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Local Public Investment and Regional Business Cycle Fluctuations in Japan

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Abstract

This paper examines the relationship between regional business cycle fluctuations and local public investment in Japan. The empirical results show that the local public investment decided by political factors does not necessarily amplify the fluctuations in prefectural business cycles.

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1 Introduction

In this paper, we examine the relationship between public investment by local governments (hereafter local public investment) and fluctuations in the regional (prefectural) economy in Japan. In particular, we focus on the investment of prefectural governments.[1] We use the framework established by Fatás and Mihov (2003), which shows that the changes in public expenditure unrelated to the current economic conditions amplify fluctuations in the business cycle. Working within this framework, we first estimate the volatility of local public investment for each region (prefecture) of Japan. Next, we regress each region's economic fluctuations regarding the volatility of local public investment and other variables.

To the best of our knowledge, no empirical study has examined the relationship between local public investment and regional (prefectural) business cycle fluctuations. Miyazaki (2016) examines the effects of public investment on regional business cycle fluctuations. However, Miyazaki (2016) does not focus on local government expenditure. Funashima (2014) and Funashima et al. (2015) estimate the policy reaction function of local public investment, but these two researches did not examine the effects on business cycle fluctuations. Accordingly, our research fills a gap in the literature on Japanese regional business cycles and local public finance.

The changes in public expenditure unrelated to the current economic conditions amplify fluctuations in the business cycle, as argued by Fatás and Mihov (2003). Fatás and Mihov (2003) itemize three types of changes in government expenditure: (i) changes associated with automatic stabilizers, (ii) changes in response to current economic circumstances, and (iii) discretionary changes not explainable as a response to current economic conditions. Here, local government expenditure is not associated with automatic stabilizers because it does not change automatically in accordance with the macroeconomic conditions, and therefore, factor (i) is omitted as to the research on local government expenditure. We define factor (ii) as "legitimate" changes in expenditure: changes in local public investment expenditure as a "proper" response to economic circumstances. Fatás and Mihov (2003) define factor (iii) as "discretionary changes" in public expenditure, that is, changes not explainable as a reaction to the current economic conditions. They attribute the discretionary factors to a country's political regime and institutional environment (e.g., its electoral system and form of governance). Incidentally, according to previous Japanese empirical works, such as Kondoh (2008), Doi and Ihori (2009), and Mizutani and Tanaka (2010), local public investment may also be decided by some political factors. Following this, we define "discretionary changes" in local public investment as ones

[1] Data on the expenditure by central government and the one by municipalities within each prefecture is also available. However, since their policymaking procedure differs from that of prefectures, it is preferable to examine these investments using another framework. Thus, we do not use the data on central government and municipalities within each prefecture.

decided by political factors related to the local governments. Here we identify the political factors using instrumental variables used in 2SLS estimation.

Section 2 presents an empirical framework underlying this research. Section 3 explains the determinants of political factors and instrumental variables used in estimation. Section 4 reports the estimation results and shows the possibility that local public investment decided by political factors may amplify business cycles in a region in some cases. Section 5 presents the conclusion.

2 Empirical framework

2.1 Extraction of factors unrelated to current economic conditions

To clarify discretionary changes in local public investment expenditure, we estimate the following equation:

$$logLGI_{it} = \alpha_i + \beta_t + \gamma_i logY_{it} + \delta_i logLGI_{it-1} + \varepsilon_{it} \tag{1}$$

where i and t are prefecture and year indices, respectively. β_t is a set of year dummies, which captures the aggregate (country-level) economic conditions. $logLGI_{it}$is the logarithm of real public investment by the local public sector (or ordinary construction expenses of prefectures).[2] $logY_{it}$ is the logarithm of real prefectural GDP (RGDP). This is used as an independent variable that captures the "legitimate" changes in expenditure. These specifications follow Fatás and Mihov (2003). ε_{it} is an error term.

We calculate volatility as the standard deviation of $\hat{\varepsilon}_{it}$ and denote it as σ_i^{ε}, a discretionary change in public investment expenditure.

Equation (1) contains a one-period lagged value of $logLGI_{it}$. The lagged value of the dependent variable is set as one period, following the specification of Fatás and Mihov (2003). We estimate Equation (1) by taking first-difference and using dynamic panel estimation developed by Arellano and Bond (1991). To avoid the problem of too many

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2 There are two types of project in local public investment: a project subsidized by the central government and local governments' own project. Projects subsidized by national treasury disbursements restrict how local governments implement the projects. Local governments' own projects are financed by local governments' own tax revenues, local government bonds, and local allocation tax grants, which are the intergovernmental transfers that local governments can use as they like. It is also possible to analyze these two types of projects. However, some papers such as that of Kondoh (2008) report that local governments tend to use these projects as substitutes depending on the availability of funds provided by central government. In this case, it is not valid to analyze separately because the proportion of each expense in each year is affected by subsidy and it possibly leads to imprecise estimates of σ_i^{ε}.

instruments (Roodman (2009)), we assume the possible lagged values of instrumental variables as at most two periods. Here the instruments are $logLGI_{it-2}$, $logLGI_{it-3}$, two valid lags of $logY_{it}$, and year dummy variables.

2.2 Effects on output volatility

To examine the link between discretionary local public investment and output volatility, we estimate the effect of σ_i^{ε} on the volatility of RGDP. The volatility of RGDP is the standard deviation of the RGDP growth rate for each prefecture, $\sigma_i^{\Delta Y}$. The basic specification is as follows:

$$log\sigma_i^{\Delta Y} = const. + \tilde{\alpha} log\sigma_i^{\varepsilon} + \tilde{\beta} logX_i + v_i \quad (2)$$

where X_i is the independent variable other than σ_i^{ε} that affects the volatility of RGDP, and v_i is the error term. Equation (2) is estimated using the residuals of Equation (1) and the standard deviation of the RGDP growth rate. Therefore, when we estimate Equation (2), independent variables other than σ_i^{ε} are "averages" over the full sample and we conduct a cross-section estimation following Fatás and Mihov (2003).

For X_i, we first use the ratio of government expenditure (the sum of government capital formation and government consumption) to RGDP as the size of each region's government. We do so because the volatility of RGDP may increase as the size of the regional government increases.

Incidentally, economic fluctuations increase with an increase in the proportion of manufacturing and construction industries, respectively. To capture this effect, we add the yearly output of manufacturing industries as a percentage of RGDP and that of construction industries per RGDP. As fluctuations may vary according to the characteristics of the industries, we use the specialization index calculated followed by Krugman (1991). In addition to σ_i^{ε} and government size, these three variables related to industrial activities in a region are used for our basic specification. Furthermore, per capita RGDP is added because economic fluctuations may increase in low-income regions. Since economic linkages between different regions may affect the economic volatility even in intranational studies, trade (sum of exports and imports, per RGDP) is also considered. These follow Fatás and Mihov (2003) for Case 2 in our estimation model.

$\tilde{\alpha}$ is expected to be both positive and negative. If it is estimated to be positive, $\sigma_i^{\Delta Y}$ increases the amplitude of fluctuations in the business cycle. That is, discretionary changes in public investment cause the regional economy to fluctuate substantially. Conversely, if this coefficient is estimated to be negative, the discretionary policy may smooth regional business cycle fluctuations. The size of the government, proportion of manufacturing industries, and trade are expected to be positive, and per capita RGDP is expected to be negative. The coefficient of the specialization index is estimated to be both positive and negative.

3. Determinants of political factor and choice of instrumental variables

In Equation (2), the variation in σ_i^{ε} may be more or less affected by output volatility. Further, the government's size may be large during recessions and small during better times. Therefore, the possible endogeneity of these two variables is addressed by using instrumental variables. In contrast, however, to avoid the apprehension that the instruments themselves are driven by output volatility, we should select variables linked to the decision of the size of public investment expenditure and government size in each region but unrelated to economic volatility.

Following the arguments in Section 1, we attribute the source of σ_i^{ε} to political factors between central and local governments. Using econometric approaches, Kondoh (2008) and Mizutani and Tanaka (2010) clarify that the size of the public investment in each region of Japan has been affected by local interest groups. Further, the influence of median voters within a region cannot be neglected. These factors affect the government size as well as some local government investment decided by political factors, σ_i^{ε}.

Moreover, as far as the central government decides the size of intergovernmental transfers, which are used for financing most local government expenditure, local government budgetary conditions may also be related to government size and politically motivated local government investment.

First, we can employ variables that identify the influence of local interest groups as one of the instruments. As proxies for interest groups' influence on public investment, we use the average ratio of construction workers to all workers and the ratio of workers in primary industries to all workers as in the case of Kondoh (2008), Mizutani and Tanaka (2010), and Miyazaki (2016).

Incidentally, employment is very sensitive to the business cycle. To deal with this, we use the potential value of these as the ratio of “potential” construction workers to all “potential” workers and the ratio of “potential” workers in primary industries to all “potential” workers calculated by Miyazaki (2016). Thus, we ensure that these two variables are uncorrelated with economic volatility, but remain strongly related to the “discretionary” part of public investment and government size following the arguments shown in the former paragraph. Thus, we can use these in conducting a 2SLS estimation.

Second, to capture the median voter's influence, we use the average of the median income. Finally, budgetary conditions in each prefectural government also decide the size of local government’s investment. For budgetary conditions, we employ the average ratio of the outstanding prefectural government debt.

4. Empirical results

Our annual panel covers the period 1990-2007 for 47 Japanese prefectures. We begin our sample period after the 1990s because the Cabinet Office of Japan does not provide data before the 1990s on the basis of the System of Integrated Environment and Economic Accounting proposed by the United Nations in 1993 (SNA93 data). As a result, we have no other choice but to set the sample period after 1990.

Moreover, although we obtain the data for 1990-2003 in real terms by using the 1995 deflator, we cannot acquire real-term data using the 1995 deflator for 2004-2007. Therefore, we must construct the real data for 2004-2007 by the 1995 deflator.[3]

We present the results of Equation (1) in Table 1. Before presenting the results, we determine that there is no second-order serial correlation for the disturbances in the first difference equation. This test is important because the consistency of the GMM estimator relies on no autocorrelation between the disturbance of period t and period t-1. According to the results shown in the table, we can confirm that there is no serial correlation between Δv_{it} and Δv_{it-2}. The lagged value of the dependent variable is set as one period.[4] The result shows that the coefficients of $\Delta logY_{it}$ and $\Delta logLGI_{it-1}$ are positive and significant. Since the coefficient of $\Delta logY_{it}$ is positive and significant, local public investment is procyclical in a regional level just as shown in Funashima (2013).

Although we conduct a cross-section estimation for Equation (2), our samples are very small because the sample size is at most 47. Moreover, since the volatility of unexpected local public investment is estimated in the first estimation equation, a problem of generated regressor is a concern. To deal with these, we calculate the standard error by 150 bootstrap replications.

We present the results of Equation (2) in Table 2.[5] The coefficient of σ_i^{ε} is estimated to be positive and significant in Case 1. However, the results become insignificant when we add trade and per capita RGDP in Case 2. While the coefficient of government size is not estimated to be significant, the proportion of manufacturing industries is estimated to be positive and significant for both cases.

5. Conclusion

This paper examines the relationship between local public expenditure and business cycle fluctuations of Japanese prefectures, with a focus on public investment. Our empirical results

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[3] For more detail, please see the discussion paper version of this paper downloadable from the author's website: https://sites.google.com/site/tomomisite/research/dp.

[4] Since we correct the bias in the two step standard errors by the Windmeijer's (2005) correction procedure, please pay attention that we do not perform over-identification restriction test.

[5] Incidentally, please see the discussion paper version of the paper for the correlation between two endogenous variables, σ_i^{ε} and government size, and the instrumental variables in the 2SLS estimation.

show that "discretionary changes" in local public investment does not necessarily amplify the fluctuations in prefectural business cycles for all cases.

Among related works, Miyazaki (2016) confirms that "total" public investment amplifies the regional business cycle fluctuation. On the other hand, Miyazaki (2009) shows that local public investment does not have a positive impact on the business cycles using macro-monthly data. He attributes the reason for this to the direct crowding-out effects caused by the characteristics of local public investment, which mainly consists of investment related to improving the living environment and thus may directly replace private consumption or investment. Our investigation has an advantage over Miyazaki (2016) in that we can examine the effects by considering the characteristics of public investment.

However, we cannot show robust results for σ_i^{ε} on the regional economic volatility unlike Miyazaki (2016). On the other hand, our results imply the findings by Miyazaki (2009) may be also applicable to the regional economy. In this sense, our results have a certain contribution to the literature.

On the other hand, relations with economic growth may also be considered, as in the case in Fatás and Mihov (2003). This point should be considered in future research.

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Table 1. Estimation Results of Equation (1) (GMM Estimation by Arellano and Bond (1991) (two-step GMM estimator), Dependent variable=$\Delta logLGI_{it}$, Observations=799).

$\Delta logY_{it}$	1.784 *** (0.121)
$\Delta logLGI_{it-1}$	0.727 *** (0.373)
Constant	-24.638 *** (4.029)
Test statistics for serial correlation (1st stage)	-4.278 ***
Test statistics for serial correlation (2nd stage)	0.542

Note: Dummy variables for years are not shown for the sake of brevity. Standard errors corrected by Windmeijer's (2005) correction procedure are in parentheses. * Significance at the 10% level. ** Significance at the 5% level. *** Significance at the 1% level.

Table 2. Estimation Results of Equation (2) by 2SLS Estimation (Dependent variable= $log\sigma_i^{\Delta Y}$, Observations=47)

	Case 1	Case 2
σ_i^{ε}	0.527 *	0.530
	(0.282)	(0.349)
Government expenditure/RGDP	0.384 *	0.683
	(0.250)	(0.544)
Specialization index	0.181	0.179
	(0.116)	(0.125)
Share of manufacturing industries/RGDP	0.520 ***	0.517 *
	(0.134)	(0.319)
Share of construction industries/RGDP	-0.232	-0.268
	(0.362)	(0.495)
Per capita RGDP		0.105
		(0.559)
Trade		0.021
		(0.419)
Constant	-1.911 ***	-2.019
	(0.726)	(1.290)
R^2	0.257	0.240
Sargan statistics	0.555 (2)	0.548 (2)

Note: We take the logarithm of all independent variables (average of sample periods except σ_i^{ε}) in estimation. The standard errors with 150 bootstrap replications are in parentheses. The Sargan statistics are chi-square statistics for the overidentification restriction test with the degree of freedom shown in parentheses. * Significance at the 10% level. ** Significance at the 5% level. *** Significance at the 1% level.