Intergovernmental Fiscal Transfers and Tax Efforts: Evidence from Japan

Miyazaki, Takeshi

Department of Economics, Kyushu University

October 2016

Intergovernmental Fiscal Transfers and Tax Efforts: Evidence from Japan

Takeshi Miyazaki[a]

[a] Department of Economics, Kyushu University, Fukuoka, Japan

6-19-1 Hakozaki, Higashi-ku, Fukuoka 812-8581, Japan

Tel.: +81-92-642-4272, fax: +81-92-642-4272

E-mail: tmiyazak@econ.kyushu-u.ac.jp

Abstract

The present study examines the incentive effects of fiscal equalization transfers on local corporate tax rates from theoretical and empirical perspectives. The study focuses on additional corporate tax on capital, which is exempt from calculations of equalization grants. A theoretical investigation reveals that a rise in equalization rate increases additional capital tax rates. The theoretical prediction is empirically examined using panel data of Japanese municipalities for 1990–2000. It is found that a higher equalization rate in fiscal equalizing transfers gives municipalities an incentive to raise corporate tax rates exempt from the transfer scheme.

Keywords: Intergovernmental fiscal transfers; regression discontinuity design; tax competition; tax effort

JEL classification codes: H7; H71; H77

1. Introduction

Intergovernmental fiscal transfers are common among developed and developing countries (e.g., Boadway and Shar, 2007). The central government, including the national and federal governments, pays transfers to lower governmental levels to ensure their fiscal capacities match their fiscal needs. These transfers can take the form of either conditional or unconditional grants, depending on the purpose of their provision. The structure of intergovernmental transfers often has incentive effects on the behavior of central and local governments. Given that intergovernmental transfers prevail across many countries and in various forms, a number of theoretical and empirical studies have addressed issues that arise from transferring grants from the central government to local governments. These issues include incentive effects of vertical and horizontal fiscal transfers, the moral hazard of regional insurance, and problems posed by soft budget constraints.

Previous investigations have focused on how equalization grants affect efficiency in local public goods provision in the presence of interregional tax competition for mobile capital. Based on numerous studies of tax competition, theoretical research on intergovernmental transfers has examined the mechanism whereby vertical or horizontal fiscal transfers alter a capital tax rate at the equilibrium arising under tax competition. The results indicate that fiscal equalization transfers can neutralize or alleviate horizontal fiscal externalities, thereby yielding efficient outcomes by insulating a tax policy from capital mobility (Boadway and Fratters, 1982; Bucovetsky and Smart, 2006; Köthenbürger, 2002; Smart, 1998). More recently, theoretical studies have addressed a situation wherein the introduction of equalization grants could not completely correct fiscal externalities. Notably, this draws attention to factors that deteriorate the efficiency effects of fiscal transfers: for example, decentralized leadership (e.g., Akai and Sato, 2009, 2011; Köthenbürger, 2004), fiscal exploitation by a Leviathan government (Köthenbürger, 2005), and elastic aggregate tax bases (Bucovetsky and Smart, 2006).

Following this surge in the theoretical literature on the incentive effects of equalization grants, a number of relevant empirical studies have recently emerged. There has been a particular focus on equalization grant systems in Canada and Germany. Baretti et al. (2002) analyzed the effects of equalization transfers in Germany on subnational government behavior. After a simple theoretical investigation, the authors demonstrated that the marginal tax rate imposed by the equalization system exerts a significantly negative impact on state tax revenue. In terms of the incentive effect of fiscal equalization in Germany on local choice of business tax rates, Buettner (2006) estimated a treatment effect using the regression discontinuity design approach, which exploits discontinuities in the rules of the fiscal equalization system. He showed that, compared with a situation without fiscal equalization, higher marginal contribution rates induce municipalities to set significantly high business tax rates. More recent empirical studies for German cases have demonstrated that higher marginal equalization rates (tax-back rates) in fiscal equalization transfers lead to higher tax rates or lower public input at the local level (Buettner et al. 2011; Egger et al. 2010; Liu 2014).

Smart (2007) examined Canadian provincial tax politics in the period of 1972–2002 and found that provinces respond to expanded equalization transfers by increasing their own tax rates. Dahlby and Warren (2002) analyzed fiscal incentive effects in the Australian equalization system and provided evidence that the equalization scheme affects states' choices of tax rates. Doi (2010) examined the effect of intergovernmental transfers on regional economic growth in Japan and showed a negative correlation from panel Granger causality tests for prefectural data for 1994–2006. However, to the best of my knowledge, no empirical studies have addressed the incentive effects of Japanese intergovernmental fiscal transfers on local tax settings.[2]

The objective of this paper is to examine the incentive effects of fiscal equalization transfers on local corporate tax rates from a theoretical and empirical perspective. Specifically, the present study focuses on an additional local corporate tax on capital in Japan, which local governments can arbitrarily determine within some upper limit. One important and interesting feature of the tax is that its revenues are exempt from the calculation of equalization grants. This exemption is aimed at motivating local governments to promote their own taxation efforts.

Does the fiscal equalization scheme affect the tax rates of the additional corporate tax? Previous theoretical researchers have paid little attention to the effects of equalizing transfers on the corporate tax not included in the transfers. I model the tax competition among local governments with regard to mobile capital in the presence of intergovernmental equalization transfers, where an additional tax on capital is exempt from the calculation of grants, and explore the incentive effect on local tax settings. The results indicate that equalization grants give a locality an incentive to raise its corporate tax rate.

Next, the theoretical predictions are empirically examined using panel data of Japanese municipalities for 1990–2000. Under the Japanese unconditional grant system, the eligibility for the transfers switches on or off discontinuously at the threshold based on fiscal capacity, calculated by the difference between "fiscal needs" and "fiscal revenues." Fiscal capacity is observable and could be objective in the sense that municipalities cannot

[2] In addition to those studies, recent empirical investigations have addressed the role of intergovernmental transfers in the light of dynamic fiscal adjustment at the local government level (e.g., Bessho and Ogawa, 2014; Buettner, 2009; Buettner and Wildasin, 2006). Others have conducted simulation studies of the mechanism of intergovernmental transfers (e.g., Dahlby and Warren, 2003; Zakalzn and Lopez-Laborda, 2011).

discretionally manipulate it. Eligible governments, whose fiscal needs exceed fiscal revenues, can receive the grants, whereas ineligible ones cannot. The grants gained by eligible localities decrease by 75%—termed equalization rates—if they expand the tax bases that are incorporated into calculation of the grants; the equalization rate for non-eligible localities is zero.

The present study attempts to estimate the treatment effects of grant eligibility by utilizing this discontinuous change in the equalization rate. Specifically, I estimate the sharp regression discontinuity (RD) coefficients from the samples close to the cutoff, exploiting the fact that the eligibility is observable and differs on the right and left sides of the threshold. In the sharp RD design variation in treatment status has to be assigned randomly around the threshold, which is termed the "local randomization assumption" (see, e.g., Lee and Lemieux, 2010). The present study appears to satisfy that condition because municipalities cannot manipulate or falsify eligibility status. That aspect is tested using graphical evidence and statistical inferences that are standard in the RD design literature (e.g., Angrist and Lavy, 1999; Imbens and Lemieux, 2008; Lee, 2008; Lee and Lemieux, 2010). To ensure the validity of the present study, I follow the conventional specification testing methods and I also apply more recent testing methodology; e.g., the integrated mean squared-error (IMSE) optimal bin choice proposed by Calonico et al. (2014a, b).

This study obtains the result that a higher equalization rate in fiscal equalization transfers gives municipalities an incentive to raise the tax rates for corporate tax exempted from the transfers. This result is consistent with theoretical predictions. Baseline sharp RD regressions provide evidence of the positive impact of grant eligibility on additional corporate tax rates. The same results are obtained from robustness checks, including regressions with lagged treatment effects, with or without additional covariates and specifying other functional forms. Furthermore, this study confirms that the RD regressions are valid and reliable in terms of the graphical presentations and statistical tests noted above.

Some countries other than Japan have exempted “extra” tax revenues, which local governments raised by imposing tax rates higher than a standard one, from the calculation of fiscal transfers. For example, in working out the general revenue support grant, the United Kingdom’s government employs as standard council tax revenue the amount that each local government could raise if it set a reasonable rate, rather than actual amount. In reality, as a large amount of local governments (about 98% as of 2000) apply higher tax rates than what is considered reasonable, the difference between revenues from the actual and reasonable rates can be viewed as exempt from the grant. Therefore, the results of the present study are also applicable to other countries, and lend important insights into relevant policy debates.

The rest of this paper is as follows. Section 2 provides background information about local public finance in Japan and the Japanese intergovernmental fiscal transfer system. Section 3 introduces the theoretical model, which helps derive certain implications for the empirical examination. Section 4 presents estimation equations and discusses relevant econometric issues. Section 5 describes the data used in this paper, and the estimation results are presented in section 6. Finally, section 7 concludes this study.

2. Local Public Finance and Intergovernmental Fiscal Transfers in Japan

2.1 Japanese Local Public Finance

Japan has three politically elected levels of government: national government, 47 prefectural governments, and municipalities (3229 as of 2000).[3] Municipalities—composed of cities, towns, and villages—form the basic local government, whereas prefectures constitute

[3] Through municipal consolidation since 1999, the number of municipalities has declined from about 3200 to 1718 in 2016.

regional government spread across wider areas. The responsibilities of local government in Japan are similar to those in many developed countries.[4]

Total public spending in Japan was about 21% of GDP in 2013, while local government spending was 12%. Municipalities in Japan represent a major part of the public sector, accounting for approximately 30% of the government budget, in contrast to the prefectures' share of 28%. Municipalities depend largely on the central government for funds. Indeed, as much as 31% of their budget comes from intergovernmental transfers; of that, 15% consists of unconditional grants (known in Japan as Local Allocation Tax[5]) and 16% consists of conditional grants (National Treasury Disbursements); the remaining 69% of municipal revenues arises from taxation (approximately 33%), bonds, and other independent resources. Municipal taxes mainly comprise income tax (municipal inhabitant tax) and property tax (fixed asset tax), which account for 45% and 42% of total tax revenues, respectively. Specifically, local income taxes comprise a tax on individual income (approximately 34% of total local tax) and a corporate tax (approximately 11%).

Figure 1 inserted around here

[4] Municipalities deal with basic concerns closely related to the daily lives of residents, such as registration of addresses, operation of elementary and junior high schools, social welfare for children and senior citizens, city planning, operation of waterworks and sewer systems, collection and disposal of garbage, and fire prevention.

[5] Specifically, this grant is classified into two categories: Ordinary Allocation Tax and Special Allocation Tax. I focus on the former—general unconditional grants—which account for 94% of the total. Special Allocation Tax is allocated based on special expenditure needs, such as disaster spending, and accounts for only 6% of the total.

Municipal corporate tax has two tax resources: per capita-based taxation (*kinto wari* in Japanese) and corporate tax-based taxation (*houjinzei wari*).[6] This study focuses on the latter—income-based corporate tax. This tax is levied on corporate tax revenues of national tax at a uniform standard tax rate of 12.3%. However, all municipalities have the authority to raise this to the maximum of 14.7%.[7,8] Figure 1 illustrates the changes over time in the number of municipalities that imposed a corporate tax rate higher than the standard rate (hereinafter, "additional corporate tax"). It is evident that a large proportion of municipalities (about 1400 of 3200) adopted additional corporate taxation every year, but that proportion showed little change before 2003. At that time, Japanese municipalities had been partly authorized to set tax rates. Over time, municipalities have lost their entitlement to determine individual income tax rates and, thus, the tax rates among municipalities are fairly uniform. In contrast, property tax rates have shown municipal variation because municipalities had long been allowed to adjust those rates within a limited range the central government established. Another similar case is corporate tax-based taxation. Revenues from corporate tax-based taxation are around six to seven times greater than those from per capita-based taxation; of corporate tax-based revenues, almost 13% was collected from additional corporate taxation in 2007.

2.2 Fiscal Equalization Grants in Japan

[6] With per capita-based taxation, corporations pay a fixed amount of taxes according to their capital funds and number of employees.

[7] More precisely, if a corporation has facilities, such as offices and company dormitories outside the municipality of interest, its corporate tax base for local corporate tax is adjusted depending on the number of employees.

[8] The standard tax rate was 12.3% after 1981, but was amended to 9.7% in October 2014.

As noted above, there are two types of intergovernmental fiscal transfers in Japan: unconditional grants and conditional grants. In Japan, unconditional grants have played the role of reducing the vertical fiscal gap, or fiscal imbalance, between central and local governments in terms of fiscal capacity and expenditure needs. This is because local governments have many duties they cannot execute using only their own revenues (such as local taxes). More importantly, unconditional grants help reduce horizontal fiscal disparities among regions (e.g., Mochida, 2006). Conditional grants mainly cover outlays on public works projects and municipal obligatory expenses, such as medical care, compulsory education, and national health insurance. The allocation of such grants varies remarkably according to the effects of political and bureaucratic powers.

The present study focuses on unconditional grants.[9] Japanese municipalities and prefectures may receive unconditional grants, which are calculated by subtracting basic fiscal revenues (BFRs) from basic fiscal needs (BFNs). However, municipalities whose BFRs are greater than their BFNs are unable to receive the grants. This scheme is represented as follows:

$$\text{Unconditional Grants} = \begin{cases} \text{BFNs} - \text{BFRs if BFNs} > \text{BFRs} \\ 0 \qquad\qquad \text{if BFNs} < \text{BFRs.} \end{cases}$$

The fiscal needs of each municipality are measured by an expenditure demand of a model local government, which is an "average" municipality, principally in terms of population, area, number of households, and length of roads.[10] If realized expenditure were used as a basis to calculate grant payments, local governments would have an incentive to expand their

[9] For example, Akai (2015) offers a good survey of Japanese intergovernmental transfers from an economic perspective.

[10] In 2015, the model municipality had a population of 100,000, area of 160 km^2, 41,000 households, and 500 km of roads. For every budgetary item of BFNs, more detailed sizes of municipality are defined.

spending to gain large grants. Therefore, fiscal needs are neither a realized expenditure nor a spending plan that the locality can readily control.

Concretely, fiscal needs are first calculated at specific budgetary levels. The formula for calculating the fiscal needs of each item is as follows:

$$\text{BFNs} = \text{unit of measure} \times \text{unit cost} \times \text{modification coefficients}.$$

Here, "unit of measure" is a measure that appropriately reflects the volume of a specific item, such as population, number of schools, and length of roads; and "unit cost" is computed by dividing the total costs of the model local government by the number of its unit of measure, so that it is uniform across the country. Importantly, the measures are, in principle, defined so that each can adequately explain a real demand. They are also sufficiently objective to avoid any possibility of arbitrary manipulation by localities. In the formula, "modification coefficients" are an indicator to adjust fiscal needs to conform to actual demands, and reflect the specific institutional, sociodemographic, economic, and regional characteristics of each municipality given that both the unit cost and unit of measure are uniform over all municipalities.[11] It is generally held that the calculation formulae for modification coefficients are complex but seem to be objective as they are based on instruments that municipalities cannot readily control (Mochida, 2006).[12]

[11] For example, there exist modification coefficients for colder regions of Japan as well as for areas that undergo unanticipated rapid economic, social, or demographic changes. The former is a coefficient to give colder regions greater grants; the latter is a coefficient to allocate more grants to municipalities that experience such radical changes.

[12] It has also been argued that modification coefficients are not objective for explaining the fiscal needs of each municipality (e.g., Reschovsky, 2007). Among many modification coefficients, some were certainly computed using realized, not objective, values such as amounts of investment. However, it is not clear that municipalities have controlled the levels of such values to hold eligibility for the grants. This concern can be tested by checking for whether the BFNs discontinuously change at the threshold of eligibility. This study checks this by

BFRs are defined as 75% of standard tax revenues, which are calculated in principle by multiplying each municipality's tax base by the standard tax rate (which is uniform across the entire country). For the corporate tax-based tax, the standard tax revenue is computed by its one-year lagged tax base multiplied by the uniform standard tax rate of 12.4%. The national government asserts that revenue-raising capacity is measured objectively and mechanically by standard tax revenues, and that local governments do not have an incentive to reduce taxation so as to receive more equalization grants (MIC, 2007; Mochida, 2006; Okamoto, 2002). According to a statement by the national government, local governments are able to take advantage of the remaining 25% of tax revenues to pursue original projects, which gives them a motivation to attract more tax bases (MIC, 2007; Mochida, 2006; Okamoto, 2002).

In contrast, to incentivize localities to raise tax revenues by their own tax efforts, several tax revenues are exempt from calculation of the BFRs. This study concerns the exemption of "additional taxation." To facilitate the adoption of additional taxation, tax revenues from the additional tax are exempted for some types of taxes. For municipalities, these include per capita-based and corporate tax-based local corporate taxes, fixed asset tax, and small-vehicle tax; for prefectures, they include per capita-based individual income tax, per capita-based and corporate tax-based corporate taxes, and business tax. It is a concern that the corporate tax-based tax revenues accruing from the additional taxation are exempted from the BFNs. The national government states that the exemption of additional tax revenues from the BFRs stimulates municipalities to make further tax efforts (MIC, 2006).

3. Theoretical Model

---

examining the existence of a jump for the BFRs at the cutoff given that, by definition, BFRs are a mirror of BFNs.

For this empirical investigation, I introduce a simple theoretical model of tax competition and intergovernmental fiscal transfers. Consider a country composed of N local governments. A central government gives local governments fiscal equalization grants to fill the gap between their expenditure needs and fiscal capacity. A local government determines the level of corporate tax rates so as to maximize identical households' utility given intergovernmental tax competition for capital.[13]

Local government i receives an equalization grant s_i, which is computed as the difference between expenditure needs x_i and fiscal capacity $tk_i + T_i$ if the expenditure needs exceed the fiscal capacity:

$$s_i = \begin{cases} x_i - \rho(tk_i + T_i) \text{ if } x_i - \rho(tk_i + T_i) > 0 \\ 0 \quad \text{if otherwise} \end{cases}, \quad (1)$$

where t $(0 < t < 1)$ refers to source-based tax rate on capital k_i, which is uniformly levied by the central government. Fiscal capacity is defined as the "equalization rate," ρ $(0 < \rho < 1)$—in other words, tax-back rates, marginal contribution rates (Buettner, 2006), or a tax rate on tax revenue (Baretti et al., 2002)—multiplied by the sum of capital tax revenue and the other tax revenues, T_i, included in the capacity calculation, which is given exogenously. Note that a local government receives no grants when its fiscal capacity exceeds its fiscal needs. This formula is in accordance with the above-mentioned Japanese intergovernmental transfer system, and akin to the transfer schemes in other developed countries, such as Sweden (e.g., Reschovsky, 2007).[15] Each locality can independently levy the additional corporate tax on capital with its tax rate being τ_i $(0 < \tau_i < 1)$, which is exempt from the calculation of the grants. A local government's revenues comprise capital tax revenues, which accrue both from

[13] It is possible that local governments aim to attract more capital, or tax bases, by expanding public investment, as previous theoretical studies modelled (e.g., Keen and Marchand, 1997). To focus on tax efforts through an increased tax rate, however, this study does not model this possibility.

[15] In Japan, the equalization rate is 0.75 (75%).

imposing the uniform rate and from its original additional taxation, and an equalizing grant. Hence, its budget constraint is as follows:

$$g_i = (t + \tau_i)k_i + s_i, \ (2)$$

where g_i is local public spending or public consumption.

For simplicity, capital owners are omitted, and each locality has an identical fixed labor supply equivalent to its population. The total value of production $f(k_i)$ is produced using capital and fixed labor; the production function is assumed to be a constant return to scale and strictly concave with regard to capital: $f_k > 0, f_{kk} < 0$. The total return to the labor supply is then given by $f(k_i) - k_i f'(k_i)$. Hence, private consumption c_i is expressed by

$$c_i = f(k_i) - k_i f', \ (3)$$

which is then the household's budget constraint. Following the literature on tax competition, assume that capital is perfectly mobile so that the net rate of return to capital in every locality is equal to a common return *r*:

$$f' - t - \tau_i = r. \ (4)$$

This is a capital market-clearing condition, which holds at equilibrium. By totally differentiating this market-clearing condition, the following is obtained: $\frac{dk_i}{d\tau_i} = \frac{1}{f''} < 0$. Assume $k_i + [(1-\rho)t + \tau_i]\frac{dk_i}{d\tau_i} > 0$ for an interior solution. The utility function of the representative household takes a quasi-linear form:

$$u_i = c_i + \alpha_i v(g_i), \ (5)$$

where $\alpha_i > 0$ is a parameter of v, and $v' > 0, v'' < 0$.

The government maximizes the utility (Eq. 5) with respect to the capital tax rate, subject to the equalization grant formula (Eq. 1), local government's budget constraint (Eq. 2), household's budget constraint (Eq. 3), and the capital market-clearing condition (Eq. 4). The following first-order condition is obtained:

$$\alpha_i v' = \frac{k_i}{k_i + [(1-\rho)t + \tau_i]\frac{dk_i}{d\tau_i}}. \quad (6)$$

The left-hand side (LHS) of Eq. (6) expresses marginal benefit from the public service, while the right-hand side (RHS) represents the marginal cost of public funds resulting from the increased tax rate. If there are no distortive capital taxes, i.e., the equalization rate and additional capital tax equal zero ($t = \tau_i = 0$), then the marginal cost of raising public funds takes one, implying absence of distortion. In contrast, from $\frac{dk_i}{d\tau_i} < 0$ and the constraints of ρ, t, and τ_i being from zero to one, the RHS of Eq. (6) is generally larger than one. This implies, as in Smart (1998) and Buettner (2006), that public spending is inefficiently low because of the existence of the uniform and additional taxes on capital and fiscal equalizing transfer. Moreover, as shown in the denominator of the RHS in Eq. (6), an additional capital tax exacerbates economic efficiency relative to an economy wherein the additional tax is not imposed as an additional capital tax does not interact with the equalization rate. Note that even when the equalization rate equals one, the marginal cost of raising public funds is greater than one because of the presence of additional capital tax. Thus, contrary to Buettner (2006), even under a complete equalization system, efficiency cannot be attained in this regime.

Next, consider the effects of change in the equalization rate on the additional tax rate chosen by localities at equilibrium. By differentiating Eq. (6) with regard to equalization rate, the effect on additional capital tax is determined as follows:

$$\frac{d\tau_i}{d\rho} = \frac{v' t \frac{dk_i}{d\tau_i}}{\Sigma} > 0, \quad (7)$$

where $\Sigma \equiv k_i v'' \left\{k_i + [(1-\rho)t + \tau_i]\frac{dk_i}{dt}\right\} + v' \frac{dk_i}{d\tau_i}$, which is negative from the second-order condition. Because $\frac{dk_i}{d\tau_i} < 0$, Eq. (7) is negative, implying that a larger equalization rate raises the additional capital tax rate of local government at equilibrium. The result can be summarized as follows.

Proposition 1: *An increase in the equalization rate increases the additional capital tax rate*.

The result of Proposition 1 is a little surprising: despite the fact that an additional capital tax is not incorporated in the transfer system, a change in the equalization rate could influence choice of the additional capital tax. The logic behind the result is as follows. As shown in the LHS of Eq. (6), other factors being constant, an increase in the equalization rate leads to greater marginal benefits for public services through a reduction in the grants. At the same time, as seen in the RHS of Eq. (6), such an increase lowers the marginal cost of public funds through the capital flow effect; i.e., a smaller negative effect of the additional tax rate on capital. As a result, to adjust the difference between the marginal benefit and marginal cost, the additional tax rate needs to be higher at equilibrium because a larger additional rate positively affects local revenue and increases the efficacy of the capital flow effect. That is, greater equalization rates raise additional tax rates on capital by way of a change in the level of public services and capital flows.

4. Empirical Strategy

4.1 Specification

The empirical analysis attempts to test the predictions obtained in the theoretical section using panel data of Japanese municipalities for 1990–2000. More specifically, the current paper focuses on the impact of changes in the equalization rate of Japanese intergovernmental transfers on additional corporate tax rates, which are exempt from the grant calculation. A dependent variable is effective additional corporate tax rates. These are not statute tax rates but rather the ratio of tax revenues from the additional taxation to corporate tax base at the municipality level, taking into account the variation in applicable tax rates across firm sizes. The policy (or regime) switch on which this study focuses is whether municipalities receive fiscal equalization grants. Municipalities that do not receive equalization grants are defined as the treatment group, whose equalization rate is zero. The control group comprises municipalities receiving equalization grants, whose equalization rate is 0.75; increased standard tax revenues reduce equalizing grants by 75% of the increase. Empirical strategy rests on how this definite distinction in the equalization rates between the treatment and control groups makes a difference in their decision making regarding setting of tax rates.

A sharp RD (regression discontinuity) design approach is used in this estimation. Sharp RD design is a research strategy applied when treatment is correlated with a forcing variable (or running or assignment variable) and a deterministic, discontinuous function of the variable (e.g., Imbens and Lemieux 2008; Lee and Lemieux, 2010). Receiving or not receiving a treatment is discontinuously determined at a cutoff point; i.e., if their forcing variables are above a cutoff, group members receive the treatment, and if not, they do not receive it. Determination of non-receiving and receiving municipalities in the Japanese equalization transfer system is based definitely on an observable indicator: the BFNs and BFRs. Thus, one key assumption for sharp RD design is satisfied. In general, eligibility for the equalization transfers is discussed using an indicator of fiscal capacity, which is basically derived by dividing the BFRs by the BFNs. This definition is used herein to argue the eligibility status of the grants.[16] Some previous studies on the effects of intergovernmental

[16] Note that in Japan, there is another local public finance term to represent fiscal capacity, *zaiseiryoku shisu* in Japanese. This fiscal capacity variable is defined as the three-year average of BFRs divided by BFNs and is used widely among local government officers and scholars in the public finance field. However, as stated above, intergovernmental grants are determined based on BFNs and BFRs; thus, "fiscal capacity" defined above is appropriate for the present research purpose. I therefore follow that definition of "fiscal capacity."

transfers on tax or fiscal efforts have also adopted the RD design, and examined discrepancies in the treatment for grants from central and local governments (e.g., Buettner, 2001; Liu and Ma, 2015).[17] Accordingly, the current study also adopts the sharp RD design approach, employing several control variables to capture financial, economic, and sociodemographic factors, as well as the forcing variable, which determines the threshold of eligibility status.

Specifically, the following regression model is estimated:

$$Y_{it} = \tau D_{it} + f(FISCAP_{it}) + \boldsymbol{x_{it}\beta} + year_t + \epsilon_{it}$$

$$i = 1, \dots, N, t = 1990, \dots, 2000,$$

where Y_{it} denotes an outcome variable—additional corporate tax rates. D_{it} denotes a treatment status with regard to eligibility for the equalization grants:

$$D_{it} = \begin{cases} 1 \text{ if } FISCAP_{it} - 1 \geq 0 \\ 0 \text{ if } FISCAP_{it} - 1 < 0 \end{cases};$$

$$FISCAP_{it} = \frac{BFRs_{it}}{BFNs_{it}} - 1,$$

where $FISCAP_{it}$ denotes "fiscal capacity index," which is normalized at zero by subtracting one from the BFRs over the BFNs. The treatment dummy D_{it} takes the value one for municipalities whose fiscal capacity indices are positive; i.e., which are ineligible to receive equalizing grants. D_{it} is then a deterministic and discontinuous function of $FISCAP_{it}$ above and below zero. τ is an RD estimator of interest, which is interpreted as the average treatment effect of the grants on tax rate setting, or the treatment effect for non-receiving municipalities. $FISCAP_{it}$ is also used to explain the trend relation between dependent variables and fiscal capacity, with the assumption it takes several functional forms. $f(FISCAP_{it})$ is a polynomial

[17] In local public finance literature, for example, Egger and Köthenbürger (2010) estimated the effect of council size on local government spending using a sharp RD design. To identify the causal relationship, they adopted the institutional characteristics that council size discontinuously varies based on population size.

function of $FISCAP_{it}$, where, to allow polynomial functions to take different forms below and above the cutoff point, two types of polynomial term are created for each order of polynomial: one is a polynomial term multiplied by D_{it}, and the other is a polynomial term multiplied by $(1 - D_{it})$. The main polynomial function is the third-order polynomial, which is expressed as follows:

$$f(FISCAP_{it}) = \sum_{k=1}^{3} \gamma_{lk}(1 - D_{it})\,(FISCAP_{it})^k + \sum_{k=1}^{3} \gamma_{rk} D_{it}\,(FISCAP_{it})^k,$$

where γ_{lk} and γ_{rk} are, respectively, parameters of the polynomials to the left and right of the cutoff point.

To broadly check for robustness of the RD estimators in terms of specification in fiscal capacity trend, I employ linear polynomial and local linear regressions as well as the cube polynomial.[19] Regarding the manner of selecting the order of polynomials, Lee and Lemieux (2010) propose using the Akaike information criterion (AIC) of model selection.[20] This study also exploits the AIC to select between the first-order and third-order polynomials. Robustness is ensured by running a nonparametric regression—local linear regression—as well. This is standard as a practical and appealing approach for estimating the treatment effect of sharp RD design (see Imbens and Lemieux, 2008; Lee and Lemieux, 2010). Regarding the local linear regression, Calonico et al. (2014a) mainly discussed three nonparametric RD estimators: conventional RD estimates with a conventional variance estimator (used in most empirical analyses); bias-corrected RD estimates with a conventional variance estimator; and bias-corrected RD estimates with a robust variance estimator. They

[19] Quadratic and quartic polynomial forms are employed in other regressions; their results are reported in Appendix B.

[20] The AIC is a measure to determine the fit of an econometric model based on the coefficient of determination and the number of its parameter.

stated that in the presence of large biases with conventional RD estimators, the bias-corrected RD estimates with a robust variance have the most preferable theoretical properties and bring superior finite-sample properties in practice.[21] Following this argument, based on recent studies, I employ bias-corrected RD estimates with a robust variance estimator as estimates of local linear regression. As is typical in nonparametric regressions, some kernels have been suggested for the RD estimation. The present study chooses the Epanechnikov kernel, one of the most popular kernels in local linear regression.[22]

A vector of control variables is expressed by $\boldsymbol{x}_{it}$, whose elements are municipal GDP per capita and city dummy. The city dummy is included because cities could have distinct attitudes toward setting the additional capital tax rate where cities and other municipality types (towns and villages) have different fiscal responsibilities in the sense that cities engage in providing a broader range of public services.[23] The use of per capita municipal GDP closely relates to the emergence of common shocks in outcome and grant eligibility, as explained later. Coefficients of these variables are represented by $\boldsymbol{\beta}$. Year dummies, $year_t$, are also included because, as shown in Figure 1, implementation of additional corporate

---

[21] Conventional RD estimates with a conventional variance estimator require the assumption of a small leading bias, usually not satisfied in advance; thus, they tend to choose a small bandwidth. Bias-corrected RD estimates with a conventional variance estimator and with a robust one correct the conventional RD estimator by adding an estimate of bias. A key difference between the latter two estimators is in estimated variances, used when calculating the confidence intervals. The bias-corrected RD estimates with a robust variance is theoretically attractive and has favorable finite-sample properties compared with ones with a conventional variance. Usually, empirical researchers employ conventional RD estimates with a conventional variance in the absence of considering the potential effects of the leading biases.

[22] As a robustness check, the regression results obtained using the triangular kernel, which is also popular, are presented.

[23] In Japan, there is a large difference between public services provided by cities and other municipalities (towns and villages), but differences between those of towns and villages are not great.

taxation takes on a decreasing trend over the sample period and the number of eligible municipalities varied remarkably over time. In addition, for a robustness check, the following variables are used as controls: log of population, population density, and taxable income per taxpayers. Following Egger et al. (2010), I adopted these other covariates to explain the demographic and economic characteristics of each municipality. Moreover, the present study runs regressions in which all the covariates except the treatment dummy and polynomial terms of the forcing variable are omitted to follow the notion that these covariates are in principle unnecessary in RD estimation. ϵ_{it} is a conventional error, which is clustered at the municipal level to deal with possible serial correlation among municipalities.

This research did not adopt a panel data regression approach, such as fixed-effects estimation. The main reason for this is that the RD analysis does not require fixed-effects regressions to identify a treatment effect (see, e.g., Lee and Lemieux, 2010). This is because an identification condition for the RD design (that a treatment is randomly assigned around the threshold of the forcing variable) does not need any control by individual dummies. It has been stated that including such dummies is legitimate only when they unambiguously reduce sampling variance (Lee and Lemieux, 2010). From this aspect of the RD design, the regressions in this research do not contain fixed effects. Further, in a study closely related to the present one, Egger et al. (2010) did not utilize a fixed-effects approach; instead, they ran cross-section regressions for seven-year panel data to evaluate the average treatment effect of transfer eligibility on business tax rates in Lower Saxony, Germany. Within-municipality correlation over time is controlled by clustered standard errors.

Table 1 inserted around here

Table 1 lists the definitions, units, and statistical sources of the variables.

4.2 Econometric Issues

4.2.1 Endogeneity and the Random Assignment Assumption

A crucial assumption for validating a causal (or treatment) effect approach in the modern program evaluation literature is that no endogeneity biases contaminate an estimated treatment effect—in the sense that a policy change of interest is exogenous. In RD design studies, a valid RD estimation in which individuals cannot "precisely manipulate" the forcing variable around the cutoff point is needed. Once this condition has been satisfied, the treatment is to be assigned randomly around the cutoff (Imbens and Lemieux, 2008; Lee and Lemieux, 2010).[24] In the present study, the necessary condition is that a municipality does not change its treatment status or eligibility for intergovernmental grants by deliberately manipulating its fiscal capacity. Were that possible, it would lead to a failure in the causal inference between eligibility for grants and decision making about the additional corporate tax rate being conditional on the control variables. In this study, eligibility to receive the grants depends only on BFNs and BFRs. As detailed in section 2, both are fundamentally calculated using exogenous or predetermined factors that local governments are unable to handle discretionally. BFNs are essentially calculated referring to the expenditure demands of the model municipalities, not the actual demands of each municipality; BFRs are quantified based on standard tax revenues, computed using tax rates uniform across the country. Hence, from an institutional perspective, it would appear difficult for municipalities to control their fiscal capacities—BFNs and BFRs—around the threshold.

Figure 2 inserted around here

[24] Specifically, Lee and Lemieux (2010, p. 293) state that the crucial point with a valid RD design is not whether individuals can manipulate the forcing variable, but whether they can precisely sort around the cutoff point.

One exception could occur in determining the BFRs. Uniform tax rates are employed when calculating BFRs, but the tax base used for the calculation in many cases has a one-year lag from the actual tax base. Hence, it is possible, albeit very slightly, that municipalities could manipulate the amount of their tax base so as to change their eligibility status.[25] To address this concern, I depict the BFRs, averaged in each bin of the fiscal capacity index, against the midpoints of the index in a figure, and then check for the existence of a discontinuity around the threshold of allocation of the equalization grants. Additionally, this testing becomes a test of discontinuity of the BFNs, given that by definition of the fiscal capacity index, BFRs are a mirror of BFNs in terms of eligibility status. This testing approach follows the fact that in empirical works applying the RD strategy, plotting binned means of covariates against the forcing variable is a legitimate way to ensure the validity of the RD design, as stated in the next section.

Additionally, the issue of reverse causality may arise if municipalities decide on the additional tax rates prior to determining fiscal capacity. With the RD design, it is well established that the covariates have to be predetermined and observable to hold the RD identification assumption of local random assignment. The causal effects of grant eligibility on the tax rate decision would also appear to be somewhat lagged when changes in the tax rates demand time. Therefore, to check for robustness, I attempted regressions with one-year lagged covariates, including the treatment dummy, instead of with non-lagged covariates.

[25] A possible scenario is that municipalities are reluctant to make fiscal efforts to gain more capital, for example by improving the infrastructure, such as roads, sewer systems, and water facilities, to retain eligibility for equalizing grants. This concern becomes crucial if the manipulation behavior is associated with the settings of the additional corporate tax rate.

Another concern about endogeneity is the emergence of common shocks for both the dependent variable and treatment status. A booming economy generally increases the share of non-receiving municipalities through an increase in their tax bases, such as through income and land price rises. At the same time, such an economy may make the effective additional corporate tax rates higher—given that large firms generally face heavy additional tax burdens in the presence of differential taxation on large firms and that the share of large firms can grow after an economic boom. Some studies have tackled this problem by employing the per capita GDP of local governments as a proxy variable (Buettner, 2006). Accordingly, the present study uses municipal GDP per capita as a proxy. However, not all Japanese municipalities calculate municipal-level GDP; I therefore quantified it from prefecture-level sectoral GDPs and municipality-level employment variables. The manner of constructing the municipal GDP is explained in Appendix A.

In the RD design, if a treatment is randomly assigned around a cutoff point, the distribution of observed and unobserved predetermined characteristics conditional on the forcing variable is continuous. Equally, the density of the forcing variable conditional on the observed and unobserved variables is continuous (see, e.g., Lee and Lemieux, 2010, pp. 293–297). Generally, a test is performed concerning the continuity of the marginal density of the forcing variable over population to ensure that the local randomization assumption is satisfied. To test this assumption, the conventional approach is to plot the number of observations in each bin of the forcing variable against the midpoints of each bin, and to detect whether there is a discontinuity in the distribution of the forcing variable at the cutoff (McCrary, 2008). If a discontinuity in the density is detected at the cutoff, it is possible that individuals are manipulating the forcing variable, and that sorting is taking place around the cutoff. McCrary (2008) proposed a statistical test that evaluates the null hypothesis of no discontinuity in the density of the forcing variable at the threshold by employing the density as a dependent variable in the local linear regression. The present study also runs this regression and inspects the no-manipulation assumption on the base covariate.

4.2.2 Tests for Validity of the RD Design

In practice, graphical analysis and related statistical inference are a crucial part of the RD design. Most important is graphing the outcome against the forcing variable, where the average outcomes in each bin of the forcing variable are plotted against the midpoints of the bins, accompanying regression lines of the corresponding flexible polynomial model (which are estimated separately on both sides of the cutoff). The major aim of the plotting is to find evidence of a jump in the conditional means of the outcome at the threshold by assessing the magnitude of the jump in the averaged outcome and fitted lines.[27] The current study also examines the existence or non-existence of such jumps by graphing additional tax rates (averaged by bin) over bins of the fiscal capacity index along with the third-order polynomial regression curves—the main polynomial form used here.

One issue in graphical presentation is how to choose the binwidth (width of the bin). It has generally been found that an excessively narrow range of bin leads to an imprecise, noisy assessment of the outcome. If the bin is too wide, a comparison between the left and right sides of the cutoff becomes inappropriate since the bin does not represent the mean value of the outcome. Partly owing to the difficulty in formally choosing the binwidth based on graphical analysis, most relevant studies have arbitrarily selected binwidths that make RD plots visually informative in terms of representativeness of outcomes. By contrast, Calonico et al. (2014a, b) have recently developed a data-driven RD plot methodology (IMSE optimal choice), whose estimator is adjusted to produce binned sample means that well fit the

[27] Moreover, the plotting of the outcomes against the forcing variable along with the regression lines provides a way of visualizing which functional forms are adequate on each side of the cutoff point.

underlying nonparametric function.[28] The present study uses the IMSE-optimal choice for bandwidth choice.[29] In practice, however, the number of bins is determined, somewhat arbitrarily, by referring to the results from the IMSE-optimal method: as stated in Calonico et al. (2014a), the number of bins reported with IMSE-optimal choice is too small to visualize the mean values of outcomes over the midpoints of each bin. I therefore chose a larger number of bins than that reported for the IMSE-optimal method.

Another aim of depicting the outcome is to inspect whether there are unexpected jumps at points away from the threshold. If one observed any jumps without plausible reason in the conditional distribution of the outcome, the conclusion would be that the treatment was not randomly assigned; the jump at the cutoff could not be interpreted as a causal effect of the treatment. I also check for the existence of such discontinuities throughout the graph of the outcome. To address this problem, this study conducts a formal test as well that detects jumps at points (usually on both sides of the cutoff) where there should not be jumps. To execute it, I run a regression that is essentially equivalent to the standard RD regression function, but different in that the treatment thresholds are set at other points, and test the hypothesis of a zero treatment. This is called the placebo (effect) test, and it has become a crucial part of the empirical analysis of RD design.

An alternative graphical illustration employs the graph of other covariates (covariates except for the forcing variable) over bins of the forcing variable. Other changes in outcome, not associated with treatment status, may occur around the cutoff owing to a variation in other covariates. If one found a discontinuity with such a covariate, the discontinuity could

[28] Calonico et al. (2014a, b) developed an alternative data-driven binwidth choice approach, which selects the number of bins so as to mimic the underlying variability of the raw data. They point out that this approach tends to report a larger optimal number of bins than the IMSE-optimal choice.

[29] Among the options Calonico et al. (2014b) proposed for this procedure, spacing estimators under evenly spaced bins are used here.

produce a jump in the outcome at the cutoff, thereby biasing the treatment effect of interest. A more formal test based on statistical inference is to test for discontinuities in additional covariates at the threshold by employing the covariates as a dependent variable. The additional covariates are then regressed on the treatment dummy along with the ordinary covariates. The present study plots the binned means of per capita GDP against the midpoints of each bin of the fiscal capacity index and then tests for a discontinuity in the GDP using the local linear regression, as employed in the baseline estimation.

Finally, choice of bandwidth is a crucial issue in RD design. Several bandwidth estimators have recently been proposed with the aim of obtaining the optimal point estimate of bandwidth (Calonico et al., 2014a; Imbens and Kalyanaraman, 2012). However, the most popular among empirical works is the cross-validation (CV) procedure, where an optimal bandwidth is determined so as to minimize the cross-validation criterion (see Ludwig and Miller, 2007). I compute the CV optimal bandwidths, in which the criterion was modified by discarding 50% of the observations to the left and right sides of the threshold. However, this study does not select the bandwidths because most empirical papers recommend estimating the RD treatment effect over some bandwidths to ensure robustness in bandwidth choice. RD regressions are run for the rounded width that was close enough to the CV optimal estimator and the other two widths on either side of the threshold.

5. Data

5.1 Descriptive Statistics

Table 2 inserted around here

Table 2 provides summary statistics for the dependent variables and all covariates for 1990–2000, sampled in the baseline regression. The reason for using this sample period is that in Japan, many municipalities have ceased to exist or drastically changed their geographical borders since the early 2000s, owing to large-scale municipal mergers. The merger has caused municipalities to undergo discrete changes in terms of sociodemographic, economic, and financial factors. The statistics of the variables used for the regressions of additional tax rates (additional corporate tax rate, fiscal capacity index, per capita GDP, and city dummy) and a robustness check (log of population, population density, and taxable income per taxpayer) are calculated for the bandwidth of ±0.1, which is the baseline for this RD estimation.

As evident in Table 2, the average of additional corporate tax rates was 1.43%; among the sampled municipalities, 376 did not levy additional taxes (not shown in the table). City accounts for about 78% of municipality, which is larger than the corresponding national average, 21%, in 1999. The average for population is about 155,000, and its variation among municipalities is large: minimum population is about 2,500, while maximum is about 800,000. The fiscal capacity index ranges within ±0.1, and its mean is slightly less than 0.

5.2 Graphical Evidence

This section presents the following four graphs: additional corporate tax rates against fiscal capacity index; density of the fiscal capacity index; and per capita GDP and BFRs against the index. Figure 2 plots the binned means of the additional corporate tax rate against the midpoints of bins of the fiscal capacity index along with the third-order polynomial regression curves estimated on both sides of the threshold (at 0). The numbers of bins, equally spaced, are 30 to the left side of the cutoff and 15 to the right, and are determined proportionally to the IMSE-optimal bin numbers—eight to the left of the cutoff and four to the right. This graph provides clear evidence of a discontinuity at the cutoff: specifically, high tax rates on the left side and low rates on the right. The polynomial regression curves fit the plotted values well. On the right side of the cutoff, however, the binned-average tax rates are considerably dispersed; this is because the number of observations in each bin declines as fiscal capacity increases (as described in the next paragraph). No remarkable discontinuities seem evident away from the threshold on either side.

Figures 2–5 inserted around here

Figure 3 presents the density of the binned means of the fiscal capacity index. The numbers of bins are 30 to the left and right sides of the cutoff along with the third-polynomial function.[31] The graph displays no evidence of a discontinuity at the cutoff point, but it does show a smoothed declining trend in density. This suggests that municipalities did not manipulate their fiscal capacity to be on either side of the threshold. In Figure 4, per capita GDPs, averaged in each of the above-mentioned bins, are plotted over the bins of the capacity index together with the polynomial curves, as before. Any salient discontinuities in per capita GDP are not observed around the cutoff; which is to say it is not possible for a jump to affect additional tax rates. Figure 5 depicts the binned average of the BFRs over the bins of the capacity index. It is evident that there is no discontinuous jump around the cutoff point and the functional forms of the cube polynomial look different between the left and right sides of the cutoff. This provides no evidence that municipalities deliberately manipulated the BFRs, or the standard tax revenues, to be on either side of the cutoff. This result also suggests the nonexistence of discontinuity for the BFNs around the cutoff.

[31] To make all bin sizes equal, the numbers of the bins are the same on both sides.

6. Estimation Results

Table 3 inserted around here

Basic estimation results of the incentive effects of fiscal equalization rate on additional corporate tax rates appear in Table 3. The selected bandwidths are ±0.05, ±0.1, and ±0.15; the ±0.1 width was selected as the baseline since the CV optimal window was ±0.12 and the other two bandwidths were 0.05 larger or smaller than the baseline.[33] As in Table 3, for all specifications and bandwidths, most of the RD estimators were negative and statistically significant at the 5% or higher significance level.[34] It was apparent, therefore, that municipalities ineligible for the equalizing grants tended to choose lower additional corporate tax rates; namely, larger equalization rates for the equalizing grants gave municipalities an incentive to increase their additional tax rates. This result is consistent with the prediction derived in the theory. Moreover, the magnitude of the treatment decreased with the bandwidth length, except for the widths of ±0.1 and ±0.15 in the linear polynomial. This finding provides positive support for the significant effects of grant eligibility, given that bias in the RD estimate increases with the range of the selected bandwidth and that thus an estimate from a smaller bandwidth is less biased (e.g., Lee and Lemieux, 2010). Regarding functional form, the AICs select the cube polynomial regressions for the bandwidths of ±0.1

[33] Panel A of Figure C1 in Appendix C depicts the CVs of the additional tax rate against every 0.025 windows; it shows that the CV takes the minimum when the width is almost 0.12 and the extraordinary large maximum at the width of 0.025.

[34] A local linear estimate with the ±0.15 width is significant at the 10% significance level, though this regression was not the basis of the present study in terms of either functional form or bandwidth.

(baseline) and ±0.15, and Figure 2 shows that the cube polynomial curves predict the actual data well. This analysis therefore adopts the cube polynomial regression as the baseline.

The RD estimator of the baseline regression with the ±0.1 width indicates that a 75% increase in the equalization rate raises the additional corporate tax rate by 0.69%; that is, one percentage point increase in the equalization rate yields about a 0.1% rise in the tax rate. This figure is in fact within the range of the corresponding estimates obtained by previous research: in absolute value, smaller than the estimates obtained by Buettner (2006) (−1.37), Buettner et al. (2011) (0.892), and Smart (2007) (−0.40), but larger than those by Egger et al. (2010) (0.28% decrease in business tax rates caused by 25% decrease in equalization rate).

Table 4 inserted around here

Robustness checks for the RD estimates of the effect of grant eligibility appear in Table 4. The table lists the results of the cube polynomial regression—baseline functional form. The first row presents estimates of the regressions in which all additional covariates (per capita GDP and city and time dummies) are excluded. As before, the estimates are significantly negative, although the size of the coefficients becomes smaller by about 0.1%. The second row displays the regression coefficients estimated by including the other covariates: log of population, population density, and taxable income per taxpayer. As before, the obtained estimates are all strongly significant and negative. The third row of the table shows the estimates from the regressions including one-year lagged treatment dummy and polynomial terms, where the numbers of observations differ from before because the sample years change to the period of 1991–2000. The RD estimates are significantly negative and similar to the previous corresponding ones (second row of Table 3), although the estimates in that row are slightly low for every bandwidth. It is evident that the greater the fiscal equalization rate, the stronger incentive municipalities have to expand their additional corporate tax rates. Moreover, identical consequences are obtained from the alternative robustness checks applying the linear polynomial and local linear regressions; the second- and fourth-order polynomial functions also give the same results as the others. The details are presented in Appendix B.

Table 5 inserted around here

Tests for the validity of the RD approach are also crucial for the RD design (Imbens and Lemieux, 2008; Lee and Lemieux, 2010). The first column of Table 5 presents the regression result concerning continuity of the density, where a dependent variable is frequency of the forcing variable in the bins set for the graphical analysis in Figure 3; the second column details a test for the misspecification on an additional covariate—per capita GDP. As in the first column, the null hypothesis of the zero jump in the density at the cutoff point is not rejected; hence, this provides evidence for supporting the no-manipulation assumption at the cutoff, consistent with Figure 3. The second column also suggests that the null hypothesis of no discontinuity in per capita GDP is not statistically rejected, which means that changes other than the grant eligibility do not affect the additional tax rate. This finding is consistent with that in Figure 4. It follows that the test results affirm the local randomization assumption.

Another specification test of the RD design is a placebo test, implemented by setting hypothetical thresholds away from the actual cutoff. Table 6 shows the regression results of placebo effects by placebo threshold and by bandwidth, where the cube polynomial function is employed. It is clear that all estimates appear insignificant, even at the 10% significance level, and their signs vary according to the employed threshold and bandwidth. This result is in line with the inference from Figure 2, whereby no other discontinuities are observed within the ± 0.5 bandwidth. Accordingly, this suggests that there are no detectible jumps over a wide range of the forcing variable; thus, the jump at the cutoff point can be interpreted as a causal effect of change in the treatment status.

To summarize, it appears from the RD analysis, applied to the effect of eligibility for fiscal equalizing grants on additional corporate taxation, that eligibility induces municipalities to raise their additional corporate tax rates. This consequence is robust for several functional forms, including parametric and nonparametric ones, alternative choices of covariates, such as a lagged treatment variable, and several bandwidth choices. Additionally, the validity of this RD strategy is supported by the graphical analysis and related specification testings.

7. Conclusion

Intergovernmental fiscal transfers are used to achieve various objectives of central and local governments, such as the following: filling the fiscal gap between central and local governments in revenue-raising capacity and expenditure needs; regional fiscal capacity equalization; and equalization from the viewpoint of the principle of horizontal equity. Recent research has examined the incentive the grants generate for central and local governments in an economy with mobile capital and tax competition on capital.

This study examines the incentive effects of intergovernmental fiscal transfers on the decision regarding additional corporate tax rates, from theoretical and empirical perspectives. Primary attention is placed on the effects of grant eligibility on the rates of the additional corporate tax, on which Japanese local governments have discretional power to decide. I then built an extended tax competition model, where jurisdictions compete with mobile capital by setting extra capital tax rates in the presence of fiscal equalization grants, which are calculated not counting tax revenues from the extra capital tax. The theoretical investigation suggests that a rise in equalization rate increases the additional capital tax rates. The theoretical prediction is empirically examined using panel data of Japanese municipalities for 1990–2000. Specifically, the present study estimates the causal effects of grant eligibility by means of the sharp RD approach, where discontinuity in the eligibility between receiving and not-receiving municipalities is deterministic and observable.

The empirical analysis finds that a higher equalization rate in fiscal equalization transfers induces municipalities to raise the additional corporate tax rates. Alternative regressions, such as excluding covariates, including other additional covariates or lagged treatment effect, placebo effect tests, and using other polynomial functional forms, also show the significant effect of the equalization grants on the additional corporate tax rates. It follows that equalization rates for municipalities affect the additional corporate tax rates, which are not incorporated into the fiscal transfer scheme.

Nevertheless, there are some caveats with this analysis. First, this study focuses on the relationship between the additional corporate taxation (unique to Japan) and Japanese fiscal equalizing transfers. The arguments applied here may not hold directly for decision making about local corporate tax rate in the presence of intergovernmental fiscal transfers in other countries. In general, such transfer systems vary somewhat among different countries in terms of aims in establishing such a scheme, mechanisms to compute and allocate grants, and size of transfers. Second, there is no investigation of the effects of the intergovernmental fiscal transfers on capital at municipalities. Although researchers in this field have paid attention to mobility of capital as a consequence of changes in capital tax rate, it is generally difficult to empirically examine changes in capital because of imperfectly mobile production factors and the co-location of labor and capital (Wildasin, 2011). Here, I therefore do not address the link between fiscal equalizing transfers and capital. Further studies should reveal these issues.

Appendix A. Creating Municipal GDP

In Japan, the national government calculates prefectural GDP, which is classified into the following industries: agriculture (including forestry and fishery); mining; construction; manufacture; wholesale and retailing; banking and insurance; real estate; transport and telecommunications; service; and government and private nonprofit service. The number of employees in each industry is counted at the municipal level and reported annually. By industry, municipal GDP is then estimated as prefectural GDP multiplied by the share of its employees in each industry to the prefectural total. Overall municipal GDP is quantified by aggregating all the industry-level municipal GDPs.

Appendix B. Other Robustness Checks

Table B1 inserted around here

Table B1 presents the results of other robustness checks. The first row shows the treatment effects from the linear polynomial estimation in the absence of the covariates. The coefficients of interest are significant and negative, albeit somewhat weakly when using the ± 0.1 width, implying the presence of adverse treatment effects. The second row displays estimates of the linear polynomial regressions including other covariates. These regressions clearly do not alter the findings I obtained from the basic regressions. The third row reports coefficients of the local linear regression using the Epanechnikov kernel, instead of the triangular kernel. The basis for running this regression is that a different kernel puts weights on observations in a different way, thereby producing a different RD estimator. The obtained treatment effects have significantly negative signs for the first two columns.[38] The fourth and fifth rows present other polynomial orders as flexible polynomial functions. The quadratic and quartic polynomial regressions both essentially give significant and negative estimates. Accordingly, the findings presented in Table B1 confirm the positive effect of the fiscal equalization rate on additional corporate tax rates.

Appendix C. Graphs of Cross-Validation

Figure C1 inserted around here

Acknowledgements

I wish to express my great appreciation toward Nobuo Akai, Michihito Ando, Thiess Buettner, William Harvey Hoyt, Maximilian Todtenhaupt and participants in the 72nd International Institute of Public Finance (Reno, NV, USA) and the 72nd Japanese Institute of Public Finance (Chuo University, Tokyo, Japan) for their helpful and insightful comments.

[38] Although the estimates using the ±0.15 bandwidth are not significant, as explained above, estimates using a wider bandwidth would probably yield biased output and be less credible.

References

Akai, N. (2015) "Fiscal Consolidation and Local Public Finances in Japan: Incentive Problems Associated with Intergovernmental Transfers and Their Political Roles," In *The Political Economy of Fiscal Consolidation in Japan*, Ihori, T. and K. Terai (eds), Springer: Japan.

Akai, N., and M. Sato (2008) "Too Big or Too Small? A Synthetic View of the Commitment Problem of Interregional Transfers," *Journal of Urban Economics*, 64(3), 551–559.

Akai, N. and M. Sato (2011) "A Simple Dynamic Decentralized Leadership Model with Private Savings and Local Borrowing Regulation," *Journal of Urban Economics*, 70(1), 15–24.

Angrist, J.D. and V. Lavy (1999) "Using Maimonides' Rule to Estimate the Effect of Class Size on Scholastic Achievement," *Quarterly Journal of Economics*, 114(2). 533–575.

Baretti, C., B. Huber, and K. Lichtblau (2002) "A Tax on Tax Revenue: The Incentive Effects of Equalizing Transfers: Evidence from Germany. *International Tax and Public Finance*, 9, 631–649.

Bessho, S. and H. Ogawa (2014) "Fiscal Adjustment in Japanese Municipalities," *Journal of Comparative Economics*, in press.

Boadway, R.W. and F.R. Fratters (1982) "Efficiency and Equalization Payments in a Federal System of Government: A Synthesis and Extension of Recent Results," *Canadian Journal of Economics*, 15, 613–633.

Boadway, R.W. and A. Shar (2007) *Intergovernmental Fiscal Transfer*, World Bank.

Bucovetsky, S. and M. Smart (2006) "The Efficiency Consequences of Local Revenue Equalization: Tax Competition and Tax Distortions," *Journal of Public Economic Theory*, 8(1), 119–144.

Buettner, T. (2006) “The Incentive Effect of Fiscal Equalization Transfers on Tax Policy,” *Journal of Public Economics*, 90(3), 477–497.

Buettner, T. (2009) “The Contribution of Equalization Transfers to Fiscal Adjustment: Empirical Results for German Municipalities and a US–German Comparison,” *Journal of Comparative Economics*, 37(3), 417–431.

Buettner, T and D.E. Wildasin (2006) “The Dynamics of Municipal Fiscal Adjustment,” *Journal of Public Economics*, 90(6–7), 1115–1132.

Buettner, T., R. Schwager, and S. Hauptmeier (2011) “Efficient Revenue Sharing and Upper-Level Governments: Theory and Application to Germany,” *Journal of Institutional and Theoretical Economics*, 167, 647–667.

Cabinet Office (2000–2010) *Prefectural Account*. (in Japanese)

Calonico, S., M.D. Cattaneo, and R. Titiunik (2014a) “Robust Nonparametric Confidence Intervals for Regression-Discontinuity Designs,” *Econometrica*, 82(6), 2295–2326.

Calonico, S., M.D. Cattaneo, and R. Titiunik (2014b) “Robust Data-Driven Inference in the Regression-Discontinuity Design,” *STATA Journal*, 14(4), 909–946.

Dahlby, B. (2002) “The Incentive Effects of Fiscal Equalization,” Atlantic Institute for Market Studies, Halifax.

Dahlby, B. and N. Warren (2003) “The Fiscal Incentive Effects of the Australian Equalization System,” *Economic Record*, 79, 434–445.

Doi, T. (2010) “Poverty Traps with Local Allocation Tax Grants in Japan,” *Japanese Economic Review*, 61(4), 466–487.

Egger, P. and M. Köthenbürger (2010) “Government Spending and Legislative Organization: Quasi-Experimental Evidence from Germany,” *American Economic Journal: Applied Economics*, 2(4), 200–212.

Egger, P., M. Köthenbürger, and M. Smart (2010) "Do Fiscal Transfers Alleviate Business Tax Competition? Evidence from Germany," *Journal of Public Economics*, 94(3–4), 235–246.

Imbens, G.W. and K. Kalyanaraman (2012) "Optimal Bandwidth Choice for the Regression Discontinuity Estimator," *Review of Economic Studies*, 79(3), 933–959.

Imbens, G.W. and T. Lemieux (2008) "Regression Discontinuity Designs: A Guide to Practice," *Journal of Econometrics*, 142, 615–635.

Keen, M. and M. Marchand (1997) "Fiscal Competition and the Pattern of Public Spending," *Journal of Public Economics*, 66, 33–53.

Köthenbürger, M. (2002) "Tax Competition and Fiscal Equalization," *International, Tax and Public Finance*, 9, 391–408.

Köthenbürger, M. (2004) "Tax Competition in a Fiscal Union with Decentralized Leadership," *Journal of Urban Economics*, 55(3), 498–513.

Köthenbürger, M. (2005) "Leviathans, Federal Transfers, and the Cartelization Hypothesis," *Public Choice*, 122, 449–465.

Lee, D.S. (2008) "Randomized Experiments from Non-Random Selection in U.S. House Elections," *Journal of Econometrics*, 142, 675–697.

Lee, D.S. and T. Lemieux (2010) "Regression Discontinuity Designs in Economics," *Journal of Economic Literature*, 48(2), 281–355.

Liu, Y. (2014) "Does Competition for Capital Discipline Governments? The Role of Fiscal Equalization," *International Tax and Public Finance*, 21, 345–374.

Liu, C. and G. Ma (2015) "Taxation without Representation: Local Fiscal Response to Intergovernmental Transfers in China," *International Tax and Public Finance*, forthcoming.

Ludwig, J. and D. Miller (2007) "Does Head Start Improve Children's Life Chances? Evidence from a Regression Discontinuity Design," *Quarterly Journal of Economics*, 122 (1), 159–208.

McCrary, J. (2008) "Manipulation of the Running Variable in the Regression Discontinuity Design: A Density," *Journal of Econometrics*, 142(2), 698–714.

MIC (2000a–2010a) *Settlement of Municipality Finances*. (in Japanese)

MIC (Ministry of Internal Affairs and Communications) (2000b–2010b) *Statistical Reports on the Land Area by Prefectures and Municipalities in Japan*. (in Japanese)

MIC (2000c–2010c) *Taxation of Municipal Taxes*. (in Japanese)

MIC (2006) *Guide for Unconditional Grants in Japan.* (in Japanese)

Mochida, N. (2006) "Local Government Organization and Finance: Japan," *Local Governance in Industrial Countries*, A. Shar (eds), Washington, DC: World Bank.

Okamoto, Z. (2002) *Discussion on the Reform of Local Public Finance*, Tokyo, Gyosei. (in Japanese)

Reschovsky, A. (2007) "Compensating Local Governments for Differences in Expenditure Needs in a Horizontal Fiscal Equalization Program," in *Intergovernmental Fiscal Transfers*, Boadway, R. and A. Shah (eds), World Bank, Washington, D.C.

Smart, M. (1998) "Taxation and Deadweight Loss in a System of Intergovernmental Transfers," *Canadian Journal of Economics*, 31, 189–206.

Smart, M. (2007) "Raising Taxes through Equalization," *Canadian Journal of Economics*, 40(4), 1188–1212.

Wildasin, D.E. (2011) "Fiscal Competition for Imperfectly-Mobile Labor and Capital: A Comparative Dynamic Analysis," *Journal of Public Economics*, 95, 1312–1321.

Table 1. Definitions of Variables, Units, and Sources

Variable	Definition	Unit	Source
	A. Dependent variables		
Additional corporate tax rate	Effective additional corporate tax rates, calculated as tax revenues from additional corporate tax divided by corporate tax base	Percentage	
	B. Covariates		
Treatment dummy	Dummy for municipalities that do not receive equalization grants	-	-
Fiscal capacity index	Fiscal capacity index, normalized at zero, computed as basic fiscal revenues divided by basic fiscal needs minus one	-	2
Per capita GDP	Real-value municipal GDP per capita	Billion JPY/thousand	1, 2
City dummy	Dummy that takes value one for cities	-	-
Log of population	Natural log of population	Thousand JPY	2
Population density	Population divided by area	Thousand JPY/ha	2, 3
Taxable income per taxpayer	Per taxpayer taxable income of local individual income tax (*kojin jumin zei* in Japanese)	Million JPY/thousand	2, 4

Notes: The table reports the definitions, units, and statistical sources of the dependent and covariates. One JPY is equal to approximately 0.01 USD.

Source: 1 = Cabinet Office (2000–2010); 2 = MIC (2000a–2010a); 3 = MIC (2000b–2010b); 4=MIC (2000c–2010c)

Table 2. Summary Statistics

	Mean	Standard deviation	Minimum	Maximum	Observations
	A. Dependent variables				
Additional corporate tax rate	1.43	0.98	0	2.40	1344
	B. Covariates				
Fiscal capacity index	-0.01	0.06	-0.10	0.10	1344
Per capita GDP	4.10	1.06	2.62	9.58	1344
City dummy	0.78	0.42	0	1	1344
Population	155,126	140,871	2,462	800,596	1344
Population density	28.8	218.2	0.13	11334	1344
Taxable income per capita	3.93	0.43	2.76	6.53	1344

Notes : The table reports summary statistics of a dependent variable and covariates. Bandwidths for the variables are ±0.1. Definition and units of the variables are listed in Table 1.

Table 3. Sharp RD Estimates of the Effects of Equalization Grants on Additional Corporate Tax Rates: Baseline

Bandwidths	±0.05	±0.1, baseline	±0.15
	(1)	(2)	(3)
Model			
Linear polynomial regression	-0.425***	-0.232**	-0.255**
	(0.157)	(0.115)	(0.100)
AIC	[1903.3]	[3626.3]	[5587.7]
Cube polynomial regression, baseline	-0.721**	-0.687***	-0.406**
	(0.300)	(0.223)	(0.185)
AIC	[1909.1]	[3617.0]	[5585.7]
Local linear regression	-0.591**	-0.404**	-0.236*
	(0.240)	(0.172)	(0.141)
Observations	691	1344	2041

Notes : The table reports RD estimates for the effects of fiscal equalization rate on additional corporate tax rates, where data source is Japanese municipalities for 1990–2000. Cluster robust standard errors are in parentheses; AICs are in brackets. *, **, and *** denote significance at 10%, 5%, and 1%, respectively. Each sample is restricted to the bandwidths described in the top row of this table. Every regression except the local linear regressions includes as controls per capita GDP as well as city and year dummies. The local linear regressions present bias-corrected RD estimates with robust standard errors, where the

Table 4. Robustness Check

Bandwidths	±0.05	±0.1, baseline	±0.15
	(1)	(2)	(3)
Excluding covariates	-0.642**	-0.583**	-0.316*
	(0.302)	(0.225)	(0.186)
Including other covariates	-0.665**	-0.653***	-0.408**
	(0.280)	(0.210)	(0.172)
One-year lagged treatment	-0.618*	-0.647***	-0.394**
	(0.315)	(0.231)	(0.189)
Observations	[656]	[1265]	[1915]

Notes : The table reports robustness checks for the effects of equalization rates on additional corporate tax rates, where the cube polynomial function is employed. Cluster robust standard errors are in parentheses. Observations for the regressions with one-year lagged treatment are in brackets; observations for the other regressions are the same as those in Table 3. *, **, and *** denote significance at 10%, 5%, and 1%, respectively. Each sample is restricted to the bandwidths described in the top row of this table. Every regression includes as controls per capita GDP as well as city and year dummies.

Table 5. Tests for Validity of the RD Design

Dependent variable	Frequency of the forcing variable	Per capita GDP
	(1)	(2)
Treatment effect	-7.141	-0.042
	(12.522)	(0.197)
Observations	60	1344

Notes: The table presents test results for the validity of the RD strategy. In the first column, frequency of the forcing variable is regressed on the treatment dummy, where the numbers of the bin (sample size) are 30 to the left and right sides of the cutoff; in the second column, per capita GDP is on the treatment variable, where the sample is restricted to the bandwidth of ±0.1. In both estimations, the local linear regressions with the triangular kernel are adopted, where bias-corrected RD estimates with robust standard errors are reported. *, **, and *** denote significance at 10%, 5%, and 1%, respectively.

Table 6. Tests for Placebo Effects of Equalization Grants on Additional Corporate Tax Rates

Placebo thresholds	-0.075	-0.05	-0.025	0.025	0.05	0.075
	(1)	(2)	(3)	(4)	(5)	(6)
Bandwidths						
±0.05			-0.637	0.187		
			(2.296)	(2.320)		
Observations			[781]	[593]		
±0.1, Baseline	1.778	-1.525	0.343	0.503	1.966	-2.287
	(3.500)	(1.366)	(0.580)	(0.794)	(2.161)	(4.419)
Observations	[1797]	[1636]	[1496]	[1225]	[1096]	[970]
±0.15	-1.858	-0.596	0.277	0.545	0.885	1.158
	(1.278)	(0.647)	(0.328)	(0.476)	(0.983)	(1.882)
Observations	[2678]	[2447]	[2241]	[1873]	[1664]	[1506]

Notes : The table reports the placebo effect tests of fiscal equalization rates on additional corporate tax rates, obtained from the cube polynomial function. Placebo thresholds are listed in the top row; the number of observations, described in brackets, varies by placebo threshold and by used bandwidth. Cluster robust standard errors are in parentheses. *, **, and *** denote significance at 10%, 5%, and 1%, respectively. Every regression includes as controls per capita GDP as well as city and year dummies.

Table B1. Other Robustness Checks

Bandwidths	±0.05	±0.1, baseline	±0.15
	(1)	(2)	(3)
Excluding covariates in linear polynomial	-0.370**	-0.198*	-0.253**
	(0.155)	(0.120)	(0.106)
Including other covariates in linear polynomial	-0.420***	-0.216**	-0.216**
	(0.143)	(0.109)	(0.098)
Local linear regression with Epanechnikov kernel	-0.606**	-0.368**	-0.202
	(0.246)	(0.171)	(0.139)
Other orders of polynomial			
Quadratic	-0.633***	-0.354**	-0.236*
	(0.236)	(0.167)	(0.141)
Quartic	-0.388	-0.741***	-0.640***
	(0.361)	(0.275)	(0.227)
Observations	691	1344	2041

Notes: The table reports other robustness checks for the effects of equalization rates on additional corporate tax rates, where adopted functional forms differ from the previous regressions. The second and third regressions from the bottom are estimates from the quadratic and quartic polynomial models, where per capita GDP, city and year dummies are included as controls. Cluster robust standard errors are in parentheses. *, **, and *** denote significance at 10%, 5%, and 1%, respectively. Each sample is restricted to the bandwidths described in the top row of this table.

Figure 1. Change in Proportion of Municipalities Adopting Additional Corporate Taxation and Municipalities Not Receiving Equalizing Grants, 1985–2005

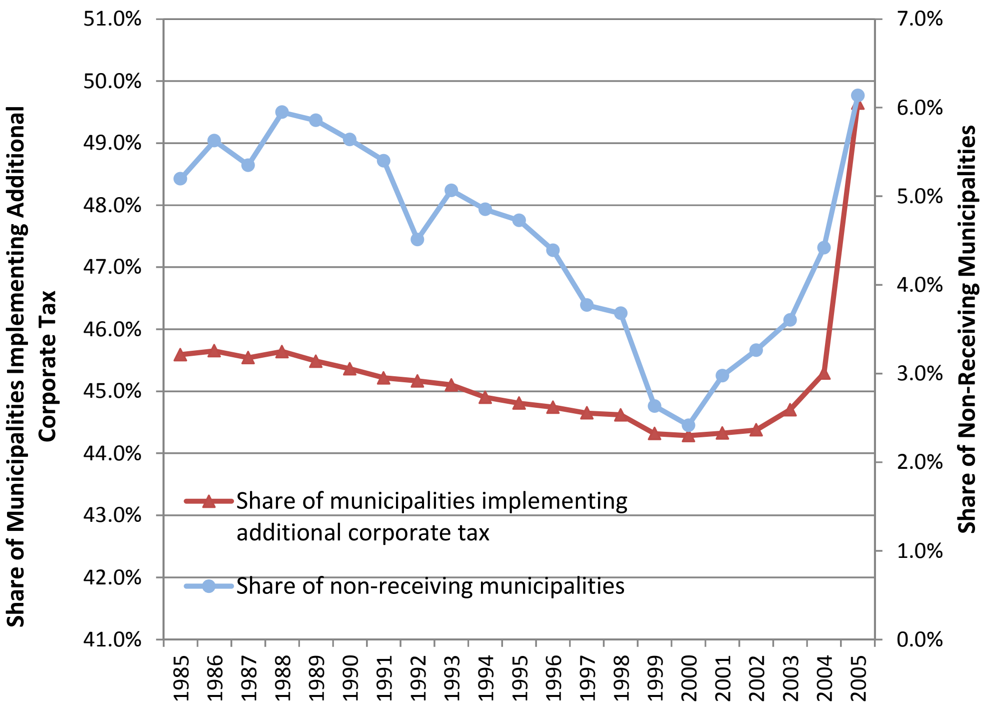


Figure 2. Additional Corporate Tax Rates against Fiscal Capacity Index

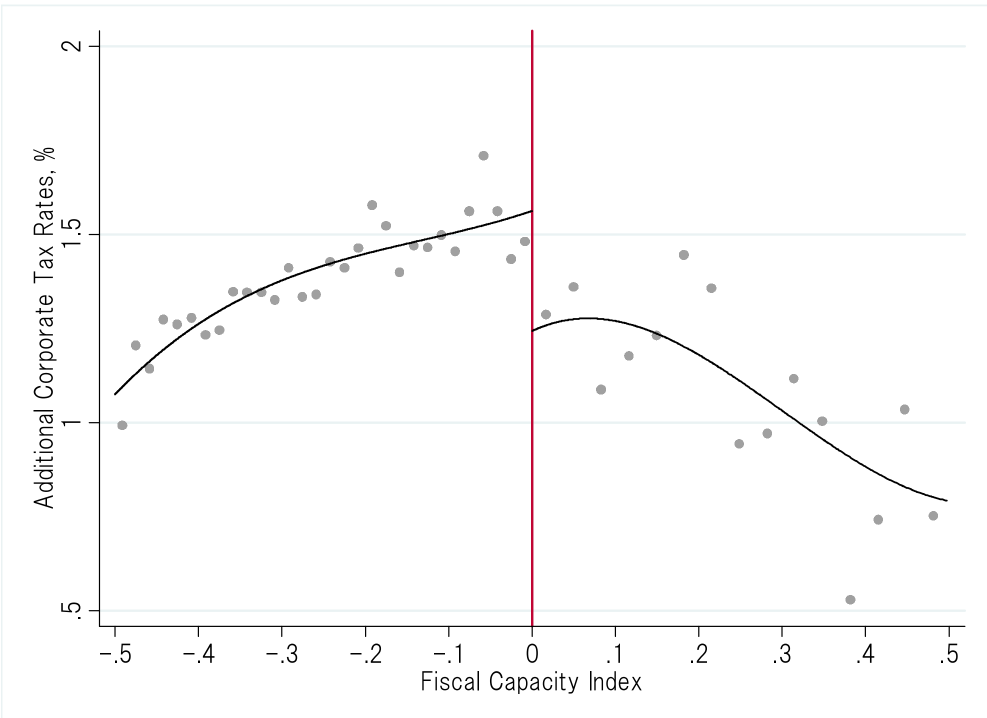


Figure 3. Density of Fiscal Capacity Index (Forcing Variable)

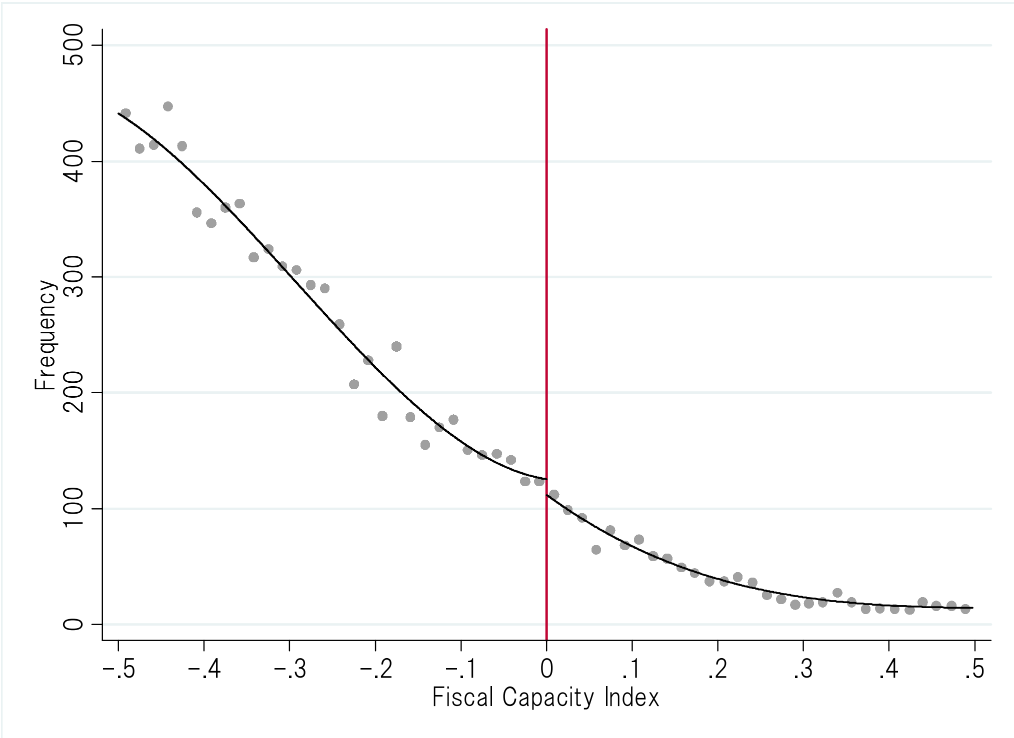


Figure 4. Per Capita GDP against Fiscal Capacity Index

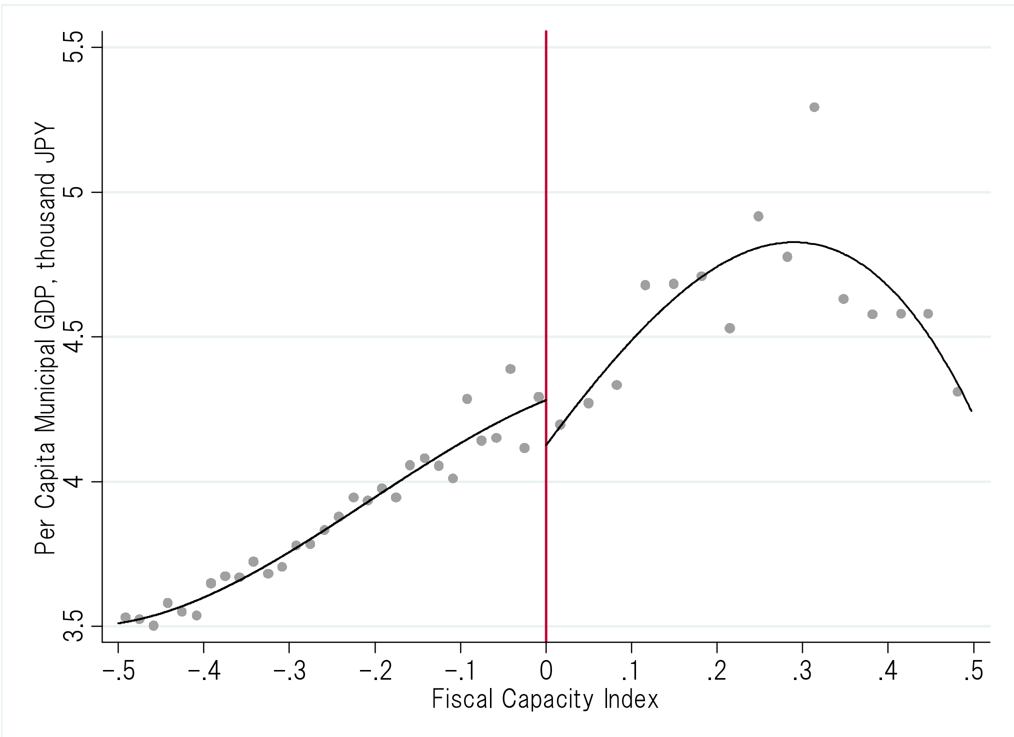


Figure 5. Basic Fiscal Revenues against Fiscal Capacity Index

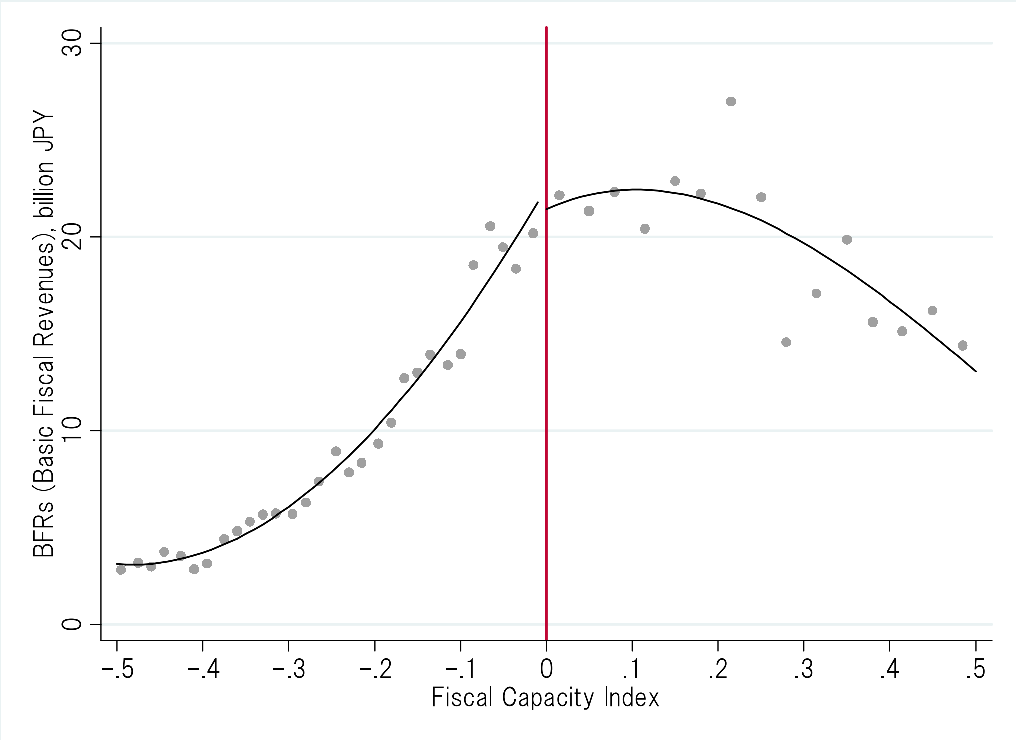
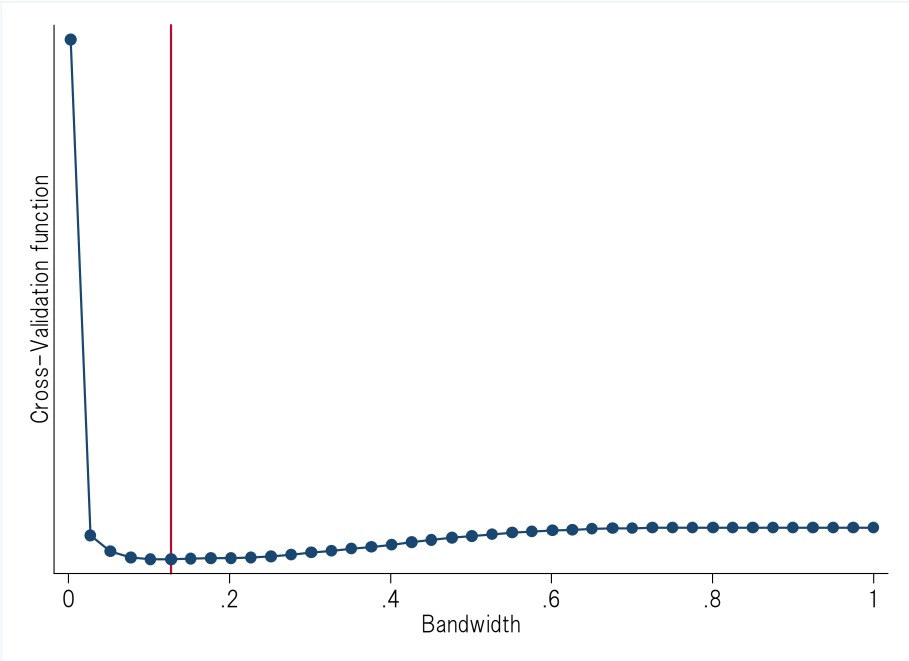


Figure C1. Cross-Validation against Bandwidth

A. Case of Additional Corporate Tax Rate



B. Case of Corporate Tax Base