N\left(\mathbf{I}_{NT} - \rho\mathrm{W}_{NT}\right)\mathbf{Q}_{0,N}\mathbf{u}_N \\
\frac{1}{N(T-1)}\mathbf{u}'_N\mathbf{Q}_{0,N}\left(\mathbf{I}_{NT} - \rho\mathrm{W}'_{NT}\right)\mathrm{M}'_N\left(\mathbf{I}_{NT} - \rho\mathrm{W}_{NT}\right)\mathbf{Q}_{0,N}\mathbf{u}_N
\end{array}\right] = \left[\begin{array}{c}
\sigma_\nu^2 \\
\sigma_\nu^2 \frac{1}{N}tr\left(\mathrm{W}'_{NT}\mathrm{W}_{NT}\right) \\
0,
\end{array}\right],
$$

where $\mathrm{W}_{NT} = (\mathbf{I}_T \otimes \mathbf{W}_N)$.

Next, using the estimated parameters ρ and σ_ν, we calculated the parameter σ_1 based on the moment condition

$$
E\left[\frac{1}{N}\mathbf{u}'_N\mathbf{Q}_{1,N}\left(\mathbf{I}_{NT} - \rho\mathrm{W}'_{NT}\right)\left(\mathbf{I}_{NT} - \rho\mathrm{W}_{NT}\right)\mathbf{Q}_{1,N}\mathbf{u}_N\right] = \sigma_1^2.
$$

Step 3 (Estimation of linear parameters). Using the estimated parameters in Step 2, spatial random effect estimator $\widehat{\boldsymbol{\delta}}_{GLS,N} = \left(\widehat{\boldsymbol{\theta}}_{GLS,N}, \widehat{\alpha}_{GLS,N}\right)' = (\lambda, \boldsymbol{\beta}', \alpha)'$ is given by

$$
\widehat{\boldsymbol{\delta}}_{GLS,N} = \left[\widehat{\widetilde{\mathbf{Z}}}_N(\boldsymbol{\vartheta})'\widetilde{\mathbf{Z}}_N(\boldsymbol{\vartheta})\right]^{-1}\widehat{\widetilde{\mathbf{Z}}}_N(\boldsymbol{\vartheta})'\widetilde{\mathbf{y}}_N(\boldsymbol{\vartheta})
$$

with $\widehat{\widetilde{\mathbf{Z}}}_N(\boldsymbol{\vartheta}) = \mathbf{P}_{H_{R,N}}\widetilde{\mathbf{Z}}_N(\boldsymbol{\vartheta})$, $\widetilde{\mathbf{Z}}_N(\boldsymbol{\vartheta}) = \boldsymbol{\Omega}_{u,N}^{-1/2}(\boldsymbol{\vartheta})\mathbf{Z}_N$, $\widetilde{\mathbf{y}}_N(\boldsymbol{\vartheta}) = \boldsymbol{\Omega}_{u,N}^{-1/2}(\boldsymbol{\vartheta})\mathbf{y}_N$ and $\boldsymbol{\Omega}_{u,N}^{-1/2} = (\mathbf{Q}_{0,N} + \frac{\sigma_\nu}{\sigma_1}\mathbf{Q}_{1,N})(\mathbf{I}_{NT} - \rho\mathbf{W}_N)$. Here, $\mathbf{P}_{H_{R,N}} = \mathbf{H}_{R,N}\left(\mathbf{H}'_{R,N}\mathbf{H}_{R,N}\right)^{-1}\mathbf{H}'_{R,N}$ is the projection matrix based on the instruments $\mathbf{H}_{R,N} = [H_{Q,N}, H_{P,N}] = [\mathbf{Q}_{0,N}[X_N, W_N X_N], \mathbf{Q}_{1,N}[X_N, W_N X_N, \iota_{NT}]]$.

Mutl and Pfaffermayr (2011) have proven that

$$
\sqrt{NT}(\theta_{GLS,N} - \theta) \xrightarrow{d} N(0, \Sigma_{GLS}),
$$

where Σ_{GLS} is the upper-left $(K+1)\times(K+1)$ block of the matrix $\sigma_\nu^2\left(\mathbf{M}'_{H_R\bar{Z}}\mathbf{M}_{H_RH_R}^{-1}\mathbf{M}_{H_R\overline{Z}}\right)^{-1}$. K denotes the number of explanatory variables in $X_{t,N}$. Then, we constructed the standard errors of the coefficients using these results.

Table 7: Data Sources

Variables	Data name	Publisher
p_i	Findings on *Furusato nozei* program	MIAC
POP	Report on population, demographics and number of households	MIAC
$DEBT$	Financial settlement of municipalities	MIAC
$INCOME$	Taxation settlement of municipalities	MIAC
$LATG$	Financial settlement of municipalities	MIAC
FCI	Financial settlement of municipalities	MIAC
$AGRI$	Taxation settlement of municipalities	MIAC
NGD	Taxation settlement of municipalities	MIAC
$DISASTER$	List of areas affected by the disaster	JPO
$TOKYO$	–	–
$15UNDER$	Report on population, demographics and number of households	MIAC
$65OVER$	Report on population, demographics and number of households	MIAC
$NBALANCE$	Financial settlement of municipalities	MIAC
$OBALANCE$	Financial settlement of municipalities	MIAC

Note. MIAC: Ministry of Internal Affairs and Communications; JPO: Japan Patent Office.

Appendix B. The data sources are in Table 7.

Appendix C. Table 8 shows the estimation results when only one of OUT and $ZERO$ is a dummy variable.

Table 8: Estimation results

	Model 5				Model 6				Model 7				Model 8			
	coef.	s.d.	t value		coef.	s.d.	t value		coef.	s.d.	t value		coef.	s.d.	t value	
p_j	0.307	0.043	7.227	***	0.332	0.042	7.825	***	0.267	0.038	7.090	***	0.295	0.037	7.963	***
POP	-0.001	0.003	-0.214		-0.001	0.003	-0.427		0.007	0.003	2.842	***	0.006	0.003	2.340	***
$DEBT$	0.001	0.001	1.460		0.001	0.001	1.133		0.002	0.001	2.967	***	0.001	0.001	2.342	***
$INCOME$	-0.102	0.024	-4.185	***	-0.110	0.025	-4.362	***	-0.158	0.023	-6.879	***	-0.159	0.024	-6.738	***
$LATG$	-0.003	0.036	-0.085		0.016	0.038	0.424		-0.079	0.034	-2.359	***	-0.055	0.035	-1.564	*
FCI	0.038	0.031	1.196		0.041	0.033	1.237		-0.068	0.029	-2.235	**	-0.056	0.031	-1.819	**
$AGRI$	0.291	0.114	2.550	**	0.247	0.116	2.127	***	0.477	0.108	4.406	***	0.431	0.110	3.395	***
NGD	-0.154	0.062	-2.491	**	-0.172	0.064	-2.690	***	-0.197	0.059	-3.363	***	-0.227	0.060	-3.766	***
$DISASTER$	-0.040	0.007	-6.015	***	-0.040	0.070	-5.838	***	-0.033	0.006	-5.199	***	-0.031	0.006	-4.738	***
$TOKYO$	0.025	0.028	0.907		0.035	0.030	1.192		-0.128	0.026	-4.964	***	-0.102	0.028	-3.688	***
$15UNDER$					0.104	0.203	0.512						0.365	0.192	1.899	
$65OVER$					-0.082	0.092	-0.899						0.024	0.087	0.278	
$NBALANCE$					-0.000	0.000	-0.378						-0.000	0.000	-1.018	
$OBALANCE$					-0.000	0.000	-0.074						0.000	0.000	0.464	
OUT									2.106	0.063	33.454	***	2.104	0.063	33.498	***
$ZERO$	-0.262	0.011	-23.277	***	-0.262	0.011	-23.231	***								
$YEAR$	0.005	0.004	1.238		0.006	0.004	1.355		0.015	0.004	3.803	***	0.015	0.004	3.754	***
const.	-9.483				-10.431				-29.709				-29.270			
Rho	-0.204				-0.156				-0.171				-0.189			
Var nu	0.021				0.016				0.019				0.019			
Var 1	0.023				0.016				0.020				0.020			
pseudo R^2	0.242				0.448				0.336				0.339			
intercept	0.196				0.213				0.207				0.200			

Note. Obs., 3,482. ***, **, and * denote significance at the 1%, 5%, and 10% levels, respectively.

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