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Regional Business Cycle Fluctuations in Japan**

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Local Public Investment and Regional Business Cycle Fluctuations in Japan

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This paper examines the relationship between regional business cycle fluctuations and local public investment in Japan. The empirical results show the possibility that a part of the local public investment decided by political factors may amplify regional business cycle fluctuations.

JEL classification: E32, E62, H30, H54, R53

Keywords: Local public investment; Volatility of the regional economy; Regional business cycles

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1 Introduction

In the wake of the 2008 world financial crisis (GFC), many developed countries promoted infrastructure investment by local governments (hereafter local public investment) in efforts to stimulate their economies. However, some local public investment may have been determined by political factors rather than attempts at macroeconomic stabilization. In fact, Stoney and Krawchenko (2011) identified criticism of politically motivated spending in the recent stimulus packages of some countries.

In this paper, we examine the relationship between 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. We define this as the factor that may be decided by political factors within local public investment. Next, we regress each region's economic fluctuations regarding the volatility of local public investment and other variables. Here

¹ Data on the expenditure by municipalities within each prefecture is also available. However, since their policymaking procedure differs from that of prefectures, it is preferable to examine the municipalities' investment using another framework. Thus, we do not use the data on municipalities within each prefecture.

we identify the political factors using instrumental variables used in 2SLS estimation, and use the fluctuations in prefectural GDP (RGDP) as the measure of economic fluctuations in each prefecture.

We focus on Japan because the approaches described in the first paragraph have been pursued in Japan. Stimulus packages in Japan included local public investment even before the GFC, as argued by Mochida (2008), Miyazaki (2009), and Miyazaki (2010).

On the other hand, the local public investment in Japan may be decided by political factors as in the case of recent countries: the pressure of local interest groups and the central government's desire to reduce the vote-value disparity, etc as suggested in Kondoh (2008), Doi and Ihori (2009), and Mizutani and Tanaka (2011). This suggests that the political factors may have been disguised in the stimulus packages in Japan, as in the case of recent cases. Therefore, an investigation of the relationship between local public investment and regional business cycle fluctuations in Japan may be helpful in ascertaining whether local government involvement in the stabilization policy is appropriate in terms of fluctuations in the business cycle in the region.

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 relations between central and local governments.

Incidentally, 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.² 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 the arguments of Stoney and Krawchenko (2011) and previous Japanese related empirical works, local public investment may be also decided by political factors. Following this, we define the “discretionary changes” in the local public investment as ones decided by political factors.

Fatás and Mihov (2003) show that this “discretionary changes” generate significant economic fluctuations because they move procyclically as shown in Figure 1. This means that the policy responses unrelated to the current economic conditions do amplify business cycle fluctuations as the arrows in Figure 1 indicate. If this argument is true of the regional economy and local public investment, some local public investment decided by political factors would amplify regional business cycle fluctuations.

Section 2 explains an relationship between intergovernmental fiscal relations and macro stabilization policy in Japan. Section 3 presents the empirical framework underlying this research. Section 4 reports the estimation results and shows the possibility that the local public investment decided by political factors may amplify

² This also follows the explanation of Tang and Leung (2016). For more details, please see the page 18 on Tang and Leung (2016).

business cycles in a region. Section 5 concludes.

2. Local public investment and macro stabilization policy and in Japan

There are two types of projects in local public investment: the project subsidized by the central government and local governments' own project. Subsidized projects are implemented using the national treasury disbursements, which is very little room for local government on how to use. Local government's own project is financed by local government's own tax revenues, local government bonds, and local allocation tax grants, which are the intergovernmental transfers that local governments can use as they like. Moreover, the issuance of local government bonds are repaid with local allocation tax grants in the future.³

Table 1 shows the fiscal stimulus packages in Japan in the 1990s. According to this table, public investment (public works excluding acquisition of land for public use) has been often included in economic stimulus packages in Japan. Note that public works by local government was also included in stimulus packages planned in August 1992, April and September 1993, February 1994, September 1995, and April 1998.

³ See Pascha and Robaschik (2001) and Doi and Ihori (2009).

Economic stimulus packages include local public investments, regardless of whether these investments are financially supported by the central government. The reason why local governments in Japan have been involved in stabilization efforts by the central government through their investment is that local governments have implemented most public works. Figure 2 depicts the trends in fixed investment for the central government and local governments. As shown, almost 80% of general government fixed investment is implemented by local governments.

3 Empirical framework

3.1 Extraction of factors unrelated to current economic conditions

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

$$\log LGI_{it} = \alpha_i + \beta_t + \gamma_i \log Y_{it} + \delta_i \log LGI_{it-1} + \varepsilon_{it} \quad (1)$$

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. $\log LGI_{it}$ is the

logarithm of real public investment by the local public sector (or ordinary construction expenses of prefectures).⁴ $\log Y_{it}$ 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 $\log LGI_{it}$. 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 instruments (Okui (2009) and Roodman (2009)), we assume the possible lagged values of instrumental variables as at most two periods. Here the instruments are $\log LGI_{it-2}$, $\log LGI_{it-3}$, two valid lags of $\log Y_{it}$, and year dummy variables.

⁴ It is also possible to analyze these two types of projects: local government’s own project and the one subsidized by the central government as argued in Section 2. However, some papers like Kondoh (2008) report that local governments tend to use these projects as substitutes depending on availability of funds provided by the central government. In this case, it is not valid to analyze separately because proportion of each expense in each year is affected by subsidy and it possibly leads to imprecise estimates of σ_i^ε .

3.2 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:

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

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 will 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. To address this issue, we use the specialization index calculated followed by Krugman (1991) as in Fatás and Mihov (2001). 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 (Case 1, in Section 4). 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.

3.3. Determinants of discretionary 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. 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 using econometric approaches. Further, the influence of median voters within a region cannot be neglected. Needless to say, these 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 the intergovernmental transfers, which are used for financing most part of local government expenditure, local

government budgetary conditions may also be related to the government size and politically motivated local government investment.

Following these, we select the instrumental variables summarized in Table 2.

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 exclude the cyclical factors from the actual data by using the time trend estimation approach proposed by Hodrick and Prescott (1997). We do so for the number of the workers in each prefecture, the number of workers in construction industries, and the number of workers in primary industries.

We name 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. 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 1990.⁵

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.

⁵ The Cabinet Office of Japan conducts retrospective estimation on the RGDP and related data of the 1980s (<http://www5.cao.go.jp/keizai3/database.html>). Here the adjustment factor is used for retrospective estimation. However, since the empirical results may differ depending on the adjustment factor, it seems unfavorable to use all of this data in empirical estimations. Another option is to use SNA68 data, following Artis and Okubo (2011) and Brückner and Tuladhar (2013). However, it is desirable to use the data made by using the new method to the extent possible. Therefore, we use SNA 93 data.

Therefore, we must construct the real data for 2004-2007 by the 1995 deflator.⁶

First, we present the results of equation (1) in Table 3. 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.⁷ The result shows that the coefficients of $\Delta \log Y_{it}$ and $\Delta \log LGI_{it-1}$ are positive and significant.

We present the results of Equation (2) in Table 4. Before we present the estimation results for the coefficients, we first confirm the correlation between two endogenous variables, σ_i^ε and government size, and the instrumental variables in the 2SLS estimation. The results show that correlations between σ_i^ε and the instrumental variables are strong. Second, we determine the validity of the instrumental variables.

The results of the Sargan test indicate that the null cannot be rejected for all cases.

These results validate our choice of instrumental variables.

Although we conduct a cross-section estimation for Equation (2), our samples are very

⁶ Appendix offers further details concerning this point and the source of the data.

⁷ 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.

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.

The coefficient of σ_t^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. The results show that the volatility of regional economies increases with an increase in the proportion of manufacturing industries.

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 show that “discretionary changes” in local public investment, that is, the part of investment decided by political factors, does not necessarily amplify the fluctuations in prefectural business cycles for all cases. This may be caused by the

characteristics of local public investment. Most local public investments are related to improving the living environment such as housing, education facilities, and sanitation and health, etc. Public investments related to improving the living environment may directly replace private consumption or investment from their characteristics. Miyazaki (2009) shows that local public investment does not have a positive impact on the business cycles using macro-monthly data, and attributes the reason for this to the direct crowding-out effects caused by the characteristics of local public investment. Since this may be true of the regional economy and local public investment may not necessarily have a positive impact on the regional economy, we cannot show robust results for σ_t^{ε} on the economic volatility.

On the other hand, relations with economic growth may also be considered, as in the case in Ramey and Ramey (1995), Fatás and Mihov (2001), and Fatás and Mihov (2003). This point should be considered in future research.

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Appendix

Data for prefectural GDP, manufacturing output, construction output, exports, imports, government capital formation, and government consumption in each prefecture came from the Annual Report on Prefectural Accounts by the Cabinet Office in Japan.⁸

The 1990-2003 data are expressed in real terms by using 1995 as the deflator. Since we were unable to acquire real-term data by using the 1995 deflator for 2004-2007, we

⁸ For Aichi Prefecture, the exports and imports expressed in real terms are not from the Annual Report on Prefectural Accounts. These variables are downloaded from the official website of the Aichi prefectural government. Incidentally, to express in real terms, we use the deflator of PGDP because we cannot acquire the deflator of exports and imports of Aichi.

constructed real term 2004 data by using the 1995 deflator as follows:

$$Y_{i,2004}^* = Y_{i,2003} + Y_{i,2003} * g_{i,2004-2003}^*, \quad (\text{A.1})$$

where $Y_{i,2004}^*$ is 2004 data expressed in real terms using the 1995 deflator, and $Y_{i,2003}$ is 2003 data expressed in real terms using the 1995 deflator, and $g_{i,2004-2003}^*$ is the real growth rate of variable Y over the period 2003-2004 (using the 2000 deflator). We also constructed the 2005-2007 real data using the 1995 deflator, following the procedure above.

Data on the local government investment is the ordinary construction of each prefecture from the Annual Statistics of Local Public Finance by the Ministry of Internal Affairs and Communications (hereafter MIAC). Incidentally, we cannot acquire the data in real terms in this data. We can acquire the deflator from 1990 to 2003 by the deflator of 1995. After 2003, we construct the 2004 deflator from the 1995 deflator as follows:

$$P_{i,2004}^* = P_{i,2003} + \Delta P_{i,2004-2003}^*, \quad (\text{A.2})$$

where $P_{i,2004}^*$ is the 2004 deflator by the 1995 deflator, $P_{i,2003}$ is the 2003 deflator by the 1995 deflator, and $\Delta P_{i,2004-2003}^*$ is the change over 2003-2004 of the PGDP deflator in the 2000 deflator. We acquire the deflator for 2005-2007 by using the 1995 deflator, following the procedure above. By using these deflators, the ordinary construction of each prefecture is expressed in real terms.

The index of specialization is based on Fatás and Mihov (2001), following Krugman (1991). Let s_{ji} be the share of Industry j in Prefecture i , we measure specialization as

$$SPEC_i = \sum_{j=1}^l |s_{ji} - s_{j,A}| \quad (A.3)$$

where $s_{j,A}$ represents the share of Industry j in Japan as a whole. There are eleven comparable sectors.⁹ All of the data are from Annual Report on Prefectural Accounts by the Cabinet Office in Japan.

Median income is relative median income. This is the ratio of the median income to the mean income. The “median” and “mean” incomes are calculated from tables on the income distribution of households reported in the “Basic Survey on Employment

⁹ These are the agriculture, forestry and fisheries industry, the mining industry, the manufacturing industry, the construction industry, utilities, the wholesale trade industry, the finance and insurance industry, the real estate industry, the transportation and communications industry, and the service industry.

Structure” by the MIAC. This is the data that Kondoh (2008) used for estimation.¹⁰

Data on outstanding local government bonds are from the annual statistical reports by MIAC. This is expressed in real terms by the deflator that we indicated before.

The ratios of workers in the primary and construction industries were determined by dividing the number of workers in these industries by the total number of workers.

These data come from the Labor Force Survey of the Ministry of Internal Affairs and Communications (MIAC). The Labor Force Survey data can be obtained for 1990, 1992, 1995, 1997, 2000, 2002, 2005, and 2007. To perform the time trend estimation, we interpolate using the growth rate. For example, we obtain the data for 1991 as follows:

$$N_{i,1991}^* = N_{i,1990} + \frac{N_{i,1992}-1990}{2}, \quad (\text{A-4})$$

where $N_{i,1991}^*$ denotes 1991 labor data, $N_{i,1990}$ denotes 1990 labor data, and $\frac{N_{i,1992}-1990}{2}$ denotes the change in labor over 1990-1992. Likewise, we acquire the data for 1996, 2001, and 2006. Further, we obtain the data for 1993 as follows:

$$N_{i,1993}^* = N_{i,1992} + \frac{N_{i,1995}-1992}{3}, \quad (\text{A-5})$$

¹⁰ This is the average of 1993, 1998, and 2003 because these three years’ data are available during our sample periods.

where $N_{i,1993}^*$ denotes 1993 labor data, $N_{i,1992}$ denotes 1992 labor data, and $\frac{N_{i,1995}-1992}{3}$ denotes the change in labor over 1992-1995. Similarly, we obtain the data for 1994, 1998, 1999, 2003, and 2004.

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Table 1. Fiscal Stimulus Packages in the 1990s (JPY trillion)

	1992 August	1993 April	September	1994 February	1995 April	September	1998 April	November	1999 November	2000 October
Tax cut		0.2		5.9			4.6	6		
Cash transfers to households								0.7		
Public works (Public investment)	6.3	7.2	2	3.7	0	7.7	3.1	3.6	2.9	2.6
Public works involving central government	4.5	5.6	1.5	3.4		6.7	1.6	3.6	2.9	2.6
Public works by local governments	1.8	1.6	5	0.3		1	1.5			
Other government investment					5.4	1.4	4.6	3.6	4	2.6
Other government measures	4.5	5.8	4	5.7	1.5	5.2	4.4	9.1	11.3	5.8
Total size of economic stimulus packages	10.8	13.2	6	15.3	6.9	14.3	16.7	23	18.2	11

Note: This table is followed by Brückner and Tuladhar (2014). Other government investment comprises investment in fields such as science and technology, education and social welfare, alternative energy and environment, and natural disaster relief. All government investment in the economic stimulus packages in April 1995 comprised natural disaster relief because this package was planned as a countermeasure against the Great Hanshin-Awaji Earthquake.

Table 2. Endogenous variables and instrumental variables used in 2SLS estimation.

Endogenous variables	Instruments
<p>1. "Discretionary" part of the investment (σ_i^{ε})</p> <p>2. Government size (The average of government expenditure/RGDP)</p>	<p>I. Average of prefecture's government debt outstanding</p> <p>II. Average of the median income of each prefecture</p> <p>III. Average of the ratio of potential construction workers to all potential workers</p> <p>IV. Average of the ratio of potential workers in primary industries to all potential workers</p>

Table 3. Estimation Results of Equation (1) (GMM Estimation by Arellano and Bond (1991) (two-step GMM estimator), Dependent variable= $\Delta \log LGI_{it}$, Observations=799).

$\Delta \log Y_{it}$	1.784 *** (0.121)
$\Delta \log LGI_{it-1}$	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

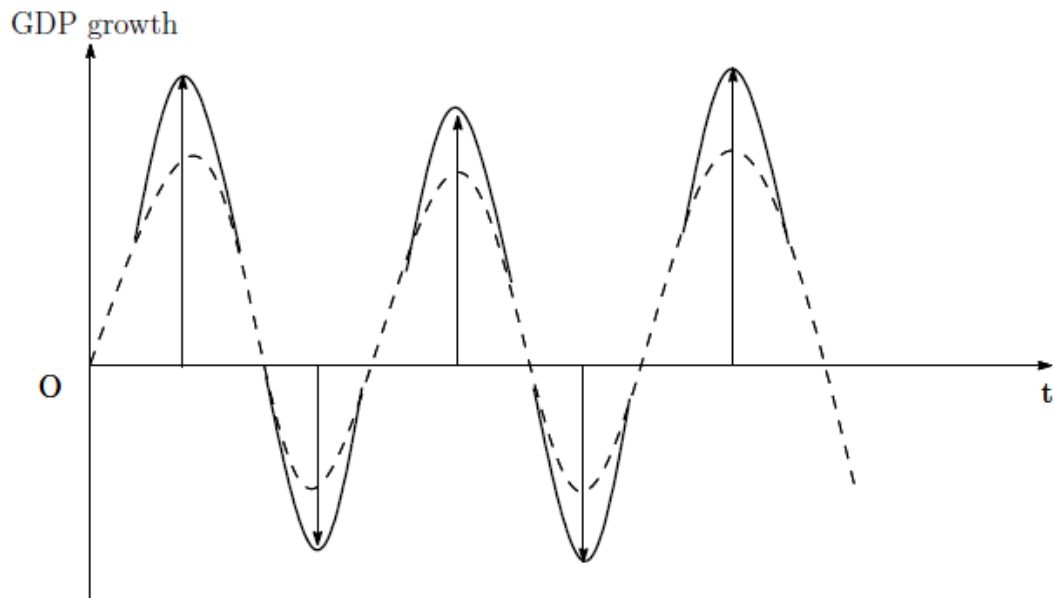
Note: Dummy variables for years are not shown for the sake of brevity. Standard errors corrected by Windmeijer's (2005) correction procedure are in parentheses. * Significance at the 10% level. ** Significance at the 5% level. *** Significance at the 1% level.

Table 4. Estimation Results of Equation (2) by 2SLS Estimation (Dependent variable= $\log\sigma_i^{\Delta Y}$, Observations=47)

	Case1	Case2
σ_i^{ε}	0.527 * (0.282)	0.530 (0.349)
Government expenditure/RGDP	0.384 * (0.250)	0.683 (0.544)
Specialization index	0.181 (0.116)	0.179 (0.125)
Share of manufacturing industries/RGDP	0.520 *** (0.134)	0.517 * (0.319)
Share of construction industries/RGDP	-0.232 (0.362)	-0.268 (0.495)
Per capita RGDP		0.105 (0.559)
Trade		0.021 (0.419)
Constant	-1.911 *** (0.726)	-2.019 (1.290)
R^2	0.257	0.240
Partial F-statistics for σ_i^{ε}	2.41 *	3.24 **
Partial F-statistics for government expenditure/RGDP	16.49 ***	7.52 ***
Sargan statistics	0.555 (2)	0.548 (2)

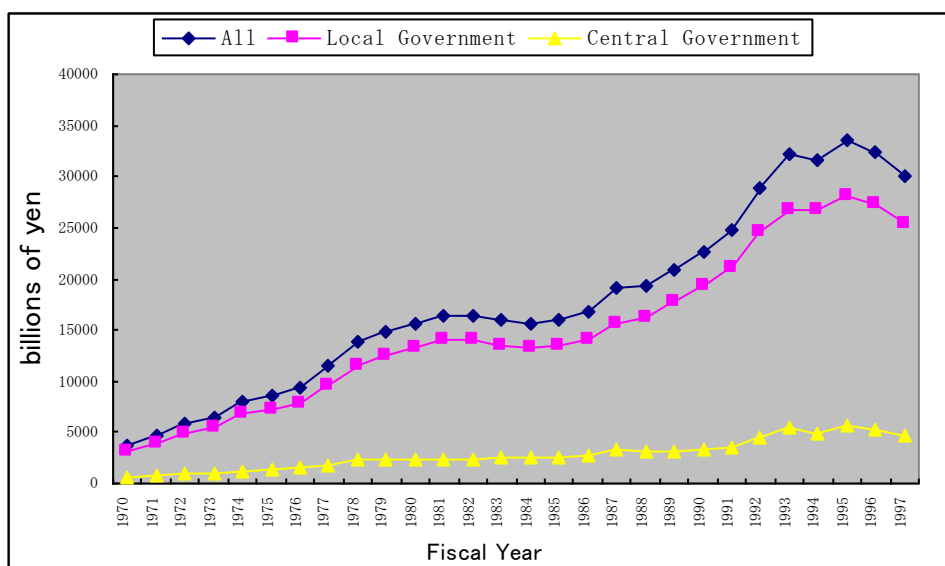
Note: We take the logarithm of all independent variables (the average of sample periods except σ_i^{ε}) in estimation. The standard errors with 150 bootstrap replications are in parentheses. The Sargan statistics are chi-square statistics for the overidentification restriction test with the degree of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

Fig.1. Relationship between discretionary public expenditure and business cycles



Note: The allowed lines indicate the movement of discretionary change in public expenditure, and dotted line the movement of GDP growth rate when there is no “discretionary” public expenditure.

Fig. 2. Trends in fixed investment by central and local governments



Source: Annual Report on National Account