

# Decomposing Local Fiscal Multipliers: Evidence from Japan\*

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## Abstract

This paper studies local fiscal multipliers, using rich dataset of the Japanese prefectural accounts. To identify local fiscal multipliers, we rely on the cross-sectional variations of earmarked transfers from the central government to local governments. We estimate the local fiscal multiplier at the regional level. This regional fiscal multiplier can be decomposed into the component of prefecture-specific variations and the component common across prefectures within the same region. We interpret the former as the prefectural fiscal multiplier and the latter as the region-wide spillover. Our estimate of the regional fiscal multiplier on output is 1.6. The region-wide spillover is estimated to be positive and to account for about a one-third of the regional fiscal multiplier. We also decompose the regional fiscal multiplier on output into multipliers on expenditure components such as consumption, investment, and net exports. We show that the crowding-in effect are observed in consumption and investment and that the region-wide spillover is economically significant in these expenditure components.

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# 1 Introduction

One of the cornerstone issue of macroeconomics is the interaction of the economic activity and the government spending. The interaction is often measured by the fiscal multiplier, the percentage increase in output when government spending increases by one percent of the gross domestic product (GDP). While it has traditionally been measured by the time series data, recent studies rely on geographical cross-sectional variations in government spending. Exploiting the regional panel data, these studies estimate the local fiscal multiplier (LFM).<sup>1</sup> While one can interpret the LFM as a fiscal multiplier that measures the effect of government spending in one region in a monetary union (Nakamura and Steinsson 2014), the LFM has an important dimension differing from the traditional national fiscal multiplier. In particular, because local economies have strong interdependence without the border effect, government spending in a local economy may easily spill over into other local economies. The spillover may be positive, if the aggregate demand of a local economy leaks to other local economies. It may be positive again, if an increase in the relative price in the targeted economy to the other local economy induces expenditure switching from the targeted local economy to the other local economy. However, it may also be negative, if the production factors, such as labor, relocate across prefectures.

In this paper, we estimate the LFM, focusing on the spillover across Japanese prefectures. In our analysis, we separate a single country into several groups of prefectures (i.e., regions) and ask the following questions. First, how large is the LFM in regions? We provide the evidence of the LFM in Japan, comparable to those in other countries. Second, how large is the spillover within the region? In our analysis, we estimate the *regional fiscal multiplier* (RFM) as the sum of the *prefectural fiscal multiplier* (PFM) and the *region-wide spillover*. We interpret the PFM as the component estimated from prefecture-specific variations and the region-wide spillover as the component common across prefectures within the same region. We then measure how much the region-wide spillover contributes to the RFM. Third, we exploit an advantage of Japanese prefectural data and ask: How large are the LFM on expenditure components of GDP? Japanese prefectural accounts are highly comparable to the national accounts and the data of consumption, investment, and net exports are available at prefectural level. This contrasts with the US state-

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<sup>1</sup>Chodorow-Reich (2017) comprehensively reviews numerous recent studies on the LFM. Ramey (2011) surveys fiscal and tax multipliers including the time-series evidence.

level data published by the Bureau of Economic Analysis.<sup>2</sup> Exploiting the data compiled by the single government agency in a consistent manner, we decompose the LFM on output into those on expenditure components. Based on the expenditure components, we investigate which expenditure components of GDP are crowded out or in by local government spending and how the spillover in these expenditure components propagates to other local economies.

As the previous studies on the fiscal multiplier emphasized, identifying the fiscal multiplier requires an isolation of changes in government spending uncorrelated with shocks to the local economy. We construct instruments from the national treasury disbursements in the local public finance data.<sup>3</sup> The expenditure by the local governments highly depend on the transfers from the central government, because of the large vertical fiscal gap between the central and the local governments (see Bessho 2016). The national treasury disbursements are the earmarked, program-based transfers from the central government to the local government. By definition, the national treasury disbursements are financed by the national tax revenues which are less likely to be affected by shocks to specific prefectures' economic activity. Furthermore, we can identify purposes and/or programs supported by the disbursements, because the transfers are earmarked (e.g., education, social welfare, construction, etc.). Using the detailed information in the local public finance data, we exclude the transfers that are strongly correlated with shocks to local economies (e.g., subsidies for the recovery from disasters) in constructing the instruments.

The main findings are as follows. First, the benchmark estimate of the RFM on output is about 1.6. In other words, when government spending increases at the regional level by one percent of GDP, the regional output increases by 1.6 percent. Second, we find that the region-wide spillover in output is estimated to be positive. Thus, even if a prefecture's government spending stays constant, output in the prefecture can increase due to an increase in the other prefecture's government spending in the same region. Our benchmark estimate suggests that the region-wide spillover is about one-third of the estimated RFM of 1.6. Third, larger regional government spending leads to larger private consumption and private fixed investment. In other words, we observe the crowding-

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<sup>2</sup>For example, the Bureau of Economic Analysis does not publish data of net exports and business investment at the state level. In the literature on the LFM in the U.S., the data of US state-level government spending are often taken from U.S. Census Bureau.

<sup>3</sup>Our approach is similar to Kraay (2012) and Guo, Liu, and Ma (2016) who use variations in the fund lent or transferred from the organization other than the local government for identification. Kraay (2012) estimates the fiscal multiplier in developing countries with the instrument of the world bank lending. Guo, Liu, and Ma (2016) estimate the LFM in China. Focusing on the local public finance fact that the Chinese poor counties receive preferential earmarked treatment in receiving transfers, they identify the LFM.

in effect of local government spending on these private expenditure components at the regional level. The crowding-in effect on consumption and investment is substantial: 53 percent of the RFM on output. By contrast, net exports decrease with regional government spending, suggesting a leakage in the aggregate demand to other local economies. We find the statistically and economically significant region-wide spillover in the “domestic absorption” or expenditure within the prefecture. Based on our estimates, the observed crowding-in effect is generated substantially by the region-wide spillover in the domestic absorption.

The literature on the LFM is very active and thus numerous previous studies contribute to the literature.<sup>4</sup> Some studies focus on spillover in the context of the LFM. Dupor and McCrory (2017) discover the evidence for the positive spillover in wage bills and employment within the regional market. Suárez-Serrato and Wingender (2016) also explore the income spillover across neighboring counties, but find no evidence of sizable spillovers. Acconcia, Corsetti, and Simonetti (2014) use Italian provincial data and find a statistically insignificant spillover to the provincial output. Our paper studies the spillover more closely than these previous studies by looking at expenditure components of GDP, as well as output. Guo, Liu, and Ma (2016) investigate the Chinese county data and estimate the LFM on investment at county level as well as output. They find the crowding-in effect on investment without assuming the region-wide spillover. Cohen, Coval, and Malloy (2011) also estimate the impact of the state-level government spending on investment at the publicly traded U.S. firms. They find negative impacts of local government spending on firms’ investment and payouts to the investors of firms.

The most closely related work to our paper is Brückner and Tuladhar (2014) who estimate the LFM in Japan. While their data source of prefectural accounts is the same as ours, they mainly focus on the financial distress in the 1990s and on its impact on the LFM. Other previous studies on the Japanese fiscal multipliers provide time-series evidence. Among these the time-series-based studies, recent works emphasize the state dependence of the national fiscal multipliers.<sup>5</sup>

This paper is organized as follows. Section 2 describes the empirical strategies. In Section 3, we discuss the data and the construction of instruments. Section 4 presents the main results and section 5 shows robustness. Section 6 concludes.

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<sup>4</sup>A few examples of earlier works are: Clemens and Miran (2012), Nakamura and Steinsson (2014), Fishback and Kachanovskaya (2015), Shoag (2016) and Suárez-Serrato and Wingender (2016). Regarding the impact of the American Recovery and Reinvestment Act (ARRA) of 2009 on employment in the US state or the US county, see Chodorow-Reich, Feiveson, Liscow, and Woolston (2012), Wilson (2012), and Conley and Dupor (2013) among others.

<sup>5</sup>See Auerbach and Gorodonichenko (2014) and Miyamoto, Nguyen, and Sergeyev (2016).

## 2 Two local fiscal multipliers and the region-wide spillover

In the literature, a typical equation for estimating the LFM is

$$\frac{Y_{r,t} - Y_{r,t-2}}{Y_{r,t-2}} = \beta_R \frac{G_{r,t} - G_{r,t-2}}{Y_{r,t-2}} + \alpha_r + \delta_t + \varepsilon_{r,t}, \quad (1)$$

where,  $Y_{r,t}$  is the regional-level per capita output in period  $t$  and  $G_{r,t}$  is the regional-level per capita government spending. Since  $\beta_R$  can be estimated by the regional-level data, we refer to  $\beta_R$  as the *regional fiscal multiplier* (RFM). The index  $r$  represents regions in a country,  $r \in \{r_1, r_2, \dots, r_M\}$ , where the country has  $M$  regions. Notice that  $\alpha_r$  and  $\delta_t$  include the entity and time fixed effect, respectively. For now, we assume no covariates to simplify the discussion but the actual empirical analysis include control variables. The error term is  $\varepsilon_{r,t}$ . The entity fixed effect  $\alpha_r$  controls for region-specific component in per capita output and government spending. The time fixed effect  $\delta_t$  captures the unobserved nation-wide effects of aggregate shocks and macroeconomic policy on the regional output (e.g., aggregate productivity, monetary policy, national tax changes, and predictable changes in the national output and government spending, etc.). Due to the time fixed effect, the RFM measures how much output in a region increases relative to that in other regions when government spending in the region increases relative to that in other regions. Here, following Nakamura and Steinsson (2014), the time unit is one year so that the dependent variable is the two-year growth rate of output. Hence,  $\beta_R$  can also be interpreted as the two-year cumulative fiscal multipliers.

The estimation equation in this paper takes the following prefecture analog of (1), but with an additional regressor:

$$\frac{y_{r,p,t} - y_{r,p,t-2}}{y_{r,p,t-2}} = \gamma_P \frac{g_{r,p,t} - g_{r,p,t-2}}{y_{r,p,t-2}} + \gamma_S \frac{G_{r,t} - G_{r,t-2}}{Y_{r,t-2}} + \eta_{r,p} + \delta_t + \varepsilon_{r,p,t}, \quad (2)$$

where  $y_{r,p,t}$  is per capita output and  $g_{r,p,t}$  is per capita government spending in prefecture  $p$  that belongs to region  $r$ . Formally, each region  $r_i$  has  $N_i$  prefectures and the index  $p_i$  is defined by  $p_i \in r_i = \{1, 2, \dots, N_i\}$  for  $i = 1, \dots, M$ . For notational simplicity, we dropped the index  $i$  from  $r$  and  $p$  in (2). As before,  $\eta_{r,p}$  captures the entity fixed effect as defined similarly to  $\alpha_r$  in (1). Note that (2) includes changes in both prefectural and regional government spending. We interpret  $\gamma_P$  as the *prefectural fiscal multiplier* (PFM), because, if  $\gamma_S = 0$ , (2) has the same structure as (1) in which we

discussed the RFM. However, if  $\gamma_S \neq 0$ , this equation indicates that the prefectural output growth is sensitive to changes in the regional government spending (scaled by the regional output). Even if government spending in the prefecture stays constant, the output of the same prefecture may change with regional government spending. Hence, we interpret  $\gamma_S$  as the *region-wide spillover*.<sup>6</sup>

The sign of the region-wide spillover  $\gamma_S$  can be positive and negative through channels discussed in the literature.<sup>7</sup> On the one hand, an increase in government spending in a prefecture may increase the relative price of the prefecture's output to the same goods in other prefectures. Thus, expenditure to the prefecture's output switches to output in other prefectures, perhaps to the prefecture in the same region. This implies a positive  $\gamma_S$ . Also, the increase in the prefecture's government spending may boost the liquidity-constrained households' demand.<sup>8</sup> If the increase in demand leaks into the other prefectures in the same region, the spillover is again positive. On the other hand, when the increase in government spending stimulates the production in the prefecture, it may also lead to the relocation of factor inputs from other prefectures within the same region. Because this may reduce the output in the other prefectures, the spillover produces a negative  $\gamma_S$ .

We interpret that the sum of  $\gamma_P$  and  $\gamma_S$  can approximate  $\beta_R$  in (1). Let  $\omega_{r,p}$  be the time-series mean of the GDP share of a prefecture to the region. Taking the weighted average of both sides of (2) with the GDP share  $\omega_{r,p}$ , we can approximate the equation by

$$\frac{Y_{r,t} - Y_{r,t-2}}{Y_{r,t-2}} \simeq (\gamma_P + \gamma_S) \frac{G_{r,t} - G_{r,t-2}}{Y_{r,t-2}} + \alpha_r + \delta_t + \varepsilon_{r,t}, \quad (3)$$

where we redefine  $\alpha_r$  as the weighted average of  $\eta_{r,p}$ :  $\alpha_r = \sum_{p \in r} \omega_{r,p} \eta_{r,p}$  and the error term  $\varepsilon_{r,t} = \sum_{p \in r} \omega_{r,p} \varepsilon_{p,t}$ . Here, the derivation of the above equation requires that the distributions of output and population be stable over the sample periods. More specifically, let the level of prefectural and regional GDP be  $y_{r,p,t}^*$  and  $Y_{r,t}^*$ . Here, a superscript  $*$  on a variable denotes the level of variable rather than per capita variable. The levels of output are given by  $y_{r,p,t}^* = y_{r,p,t} l_{r,p,t}^*$ ,

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<sup>6</sup>The previous studies also employ somewhat different but similar approach to ours. Acconcia, Corsetti and Simonelli (2014) and Suárez-Serrato and Wingender (2016) employ the regressions where the per capita output growth in an area (province or county) is correlated with the government spending aggregated across adjacent areas (provinces or counties), excluding that in its own area.

<sup>7</sup>For example, see Acconcia, Corsetti, and Simonelli (2014), Suárez-Serrato and Wingender (2016) and Chodorow-Reich (2017).

<sup>8</sup>See Galí, López-Salido, and Vallés (2007) for the model with liquidity-constrained households. They introduce the rule-of-thumb households who have no access to capital markets and behave in a hand-to-mouth fashion. An increase in government spending that leads to higher income of the rule-of-thumb households can directly increase their consumption.

and  $Y_{r,t}^* = Y_{r,t}L_{r,t}^*$  where  $l_{r,p,t}^*$  and  $L_{r,t}^*$  are the population in prefecture  $p$  and in region  $r$ , respectively. Also note that the regional output and the regional population satisfy  $Y_{r,t}^* = \sum_{p \in r} y_{r,p,t}^*$  and  $L_{r,t}^* = \sum_{p \in r} l_{r,p,t}^*$ , respectively. By the assumption of the stable distributions of output and population, we mean that  $y_{r,p,t}^*/Y_{r,t}^*$  and  $l_{r,p,t}^*/L_{r,t}^*$  are sufficiently close to their time-series mean. Under this approximation assumption, we have  $\sum_{p \in r} \omega_{r,p} (y_{r,p,t} - y_{r,p,t-2}) / y_{r,p,t-2} \simeq (Y_{r,t} - Y_{r,t-2}) / Y_{r,t-2}$  and  $\sum_{p \in r} \omega_{r,p} (g_{r,p,t} - g_{r,p,t-2}) / g_{r,p,t-2} \simeq (G_{r,t} - G_{r,t-2}) / G_{r,t-2}$ . Comparing (3) with (1) yields our interpretation that  $\beta_R \simeq \gamma_P + \gamma_S$ .

It should be noted that there are some other factors that weaken the link between  $\gamma_P + \gamma_S$  and  $\beta_R$ , in addition to the assumption on the distribution of output and population. First, the region must be defined as a group. In other words, we must have  $Y_{r,t}^* = \sum_{p \in r} y_{r,p,t}^*$  and  $L_{r,t}^* = \sum_{p \in r} l_{r,p,t}^*$ . In the subsequent sections, we use the definition of regions that satisfy these conditions to estimate parameters in (2). Second, if we include the vector of prefectural control variables  $x_{r,p,t}$  into (2), it requires that (1) also have the vector of the control variables  $X_{r,t} = \sum_{p \in r} \omega_{r,p} x_{r,p,t}$  as additional regressors. In other words, the control variables in (1) need to be the weighted average of the control variables across prefectures to have approximation results of  $\beta_R \simeq \gamma_P + \gamma_S$ . In some cases, however, control variables introduced in (1) as the weighted average may be difficult to interpret. Furthermore, if we consider  $\beta_R$  when (1) has control variables that are not the weighted average of prefectural control variables, the link between  $\beta_R$  and  $\gamma_P + \gamma_S$  may be weakened. Nevertheless, in our empirical analysis, we estimate  $\gamma_P$  and  $\gamma_S$  from (2) and report  $\gamma_P + \gamma_S$  as the estimate of  $\beta_R$ .

Regarding the control variables introduced in (2), the benchmark estimation equation includes the dummy variable for the Great East Japan Earthquake on March 11, 2011, the last month of the fiscal year 2010.<sup>9</sup> This natural disaster shock is considered to have a prefecture- and time-specific negative impact on the output growth in some prefectures off the northeast coast of Japan. See also the location of these prefectures in Figure 1. To control for the negative impact of the earthquake, we introduce a dummy variable  $D_{r,p,t}^E$  that takes one if prefecture  $p$  experienced strong influences

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<sup>9</sup>The fiscal year in Japan begins in April and ends in March.

of the earthquake and year  $t = 2011, 2012$ :<sup>10</sup>

$$D_{r,p,t}^E = \begin{cases} 1 & \text{if the prefecture is Fukushima, Ibaraki, Iwate, Miyagi and } t = 2011, 2012 \\ 0 & \text{otherwise.} \end{cases} \quad (4)$$

There are many other potential factors that should be included in (2). Examples include the revenue of the prefectural government. For example, the information on the local tax rates may be useful because they may directly affect the prefectural output. However, the local tax rates in a given year are very similar across prefectures (and municipalities) and changes in the local tax in time-series dimension take place in the same fiscal year. Therefore, the effect of local tax rates could be captured by the time-fixed effects.

### 3 Data and the instruments

#### 3.1 Data

We use the data of prefectural output and government spending from *Annual Report on Prefectural Accounts* published by Economic and Social Research Institute (ESRI) in Cabinet Office of the Government of Japan. The report provides the prefectural accounts comparable to the national accounts. The sample period is over 1990–2012. The government spending used for regressions includes the government final consumption expenditure and the gross fixed capital formation for public sectors in the report.

Japan basically comprises of two levels of local administrative divisions: prefectures, and municipalities. Traditionally, the country separates into eight regions (Hokkaido, Tohoku, Kanto, Chubu, Kinki, Chugoku, Shikoku, Kyusyu).<sup>11</sup> Except for Hokkaido, each region has multiple prefectures.<sup>12</sup> The number of prefectures is 47. The *Annual Report on Prefectural Accounts* divides the prefectures into seven regions, where Hokkaido and Tohoku is combined into one region (see Figure 1).

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<sup>10</sup>We choose these prefectures for the earthquake dummy based on whether the central government immediately provided a huge amount of special earmarked transfers (the grants for recovery from the Great East Japan Earthquake). In fiscal year 2011, only these four prefectures received the transfers from the central government. In the next year, the transfers are provided to other prefectures. But they are not necessarily a prefecture that is seriously damaged by the earthquake (e.g., Osaka and Kagawa prefectures located in the western area of Japan).

<sup>11</sup>These regions are not officially specified because regions do not have their own elected officials and policy decisions within the same region are independent.

<sup>12</sup>Hokkaido is the northern-end prefecture of Japan. See Figure 1.



We follow the annual reports' definition of regions.

As we will elaborate in the next subsections, we utilize the cross-sectional variations of transfers from the central government to the prefectural governments to instrument government spending. We take the data of the transfers from *Annual Statistical Report on Local Government Finance* published by the Ministry of Internal Affairs and Communications. All data are reported as nominal variables. When we convert the nominal variables into the real variables, we deflate the nominal variables by prefecture-specific GDP deflator, with the base year of 2005.

## 3.2 Instrumenting government spending

Government spending is endogenous. Indeed,  $g_{r,p,t}$  is a policy variable affected by the states of the local economy. In the estimation, aggregate shocks to local output can be controlled by the time fixed effect. Yet,  $g_{r,p,t}$  (and  $G_{r,t}$ ) may be correlated with shocks to local output. For example, disasters that decrease prefectural output may cause government spending in the prefecture to increase.

To address the endogeneity issues, we instrument government spending, using cross-sectional variations in transfers from the central government to the local governments. In particular, we rely on the institutional local public finance facts: (i) The local governments in Japan highly depends on the transfers from the central government in their revenue; (ii) The transfers from the central government are financed by the national tax revenue that is unlikely to be affected by the local business cycles; (iii) Depending on the type of transfers, the transfers are disbursed to implement specific national objectives and are hard to reconcile with the local government's objective of stimulating the local economy.

### 3.2.1 Institutional background

The government activity in Japan is highly centralized and the local governments (prefectures or municipalities) critically depends on transfers or redistribution of national tax revenue from the central government, in financing their expenditure. This large dependence stems from the vertical fiscal gap between the central and local governments. Whereas the central government assigns various functions to local governments, the local governments do not have sufficient resources of their own revenues to carry out their functions (see Bessho 2016). In particular, whereas the local

governments' expenditure accounts for about 60 percent of total governmental expenditure, the local governments' revenue is only 40 percent of the total government revenue. This large vertical fiscal gap between the central and local governments leads to the necessity of the transfers from the central government. In the fiscal year 2012, for example, these transfers from the central government to all prefectural governments account for 35 percent of the total revenue of all prefectural governments. The size of these transfers is comparable to that of local tax revenues which account for 32 percent of the total revenue of the prefectural governments (Ministry of Internal Affairs and Communications 2014). These facts suggest that there would be significant correlations between the local government spending and the transfers from the central government.

The transfers from the central government are financed by the national tax revenue. The nationally collected taxes are pooled in the country and, by construction, they are unlikely to be affected by the state of the local economies. The national tax revenue is strongly affected by business cycle fluctuations and the fiscal policy at the national level. However, such macroeconomic variations over time could be controlled by the time fixed effect in regression, unless the macroeconomic shocks have heterogeneous impacts on the local economy.

The local governments in Japan broadly receive two types of transfers from the central government: "the local allocation tax" and "the national treasury disbursements." The former is allocated to reduce the horizontal fiscal gap across local governments. The transfers are financed by the national taxes and account for 18.3 percent of total revenue of the prefectural governments in the fiscal year of 2012. For example, when the local tax revenue in a prefecture is lower than other prefectures, the central government allocates more funds to the prefecture than to other prefectures to adjust imbalance in the tax revenue across local governments. Hence, the local allocation tax is likely to be strongly correlated with shocks to the local economy and thus is not qualified as the instrument.

The national treasury disbursements, or the treasury disbursements for short, are also financed by the national tax revenue and have a high fraction of total revenue (12.9 percent in the fiscal year 2012) as well as the local allocation tax. However, the treasury disbursements are granted for promoting projects that contribute to the specific national objectives (e.g., education, social welfare, and social capital constructions etc.), rather than adjusting imbalance of the tax revenues across local governments. To receive the treasury disbursements, local governments prepare applications describing specific projects with the emphasis of the necessity and earmarking of grants. Ministries

in the central government review their applications and decide whether or not to approve the grants and/or subsidies. In general, it is difficult for the applications to reflect the local government’s counter-cyclical fiscal policy, because the fiscal stimulus to specific prefectures is usually inconsistent with the national objectives. Of course, some programs supported by treasury disbursements have the purposes related to the specific local economy. For example, the central government promotes the disaster-hit prefectures to recover from natural disasters (e.g., the grants for restoring from disaster and the special grants for restoring from the Great East Japan earthquake). However, the data of the treasury disbursements consist of a number of categories according to the purposes and programs of grants. Using the detailed information on purposes and programs supported by the treasury disbursements, we can remove those grants when constructing the instruments for regression analysis.

### 3.2.2 Constructing the instruments

The *Annual Statistical Report on Local Government Finance* provides the detailed information on purposes and/or programs supported by the treasury disbursements. Table 1 shows purposes and programs that can be identified from the report in 2012. As indicated in Table 1, main components of the treasury disbursements are education (30.3% of the treasury disbursements), construction (21.3%), grants and subsidies that may be related to local business cycles and counter-cyclical policies (11.2%) and grants for recovery from disasters (9.2%).

We look for purposes and programs of the treasury disbursements that we can keep track of during the sample period. To construct instruments, we consider all purposes and programs shown in Table 1 and select categories that are considered to be uncorrelated to shocks to the local economy. As the first category, we choose the treasury disbursements for education. This category mainly includes compulsory education. The total amount of this subsidy largely depends on the number of teachers and staffs in public schools prescribed by law and on the salary for teachers and staffs in public schools that is insensitive to local business cycles.<sup>13</sup> We argue that other subsidy and grants used for education would mainly vary based on the prefecture’s distribution of children.

The second category we select for constructing instruments is constructions which include “ordinary construction” and “grants for comprehensive infrastructure development.” They include

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<sup>13</sup>The transfers from the central government for construction of school buildings and related facilities are included as the category of construction in the treasury disbursements.

grants for building public facilities and infrastructures (e.g., construction and maintenance of public facilities, road and bridges, river improvement, and coastal defenses). Among others, the latter is the infrastructure-related grants exclusively approved by the Ministry of Land, Infrastructure, Transport and Tourism. To apply for these types of grants, the local governments need to prepare the application describing their specific purposes of projects that contributes to the national objectives.

We do not choose purposes and programs in the treasury disbursements that are strongly related to shocks to the local economy. In particular, we do not choose subsidies for livelihood protection (i.e., supplemental social security income for low income people) and child protection because these subsidies depend on the number of recipients which comoves with business cycle fluctuations at the prefectural level. In addition, the grants for regional autonomous strategies are not included for constructing instruments, since this category of grants is designed to allow the local government to use the grants for discretionary purposes. As we discussed, we exclude the grants for disaster restoration, since the grants are designed for stimulating the local economies.

Some earmarked transfers are also selected for constructing our instruments, though these transfers accounts for only 4.7 percent. This is the third category chosen for constructing instruments. More specifically, the subsidy for self-support of the disabled is the statutory subsidy. The sub-category of “money in trust” corresponds to the cost of conducting the national projects (e.g., national elections, the collection of statistical data and census data, etc.) and is fully funded by the central government. Grants for area locating electric power plants and grants for locating petroleum reserving facilities are given to prefectures, depending on whether power plants or petroleum reserving facilities have been built in the prefecture. These sub-categories may be assumed to be unrelated to shock to the local economy.

The *Annual Report* does not provide the detailed information on other small grants, while the total sum accounts for 23.3 percent of the treasury disbursements. In the report, these grants are simply treated as “others” and the programs and/or purposes cannot be identified. Hence, we exclude this category in constructing instruments.

We construct instruments used for our analysis by taking the sum of the grants in the selected categories of the treasury disbursements. In what follows, we refer to the sum as the “selected treasury disbursements.” Figure 2 shows how the selection of categories in the treasury disbursements influences the data fluctuations. The figure plots the total treasury disbursements and the

selected treasury disbursements, both of which are at the national level to facilitate comparisons. The treasury disbursements (shown in a black line) reflects two large-scale changes in government spending. We see the impacts of the large-scale fiscal stimulus package in the aftermath of the 2008 global financial crisis and the large-scale expenditure for recovery from the Great East Japan Earthquake in 2011. The selected treasury disbursements (shown in red) does not have a large increase in 2009, because most grants for implementing the fiscal stimulus packages are temporary and discretionary grants categorized as “others” which we excluded from the instrument.<sup>14</sup> Likewise, no large increase in 2011 is observed in the selected treasury disbursements, because we remove the grants for recovering from the earthquake from the instruments.

### 3.2.3 First-stage regressions

With the above arguments in mind, we instrument two endogenous regressors in the estimation equation (2) with changes in the selected treasury disbursements. We employ the instruments at both prefectural- and regional-levels because (2) includes the prefectural government spending ( $g_{r,p,t}$ ) and the regional government spending ( $G_{r,t}$ ). More specifically, our instruments are  $\Delta s_{r,p,t}/y_{r,p,t-1}$ ,  $\Delta s_{r,p,t-1}/y_{r,p,t-2}$ ,  $\Delta S_{r,t}/Y_{r,t-1}$ , and  $\Delta S_{r,t-1}/Y_{r,t-2}$  and a regional dummy interacted with  $\Delta S_{r,t}/Y_{r,t-1}$ , and  $\Delta S_{r,t-1}/Y_{r,t-2}$ , where  $s_{r,p,t}$  and  $S_{r,t}$  are the selected treasury disbursements at prefectural and regional levels, respectively. In the two first-stage regressions of  $(g_{r,p,t} - g_{r,p,t-2})/y_{r,p,t-2}$  and  $(G_{r,t} - G_{r,t-2})/Y_{r,t-2}$ , we allow for region-specific variations in coefficients on regional instruments, following Nakamura and Steinsson (2014).<sup>15</sup> We also impose the restriction that the sum of coefficients on the regional dummies interacted with  $\Delta S_{r,t}/Y_{r,t-1}$  (or  $\Delta S_{r,t-1}/Y_{r,t-2}$ ) equals zero such that the coefficients on the regional instruments represent the mean response of government spending to the regional instruments.

The results of the first-stage regressions are reported in Table 2. The first-stage regressions suggest that our instruments are not weak to identify the fiscal multipliers. The first column of

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<sup>14</sup>We also note that the supplementary budget allows the central government to respond to shocks to the national economy in the middle of the fiscal year, as in the case of fiscal stimulus packages in 2009. Because the central government can observe the current state of the economy, this extra budget may generate endogeneity biases if the central government has a strong intention to affect specific prefectures through the supplementary budget. Unfortunately, our dataset of the treasury disbursement does not permit us to identify which disbursements result from the supplementary budget. However, we observe that most changes in the total treasury disbursements between 2008 and 2009 come from the subcategories of “others.” Hence, we consider that the impacts of the supplementary budget on the multiplier would be limited.

<sup>15</sup>Guo, Lio, and Ma (2015) and Pennings (2016) also allow for the cross-sectional variations in coefficient on instruments in the first-stage regressions.

the table corresponds to the regression of  $(g_{r,p,t} - g_{r,p,t-2})/y_{r,p,t-2}$  on instruments. The Angrist – Pischke F statistic is 17.9 with the adjusted  $R^2$  of 0.69. The coefficients on the changes in the selected treasury disbursements at the prefectural level are 1.86 and 2.63. Both coefficients are estimated to be positive and consistent with our prediction that higher treasury disbursements lead to higher government spending at local level. Turning to the second column of the table, The Angrist – Pischke F statistic is 763.4 for  $(G_{r,t} - G_{r,t-2})/Y_{r,t-2}$  with the adjusted  $R^2$  of 0.86. In this case, the mean response of regional government spending to regional treasury disbursements are again both positive, consistent with the expected relationship between regional government spending and transfers from the central government.

## 4 Main Results

### 4.1 Output fiscal multipliers and region-wide spillover

Table 3 reports our results of the output multipliers estimated from (2). In all specifications, the entity fixed effects are included at the prefectural level and the number in the parentheses below the estimate is the standard errors clustered by 47 prefectures.

We first describe the ordinary least squares (OLS) estimates and compare them to the results estimated by the two-stage least squares (2SLS). Specification (1) assumes the region-wide spillover. The OLS estimate of the RFM ( $\beta_R$ ) is 1.14, which is estimated as the sum of  $\gamma_P$  and  $\gamma_S$ .<sup>16</sup> The RFM is decomposed into the PFM and the region-wide spillover. The PFM is 0.44 and the region-wide spillover is 0.70. Approximately, the former accounts for 40 percent and the latter is 60 percent of the RFM. Specification (2) assumes no region-wide spillover. In this case, the PFM equals 0.60, slightly larger than the case assuming region-wide spillover but smaller than one.

Specification (3) of the same table points to 2SLS results. The point estimate of  $\beta_R$  is 1.55. The estimate is statistically different from zero at the conventional significance level and is larger than the OLS estimate. This may result from the counter-cyclical policy taken by the prefectural governments. The estimated PFM and the region-wide spillover is 0.95 and 0.60, respectively, though the latter spillover is estimated somewhat imprecisely. The contribution of the region-wide spillover to the RFM is 39 percent. In Specification (4), we assume that  $\gamma_S = 0$  and find that

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<sup>16</sup>When we estimate  $\beta_R$  from (1) by OLS, it is estimated to be 1.26 with the standard error of 0.31. This is slightly larger than  $\beta_R$  estimated from (2).

the PFM is estimated to be 1.18. Specification (5) reports the estimates based on the limited information maximum likelihood (LIML), in which the bias due to possible weak instruments is less severe than that in 2SLS. In this case, the RFM is 1.65 and the region-wide spillover is 0.51, not substantially different from specification (3).

Our empirical results are broadly consistent with multipliers estimated by previous studies. Nakamura and Steinsson (2014) report that the LFM is 1.43 using the US state-level data and 1.85 using the US regional-level data. Shoag (2010) also uses the US data and finds the LFM on US state personal income is 2.12. Acconcia, Corsetti, and Simonelli (2014) use the Italian provincial data and estimate the LFM on output to be 1.5 or 1.9. The multipliers may be large, if they are directly compared to the national fiscal multipliers. However, these estimates of multipliers including ours would be actually reasonable. Chodorow-Reich (2017) concludes that the cross-study mean of the LFM is about two. Ramey (2011) reports that the LFM on income takes a value between 1.5 and 1.8.<sup>17</sup>

Notice that our estimates are slightly larger than the estimates of 0.78 in Brückner and Tuladhar (2014) obtained from the sample period over 1990 – 2000. They estimate the impact multiplier defined as one-year change in the output in response to one-year change in the government spending. To see whether we can reproduce similar results to Brückner and Tuladhar (2014), we replace  $(y_{r,p,t} - y_{r,p,t-2})/y_{r,p,t-2}$  and  $(g_{r,p,t} - g_{r,p,t-2})/y_{r,p,t-2}$  in (2) by one-year growth of output and one-year change in government spending divided by the lagged output, respectively. We then estimate PFM without the region-wide spillover based on their sample period over 1990 – 2000. Our estimation yields the estimated PFM of 0.79 with the standard error of 0.27, an estimate very close to that in Brückner and Tuladhar (2014).

The 2SLS results presented here also seem to suggest that a positive spillover is not strongly supported by the data. This result is not inconsistent with previous studies. For example, Acconcia, Corsetti, and Simonelli (2014) find positive spillovers, but the effects are statistically insignificant at 5 percent significance level. Suárez-Serrato and Wingender (2016) use the US county-level data to estimate the LFM. They find negative spillovers in their regression. But, again, the effect does not statistically differ from zero. Brückner and Tuladhar (2014) introduce government expenditures aggregated across neighboring prefectures and estimate its coefficient. They find that, at least

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<sup>17</sup>Clemens and Miran (2012) argue that the LFM tends to be large when the source of variations in government spending is “windfall-financed” like the transfers from the central government. This may be another reason that we obtain relatively large estimates of the multiplier.

during the 1990s, the effect is positive but not significantly different from zero.

## 4.2 Multipliers on expenditure components

Our dataset of prefectural accounts provides the information on private consumption, private fixed investment, and net exports over our sample periods. Recall that the estimated RFM exceeds unity. Hence, given the estimation results in the previous section, we expect that there should be the crowding-in effect on some expenditure components. The question is, which expenditure components are crowded in by local government spending?

To answer this question, we estimate the multipliers on expenditure components by the following estimation equation:

$$\frac{d_{r,p,t} - d_{r,p,t-2}}{y_{r,p,t-2}} = \gamma_P \frac{g_{r,p,t} - g_{r,p,t-2}}{y_{r,p,t-2}} + \gamma_S \frac{G_{r,t} - G_{r,t-2}}{Y_{r,t-2}} + \eta_{r,p} + \delta_t + \varepsilon_{r,p,t}, \quad (5)$$

where  $d_{r,p,t}$  is the aggregate demand component per capita in prefecture  $p$  in region  $r$ . Here, we slightly abuse the notations for parameters, because the estimation of (5) uses the same regressors as (2). In what follows, we present the fiscal multipliers on private consumption and private fixed investment, as well as “domestic absorption” (i.e., the sum of private consumption, the government consumption, and the gross capital formation in a single prefecture) to measure the impacts of local government spending on the aggregate demand within the prefecture. We then estimate fiscal multipliers on net exports. Here, net exports are constructed by calculating the absorption in the prefecture (or the “domestic absorption”) and subtracting it from the prefectural GDP compiled from the production side. In all estimations, we use the same control variables and the same instruments as the benchmark 2SLS estimation of output.

Table 4 presents the estimation results of (5). Importantly, the RFM on private consumption and private fixed investment are estimated to be positive and statistically significant (panels (A) and (B)). They are economically significant, in comparison to the RFM on output. The RFM on private consumption is 0.36, 23 percent of the RFM on output. The RFM for private fixed investment is also large, 0.47, approximately 30 percent of the RFM on output. The positive RFM on consumption and investment imply that these two expenditure components are crowded in by local government spending. In other words, they contribute to the RFM on output in exceeding unity. A similar measure that summarizes the size of the crowding-in effect may be the RFM on



absorption. Because absorption consists of only within-prefecture aggregate expenditure, we can measure how large the RFM on expenditure is, prior to the leakage in the aggregate demand to economies outside the prefecture. As shown in panel (C), the RFM on absorption is 1.81, which is by 17 percent larger than the RFM on output.

The fact that the RFM on absorption may be larger than the RFM on output suggests that the local government spending may not be crowding in net exports. In fact, the RFM on net exports is estimated to be negative, though it is not statistically different from zero. As indicated in panel (D) of Table 4, the estimate is -0.26. The negative RFM on net exports implies that, if regional net exports were constant in response to the increase in regional government spending, the aggregate demand would leak into other regions of Japan or foreign countries. Though the RFM on net exports is not statistically different from zero, net exports in the region are expected to decrease by 0.26 percent of the regional output in response to an increase in regional government spending by one percent of the regional output.

Figure 3 summarizes the results of our decomposition of the RFM. The most left bar of the figure represents the RFM on output which amounts to 1.55. The middle bar represents the results when we decompose the RFM on output into those for absorption (1.81) and net exports (-0.26). We can further decompose the RFM on output into private consumption (0.36), private fixed investment (0.47), net exports (-0.26), government spending (1.00), and the remaining expenditure such as inventories (-0.03).

If the negative RFM on net exports results from increases in imports and the leakage in aggregated demand concentrates on the prefectures within the same region, the region-wide spillovers to private consumption and investment are expected to be positive. The estimated region-wide spillovers suggest that this may be the case. More specifically, panels (A) and (B) show that the region-wide spillovers of private consumption and private fixed investment are economically significant in comparison to the RFM. For example, while the RFM on private consumption is 0.36, the region-wide spillover to consumption expenditure is 0.41. In our estimates, the crowding-in effects which we observe in the RFM on private consumption and private fixed investment mainly arise from the region-wide spillover rather than the PFM. The region-wide spillovers are also statistically significant. In both consumption and investment, the null of no region-wide spillover is strongly rejected. The economically and statistically significant impact of the region-wide spillover can also be observed in the absorption in Panel (C). This statistically significant spillover in absorption

sharply contrasts with the spillover in output that is imprecisely estimated. In other words, the positive region-wide spillover can be supported by the data if we remove the effect of transactions outside the prefecture on the RFM on output.

Finally, when we do not assume the region-wide spillover, the estimated PFM on expenditure components are positive except for net exports. The PFM on consumption is estimated to be positive but is imprecisely estimated. Furthermore, the p-value of overidentifying restriction rejects the null of the orthogonality at the five percent significance level, suggesting the possible misspecification under the current instruments and the second-stage regressions. Hence, we have only weak evidence for the crowding-in effect in private consumption. The PFM on private fixed investment is positive and significantly different from zero at the five percent significance level. Turning to absorption, the estimated PFM is 1.35 which strongly rejects the null of the coefficient of zero. However, as in private consumption, the test of overidentifying restriction does not support the current instruments and the second-stage regressions of absorption.

### 4.3 Relationship to the national fiscal multiplier

As a remark of our multiplier estimates, we note that the estimated RFM can conceptually be associated with the national fiscal multipliers through the nation-wide spillover. Consider the time-series regression to estimate the national fiscal multiplier  $\beta$ :

$$\frac{Y_t - Y_{t-2}}{Y_{t-2}} = \beta \frac{G_t - G_{t-2}}{Y_{t-2}} + \alpha + \varepsilon_t, \quad (6)$$

where  $Y_t$  and  $G_t$  denote the national-level per capita output and government spending, respectively. In the above equation,  $\alpha$  is a constant term. However, we do not have the time fixed effect, because of colinearity with national government spending. Next, consider a variant of (1):

$$\frac{Y_{r,t} - Y_{r,t-2}}{Y_{r,t-2}} = \beta_R \frac{G_{r,t} - G_{r,t-2}}{Y_{r,t-2}} + \beta_S \frac{G_t - G_{t-2}}{Y_{t-2}} + \alpha_r + v_{r,t}. \quad (7)$$

Note that, while (1) has the time fixed effect  $\delta_t$ , (7) has  $(G_t - G_{t-2})/Y_{t-2}$ . Hence,  $v_{r,t}$  includes all macroeconomic factors other than  $(G_t - G_{t-2})/Y_{t-2}$ . We interpret the parameter  $\beta_S$  as the nation-wide spillover, using the same logic as the region-wide spillover. Thus, if the approximation assumption is well satisfied, the national fiscal multiplier  $\beta$  can also be decomposed into  $\beta_R$  and

$\beta_S$ . Clearly, the regression taking  $v_{r,t}$  as the error term is likely to suffer from endogeneity bias, due to lack of the time fixed effect. Hence, in general, it is difficult to estimate  $\beta_R$  and  $\beta_S$ , unless fully exogenous government spending is available.<sup>18</sup>

We could still perform the back-of-envelope calculation to evaluate the nation-wide spillover by comparing  $\beta_R$  in our analysis and  $\beta$  successfully identified by the previous studies on national fiscal multipliers. Watanabe, Yabu, and Ito (2010) estimate the national fiscal multipliers using the structural VAR approach similar to Blanchard and Perotti (2002). Their impulse responses give rise to the aggregate two-year cumulative fiscal multipliers of 1.56.<sup>19</sup> This national fiscal multiplier is close to our RFM estimates of 1.55. Hence, based on our RFM estimate, the nation-wide spillover may be small:  $\beta_S \simeq 0.01$ . A more recent work by Miyamoto, Nguyen, and Sergeyev (2016) estimate the national fiscal multipliers under the zero lower bound. They define the zero lower bound period as the period after 1995:Q4. They estimate two-year cumulative fiscal multiplier over this period to be 1.70. Based on comparisons between our RFM and their estimate of the national fiscal multiplier, the nation-wide spillover is again small, 0.15.

The small nation-wide spillover is also reconfirmed from the estimates from structural simultaneous equation models. For example, Hamada et al. (2015) find the aggregate two-year cumulative fiscal multiplier of public investment is 1.24, under the assumption that the short-term nominal interest rate is constant. If the fiscal multipliers do not substantially differ across public investment and government spending including government consumption as well as public investment, the point estimate of 1.24 implies that the nation-wide spillover is around -0.31. If we do not assume the region-wide spillover, the LFM is 1.18 in our case so that the nation-wide spillover is 0.06. In any case, the nation-wide spillover may be small. The final example of the estimated national fiscal multiplier is Bank of Japan (2016). This study reports that the two-year cumulative fiscal multiplier of public investment under the fixed nominal interest rate is 1.4, implying that the nation-wide spillover ranges between -0.15 and 0.22.

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<sup>18</sup>The study that circumvents possible endogeneity bias is Dupor (2016) who use the national- and state-level defence spending to estimate the nation-wide spillover.

<sup>19</sup>We thank Arata Ito for providing us the point estimates of the impulse response functions. To be consistent with our estimates of the two-year cumulative fiscal multiplier, we compute two-year cumulative fiscal multipliers from their impulse response function. The value of 1.56 was obtained under the assumption that the GDP and the government spendings at national level has a deterministic trend.

## 5 Robustness

In this section, we discuss the robustness of our results.

### 5.1 Adding control variables

Table 5 reports the results of the robustness checks to the introduction of additional control variables. To reconfirm the importance of region-wide spillover to expenditures within the prefecture, the table shows the multipliers on absorption as well as those on output. Recall that the decomposition of the RFM into the PFM and region-wide spillover relies on the approximation assumption that the distribution of population within the region is stable. Hence, in specifications (1) and (2) of Table 5, we simply add the two-year growth rates of prefectural population and of regional population into the regressions. In specifications (3) and (4), we follow Acconcia, Corsetti, and Simonelli (2014) and introduce the lagged dependent variables (e.g.,  $(y_{r,p,t-2} - y_{r,p,t-4})/y_{r,p,t-4}$ ) into the regression. In specifications (5) and (6), we included both factors into the regression.

Overall, the results are quite robust to adding control variables. In other words, the RFM on output takes a value around 1.5 and the spillover is estimated to be positive. The estimated spillover is statistically insignificant in output, but when we focus on expenditure within the prefecture, the region-wide spillover matters for the prefecture's spending.

### 5.2 Dropping possible outliers

We next explore whether possible outliers may influence of the results in Table 6. Specifications (1) – (4) drop possible outliers in cross-sectional dimension. Specification (5) – (8) exclude the samples in time-series dimension.

In specifications (1) and (2), we first drop the northern-end prefecture (Hokkaido islands) and the southern-end prefecture (Okinawa islands) from the 47 sample prefectures. This is because these prefectures are separated geographically from the largest main island of Japan. In specifications (3) and (4), we eliminate the most economically influential prefecture, Tokyo, from the sample prefectures, because the local tax revenue of Tokyo may have strong influence on the national tax revenue as a whole. However, in these specifications, we find no substantial difference in the estimated multipliers and the region-wide spillover.

Specifications (5) and (6) remove the sample periods between 2009 and 2012 to allow for possible

heterogeneous impacts of the global financial crisis. While the global financial crisis is a macroeconomic event that could be controlled by the time-fixed effect, the crisis may strongly influence net exports of prefectures and may have heterogeneous impacts on prefectural output and net exports. In these specifications, the estimated RFM on output are slightly larger than the benchmark estimate of 1.55 in Table 3. The RFM on absorption is larger than that for output. However, the difference in the RFM on between output and absorption is about 0.25, which is close to the difference in the RFM estimated from benchmark estimation (i.e., 0.26, the difference between 1.55 in Table 3 and 1.81 in Table 4). However, the region-wide spillover to output is somewhat larger than the benchmark case. In specifications (7) and (8), we drop the prefectural data after 2011 (i.e., the year of the Great East Japan Earthquake) of the four prefectures (Iwate, Ibaraki, Fukushima, and Miyagi) that were most severely damaged by the earthquake. In other words, we drop the samples if  $D_{r,p,t}^E$  in (4) equals unity. Our results are robust to dropping the samples. That is, the region-wide spillover is not statistically different from zero, but when we turn to the absorption, the region-wide spillover continues to be economically and statistically significant.

### 5.3 Cumulative multipliers

In the benchmark regression, we followed Nakamura and Steinsson (2014) to estimate the two-year cumulative multipliers, using two-year growth rate of output and the two-year change in government spending scaled by output. We now discuss different time horizons of cumulative multipliers. Table 7 reports cumulative multipliers with different time horizons. In the table, we compare the cumulative multipliers for one, two, and three years. For comparisons, specifications (3) and (4) replicate the estimates in Table 3 (for multipliers on output) and in Table 4 (multiplier on absorption).

The regression results for impact multipliers are somewhat unstable depending on the sample period. When we use the whole sample period over 1990 – 2012 for regression of output growth, the estimated RFM is 0.44 and the estimated region-wide spillover is 0.36, both of which are imprecisely estimated. This result may arise due to large swings in output and net exports after the global financial crisis and the earthquake in 2011. Such large swings in the data may affect the regression fit for the impact multiplier more strongly than that for two-year cumulative multiplier, because changes in output (and net exports) are not smoothed out in the one-year change relative to the

two-year change. Hence, as we did in specification (5) and (6) of Table 6, we drop the sample period after 2009 and reestimate the impact multipliers on output based on the sample period between 1990 and 2008. In this case, the results are similar to our benchmark estimation for the two-year cumulative fiscal multiplier on output, as indicated in specification (1) of Table 7. The magnitude of the estimated RFM at impact is 1.49, similar to the two-year cumulative RFM of 1.55 (replicated as specification (3)). The region-wide spillover is 0.65, also similar to that in specification (3). The multiplier on absorption is not substantially different from the two-year cumulative multiplier on absorption. However, one remark regarding specification (2) is that, under our instrument set specified in the previous sections, the test of the overidentifying restrictions rejects the null hypothesis of the orthogonality, at 10 percent significance level.

Specifications (5) and (6) report the three-year cumulative multipliers on output and absorption. In these specifications, we use the whole sample period between 1990 – 2012. Again, we do not observe substantial difference in the RFM, PFM and the region-wide multiplier on both output and absorption. In specification (5), however, the test of the overidentifying restrictions in the regression rejects the null hypothesis at 10 percent significance level.

## 6 Conclusion

This paper investigated local fiscal multipliers, using the rich dataset of prefectural accounts in Japan. Measuring the region-wide spillover from common variations due to the regional government spending, we estimated the prefectural fiscal multiplier with the region-wide spillover. We showed that the regional fiscal multiplier approximately equals the sum of the prefectural fiscal multiplier and the region-wide spillover. Our estimate of regional fiscal multiplier on output ranges between 1.5 and 1.8. When we extract the region-wide spillover from the regional fiscal multiplier, the region-wide spillover is estimated to be positive, ranging between 0.3 and 0.9.

Our data of prefectural accounts allow us to investigate components of aggregate demand at the prefectural level and to decompose the regional fiscal multiplier into expenditure components. We found the crowding-in effects in private consumption and private fixed investment in the regional fiscal multiplier and aggregate demand leaks through net exports at the prefectural level. In addition, when we focus on expenditure within the prefecture, the region-wide spillover to aggregate expenditure is statistically and economically significant.

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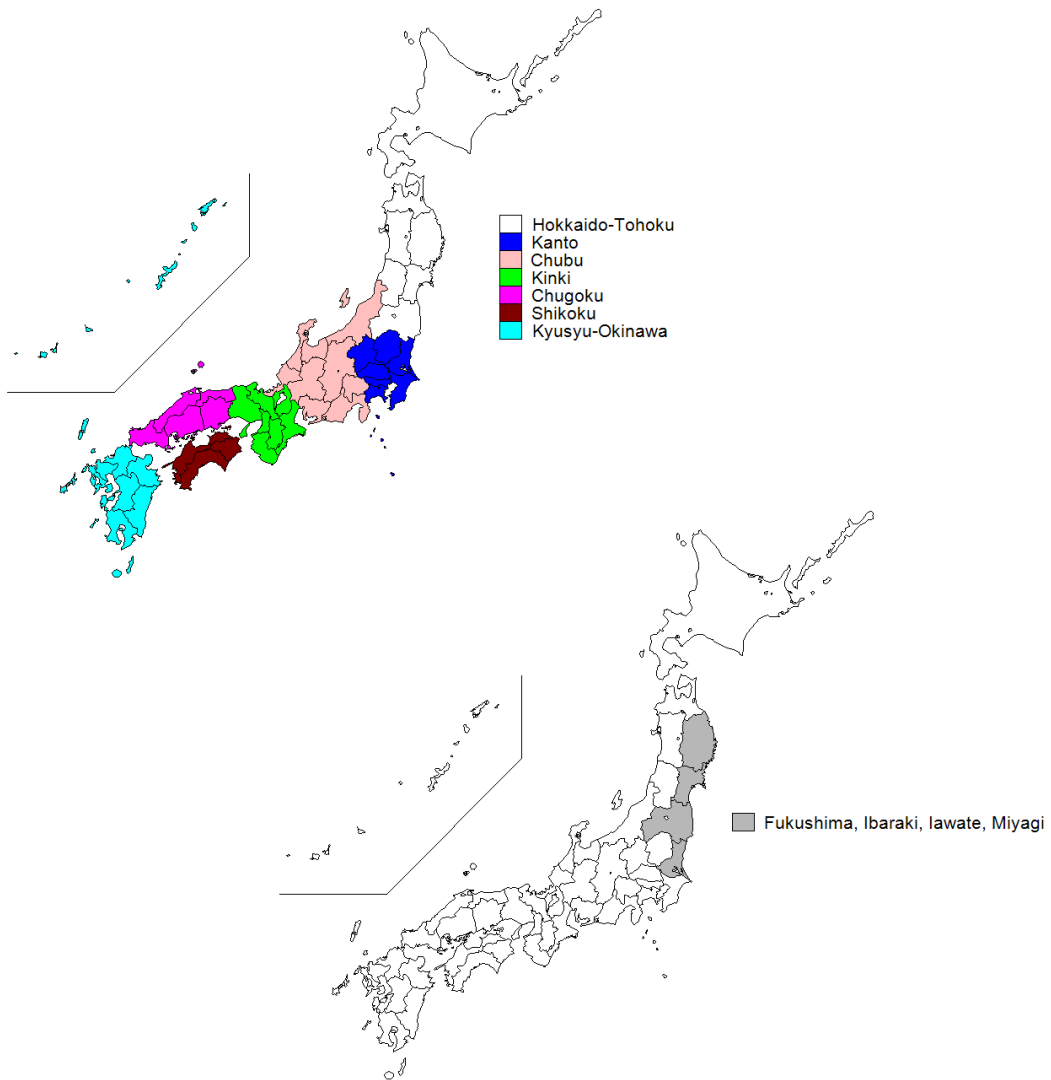


Figure 1: Regions and prefectures strongly damaged by Great East Japan Earthquake

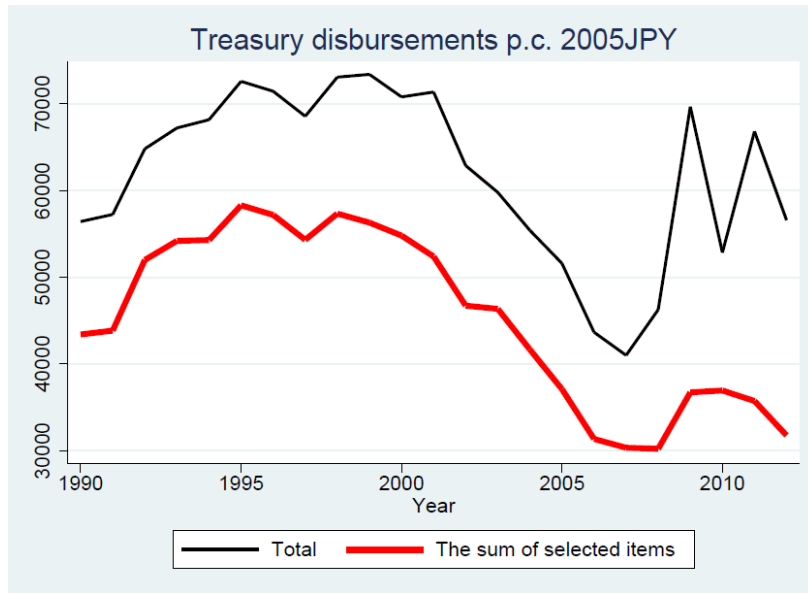


Figure 2: Treasury disbursements per capita (constant 2005 JPY)

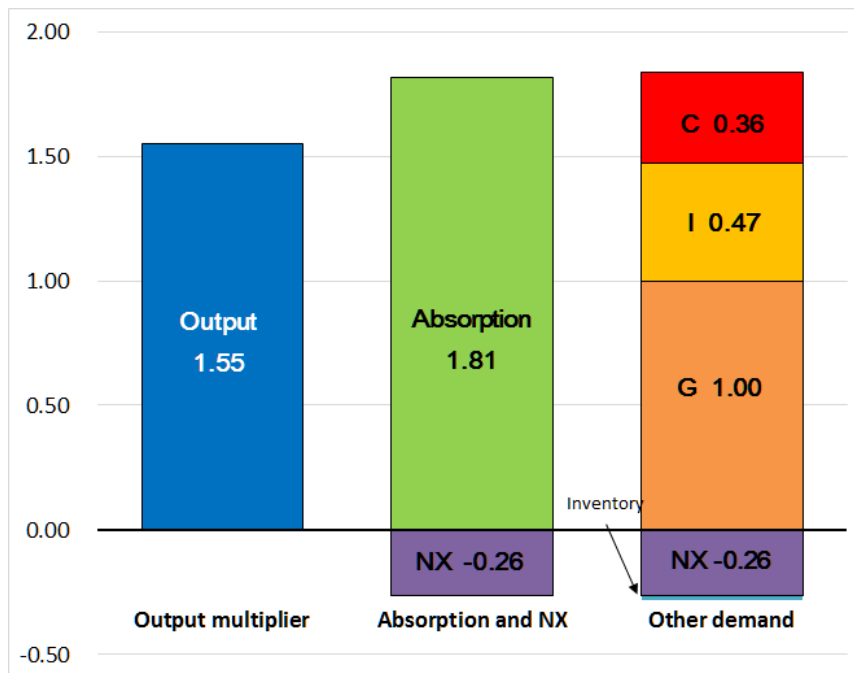


Figure 3: Decomposing aggregate demand components

Table 1: Components of treasury disbursements used in the construction of instruments

Category	Fractions	Included in IV?
Education (30.3%)		
Compulsory education	23.2%	Y
Subsidies for private senior high schools	1.7%	Y
Grants for tuition non-collecting at public senior high school	3.4%	Y
Grants for financial support for senior high school attendance	2.0%	Y
Construction (21.3%)		
Ordinary construction	11.8%	Y
Grants for comprehensive infrastructure development	9.5%	Y
Grants and subsidies related to local business cycles/counter-cyclical policy (11.2%)		
Livelihood protection	2.2%	N
Child protection	2.0%	N
Grants for regional autonomous strategies	7.0%	N
Unemployment measures	0.0%	N
Disaster (9.2%)		
Disaster restoration	5.8%	N
Grants for recovery from Great East Japan Earthquake	3.4%	N
Other earmarked transfers (4.7%)		
Subsidies for self-support of the disabled	1.1%	Y
Money in trust	2.0%	Y
Finance subsidy	0.1%	Y
Grants for area locating electric power plants	1.4%	Y
Grants for locating petroleum reserving facilities	0.1%	Y
Transfers whose purposes of grants are not reported (23.3%)		
Others	23.3%	N

Notes: Components of the treasury disbursements. The fraction of each components are based on the data as of fiscal year 2012. Categories with “Y” are included in the construction of the instruments while those with “N” are not included in the instruments.

Table 2: The first-stage regressions

Dependent variable	$(g_{r,p,t} - g_{r,p,t-2})/y_{r,p,t-2}$	$(G_{r,t} - G_{r,t-2})/Y_{r,t-2}$
$\Delta s_{r,p,t}/y_{r,p,t-1}$	1.861*** (0.227)	-0.166** (0.0696)
$\Delta s_{r,p,t-1}/y_{r,p,t-2}$	2.625*** (0.326)	-0.155 (0.122)
$\Delta S_{r,t}/Y_{r,t-1}$	1.125 (0.831)	4.472*** (0.320)
$\Delta S_{r,t-1}/Y_{r,t-2}$	0.873 (0.769)	4.376*** (0.590)
Angrist-Pischke F-value	17.901	763.356
Number of Observations	987	987
R-squared	0.689	0.864

Notes: The estimated coefficients of the first stage regression. The first column corresponds to the first-stage regression where the regressand is the two-year change in the prefectural government spending divided by the prefectural output. The second column corresponds to the first-stage regression where the regressand is the two-year change in the regional government spending. The regions are defined in the main text. Coefficients are statistically significant at the \*10% significance level, \*\*5% significance level or \*\*\*1% significance level.

Table 3: Benchmark estimations

	OLS		2SLS		LIML
	(1)	(2)	(3)	(4)	(5)
Regional fiscal multiplier ( $\beta_R$ )	1.142*** (0.195)	–	1.550*** (0.268)	–	1.647*** (0.294)
Prefectural fiscal multiplier ( $\gamma_P$ )	0.443*** (0.132)	0.595** (0.129)	0.950*** (0.274)	1.177*** (0.212)	1.138*** (0.358)
Spillover ( $\gamma_S$ )	0.699*** (0.190)	–	0.600* (0.346)	–	0.509 (0.402)
P-value of overidentifying restrictions	–	–	0.115	0.168	0.121
Observations	987	987	987	987	987
Adj. R-squared	0.548	0.540	0.506	0.489	0.490

Note: The regressions for local fiscal multipliers. In each column, the dependent variable is a two-year change of per capita GDP divided by the initial value. In all regressions, time fixed effect are included. The benchmark regressions are 2SLS shown in specifications (3) and (4) where we use the treasury disbursements at prefectural and regional levels as instrument. The numbers in parentheses below the estimates are standard errors clustered by prefectures. Specifications (1) and (2) report OLS results for comparisons. Specifications (2) and (4) assume no region-wide spillover, implying the equality of regional fiscal multiplier and prefectural fiscal multiplier. Specification (5) estimates the multiplier by the limited information maximum likelihood (LIML) with the instrument variables used in the benchmark estimation. The regions are defined in the main text. Coefficients are statistically significant at the \*10% significance level, \*\*5% significance level or \*\*\*1% significance level.

Table 4: Regressions of expenditure components

Dependent variables	(A) Private consumption		(B) Private fixed investment		(C) Absorption		(D) Net exports	
	(1)	(2)	(1)	(2)	(1)	(2)	(1)	(2)
Regional fiscal multiplier ( $\beta_R$ )	0.364** (0.148)	–	0.471*** (0.139)	–	1.814*** (0.203)	–	-0.264 (0.323)	–
Prefecture fiscal multiplier ( $\gamma_P$ )	-0.0420 (0.166)	0.112 (0.141)	0.218* (0.125)	0.314** (0.126)	1.188*** (0.232)	1.353*** (0.201)	-0.238 (0.304)	-0.248 (0.252)
Spillover ( $\gamma_S$ )	0.406*** (0.146)	–	0.253*** (0.0981)	–	0.626*** (0.187)	–	-0.0260 (0.380)	–
P-value of overidentifying restrictions	0.367	0.028	0.288	0.176	0.314	0.031	0.172	0.221
Observations	987	987	987	987	987	987	987	987
Adj. R-squared	0.213	0.201	0.581	0.576	0.581	0.571	0.142	0.143

Note: Regression of the aggregate demand components on the government spending. In each panel, the dependent variable is the two-year changes of per capita aggregate demand components divided by the per capita GDP. The absorption is defined as the sum of private consumption, the government consumption, and the gross capital formation (including inventory investment). In each panel, specification (1) assumes the spillover while specification (2) does not assume the spillover. All parameters are estimated by 2SLS. For the other details, see the footnote of Table 3.

Table 5: Robustness: Additional control variables

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Output	Absorption	Output	Absorption	Output	Absorption
Regional fiscal multiplier ( $\beta_R$ )	1.534*** (0.282)	1.758*** (0.229)	1.541*** (0.270)	1.940*** (0.198)	1.458*** (0.254)	1.873*** (0.208)
Prefecture fiscal multiplier ( $\gamma_P$ )	0.948*** (0.276)	1.174*** (0.237)	1.081*** (0.299)	1.288*** (0.223)	1.061*** (0.294)	1.270*** (0.224)
Spillover ( $\gamma_S$ )	0.586* (0.351)	0.584*** (0.207)	0.459 (0.319)	0.652*** (0.171)	0.397 (0.300)	0.603*** (0.188)
Prefectural population growth	-0.0974 (0.362)	0.205 (0.394)			0.391 (0.576)	0.735 (0.634)
Regional population growth	0.0506 (0.489)	0.0800 (0.519)			0.473 (0.560)	0.394 (0.596)
Lagged dependent variable			-0.188*** (0.0427)	-0.209*** (0.0436)	-0.203*** (0.0473)	-0.239*** (0.0511)
P-value of overidentifying restrictions	0.110	0.262	0.193	0.543	0.177	0.505
Observations	987	987	893	893	893	893
Adj. R-squared	0.505	0.581	0.535	0.619	0.538	0.625

Note: Specifications (1) and (2) add the population growth rate at the prefectural and regional level into the regressions. In specifications (3) and (4), we add the lagged dependent variables into the regression. In specifications (5) and (6), we include population growth rates and lagged dependent variables. All parameters are estimated by 2SLS. For the other details, see the footnote of Table 3.



Table 6: Robustness: Dropping possible outliers

	(1)	(2)	(3)	(4)	(5)	(6)	(7)	(8)
Dependent variable	Output	Absorption	Output	Absorption	Output	Absorption	Output	Absorption
Regional fiscal multiplier ( $\beta_R$ )	1.617*** (0.291)	1.717*** (0.204)	1.538*** (0.278)	1.824*** (0.210)	1.787*** (0.301)	2.036*** (0.246)	1.736*** (0.278)	1.856*** (0.218)
Prefecture fiscal multiplier ( $\gamma_P$ )	1.031*** (0.254)	1.065*** (0.237)	0.941*** (0.276)	1.209*** (0.235)	0.856*** (0.251)	1.220*** (0.238)	1.209*** (0.235)	1.249*** (0.244)
Spillover ( $\gamma_S$ )	0.586 (0.368)	0.652*** (0.204)	0.597* (0.346)	0.615*** (0.184)	0.931** (0.412)	0.816*** (0.316)	0.528 (0.342)	0.607*** (0.191)
P-value of overidentifying restrictions	0.117	0.371	0.139	0.242	0.298	0.118	0.204	0.315
Observations	945	945	966	966	799	799	979	979
Adj. R-squared	0.514	0.595	0.514	0.584	0.421	0.533	0.500	0.563

Note: Each specification estimate the multipliers after dropping possible outliers. Specifications (1) and (2) drop Hokkaido and Okinawa prefectures (i.e., the northern-end and the southern-end prefectures) from the sample. Specifications (3) and (4) drop Tokyo, the economically largest prefecture, from the sample. Specifications (5) and (6) reestimate the model using the sample period before 2009. Specifications (7) and (8) drop the data after 2011 of the four prefectures that were severely damaged by the Great East Japan Earthquake. All parameters are estimated by 2SLS. For the other details, see the footnote of Table 3.

Table 7: Robustness: Different horizons in cumulative fiscal multipliers

	(1)	(2)	(3)	(4)	(5)	(6)
Dependent variable	Output	Absorption	Output	Absorption	Output	Absorption
Regional fiscal multiplier ( $\beta_R$ )	1.494*** (0.299)	2.146*** (0.290)	1.550*** (0.268)	1.814*** (0.203)	1.708*** (0.275)	2.063*** (0.262)
Prefecture fiscal multiplier ( $\gamma_P$ )	0.849*** (0.209)	1.286*** (0.270)	0.950*** (0.274)	1.188*** (0.232)	0.905*** (0.271)	1.203*** (0.213)
Spillover ( $\gamma_S$ )	0.646** (0.324)	0.860** (0.361)	0.600* (0.346)	0.626*** (0.187)	0.803** (0.336)	0.860*** (0.256)
P-value of overidentifying restrictions	0.240	0.067	0.115	0.314	0.098	0.237
Observations	799	799	987	987	940	940
Adj. R-squared	0.455	0.449	0.506	0.581	0.477	0.589

Note: The cumulative fiscal multipliers with different time horizons. Specifications (1) and (2) estimate the impact multipliers on output and absorption based on the sample period between 1990 and 2008. The sample period allows for large swings in the one-year change in the prefectural output growth after the global financial crisis. Specifications (3) and (4) replicate the two-year cumulative multipliers on output and absorption in Tables 3 and 4, respectively. Specifications (5) and (6) present the estimation results for three-year cumulative multipliers on output and absorption. All parameters are estimated by 2SLS. For the other details, see the footnote of Table 3.