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Abstract This paper ascertains whether a soft budget constraint (SBC) problem is caused by the Local Allocation Tax (LAT) transfer in Japan. We develop a two-period Stackelberg game model that describes the dynamic commitment (DC) problem of the central government and the common pool behavior (CPB) of prefectural governments. We identify two types of CPB: the typical behavior caused by the marginal cost being less than the marginal benefit of the transfer and a type of fiscal externality the changes the transfers to other prefectures. Then, using the data of Japanese prefectural government, we estimate the reaction function of the central government, which represents a DC problem, and the borrowing equation for capturing the CPB of the prefectural government. We find no definitive evidence for CPB whereas the bailout by the LAT transfer is clear. Therefore, we cannot ascertain the so-called SBC problem of the LAT transfer. On the other hand, it seems that the decision-making of the prefectural government is merely incremental not strategic.

JEL Classification: C33; C36; H77; H72

Keywords: Intergovernmental transfer; Soft budget constraint; Common pool behavior

1 Introduction

The objective of this paper is to ascertain whether a soft budget constraint (SBC) problem occurs in the intergovernmental transfer system of Japan, namely the Local Allocation Tax (LAT) transfer from the central government to sub-national governments.

According to a seminal review by Kornai et al. (2003), the SBC caused by bailout results in an inefficient behavior of the organization supported. According to Goodspeed (2002), the SBC problem consists of two phases; a dynamic commitment (DC) problem on decision-making of

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the central government facing the failure by a sub-national government and a common pool behavior (CPB) by a sub-national government which can avoid full payment for the marginal cost of bailout.

Pettersson-Lidbom (2010) and Bordignon and Turati (2009) are leading literature of the empirical analysis of SBC phenomenon. Pettersson-Lidbom (2010) implemented an estimation on the equation which represents owning a debt by the Swedish local government with an expectation on the discretionary fiscal transfer from the central government and found the SBC phenomenon. Bordignon and Turati (2009) confirmed the SBC hypothesis on the health expenditure by the Italian regional government. Using similar framework, the SBC problem is found in German states (Baskaran 2012), Italian and French regions (Josselin et al. [2013] and Padovano [2014]).

Common feature of these analysis is to focus on the role of expectation about the bailout on the behavior by a sub-national government. Therefore, by using an instrumental variable method, they assume that the transfer by the central government is determined by demographic, geographic and economic characteristics of each region, and thus, as assumed to be given for a sub-national government. However, there is a methodological problem because the theoretical literature on SBC tell us that the decision-making of the central government as a Stackelberg follower is affected by the behavior by a sub-national government as a leader, that is, the policy variable of the central government must be treated as endogenous variable in an empirical analysis. We can point out the same problem for other approaches on SBC: difference-in-difference approach,¹ VAR model,² and a stochastic frontier-based approach.³

Turning to different perspective, Miyazaki (2007), which is one of exceptional literature on the SBC problem of the LAT transfer in Japan, studied the effect of past prefectural expenditure on the discretionary change in the calculation formula of the LAT, by implementing dynamic panel data estimation. In order to accurately capture the effect, Miyazaki (2007) aimed to investigate the calculation for individual expense items, not for total expenditure. Then, he shows that the calculation formula has been changed to substantially support to the prefecture facing the larger deviation of expenses from its budget in previous period.

¹ This method captures the effect of institutional and structural changes to transfer systems on the expectations or behavior of lower-tier governments, such as Swedish municipalities (Dietrichson and Ellegård 2015), German states (Baskaran 2017), and Dutch municipalities (Allers and Merkus 2013).
² Irandoust (2017) approaches the Swedish SBC problem by checking for cointegration between spending and revenue. Paleologou (2013) considers the linkage between revenue and expenditure in Sweden, Greece and Germany.
³ Ogawa and Tanahashi (2008) and Otsuka et al. (2014) show that the LAT makes prefectural management inefficient. Interestingly, almost of all Japanese literature on SBC relating the LAT transfer use a stochastic frontier analysis, perhaps because Akai et al. (2003) firstly approached to the SBC problem in the LAT transfer by using this analysis.

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In the context of Goodspeed’s DC and CPB, it is considered that the analysis by Miyazaki (2007) approaches to the DC problem and the analyses by Pettersson-Lidbom (2010) and Bordignon and Turati (2009) clarify the CPB. Based on their remarks, we attempt to ascertain both of DC and CPB in order to comprehensively explore the SBC problem on the LAT transfer system.

We obtain the following results from the empirical analysis. First, bailouts by LAT transfers occur regardless of the fiscal health of a prefectural government. Second, we found a positive fiscal externality among bad-fiscal-health prefectures through an equal treatment for prefectures in a same group and a negative fiscal externality from bad-fiscal-health prefectures to good-fiscal-health prefectures in some case of the estimation method. However, third, we could not observe CPB. On the other hand, forth, it seems that the decision-making of prefectural government is merely incremental not strategic.

The remainder of the paper is composed of the following parts. In the next section, we review the LAT transfer system and discuss the possibility that the SBC phenomenon may arise in the system. Then, in Sect. 3, we construct a theoretical model to interpret the estimation results. After establishing the empirical strategy in Sect. 4, we consider the SBC problem in the cause of LAT transfers by interpreting the estimation results in Sect. 5. Finally, Sect. 6 provides concluding remarks.

2 Institutional Description

2.1 Local allocation tax (LAT) transfer calculation

In Japan, there are 47 prefectures as middle-tier of local governments and 1,718 municipalities as lowest-tier of local governments. We consider the relation between the 47 prefectures and the central government. According to Fig.1 that shows a composition of total prefecture revenues, the LAT transfer is the second-largest revenue source and accounts for 17.0% of total revenue. Its share varies across prefectures from 0% to 39.0%.

LAT transfers are used to adjust imbalances in revenue resources between local governments and to ensure their financial capacity to provide standard public services and basic infrastructure to residents across the country. Because LAT transfers are preferentially distributed to prefectures that are unable to acquire the necessary tax revenue, these transfers are important revenue sources for prefectures that do not have adequate financial capabilities.

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4 This information comes directly from MIC (2017).
Specifically, the transfer distributed to prefecture \( i \) is calculated as follows:

\[
LAT_i = SFD_i - SFR_i,
\]

where \( SFD_i \) denotes the standard fiscal demand (SFD) determined based on the rational and appropriate service standard for each prefectural government,\(^5\) and \( SFR_i \) denotes the standard fiscal revenues (SFR) that are defined as the sum of 75% of local tax revenues and some intergovernmental transfers. The LAT transfer is positive for a prefecture whose \( SFR_i \) is less than its \( SFD_i \) and is zero for a prefecture whose \( SFR_i \) exceeds its \( SFD_i \).

Each element of \( SFD_i \) is derived by multiplying the unit cost, the measurement unit, and the correction coefficients. The unit cost is estimated as the average cost of public service, which is assumed to be provided in the standard model of a prefecture.\(^6\) Thus, the unit cost is commonly applied to calculate the \( SFD_i \) for all prefectures. The measurement units are defined by real statistics, such as the population, the length of rivers in each prefecture, and so on. The correction coefficients are used to take into account demographic and geographic characteristics of the prefecture that may cause additional service costs. Therefore, the same coefficients are applied to similar prefectures in terms of these characteristics. In addition, a certain percentage of expenses for debt service are included as elements of \( SFD_i \).

Akai et al. (2003) and Miyazaki (2007) investigated the calculation formula of the \( SFD_i \) in detail and pointed out that the unit cost and some correction coefficients are estimated based on the past administration cost, and, thus, may be affected by the previous expenditure behavior of prefectural governments.

Furthermore, in recent decade, 40.3% of 90 requests regarding unit costs and 24.7% of 126

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\(^5\) This information comes directly from MIC (2017).

\(^6\) It is assumed to be a virtual jurisdiction of 1.7 million people who form 690 thousand households in an area of 6.5 thousand km\(^2\) with roads up to 3.9 thousand km long.
requests regarding correction coefficients from prefectures and municipalities for the revision of the calculation formula of the $SFD_i$ have been accepted, as shown by Fig.2. Thus, the DC problem may be inherent in the LAT transfer system.

**Fig.2 Acceptance rate of requests regarding the standard fiscal demand formula**

![Acceptance rate of requests regarding the standard fiscal demand formula](image)

Source: Web-site of the Ministry of Internal Affairs and Communications (MIC).

From a macro perspective, although it is institutionalized that the LAT transfer is financed by a fixed percentage of national tax revenues, the amount does not correspond to and has been less than the total amount required across sub-national governments. These shortages have been compensated by special increases in the LAT source and additional issues of local bonds as an exception. According to the FY2015 settlement, a 7.8 trillion yen shortage of the source was compensated by a 2.4 trillion yen increase in the LAT source and 5.4 trillion yen increase in the issue of local bonds. Although the ratios of increases in the LAT source have varied across periods, this evidence suggests that sub-national governments might be able to expect a bailout with a certain probability.

### 2.2 Local bond and discretion of prefectural governments

Returning to Fig.1, we know the fourth largest source of revenue is the issue of local bonds. Although the component ratio is 10.6% on average, it ranges among prefectures from 2.2% to 18.5% depending on their financial conditions.

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7 These fixed percentages are 33.1% of personal income tax and corporate tax revenues, 50% of liquor tax revenues, 22.3% of consumption tax revenues, and all local corporate tax.

8 For instance, 51.8% of the shortage in FY2010 was compensated by the special increase in the LAT source.
In recent, the outstanding debts of sub-national governments have become a serious problem same as have those of the central government. During the past two decades, the total outstanding debt across all sub-national governments has rapidly increased from 92.9 trillion-yen in FY1995 to 199 trillion-yen in FY2015. At the same time, expenses for debt service have increased from 8.8% of total expenditures in FY1995 to 13.1% in FY2015. In the case of prefecture, the percentage in FY2015 (14.2%) was become double that of FY1995 (7.4%). This evidence indicate that the sub-national governments budgets have become more rigid, and their fiscal health has declined.

Local bonds are closely connected with the LAT transfer system. First, as mentioned above, additional issues of local bonds are required to compensate for shortages in the LAT source; those bonds are called “bonds for the extraordinary financial measures (BEFM)”\(^9\). These bonds were issued starting FY2001, but other kinds of bonds were used in the past. Second, part of the expenses for debt service for almost of all kinds of bonds are included in the SFD. In particular, debt service expenses of BEFMs are perfectly included as one element of the SFD. Therefore, local bonds issues can be considered as automatically supported by LAT transfers. Furthermore, the number of SFD elements related to expenses for debt service has increased from eight items in FY1985 to 16 items in FY2015. That is, it is possible to consider a discretionary increase in the financial support from LAT transfers.

However, sub-national governments are legally restricted from issuing local bonds at their own discretion, and, thus, they cannot freely borrow money to finance their deficits. First, the Article 5 of Local Finance Law only permits the issue of local bonds to finance public investment expenses. Second, sub-national governments were unable to issue local bonds without the permission of the central government until 2006. Third, governments whose “real debt service ratios” exceed 18% are still restricted from issuing bonds even though the permission scheme has been changed to a consultation scheme\(^{10}\).

Fig.3 shows trends in the bond dependence rate, which is the ratio of local bond revenue to total prefecture revenue. We find a structural change in 1993, after which the mean bond dependence rate consistently exceeds 12% because local bonds have been used as the revenue sources for countercyclical measures since the collapse of the Heisei bubble economy. Although the effect of the introduction of BEFMs on the mean of the dependence rate is not immediately clear, the standard deviation seems to have increased starting in 2001. Although the introduction

\(^9\) These bonds are issued as an exception to Article 5 of Local Finance Law to address shortages of General revenue resources of sub-national governments. Proceeds financial measures from these bonds can be used for expenses other than investments expenses (MIC, 2017).

\(^{10}\) The real debt service ratio is an index of the size of the redemption amount of debts and similar expenditure and represents the cash-flow level (MIC, 2017). The average value for a prefecture in FY2015 was 12.7%, whereas it was 9.9% on average for all sub-national governments.
of the consultation scheme for the issue of local bonds may not have had a clear effect on the mean and standard deviation of the dependence rate, the standard deviation seems to have increased gradually. From this evidence, sub-national governments may be considered to have a certain amount of discretion to issue local bonds, and, thus, can engage in CPB.

**Fig.3 Bond dependence rate (prefectures)**

![Graph showing bond dependence rate for prefectures](source)

Source: Annual Report for Local Public Finance (MIC; each year)

### 3 Theoretical background

#### 3.1 Basic setup

We briefly consider the theoretical background of the SBC under a fiscal equalization scheme, by extending the simple two-period Stackelberg game between the central and regional governments that is proposed by Goodspeed (2002).

Whereas Goodspeed (2002) assumes that a central government with a political motivation controls interregional transfers to garner votes, we apply the assumption of a fiscal egalitarian central government that seeks to reduce inter-prefectural disparities of fiscal health. This assumption might be more appropriate for the behavior of the central government in Japan than the assumption of a political motivation is. In usual, the term “egalitarian” is used to describe a social welfare function that aims to equalize individual incomes or utilities in welfare...
To distinguish our use of the term, we refer to a fiscal egalitarian central government in this discussion.

Our model includes \( n \) prefectures, denoted by the subscript \( i \) \((= 1, \ldots, n)\), each of which have a prefectural government and one standardized resident in two periods. Each prefectural government belongs to the good group \((G)\) or the bad group \((B)\) depending on its fiscal health. For simplicity, we assume homogenous level of fiscal health within each group. Moreover, we assume that prefectural governments do not move between groups even if their fiscal health changes. The classification is used as a reference for intergovernmental fiscal transfer implemented by the central government. The utility function of a representative resident in prefecture \( i \) is composed of his consumption of a private good \((c_{i,1}, c_{i,2})\) and a local public good \((q_{i,1}, q_{i,2})\), over two periods based on his income \((y_{i,1}, y_{i,2})\), which we take as given.

A prefectural government levies a local tax on its resident’s income at a controllable rate \( t_{i,1} \) and borrows money to provide the local public good \((q_{i,1})\) in period 1. Then, it provides the local public good \((q_{i,2})\) and pays debt services using local tax revenue \((t_{i,2}y_{i,2})\) in period 2. The central government provides an intergovernmental fiscal transfer \((g_{i,1}, g_{i,2})\) financed by the central tax revenue in both periods.

The structure of Stackelberg game between a prefectural government and the central government is described as the follows. In both periods, we use a Nash game to reflect the relations among prefectural governments.

0. The central government sets the amount of the transfer \((g_{i,1})\) to the prefectural government prior to period 1.
1. The prefectural government sets the local tax rate \((t_{i,1})\) and the amount to borrow \((b_{i,1})\) to produce the local public good in period 1, taking \( g_{i,1} \) as given.
2. The central government sets the central tax rate \((t_{C})\) and the transfer amount \((g_{i,2})\) in period 2, taking \( b_{i,1} \) and \( t_{i,1} \) as given. Then, the prefectural government sets the local tax rate \((t_{i,2})\).

Therefore, the prefectural government, as a Stackelberg leader, determines the financing the local public good in period 1, anticipating the behavior of the central government, as the follower, in period 2.

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11 This definition is described by Atkinson and Stiglitz (1980) in their chapter 11.
12 For simplicity, we assume a homogeneous population size among prefectures and that the heterogeneity of fiscal health is mainly caused by income differences.
3.2 The optimization problem of the central government

To evaluate this game, we first consider the optimization problem of the central government, which is motivated by fiscal egalitarianism. The objective function of the central government is composed of each prefecture’s utility with weights based on the fiscal health (\(G\) or \(B\)), and the amount of borrowing of each prefectural government, as follows:

\[
\max_{g_{i,2}} \sum_i w_i(b) \left[ v_i(q_{i,2}) + z_i(c_{i,2}) \right]
\]

s.t. \( t_2^C \sum_i y_{i,2} = \sum_i g_{i,2} \)

\[
q_{i,2} = g_{i,2} + t_{i,2} y_{i,2} - b_{i,1}(1 + r)
\]

\[
c_{i,2} = y_{i,2} (1 - t_{i,2} - t_2^C)
\]

where \( v_i() \) and \( z_i() \) are the sub-utilities of local public and private good consumption, respectively. They are strictly concave such that \( v_{qq} < 0 < v_q \), \( z_{cc} < 0 < z_c \). \( b = (b_{1,1}, ..., b_{n,1}) \) is a vector of the amount of the borrowing by each prefectural government. The egalitarian weight, \( w_i(b) \), which is a function of this vector, will be explained later. The central government maximizes this objective function subject to the budget constraints of governments and households.

Using the balanced budget condition of the central government, we obtain the following first-order condition:

\[
w_i v'_i - \frac{1}{Y} \sum_{i=1}^n w_i z'_i y_{i,2} = 0, \text{ for all } i
\]

where \( Y = \sum_{i=1}^n y_{i,2} \) and \( \partial t_2^C / \partial g_{i,2} = 1/Y \). From Eq. 1, assuming an interior optimum, the optimization condition of the central government’s fiscal transfer can be derived as follows:

\[
w_1(b) v'_1 = w_2(b) v'_2 = \ldots = w_n(b) v'_n.
\]

In other words, the central government sets the amount of the transfer to each prefectural government to equalize the weighted marginal utilities among prefectures. The egalitarian weight depends on the amount of borrowing.
Fiscal egalitarianism and dynamic commitment

We characterize the egalitarian weight as a function of borrowing in the first period. Importantly, one prefecture’s weight can be affected by another prefectural government’s fiscal health because the objective of the intergovernmental transfer is to reduce fiscal health disparities. We show that a representative prefecture government in the bad group as prefecture \(l\) and that in the good group as prefecture \(h\).

Weight of a prefecture in the bad group

The weight of a prefecture in the bad group always increases when its own fiscal health becomes much worse: \(\frac{\partial w_l}{\partial b_l,1} > 0\). Furthermore, because fiscal demand is measured by a common formula for calculating the transfer, such as the SFD formula mentioned in Sect.2, the egalitarian weights of the group members simultaneously increase in the transfer system: \(\frac{\partial w_l}{\partial b_{m,1}} > 0\). In addition, we assume within-group homogeneity: \(\frac{\partial w_l}{\partial b_{m,1}} = \frac{\partial w_l}{\partial b_{l,1}}\).

Furthermore, a decrease in the local public good in prefecture \(h\), \(q_{h,2}\), caused by an increase in borrowing by that prefecture \(h\) \((b_{h,1})\) causes the transfer to that prefecture \((g_{h,2})\) to increase. However, such a bailout expands the disparity of fiscal health, which is undesirable for the egalitarian central government. Thus, the central government increases the weight of prefecture \(l\) as borrowing by a good-fiscal-health prefectural government increases: \(\frac{\partial w_l}{\partial b_{h,1}} > 0\).

Weight of a prefecture in the good group

The weight of a prefecture in the good group does not increase, if its own fiscal health becomes worse: \(\frac{\partial w_h}{\partial b_{h,1}} = 0\). Furthermore, the weight does not change if the fiscal health of a prefectural government in the same group becomes worse: \(\frac{\partial w_h}{\partial b_{k,1}} = 0\). However, the weight does decrease when borrowing by prefecture \(l\) increases: \(\frac{\partial w_h}{\partial b_{l,1}} < 0\) because the egalitarian central government intends to reduce fiscal health disparities.

Transfer to a prefecture in the bad group

Next, we consider the relationship between changes in transfers and borrowing. The transfer in period 2 is represented by the following function from the first-order condition (Eq.1).

\[
g_{i,2}^* = g_{i,2}(b) \text{ for all } i. \quad (3)
\]

13 Although, Cowell (2000) noted that various features of egalitarian-based social welfare function are considered, we do not strictly specify the features of the objective function of the central government to keep the empirical analysis tractable. However, we can consider the egalitarian weight as the coefficient on the first derivative of the objective function with respect to the amount of borrowing. Thus, we refer to the assumptions on the second and cross derivatives in the following explanation.

14 Prefecture \(m\) denotes other prefectural government in a bad group.

15 Prefecture \(k\) denotes other prefectural government in a good group.
From the comparative statics, the influences of the prefectural government’s decision as a Stackelberg leader on the central government’s reaction in period 2 are described as follows.\(^{16}\)

\[
\frac{\partial g_{l,2}}{\partial b_{l,1}} = \frac{\partial w_l}{\partial b_{l,1}} v'_l - w_l v''_l (1 + r) - \frac{1}{Y} \frac{\partial X}{\partial b_{l,1}} > 0, \quad (4a)
\]

\[
\frac{\partial g_{l,2}}{\partial b_{m,1}} > 0, \text{ and} \quad (4b)
\]

\[
\frac{\partial g_{l,2}}{\partial b_{h,1}} > 0, \quad (4c)
\]

where \(\frac{\partial X}{\partial b_{l,1}} = \frac{\partial X}{\partial b_{m,1}} = \sum_l \frac{\partial w_l}{\partial b_{l,1}} z'_l y_l + \sum_h \frac{\partial w_h}{\partial b_{l,1}} z'_h y_h\).

The first and second terms on the middle-hand side in Eq.4a represent the change in the egalitarian weight and the change in the marginal utility as borrowing by the bad-fiscal-health prefecture exogenously increases, respectively. Considering the assumption on the egalitarian weight and the definition of the utility function, the signs of them are positive. The third term on the middle-hand side in Eq.4a represents a change in the marginal social disutility of taxation to finance a transfer to a bad-fiscal-health prefectural government that borrows more through the change in the egalitarian weight. We assume \(\frac{\partial X}{\partial b_{l,1}} < 0\). This means that the central government with strong fiscal egalitarianism underrates the marginal disutility of taxation on the residents in a good-fiscal-health prefecture. Under this assumption, we obtain \(\frac{\partial g_{l,2}}{\partial b_{l,1}} > 0\). That is, the bailout is inherently assumed in our model, in contrast to the literature on the SBC. The bailout is further increased as the egalitarian weight changes as borrowing changes, especially for the bad-fiscal-health prefecture.\(^{17}\)

Furthermore, we recognize from Eq.4b that \(\frac{\partial g_{l,2}}{\partial b_{m,1}} > 0\). We call the increase in the transfer a positive fiscal externality through the equal treatment of prefectures in the same fiscal health group.

However, we know from Eq.4c that the transfer to a prefecture with bad fiscal health increases when a good-fiscal-health prefectural government borrows more: \(\frac{\partial g_{l,2}}{\partial b_{h,1}} > 0\). That is, a positive fiscal externality always occurs through the transfer system regardless of the

\(^{16}\) See the appendix for the derivation.

\(^{17}\) Relaxing our assumption on the number of prefectures, we find another possibility that brings about \(\frac{\partial X}{\partial b_{l,1}} < 0\). If the number of good-fiscal-health prefectures is larger than that of bad-fiscal-health prefectures, \(\frac{\partial X}{\partial b_{l,1}} \) tends to be negative. Either way, a bailout for a bad-fiscal-health prefecture may occur under a strong egalitarian central government.
strength of fiscal egalitarianism.

Transfer to a prefecture in a good group

\[
\frac{\partial g_{h,2}}{\partial b_{h,1}} = -w_h v''_h (1 + r) - \frac{1}{Y} \frac{\partial X}{\partial b_{h,1}} \geq 0, \quad (5a)
\]

\[
\frac{\partial g_{h,2}}{\partial b_{k,1}} < 0, \text{ and} \quad (5b)
\]

\[
\frac{\partial g_{h,2}}{\partial b_{l,1}} < 0, \quad (5c)
\]

where \( \frac{\partial X}{\partial b_{h,1}} = \frac{\partial X}{\partial b_{k,1}} = \sum_l \frac{\partial w_l}{\partial b_{h,1}} z'_l y_l > 0. \)

The first term on the middle-hand side in Eq.5a represents a change in the marginal utility of the transfer as borrowing by the good-fiscal-health prefecture exogenously increases. The second term on the middle-hand side in Eq.5a represents an increase in the weight of the marginal disutility of bad-fiscal-health prefectures on taxation to finance a bailout for a good-fiscal-health prefectoral government that borrows more.

We assume \(-w_h v''_h (1 + r) \geq \frac{1}{Y} \frac{\partial X}{\partial b_{h,1}}, \) which is a non-negativity condition on the change in the transfer to a good-fiscal-health prefecture that borrows more. However, we consider that the central government does not rescue a good-fiscal-health prefectoral government if the central government is concerned about the marginal disutility of bad-fiscal-health prefectures on taxation relative to the marginal utility of good-fiscal-health prefectures.

From Eq.5b, transfers to good-fiscal-health prefectures decrease owing to the budget constraint of the transfer system when other prefectural governments in the same group increase their own borrowing. That is, a negative fiscal externality is caused by the monetary trade-offs among good-fiscal-health prefectures.

However, we recognize from Eq.5c the other type of the negative fiscal externality, which is caused by the egalitarian transfer system.
3.3 The optimization problem of the prefectural government

Considering the reaction of the central government, the optimization problem of a prefectural government is described as follows:

$$\max_{b_{i1}, t_{i1}, t_{i2}} u_i(q_{i1}) + v_i(q_{i2}) + x_i(c_{i1}) + z_i(c_{i2})$$

s.t.

$$q_{i1} = g_{i1} + t_{i1}y_{i1} + b_{i1}, \quad c_{i1} = y_{i1} (1 - t_{i1}),$$
$$q_{i2} = g_{i2}^* + t_{i2}y_{i2} - b_{i1}(1 + r), \quad c_{i2} = y_{i2} (1 - t_{i2} - t_C^C),$$
$$t_C^C \sum_j y_{i2} = \sum_i g_{i2}^*, \quad \text{and}$$
$$g_{i2}^* = g_i(b), \text{ for all } i.$$  

The first-order conditions are summarized as follows:

$$t_{i1} : u'_i t_{i1} - x'_{i1} = 0, \quad (7a)$$
$$b_{i1} : u'_i t_{i1} - (1 + r)v'_{i2} + v'_{i2} \frac{\partial g_{i2}}{\partial b_{i1}} - \frac{z'_{i2}y_{i2}}{Y} \sum \frac{\partial g_{i2}}{\partial b_{i1}} = 0, \text{ and} \quad (7b)$$
$$t_{i2} : v'_{i2} - z'_{i2} = 0. \quad (7c)$$

Eq.7b is derived from the following equilibrium budget equation.

$$Y \sum \frac{dt_C^C}{dg_{i2}} = \sum \frac{\partial g_{i2}}{\partial b_{i1}} + \frac{\partial g_{i2}}{\partial b_{i1}} + \sum_{j \neq i} \frac{\partial g_{j2}}{\partial b_{i1}} \quad (8)$$
That is, we recognize that the increase in the central government’s tax rate covers the changes in transfers not only to \(i\) but also to the other prefectural governments, according to the right-hand side of Eq.8.

Using Eq.7c, Eq.7b can be rewritten as the following optimization condition.

\[
\frac{u'_i}{\nu'_i} = (1 + r) - \left( 1 - \frac{y_{i,2}}{Y} \right) \frac{\partial g_{i,2}}{\partial b_{i,1}} + \frac{y_{i,2}}{Y} \sum_{j \neq i} \frac{\partial g_{j,2}}{\partial b_{i,1}}.
\]

(9)

### Common pool behavior

The first term of Eq.9, \((1 + r)\), is the opportunity cost of the borrowing at the first-best rate. Because \(y_{i,2}/Y < 1\) by definition, the sign of the second term on the right-hand side of Eq.9 depends on the sign of \(\partial g_{i,2}/\partial b_{i,1}\). The meaning of the third term on the right-hand side of Eq.9 is complicated because the sign of \(\partial g_{j,2}/\partial b_{i,1}\) for each of \(j\) is able to be considered either positive or negative as we mentioned above. Furthermore, because the third term consists of increases and decreases in transfers to the prefectural governments other than \(i\), the sign of the third term consequently depends on its composition.

Therefore, we consider CPB by separating prefectures in the bad and good groups mentioned above. We rewrite Eq.9 as the following.

\[
\frac{u'_i}{\nu'_i} = (1 + r) - \left( 1 - \frac{y_{i,2}}{Y} \right) \frac{\partial g_{i,2}}{\partial b_{i,1}} + \frac{y_{i,2}}{Y} \sum_{j = l} \frac{\partial g_{j,2}}{\partial b_{i,1}} + \frac{y_{i,2}}{Y} \sum_{j = h} \frac{\partial g_{j,2}}{\partial b_{i,1}}.
\]

(10)

where each of \(l\) and \(h\) is denoting a bad-and good- fiscal-health prefecture, respectively.

### Common pool behavior by the prefecture in the bad group

Suppose prefecture \(i\) is in the bad fiscal health group. As described above, the sign of \(\partial g_{i,2}/\partial b_{i,1}\) is positive under a strong egalitarian central government. Therefore, we recognize that the second term on the right-hand side in Eq.10, with a negative sign, represents the inefficiency bias causing over-borrowing in the prefecture whose economic size is small. This behavior is a typical CPB because the marginal cost is smaller than the marginal benefit of a transfer. Small prefectures have advantages to enjoy net benefits from the common pool by depending on the other prefecture’s burden.

Next, as described above, the sign of \(\partial g_{i,2}/\partial b_{i,1}\) is positive by the positive fiscal externality, which is caused by the equal treatment for prefectures within group. The third term implies an additional burden of \(i\)’s borrowing on \(i\)’s residents. Inversely, the sign of \(\partial g_{h,2}/\partial b_{i,1}\) is negative owing to the negative fiscal externality. Therefore, the total effect of fiscal
externalities may be an inefficiency bias that causes over-borrowing in the case where the magnitude of the fourth term exceeds that of the third term. This means that the bad fiscal health group is a minority.

On the other hand, as Goodspeed (2002) emphasizes, we can suppose that the amount of $i$’s borrowing achieves (or is less than) an efficient level in this model when prefecture $i$ belongs to a majority group. In this situation, we conclude that prefectoral governments with bad fiscal health do not take CPB whereas a bailout by the central government occurs.

**Common pool behavior by the prefecture in the good group**

In contrast, suppose prefecture $i$ is the good-fiscal-health prefectoral government. As described above, the sign of $\partial g_{i,2}/\partial b_{i,1}$ may be zero if the central government is not concerned about the utility reduction in the prefecture. Thus, the decision-making of a good-fiscal-health prefectoral government regarding its borrowing does not depend on the degree of the discount on the burden of $i$’s borrowing on $i$’s residents.

However, the sign of $\partial g_{l,2}/\partial b_{l,1}$ may be positive because of a positive fiscal externality through the egalitarian transfer system, whereas the sign of $\partial g_{h,2}/\partial b_{l,1}$ is negative owing to the budget constraint of the transfer system. Therefore, same as the above discussion, the sign of the total effect of fiscal externalities depends on the share of good-fiscal-health prefectures. That is, over-borrowing will occur if the sign of the third term is negative, and vice versa.

Summarizing the above discussion, we propose empirical propositions. To verify the typical CPB represented by the second term on the right-hand side in Eq.10, we check the sign of relation between the prefectoral government’s borrowing and the relative economic size of prefecture $i$. If we find a negative sign meaning that the lager prefecture issues the smaller amount of its local bonds, we confirm CPB by the bailout

On the other hand, we confirm CPB caused by the fiscal externality if we observe the significant sign of the relation between the prefectoral government’s borrowing and the ratio of good- and bad-fiscal-health prefectures to total.

**4 Strategy of empirical analysis**

**4.1 Estimation model**

To empirically investigate DC problem and CPB, we set up the following empirical model. In contrast to our theoretical solution procedure that uses a backward induction, we implement an empirical estimation following the game stage. Thus, we estimate Eq.11 that represents the
decision-making of prefectural governments at first. Then, we estimate Eq.12 that represents the reaction function of the central government.

\[ b_{it} = \gamma + \delta \text{size}_{it} + \eta_1 \text{ratio}_{ht} + \eta_2 \text{ratio}_{lt} + \mu_{it}, \quad \text{and} \quad (11) \]

\[ g_{lt} = \alpha + \rho \tilde{b}_{it-1} + \beta_1 \tilde{b}_{lt-1} + \beta_2 \tilde{b}_{lt-1} + \epsilon_{lt}, \quad (12) \]

where \( \gamma, \delta, \eta_1, \eta_2, \alpha, \rho, \beta_1 \) and \( \beta_2 \) are the estimated parameters and \( \epsilon_{lt} \) and \( \mu_{it} \) are the error terms. \( \tilde{b}_{it-1}, \tilde{b}_{lt-1} \) and \( \tilde{b}_{lt-1} \) are made of a fitted value of \( b_{it} \), which is derived from the results of the estimation on Eq.11.

The challenge, which we face in our empirical analysis, is to distinguish between the estimations on the behavior of good- and bad-fiscal-health prefectures because there is no threshold that divides the sample we use. Therefore, to distinguish the estimation, we employ the index of financial capability (IFC), which is defined as the ratio of SFR to SFD.\(^{18}\) The IFC is used as an indicator for the fiscal health of a sub-national government in Japan. According to the “Table of the fiscal index on prefectural government” by the Ministry of Internal Affairs and Communications (MIC), the 47 prefectures are categorized by the certain range of the IFC into some group in each fiscal year. For example, Table 1 shows the groups in the fiscal year 2015.

Table 1 Group of fiscal health by IFC (2015)

<table>
<thead>
<tr>
<th>Group</th>
<th>Range of IFC</th>
<th>Member of group</th>
</tr>
</thead>
<tbody>
<tr>
<td>Exceptional</td>
<td>More than 1</td>
<td>Tokyo</td>
</tr>
<tr>
<td>A</td>
<td>0.7–1.0</td>
<td>Aichi, Chiba, Kanagawa, Osaka, Saitama, Shizuoka</td>
</tr>
<tr>
<td>B1</td>
<td>0.5–0.7</td>
<td>Fukuoka, Fukushima, Gifu, Gunma, Hiroshima, Hyogo, Ibaragi, Kyoto, Mie, Miyagi, Okayama, Shiga, Tochigi</td>
</tr>
<tr>
<td>C</td>
<td>0.4–0.5</td>
<td>Hokkaido, Ehime, Ishikawa, Kagawa, Nagano, Nara, Niigata, Toyama, Yamaguchi</td>
</tr>
<tr>
<td>D</td>
<td>0.3–0.4</td>
<td>Aomori, Fukui, Iwate, Kagoshima, Kumamoto, Miyazaki, Nagasaki, Oita, Okinawa, Saga, Tokushima, Wakayama, Yamagata, Yamanashi</td>
</tr>
<tr>
<td>E</td>
<td>Less than 0.3</td>
<td>Akita, Kochi, Shimane, Tottori</td>
</tr>
</tbody>
</table>

Using this IFC, we set two estimation models. Model I represents the estimation model from

\(^{18}\) See Sect.2 for the definitions of SFD and SFR.
the viewpoint of a prefecture in the bad fiscal health group. We presume that prefecture $i$ behaves regarding the change in transfer to prefectures whose IFC are higher than $i$’s one.\footnote{Tokyo is dropped from Model I because there is no prefecture whose IFC is higher than (or same as) Tokyo.} In contrast, Model II represents the estimation model from the viewpoint of a prefecture in the good fiscal health group. That is, prefecture $i$ is considered to behave regarding the change in transfer to prefectures whose IFC are lower than $i$’s one.\footnote{Tokyo is also dropped from this model for lack of a prefecture with similar IFC as Tokyo. In addition, the prefectures that have belonged to the Group E with the lowest IFC during our sample period (FY1985 – FY2015).}

In Model I, Eqs.11 and 12 can be rewritten as follows:

$$b_{i,t} = \gamma + \delta \text{size}_{i,t} + \eta_1 \text{ratio}_{i,t}^\text{same} + \eta_2 \text{ratio}_{i,t}^\text{upper} + \mu_{i,t}, \quad \text{(11-I)}$$

$$g_{i,t} = \alpha + \rho \hat{b}_{i,t-1} + \beta_1 \hat{b}_{i,t-1}^\text{same} + \beta_2 \hat{b}_{i,t-1}^\text{upper} + \epsilon_{i,t}. \quad \text{(12-I)}$$

$\text{ratio}_{i,t}^\text{same}$ is defined as the ratio of prefectures with the same fiscal health group as prefecture $i$ to total. For example, according to Table 1, $\text{ratio}_{2015}^\text{same}$ for Hokkaido is calculated as $0.170 (=8/47)$. $\text{ratio}_{i,t}^\text{upper}$ is defined as the ratio of prefectures in the upper-IFC group. For example, $\text{ratio}_{2015}^\text{upper}$ for Hokkaido is calculated as $0.426 (=20/47)$.

If prefectural governments expect the reaction of the central government as our theoretical consideration, we predict the sign of estimation parameters in Eq.11-I as follows. $\delta$ will be negative because an increase in the size of prefecture reduces an advantage to enjoy the common pool. $\eta_1$ will be negative owing to an increase in the marginal cost of borrowing through the positive fiscal externality within the same fiscal health members. In contrast, $\eta_2$ will be positive because the marginal cost of the borrowing is decreased by the negative fiscal externality that reduces transfers to good-fiscal-health prefectures.

As the estimation parameters in Eq.12-I, we predict that all of them will be positive, according to the theoretical consideration. $\rho$ implies an existence of a bailout. Each of $\beta_1$ and $\beta_2$ should represent each positive fiscal externality within the same fiscal health group and between groups, respectively.

Each amount of the borrowing by other prefectures ($\hat{b}_{i,t-1}^\text{same}, \hat{b}_{i,t-1}^\text{upper}$) is defined as a weighted average of borrowings in each group. To derive $\hat{b}_{i,t-1}^\text{same}$, we define the same group weight as:

$$\omega_j^i = \frac{1}{n_j}, j \in \text{same group as } i's, \text{and } j \neq i, \quad \text{(13)}$$
where \( n_j^S \) is the number of prefectures belonging to \( i \)'s group other than \( i \). We construct the same group weight matrix \( \Omega^S \) that includes the weight \( \omega_j^S \) as its element. Using this matrix, we calculate \( \bar{b}_{j,t-1}^{same} \) as the weighted average of the borrowing by the prefectural governments in the same group, that is, \( \bar{b}_{j,t-1}^{same} = \Omega^S \bar{b}_{j,t-1} \).

In a similar manner, to derive \( \bar{b}_{j,t-1}^{upper} \), we define the upper group weight as:

\[
\omega^U_j \frac{f_{j,t}^{upper} - f_{i,t}}{\sum_j (f_{j,t}^{upper} - f_{i,t})}, j \in \text{upper group than } i',
\]

where each of \( f_{i,t} \) and \( f_{j,t}^{upper} \) is the IFC of prefecture \( i \) and that of the prefecture whose IFC is higher than \( i \)'s group. This weight means that prefecture \( i \) pays greater attention to the prefecture with the higher IFC than its own. The upper group weight matrix \( \Omega^U \) includes the weight \( \omega^U_j \) as its element. Using this matrix, \( \bar{b}_{j,t-1}^{upper} \) is defined as the weighted average of the borrowing by the prefectural governments in the upper groups, that is, \( \bar{b}_{j,t-1}^{upper} = \Omega^U \bar{b}_{j,t-1} \).

In Model II, Eqs.11 and 12 can be rewritten as follows:

\[
b_{i,t} = \gamma + \delta \text{size}_{i,t} + \eta_1 \text{ratio}_{i,t}^{same} + \eta_2 \text{ratio}_{i,t}^{lower} + \mu_{i,t}, \quad \text{and} \quad (11-II)
\]

\[
g_{i,t} = \alpha + \rho \text{\bar{b}_{i,t-1}^{same}} + \beta_1 \text{\bar{b}_{j,t-1}^{same}} + \beta_2 \text{\bar{b}_{j,t-1}^{lower}} + \varepsilon_{i,t}. \quad (12-II)
\]

\( \text{ratio}_{i,t}^{same} \) is same as that in Model I. \( \text{ratio}_{i,t}^{lower} \) for prefecture \( i \) is defined as the ratio of prefectures in the lower-IFC group to total. For example, according to Table 1, \( \text{ratio}_{i,2015}^{lower} \) for Hokkaido is calculated as 0.383 (=18/47).

According to the remarks from our theoretical analysis, we predict that \( \delta \) may equal zero or more and that \( \eta_1 \) will be a positive value, whereas \( \eta_2 \) will be a negative value in Eq.11-II. As mentioned by Eq.5a, the central government may leave a good-fiscal-health prefecture that borrows more. Thus, the size of the prefecture may have no influence on the decision-making of the prefecture about borrowing. \( \eta_1 \) should represent a decrease in the marginal cost of borrowing via a negative fiscal externality across good-fiscal-health prefectures through the budget constraint of the transfer system. \( \eta_2 \) should represent an increase in the marginal cost of borrowing via a positive fiscal externality from good-fiscal-health prefecture’s borrowing to transfers to bad-fiscal-health prefectures.

As for the estimation parameters in Eq.12-II, we suppose that \( \rho \) may equal zero or more and that \( \beta_1 \) and \( \beta_2 \) are negative. The reason for the sign of \( \rho \) is same as that for the sign of \( \delta \). Each of \( \beta_1 \) and \( \beta_2 \) should indicate negative fiscal externality within the group and between
bad and good groups, respectively.

In this Model II, to derive $b_{j,t-1}^{\text{lower}}$, we define the lower group weight as:

$$\omega^l_j = \frac{|f_{j,t}^{\text{lower}} - f_{i,t}|}{\sum_j |f_{j,t}^{\text{lower}} - f_{i,t}|}, j \in \text{lower group than } i's.$$  \hspace{1cm} (15)

where $f_{j,t}^{\text{lower}}$ is the IFC of the prefecture whose IFC is lower than $i$'s group. This weight means that prefecture $i$ pays greater attention to the prefecture with the lower IFC than its own. The lower group weight matrix $\Omega^L$ includes the weight $\omega^l_j$ as its element. Using the matrix, $b_{j,t-1}^{\text{lower}}$ is defined as the weighted average of borrowings by the prefectural governments belonging lower groups, that is, $b_{j,t-1}^{\text{lower}} = \Omega^L b_{j,t-1}$.

4.2 Estimation strategy

Estimation method

We analyze Model I and II by two estimation methods: a panel OLS on the two-way error component model and a dynamic panel data estimation.

The reason why we take a dynamic panel data estimation is to capture incrementalism in the process of making budget by both governments. In Japan, a bureaucracy in the central and prefectural government usually makes the budget of a next fiscal year referring the past fiscal year result. Therefore, we employ a dynamic panel model including the lagged-dependent variable as an explanatory variable. We use system GMM proposed by Blundell and Bond (1998) to estimate the dynamic panel data estimation.

Data set

Table 2 provides descriptive statistics about the variables in the estimation.\textsuperscript{21} We employ a sample of 47 prefectures in 1985 – 2015. Local bond revenue per capita ($BOND_{i,t}$) represents $i$’s borrowing ($b_{i,1}$), and LAT revenue per capita ($LAT_{i,t}$) represents the intergovernmental transfer ($g_{i,2}$) made by the central government in the theoretical model in Sect.3. These endogenous variables represent decision-making by prefectural governments and the reaction of the central government in Eqs.11 and 12. We confirm that $BOND_{i,t}$ and $LAT_{i,t}$ are stationary using the Levin, Lin, and Chu t-test; Im, Pesaran, and Shin W-stat test; and the augmented Dickey-Fuller-Fisher chi-square test.

\textsuperscript{21} The definitions of variables are summarized in the annexed table in the Appendix.
We employ the ratio of i’s prefectural GDP to total GDP as $size_{i,t}$ in Eq.11. $ratio_{ij}^{same}$, $ratio_{ij}^{upper}$, and $ratio_{ij}^{lower}$ is represents the ratio of prefectures in the same, the upper, and the lower IFC group to total, respectively. Other explanatory variables are employed for controlling two types of regional characteristics in the first regression to obtain the fitted value of $BOND_{i,t}$. Area ($AREA_{i,t}$), the ratio of people aged over 65 years to the total population ($OLD_{i,t}$) and the ratio of people aged under 15 years to the total population ($YOUNG_{i,t}$) represent demand for prefectural public services.\textsuperscript{22} The ratio of labor in secondary ($SECOND_{i,t}$) and tertiary ($TERT_{i,t}$) industries to the total labor force and the unemployment rate ($UNEMP_{i,t}$) are variables capturing the economic features of a prefecture.

Because we assume that the utility function is strictly concave, the estimation model is not a simple liner equation. Thus, we transform all variables in natural logarithms to avoid misspecification.

**Table 2 Descriptive statistics**

<table>
<thead>
<tr>
<th>Name of variable</th>
<th>Obs.</th>
<th>Mean</th>
<th>Std. Dev.</th>
<th>Max</th>
<th>Min</th>
</tr>
</thead>
<tbody>
<tr>
<td>$BOND_{i,t}$</td>
<td>1457</td>
<td>3.960</td>
<td>0.530</td>
<td>5.341</td>
<td>1.739</td>
</tr>
<tr>
<td>$LAT_{i,t}$</td>
<td>1400</td>
<td>4.512</td>
<td>0.754</td>
<td>5.682</td>
<td>-0.619</td>
</tr>
<tr>
<td>$size_{i,t}$</td>
<td>1457</td>
<td>-4.289</td>
<td>0.832</td>
<td>-1.628</td>
<td>-5.749</td>
</tr>
<tr>
<td>$ratio_{ij}^{same}_{i,t}$</td>
<td>1422</td>
<td>-1.585</td>
<td>0.452</td>
<td>-1.078</td>
<td>-3.850</td>
</tr>
<tr>
<td>$ratio_{ij}^{upper}_{i,t}$</td>
<td>1426</td>
<td>-1.447</td>
<td>1.229</td>
<td>-0.089</td>
<td>-3.850</td>
</tr>
<tr>
<td>$ratio_{ij}^{lower}_{i,t}$</td>
<td>1124</td>
<td>-0.835</td>
<td>0.552</td>
<td>-0.022</td>
<td>-2.464</td>
</tr>
<tr>
<td>$AREA_{i,t}$</td>
<td>1457</td>
<td>1.751</td>
<td>0.649</td>
<td>4.425</td>
<td>0.621</td>
</tr>
<tr>
<td>$OLD_{i,t}$</td>
<td>1457</td>
<td>-1.711</td>
<td>0.301</td>
<td>-1.128</td>
<td>-2.620</td>
</tr>
<tr>
<td>$YOUNG_{i,t}$</td>
<td>1457</td>
<td>-1.850</td>
<td>0.169</td>
<td>-1.301</td>
<td>-2.240</td>
</tr>
<tr>
<td>$SECOND_{i,t}$</td>
<td>1457</td>
<td>-1.260</td>
<td>0.219</td>
<td>-0.822</td>
<td>-1.979</td>
</tr>
<tr>
<td>$TERT_{i,t}$</td>
<td>1457</td>
<td>-0.495</td>
<td>0.103</td>
<td>-0.257</td>
<td>-0.798</td>
</tr>
<tr>
<td>$UNEMP_{i,t}$</td>
<td>1457</td>
<td>-3.149</td>
<td>0.349</td>
<td>-2.133</td>
<td>-4.104</td>
</tr>
</tbody>
</table>

\textsuperscript{22} Although we intended to employ population as one of explanatory variables, we gave up to do so due to an extremely high correlation coefficient between population and $size_{i,t}$: 0.981.
5 Estimation results

5.1 Common pool behavior

We first study two models, Eq.11-I and 11-II, using two estimation methods. Table 3 summarizes the results.

We cannot find a significant sign of $\delta$. This result is explained as follows. If we will not find a bailout from the next estimation about Eq. 12-I and 12-II, this result implies that there may be no incentive for the typical CPB by prefectural governments. On the other hand, if we will find a bailout represented by the significantly positive sign of $\rho$ from the next estimation about Eq. 12-I and 12-II, we recognize that the bailout by the central government is not an incentive to CPB in contrast our theoretical prediction.

From the result of the panel OLS estimation about Model I, which is shown in the first column of Table 3, we find a positive but slightly significant sign of $\eta_1$. According to our theoretical prediction from Eq.10, the positive fiscal externality through the equal treatment for prefectures within the same group increases the marginal cost of its own borrowing, and, thus, restrain the borrowing by the prefectural government. Therefore, the estimation result may be opposite to the theoretical suggestion.

The result of the panel OLS estimation about Model II, which is shown in the second column of Table 3, may be contrasting to our theoretical prediction that an increase in the ratio of the lower-IFC group to the total restrains the borrowing by upper-IFC prefectures.

On the other hand, from the results of the system GMM estimation shown in the third and fourth columns of Table 3, we find that the sign of the lagged-dependent variable ($BOND_{i,t-1}$) is positive and strictly significant, and at the same time, that all variables about the behavior by the prefectural government is insignificant whereas some regional characteristics are significant. Therefore, the borrowing decision of the prefectural government may be merely incremental not strategic.

However, because the meanings of these results depend on whether the positive fiscal externality through LAT transfer system is existing or not, we will interpret these results with the results from the estimation about Eq. 12-I and 12-II.

---

23 We unified to employ a one-step GMM for the dynamic panel estimation on all of equations, because a variance-covariance matrix of the two-step estimator was not full rank in the estimation on Eq.12-II. It might to be because large number of cross section units were dropped. However, it might need to consider an appropriate procedure of a system GMM estimation further, according to discussion by Windmeijer (2005) and Soto (2009).
### Table 3 Estimation on common pool behavior

<table>
<thead>
<tr>
<th></th>
<th>Panel OLS</th>
<th></th>
<th>System GMM</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model I</td>
<td>Model II</td>
<td>Model I</td>
<td>Model II</td>
</tr>
<tr>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Dep. $BOND_{it}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>$size_{it}$ ($\delta$)</td>
<td>0.131</td>
<td>0.256</td>
<td>-0.040</td>
<td>-0.072</td>
</tr>
<tr>
<td></td>
<td>(0.247)</td>
<td>(0.263)</td>
<td>(0.038)</td>
<td>(0.053)</td>
</tr>
<tr>
<td>$ratio_{ij}^{same}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>($\eta_1$)</td>
<td>0.030*</td>
<td>0.010</td>
<td>0.014</td>
<td>-0.020</td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td>(0.019)</td>
<td>(0.014)</td>
<td>(0.017)</td>
</tr>
<tr>
<td>$ratio_{ij}^{upper}$</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>($\eta_2$)</td>
<td>-0.006</td>
<td></td>
<td>0.010</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.016)</td>
<td></td>
<td>(0.011)</td>
<td></td>
</tr>
<tr>
<td>$ratio_{ij}^{lower}$</td>
<td></td>
<td>0.081*</td>
<td></td>
<td>0.014</td>
</tr>
<tr>
<td>($\eta_2$)</td>
<td></td>
<td>(0.042)</td>
<td></td>
<td>(0.015)</td>
</tr>
<tr>
<td>$BOND_{it-1}$</td>
<td></td>
<td>0.557***</td>
<td>0.508***</td>
<td></td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.059)</td>
<td>(0.059)</td>
<td></td>
</tr>
<tr>
<td>$AREA_{it}$</td>
<td>-0.068</td>
<td>-0.155*</td>
<td>-0.032</td>
<td>-0.004</td>
</tr>
<tr>
<td></td>
<td>(0.120)</td>
<td>(0.084)</td>
<td>(0.062)</td>
<td>(0.056)</td>
</tr>
<tr>
<td>$OLD_{it}$</td>
<td>0.479*</td>
<td>-0.055</td>
<td>0.572***</td>
<td>0.536*</td>
</tr>
<tr>
<td></td>
<td>(0.269)</td>
<td>(0.346)</td>
<td>(0.216)</td>
<td>(0.297)</td>
</tr>
<tr>
<td>$YOUNG_{it}$</td>
<td>0.167</td>
<td>-0.221</td>
<td>-0.077</td>
<td>-0.404</td>
</tr>
<tr>
<td></td>
<td>(0.515)</td>
<td>(0.660)</td>
<td>(0.252)</td>
<td>(0.381)</td>
</tr>
<tr>
<td>$SECOND_{it}$</td>
<td>-0.497*</td>
<td>-0.766</td>
<td>-0.093</td>
<td>-0.054</td>
</tr>
<tr>
<td></td>
<td>(0.258)</td>
<td>(0.464)</td>
<td>(0.172)</td>
<td>(0.265)</td>
</tr>
<tr>
<td>$TERT_{it}$</td>
<td>-1.205</td>
<td>-1.267</td>
<td>-1.131</td>
<td>-0.650</td>
</tr>
<tr>
<td></td>
<td>(1.118)</td>
<td>(1.314)</td>
<td>(0.702)</td>
<td>(0.752)</td>
</tr>
<tr>
<td>$UNEMP_{it}$</td>
<td>0.150</td>
<td>-0.229</td>
<td>0.359***</td>
<td>0.170</td>
</tr>
<tr>
<td></td>
<td>(0.246)</td>
<td>(0.333)</td>
<td>(0.128)</td>
<td>(0.127)</td>
</tr>
<tr>
<td>Const</td>
<td>4.366**</td>
<td>1.562</td>
<td>3.076***</td>
<td>2.071</td>
</tr>
<tr>
<td></td>
<td>(1.750)</td>
<td>(2.108)</td>
<td>(0.884)</td>
<td>(1.409)</td>
</tr>
<tr>
<td>Adj. $R^2$</td>
<td>0.826</td>
<td>0.844</td>
<td></td>
<td></td>
</tr>
<tr>
<td>OBS.</td>
<td>1422</td>
<td>1089</td>
<td>1376</td>
<td>1052</td>
</tr>
<tr>
<td>No. of Cross section</td>
<td>46</td>
<td>43</td>
<td>46</td>
<td>43</td>
</tr>
</tbody>
</table>

Note: Heteroskedasticity-robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Cross section and period fixed effect terms in panel OLS estimation and period dummy variables in system GMM estimation are excluded from the table in order to avoid complicatedness.

### 5.2 Dynamic commitment problem

Next, we study about DC problem of the central government. The results are summarized in Table 4.

According to the panel OLS estimation results that indicate a slightly positive $\rho$ only in Model II, it seems that the central government does bailouts not for bad-fiscal-health prefectures.
but for good-fiscal-health prefectures. These results are opposite to our theoretical prediction. Summarizing these results and the estimation results about $\delta$, although the prefectural government as a relatively upper-IFC prefecture receives a bailout from the central government, it does not think to reduce the marginal cost of the borrowing by the bailout.

However, we find that the sign of $\rho$ is significantly positive under the system GMM estimation. Thus, controlling the effect of incrementalism in the decision-making on the amount of LAT transfers, we recognize that the central government adjusts LAT transfers to rescue prefectural governments that have worsened their fiscal health in the past fiscal year, regardless of the fiscal health condition. That is, the bailout by the central government is confirmed. The result corresponds with that of Miyazaki (2007).

Remembering the estimation results under the system GMM in Table 3, the borrowing decisions of prefectural governments are not affected by the own economic size, regardless of the fiscal health condition. That is, they do not intend to reduce the marginal cost of the borrowing by obtaining the bailout more. Therefore, summarizing the estimation results about $\delta$ in Table 3 and $\rho$ in Table 4, we recognize that there is not the typical SBC problem that represents CPB by the prefectural government caused by the central government’s bailout, whereas DC problem occurs.

As for the estimated parameters of fiscal externalities, we find a significantly positive sign of $\beta_1$ in Model I under system GMM and a significantly negative sign of $\beta_2$ in Model II under both estimations. The former result is considered to mean the positive fiscal externality across bad-fiscal-health prefectures through the equal treatment on prefectures within the group. The latter result is considered to represent the negative fiscal externality under the egalitarian transfer system.

Summarizing the results on $\eta_1$ and $\beta_1$ in Model I under system GMM estimation, we recognize that the lower-IFC prefectural government is not aware of the positive fiscal externality across the same fiscal health prefectures.

Furthermore, summarizing the estimation results on $\eta_2$ and $\beta_2$ under both estimations, we recognize that the lower-IFC prefectural government is not aware of the negative fiscal externality that is theoretically considered to reduce the marginal cost of its own borrowing.

Therefore, although some fiscal externalities are ascertained, prefectural governments does not take account of them in the decision-making about the borrowing.
Table 4 Estimation on dynamic commitment and fiscal externality

<table>
<thead>
<tr>
<th></th>
<th>Panel OLS</th>
<th>System GMM</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>Model I</td>
<td>Model II</td>
</tr>
<tr>
<td>( b_{i,t-1} (\rho) )</td>
<td>0.236</td>
<td>0.626*</td>
</tr>
<tr>
<td></td>
<td>(0.192)</td>
<td>(0.351)</td>
</tr>
<tr>
<td>( b_{j,t-1}^{same} (\beta_1) )</td>
<td>0.270</td>
<td>0.487</td>
</tr>
<tr>
<td></td>
<td>(0.235)</td>
<td>(0.384)</td>
</tr>
<tr>
<td>( b_{j,t-1}^{upper} (\beta_2) )</td>
<td>0.024</td>
<td>0.015</td>
</tr>
<tr>
<td></td>
<td>(0.048)</td>
<td>(0.023)</td>
</tr>
<tr>
<td>( b_{j,t-1}^{lower} (\beta_2) )</td>
<td>-0.560**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(0.238)</td>
<td></td>
</tr>
<tr>
<td>( LAT_{i,t-1} )</td>
<td></td>
<td>0.890***</td>
</tr>
<tr>
<td></td>
<td></td>
<td>(0.034)</td>
</tr>
<tr>
<td>Const</td>
<td>2.661***</td>
<td>1.146</td>
</tr>
<tr>
<td></td>
<td>(0.823)</td>
<td>(1.324)</td>
</tr>
<tr>
<td>OBS</td>
<td>1146</td>
<td>730</td>
</tr>
<tr>
<td>No. of cross section</td>
<td>44</td>
<td>32</td>
</tr>
</tbody>
</table>

Note: Heteroskedasticity-robust standard errors in parentheses. *** p<0.01, ** p<0.05, * p<0.1. Cross section and period fixed effect terms in panel OLS estimation and period dummy variables in system GMM estimation are excluded from the table in order to avoid complicatedness.

6 Concluding remarks

We discussed whether an SBC problem occurs in the intergovernmental transfer system of Japan, that is, the system of LAT transfers from the central government to prefectures.

Although many empirical approaches to ascertain the intergovernmental SBC that take the policy variable of the central government as exogenous, there is a methodological problem because the theoretical literature on SBC tell us that the decision-making of the central government as a Stackelberg follower is affected by the behavior by a sub-national government as a leader, that is, the policy variable of the central government must be treated as endogenous variable in an empirical analysis.

Thus, following Goodspeed (2002), we constructed a theoretical model to capture two phases of the SBC problem: the DC problem of the decision-making of the central government facing the failure of a sub-national government and the CPB of a sub-national government that can avoid full payment for the marginal cost of a bailout. Based on this framework, we attempted to empirically ascertain each of the DC problem and CPB to explore the SBC problem in the LAT transfer system, using a sample of prefectural government in Japan.
We obtained the following results from the empirical analysis. First, bailouts through LAT transfers were found regardless of the fiscal health conditions of prefectural governments. Second, we found a positive fiscal externality across prefectures with worse fiscal health through the equal treatment on prefectures in the same group and a negative fiscal externality from prefectures with worse fiscal health to those with better fiscal health in some case of the estimation method. Third, we could not observe CPB. Forth, the estimation results showed that the decision-making of prefectural government was merely incremental not strategic.

From the results, we find little evidence for the CPB of prefectural governments, whereas bailout by the LAT transfer clearly emerge. Therefore, we cannot find evidence supporting the SBC problem of the LAT transfer. However, it might be understood that a prefectural government can behave incrementally without choosing its measures under the budget constraint due to the bailout even if its fiscal health becomes worse. Because the borrowing based on incrementalism is obviously inefficient, this is considered as a kind of the SBC problem.

Our analysis could be further improved or extended by choosing alternative estimation methods and variables, because an explanatory power of regional characteristics variable is not significant on the whole. In addition, the variables especially for the prefecture in the lowest IFC group are omitted by transforming natural logarithm. We might need to reconsider specification of the estimation model and group weight.

In addition, we may obtain different results if we employ statistics other than local bonds, such as expenses for non-granted public engineering work, for which a prefectural government may have a higher degree of discretion, as the dependent variable. These ideas are topics for our future analysis.

Acknowledgments This study is supported by a Grant-in-Aid for Scientific Research (KAKENHI, grant No.16K03722) from Japan Society for the Promotion of Science.
Appendix

Reaction of the transfer on the change in the borrowing

Noting that \( \frac{\partial t^C}{\partial g_{i,2}} = 1/Y \), total differential with respect of \( g_{i,2} \) and \( b_{l,1} \) derives follows.

\[
\frac{\partial g_{l,2}}{\partial b_{l,1}} = -\frac{1}{Z_l} \left( \frac{\partial w_l}{\partial b_{l,1}} v'_{l} - w_l v''_{l}(1 + r) - \frac{1}{Y} \frac{\partial X}{\partial b_{l,1}} \right),
\]
(A1)

\[
\frac{\partial g_{l,2}}{\partial b_{m,1}} = -\frac{1}{Z_l} \left( \frac{\partial w_l}{\partial b_{m,1}} v'_{l} - \frac{1}{Y} \frac{\partial X}{\partial b_{m,1}} \right),
\]
(A2)

\[
\frac{\partial g_{l,2}}{\partial b_{h,1}} = -\frac{1}{Z_l} \left( \frac{\partial w_l}{\partial b_{h,1}} v'_{l} - \frac{1}{Y} \frac{\partial X}{\partial b_{h,1}} \right),
\]
(A3)

\[
\frac{\partial g_{h,2}}{\partial b_{h,1}} = \frac{1}{Z_h} \left( w_h v''_h(1 + r) + \frac{1}{Y} \frac{\partial X}{\partial b_{h,1}} \right),
\]
(A4)

\[
\frac{\partial g_{h,2}}{\partial b_{k,1}} = \frac{1}{Z_h} \left( \frac{1}{Y} \frac{\partial X}{\partial b_{k,1}} \right), \text{ and}
\]
(A5)

\[
\frac{\partial g_{h,2}}{\partial b_{l,1}} = -\frac{1}{Z_h} \left( \frac{\partial w_h}{\partial b_{l,1}} v'_{h} - \frac{1}{Y} \frac{\partial X}{\partial b_{l,1}} \right)
\]
(A6)

where \( Z_h = w_h v''_h + \sum_i y^2_i z''_i/Y < 0 \) and \( Z_l = w_l v''_l + \sum_i y^2_i z''_l/Y < 0 \).

Using \( \frac{\partial w_l}{\partial b_{l,1}} = \frac{\partial w_l}{\partial b_{m,1}} \) and the first-order condition, we can derive the sign of the term in a parenthesis on the right-hand side of Eq.A2 as positive, and thus Eq.4b from Eq.A2. We can also derive Eq.4c from Eq.A3 and Eq.5c from Eq.A6 in the same manner as derivation of Eq.4b.
### Annexed table to empirical results

**Definition of variables**

<table>
<thead>
<tr>
<th>Name of variable</th>
<th>Definition</th>
<th>Source</th>
</tr>
</thead>
<tbody>
<tr>
<td>$BOND_{i,t}$</td>
<td>Local bond revenue per capita: 1,000 yen</td>
<td>Annual statistic of Local Public Finance</td>
</tr>
<tr>
<td>$LAT_{i,t}$</td>
<td>Local allocation tax transfer per capita: 1,000 yen</td>
<td>Annual statistic of Local Public Finance</td>
</tr>
<tr>
<td>$size_{i,t}$</td>
<td>The ratio of prefectural GDP to total prefectural GDP</td>
<td>Annual report on Prefectural Accounts</td>
</tr>
<tr>
<td>$AREA_{i,t}$</td>
<td>Area: 1,000 km²</td>
<td>Survey on Area of Prefectures and Municipalities</td>
</tr>
<tr>
<td>$OLD_{i,t}$</td>
<td>The ratio of people aged 65 old and more to total population</td>
<td>Population Census</td>
</tr>
<tr>
<td>$YOUNG_{i,t}$</td>
<td>The ratio of people aged less than 15 old to total population</td>
<td>Population Census</td>
</tr>
<tr>
<td>$SECOND_{i,t}$</td>
<td>The ratio of labor in secondary industry to total labor force</td>
<td>Population Census</td>
</tr>
<tr>
<td>$TERT_{i,t}$</td>
<td>The ratio of labor in tertiary industry to total labor force</td>
<td>Population Census</td>
</tr>
<tr>
<td>$UNEMP_{i,t}$</td>
<td>Unemployment rate</td>
<td>Population Census</td>
</tr>
</tbody>
</table>
References


Ogawa, H. and Tanahashi, K., 2008, Effect of New Public Management: Date envelopment


