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Is Japanese Local Finance Really Centralized?:
From a Viewpoint of the Revenue-Expenditure Nexus

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Abstract

We analyze whether Japanese local finance system is centralized or not. We apply the literature on the revenue-expenditure nexus through the Granger causality tests to examining it. We propose another interpretation with considering Japanese local finance system. The causality from revenues to expenditures means that the management of local finance is more centralized. The causality from expenditures to revenues implies that the management of local finance is more decentralized. The bidirectional causality between expenditures and revenues suggests that that Japanese local finance is managed jointly by the control of the central government and the request of the local governments. We confirm the bidirectional causality between revenues and expenditures in most (70~80%) prefectures through the Granger causality tests in VAR established by Toda and Yamamoto (1995). We conclude that the central government and prefectural governments jointly affect the decision of revenues and expenditures in Japanese prefectural finance. It implies that Japanese local finance system is legally centralized, but the prefectures also have the enough power to affect the management of prefectural finance in fact.

Key words: The Revenue-Expenditure Nexus, Japanese Local Finance,
Granger Causality Test, Toda-Yamamoto Vector Autoregressions
JEL classification: H71, H72, H77, D78

I. Introduction

We investigate whether Japanese local finance is centralized or not, through the Granger causality tests in this paper. We have never directly and comprehensively analyzed that Japanese local finance is centralized not in name (its legal institution) but in fact (its management).

We can apply many previous papers on the relationship between revenues and expenditures in the U.S. that is a federal state. There exist empirical evidences as follows. In one case, the levels of revenues affect the decision of expenditures. In another case, changes in expenditures cause changes in revenues. Time series analyses have been employed in examining these revenue-expenditure nexus. Finding the relations is useful to explain the decision of the government size.

We newly consider another interpretation of these relations with considering Japanese local finance system as follows. As we will describe in Section II, Japanese local revenues are managed by the central government. On the other hand, local expenditures can be reflected needs of the residents by local governments. In other words, the decision of revenues is more centralized, and the decision of expenditures is more decentralized in Japanese local finance. Therefore if we can confirm the causality from revenues to expenditures in Japanese local finance, its management is centralized. if we can find the causality from expenditures to revenues, Japanese local finance system is substantially decentralized.

This paper consists of four sections. In Section II, we propose an original interpretation of the revenue-expenditure nexus in Japanese local finance with considering its institution. We also show how to test it. Section III reports the results of the test of the revenue-expenditure nexus in Japanese prefectural finance. Concluding remarks follow in Section IV.

II. Empirical Framework

II-1. Previous works on the revenue-expenditure nexus

On the relation between revenues and expenditures, previous studies have advanced the following hypotheses: the causality from expenditures to revenues, the causality from revenues to expenditures, the bidirectional causality between expenditures and revenues, and the independence of expenditures and revenues. We review the interpretations of these hypotheses according to previous research.

The causality from expenditures to revenues, that is, the spend-tax hypothesis, means that expenditures change before revenues. It is valid when increasing expenditures created by some special events and crises compels governments to increase taxes. This hypothesis is proposed by Peacock and Wiseman (1979) and so on. Barro (1974) also implies such a view because he implies that households consider issuing government bonds with increasing expenditures today as a tax increase in the future. Moreover this hypothesis is supported by Barro (1978), i.e. the tax-smoothing model.

The causality from revenues to expenditures, that is, the tax-spend hypothesis, suggests that revenues change before expenditures. It is true when the level of expenditure is adjusted in response to changes in revenues. This hypothesis is advocated by Friedman (1978) and so on.

The bidirectional causality between expenditures and revenues, namely the fiscal synchronization hypothesis, suggests that expenditures change concurrently with revenues. It is valid when the levels of both expenditures and revenues are decided with respect to the requests of the voters. Musgrave (1966) and Meltzer and Richard (1981) argue this hypothesis.

The independence of expenditures and revenues implies that changes in expenditures and revenues are dominated by macroeconomic fluctuations, rather than changes in the other. Buchanan and Wagner (1977, 1978) suggest this hypothesis.

In previous studies, the revenue-expenditure nexus have been investigated through causality test defined by Granger (1969). The techniques of vector autoregression (VAR) and error correction models (ECMs) have been used in this test. The causality from expenditures to revenues has been supported by von

Fustenberg, Green and Jeong (1985, 1986), Anderson, Wallace and Warner (1986), Jones and Joulfaian (1991). The causality from revenues to expenditures has been supported by Blackley (1986), Manage and Marlow (1986), Marlow and Manage (1987, 1988), Ram (1988), Holtz-Eakin, Newey and Rosen (1989), Joulfaian and Mookerjee (1990), and Owoye (1995). The bidirectional causality between expenditures and revenues has been supported by Chowdhury (1988), Miller and Russek (1989), and Baghestani and McNown (1994). Finally the independence of expenditures and revenues has been supported by Hoover and Sheffrin (1992).[1]

The objects of most empirical studies are the U.S. revenues and expenditures at the federal, state and local levels. We have never comprehensively examined the test in Japanese local finance.

II-2. Application to Japanese local finance

The tasks of our paper are testing the above hypotheses in Japanese local finance, and evaluating the results with considering its institution. In this section, we show another interpretation of these hypotheses that applies to Japanese local finance. In other words, the interpretation of these hypotheses in a centralized local system such as Japan is different from that in a federal system such as the U.S..

Reed (1986) suggests that Japanese local governments have less authority than in federal states but more authority than in other unitary states from case studies. One of points that Japanese local governments have less authority than in federal states is the decision of the local revenues.[2] The local revenues are divided into six categories; Local Taxes, Local Transfer Taxes, Local Allocation Tax, National Government Disbursements, Local Public Bonds, and Miscellaneous Revenue. The revenues can be controlled by the central government in Japan. Rates and sources of Local Taxes are basically decided by national laws, local governments rarely have discretion over them. Issuing Local Public Bonds is controlled through the central

[1] Hoover and Sheffrin (1992) obtain such a result while the period following the mid-1960s. They also gain the result that taxes causes spending prior to the mid-1960s.

[2] See Shibata (1993) for further details.

government. Local Transfer Taxes, Local Allocation Tax, and National Government Disbursements are distributed to local governments by the central government.

Accordingly Japanese local revenues are managed by the central government. On the other hand, local expenditures can be reflected needs of the residents by local governments. If Japanese local governments want to manage their finance as they require, they need to request the central government to distribute these revenues. Especially, the interregional distribution of National Government Disbursements often affects political pressure, suggested by Doi and Ashiya (1997). Namely the Dietmen, the prefectural governors, and mayors appeal to the central bureaucrats to distribute more in their own jurisdictions.

To sum up, the decision of revenues is more centralized, and that of expenditures is more decentralized in Japanese local finance. We newly construct an interpretation of these hypotheses with considering its institution as follows. The causality from revenues to expenditures means that the management of local finance is more centralized, because changes in revenues decided by the central government lead to changes in expenditures. The causality from expenditures to revenues implies that the management of local finance is more decentralized, since changes in expenditures required by the local governments lead to changes in revenues. The bidirectional causality between expenditures and revenues suggests that Japanese local finance is managed jointly by the control of the central government and the request of the local governments. The independence of expenditures and revenues implies that the levels of expenditures and revenues are independently determined each other.

Therefore testing the revenue-expenditure nexus in Japanese local finance means investigating whether it is centralized or not. We explain the methods of this test in the next section.

II-3. Test Procedure

In previous works, the Granger causality tests using the conventional VAR analysis and ECMs have been implemented. One of these shortcomings is the tests cannot implement when the orders of integration of revenues and expenditures are different, or when either order of integration is more than two. To avoid it, we employ the method of Toda and Yamamoto (1995).[3] An advantage of this method is that we can implement the Granger causality tests when the order of integration of revenues is not equal to that of expenditures and when either order of integration is more than two. The method is as follows.

We consider the following VAR of an n-vector time series $\{\mathbf{y}_t\}_{t=-k+1}^{\infty}$ $(k \geq 1)$:

$$\mathbf{y}_t = \mathbf{b}_0 + \mathbf{b}_1\mathbf{t} + A_1\mathbf{y}_{t-1} + \cdots + A_k\mathbf{y}_{t-k} + \cdots + A_l\mathbf{y}_{t-l} + \mathbf{e}_t\,, \tag{1}$$

$$\text{where}\quad \mathbf{y}_t \equiv \begin{pmatrix} y_{1t} \\ y_{2t} \\ \vdots \\ y_{nt} \end{pmatrix},\quad A_i \equiv \begin{pmatrix} a_{11}^i & a_{12}^i & \cdots & a_{1n}^i \\ a_{21}^i & a_{22}^i & & \\ \vdots & & \ddots & \vdots \\ a_{n1}^i & & \cdots & a_{nn}^i \end{pmatrix},$$

A_i $(i = 1,2, .., k, .., l)$ denotes an n×n matrix of coefficients, $\mathbf{t}$ denotes a vector of a time trend, and $\mathbf{e}_t$ denotes an n-vector of the innovation. We assume that the order of integration of $\mathbf{y}_t$ is at most $d_{\max}$ around a linear trend. $d_{\max}$ denotes the maximal order of integration of variables in $\mathbf{y}_t$.

First we select the lag length in (1). According to Toda and Yamamoto (1995), under the following null hypothesis:

H'_0: $A_{m+1} = \ldots = A_l = \mathbf{0}$,

where $k \leq m \leq l\text{-}1$

the usual Wald statistic obtained from the OLS estimators of coefficients in (1), has an asymptotic χ^2 distribution with $n^2(l - m)$ degrees of freedom if $m \geq d_{\max}$. After this test, we select the lag length as the null hypothesis can be rejected. p denotes the selected lag length.

For implementing the Granger causality tests, we estimate the following VAR:

$$\mathbf{y}_t = \mathbf{b}_0 + \mathbf{b}_1\mathbf{t} + A_1\mathbf{y}_{t-1} + \cdots + A_k\mathbf{y}_{t-k} + \cdots + A_p\mathbf{y}_{t-p} + \mathbf{e}_t\,, \tag{2}$$

In this regression, the i-th variable, y_{it}, does not Granger-cause the j-th variable, y_{jt},

[3] Examples that apply this method are Morimune and Zhao (1995), and Asai and Shiba (1995). There is no study employing this method on the revenue-expenditure nexus.

if we cannot reject the following null hypothesis:

$$H_0: a^1_{ji} = \ldots = a^p_{ji} = 0.$$

Toda and Yamamoto (1995) prove that under the above null hypothesis, the the usual Wald statistic obtained from the OLS estimators of coefficients in (2), has an asymptotic χ^2 distribution with p degrees of freedom if $p \geq k + d_{\max}$. Note that the conditions, $p \geq k + d_{\max}$ and $k \geq 1$, must be satisfied.

III. Empirical Results

III-1. Data

We analyze the revenue-expenditure nexus in Japanese local finance. In investigating the log-run relation between local revenues and local expenditures, prefectural data are suitable in Japan. The reasons that we deal with not municipalities but prefectures, are (1) municipal time series data are discontinuous by mergers with other municipalities, (2) we can obtain municipal data for about 30 years that are shorter than in prefectural data, and (3) municipal governments have less authority than prefectural governments. There is no merger among Japanese prefectures in the postwar era. We use data by prefecture in all prefectures excluding Okinawa. We cannot obtain the data on Okinawa prefecture before FY1971. We can gain the 41 years prefectural data from FY1955 to FY 1995. The data source is Ministry of Home Affairs, “Annual Statistical Report on Local Government Finance.”

We define the expenditures, E_t, used in the test as what exclude the reserve for the adjusting fund for finance from Total Expenditure. We also define the revenues, R_t, as what exclude the transfer from the adjusting fund for finance from Total Revenue. It is because we eliminate the effect of fund flow between Ordinary Account and the adjusting fund for finance. Moreover we prepare another definition. We define the expenditures, G_t, as what exclude the local debt service from E_t, and the revenues, T_t, as what exclude Local Public Bonds from R_t.[4] In this paper, we set the above $\mathbf{y}_t$ as $[R_t, E_t]'$, or $[T_t, G_t]'$.

We deal with nominal values of these variables in these tests. Because nominal values are employed in the budget process, and we analyze how to decide the budget. We set the sample periods as from FY1956 to FY1995 and FY1960 to FY1991.

We investigate these hypotheses by prefecture, that is, as cross section data. We don't try panel analyses. Because the method of Toda and Yamamoto (1995) cannot be directly applied to panel analyses,[5] and the techniques of panel unit root tests, for instance Levin and Lin (1992), have been established but those of panel cointegration tests have not been stylized yet.

We examine the following tests using these data.

III-2. Unit root tests

Before the Granger causality tests, we implement the unit root tests by prefecture. We employ the augmented Dickey-Fuller tests because the number of observation of these variables is not enough large in order to implement the Phillips-Perron tests. We use the criteria advocated by Pantula, Gonzalez-Farias and Fuller (1994), and based on the principle of parsimony in deciding the lag length.

We find the order of integration of each variable in each prefecture by the augmented Dickey-Fuller tests. We set the 5% significance level in testing the null hypothesis that the variable has a unit root. The results of unit root tests are shown in Table 1. The order of integration of each variable by prefecture is identified by the tests. Moreover, we summarize $d_{\max}$ by prefecture in Table 2. From this result, we set $d_{\max}$ as the larger of the two variables; E_t and R_t, or G_t and T_t.

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[4] Strictly speaking, we should define G_t as what also exclude the transfer to the bond redemption fund, that appropriate for repayments of local bonds in the future, from E_t. Unfortunately, we cannot obtain the data on the transfer by prefecture. Hence we set such a definition.

[5] In panel analyses, we must use the method of moments, not OLS, in estimation of VAR as mentioned by Holtz-Eakin, Newey and Rosen (1989), Baltagi (1995) and so on.

III-3. VAR results

In the next step, we select the lag length of VAR. As mentioned above, we decide the lag length, p, using the Wald statistic by prefecture. The results are reported in Table 3. We note that the conditions, $p \geq k + d_{max}$ and $k \geq 1$, must be satisfied.

We estimate the VAR, equations (2), whose lag length is equal to p reported in Table 3, and implement the Granger causality tests based on the Wald statistics from the OLS estimators. We estimate four versions of VAR; $\mathbf{y}_t = [R_t, E_t]'$ from FY1956 to FY1995, $\mathbf{y}_t = [R_t, E_t]'$ from FY1960 to FY1991, $\mathbf{y}_t = [T_t, G_t]'$ from FY1956 to FY1995, and $\mathbf{y}_t = [T_t, G_t]'$ from FY1960 to FY1991. The Wald statistics are reported in Table 3. They have an (asymptotic) $\chi^2(p)$. Asterisks indicate the significance levels.

In all versions shown in Table 3, there is the bidirectional causality between revenues and expenditures in most (70%~80%) prefectures. Furthermore, there is no case of the unidirectional causality, from revenues to expenditures, or from expenditures to revenues, excluding the case of $\mathbf{y}_t = [T_t, G_t]'$ from FY1956 to FY1995 in Kumamoto prefecture. It generally implies not that the central government or the prefectural government only affects the management of local finance, but that the central government and prefectural governments jointly affect the decision of revenues and expenditures in Japanese prefectural finance.

There is the independence of expenditures and revenues in some prefectures. It may mean that the levels of expenditures and revenues are independently determined each other. Or it may mean that the causality is ambiguous in sample period, since there is the causality from expenditures to revenues in some period, and there is the causality from revenues to expenditures in another period. We cannot conclude which interpretation is accurate in our data and tests .

We consider the relation between causality and prefectural circumstances. Where the causality exists (or not). The prefectures where the bidirectional causality exists in all version are Hokkaido, Aomori, Miyagi, Yamagata, Ibaraki, Tochigi, Chiba, Tokyo, Toyama, Gifu, Kyoto, Osaka, Hyogo, Nara, Wakayama, Shimane, Okayama, Tokushima, Ehime, Fukuoka, Nagasaki, and Miyazaki. The prefecture where any causality does not exist in all version is Shizuoka. There exist the prefectures where the bidirectional causality exists in all version in not only rural areas but urban areas. From our tests, we cannot easily conclude the reason that the bidirectional causality exists.

IV. Concluding Remarks

We examine the long-run relation between revenues and expenditures in Japanese prefectural finance, and evaluating the results with considering its institution. We propose an original interpretation that applies to Japanese local finance. If we confirm the causality from revenues to expenditures, the management of local finance is more centralized. Because changes in revenues decided by the central government lead to changes in expenditures. If we find the causality from expenditures to revenues, the management of local finance is more decentralized, since changes in expenditures required by the local governments lead to changes in revenues. When we confirm the bidirectional causality between expenditures and revenues, Japanese local finance is managed jointly by the control of the central government and the request of the local governments. The independence of expenditures and revenues implies that the levels of expenditures and revenues are independently determined each other.

We confirm the bidirectional causality between revenues and expenditures in most (32~38) prefectures through the Granger causality tests in VAR established by Toda and Yamamoto (1995). This method is implemented the causality tests when the order of integration of revenues is not equal to that of expenditures and when either order of integration is more than two.

We conclude Japanese local finance is managed jointly by the control of the central government and the request of the local governments. In this sense, Japanese prefectural finance is not perfectly centralized in fact. We support the study of Reed (1986) through econometric methods. Also Doi (1998a, 1998b) show that the voters affect the gubernatorial election, the elected governor petitions the central government as a agent of the voters, and the central government manages local expenditures through interregional grants to reflect the preference of the voters in its jurisdiction. The results in this paper are consistent with these.

There are other issues that we have not investigated in our model. We need to deal with also real revenues and expenditures deflated by price level. We also need to consider the relation between causality and prefectural circumstances. In this paper, there is no clear relation. These are our further research.

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Table 1

Unit Root Tests

Sample Period: FY1956-FY1995

The significance level is 5%.

Dependent Variable		R_t, E_t			$\Delta R_t, \Delta E_t$			$\Delta^2 R_t, \Delta^2 E_t$			$\Delta^3 R_t, \Delta^3 E_t$			$\Delta^4 R_t, \Delta^4 E_t$			Order of Integration	d_{max}
Prefecture		t statistic	Model	p	t statistic	Model	p	t statistic	Model	p	t statistic	Model	p	t statistic	Model	p		
Hokkaido	R_t	-0.841	I	10	0.212	I	10	-1.493	I	10	-2.574 ***	I	10				3	3
	E_t	-0.825	I	10	0.217	I	10	-1.415	I	10	-2.189 **	I	10				3	
Aomori	R_t	-0.621	I	10	-1.991	II	2	-2.278 **	I	9							2	2
	E_t	0.961	I	3	-2.101	II	2	-4.698 ***	I	2							2	
Iwate	R_t	1.329	I	3	-2.220	II	2	-3.646 ***	I	2							2	2
	E_t	1.097	I	3	-2.248	II	2	-3.465 ***	I	2							2	
Miyagi	R_t	0.966	I	3	-3.068	III	6	-1.882 *	I	8	-2.110 **	I	9				3	3
	E_t	0.519	I	3	-1.439	II	10	-1.726 *	I	10	-3.088 ***	I	10				3	
Akita	R_t	1.292	I	5	-1.644	II	4	-2.885 ***	I	3							2	2
	E_t	1.350	I	5	-1.806	II	4	-2.659 ***	I	3							2	
Yamagata	R_t	1.371	I	4	-2.079	II	3	-2.734 ***	I	3							2	2
	E_t	1.135	I	6	-1.754	II	2	-3.021 ***	I	3							2	
Fukushima	R_t	1.108	I	3	-1.775	II	10	-3.796 ***	I	3							2	2
	E_t	1.052	I	3	-1.827	II	2	-3.809 ***	I	3							2	
Ibaraki	R_t	-0.489	I	10	-1.997	II	6	-2.267 **	I	8							2	2
	E_t	0.222	I	5	-1.787	II	2	-2.565 ***	I	3							2	
Tochigi	R_t	1.929	I	3	-1.968	II	2	-4.098 ***	I	2							2	2
	E_t	1.583	I	3	-1.802	II	2	-3.778 ***	I	2							2	
Gunma	R_t	0.800	I	3	-1.745	II	2	-3.276 ***	I	3							2	2
	E_t	0.780	I	3	-1.773	II	2	-3.550 ***	I	3							2	
Saitama	R_t	-2.379	IV	5	-1.522	II	4	-3.401 ***	I	3							2	2
	E_t	-2.293	IV	5	-1.571	II	4	-3.165 ***	I	3							2	
Chiba	R_t	-2.200	IV	4	-1.946	II	3	-3.779 ***	I	2							2	2
	E_t	-2.280	IV	4	-1.726	II	3	-4.082 ***	I	2							2	
Tokyo	R_t	-0.537	I	10	-2.216	III	10	-2.906 ***	I	8							2	2
	E_t	-0.257	I	10	-3.607 **	III	8										1	
Kanagawa	R_t	0.248	I	4	-1.389	II	7	-3.762 ***	I	2							2	2
	E_t	-1.553	I	10	-0.845	I	3	-3.714 ***	I	2							2	
Niigata	R_t	0.061	I	10	0.446	I	10	-2.004 **	I	9							2	2
	E_t	-0.081	I	10	0.466	I	10	-2.048 **	I	9							2	
Toyama	R_t	1.697	I	4	-2.014	II	3	-4.045 ***	I	2							2	2
	E_t	1.576	I	3	-2.193	II	2	-4.503 ***	I	2							2	
Ishikawa	R_t	1.231	I	4	-1.643	II	3	-2.886 ***	I	3							2	2
	E_t	1.636	I	5	-1.280	II	6	-2.595 ***	I	3							2	

Dependent Variable		R_t, E_t			$\Delta R_t, \Delta E_t$			$\Delta^2 R_t, \Delta^2 E_t$			$\Delta^3 R_t, \Delta^3 E_t$			$\Delta^4 R_t, \Delta^4 E_t$			Order of Integration	d_{max}
Prefecture		t statistic	Model	p	t statistic	Model	p	t statistic	Model	p	t statistic	Model	p	t statistic	Model	p		
Fukui	R_t	2.058	I	2	-1.982	II	2	-4.438 ***	I	3							2	2
	E_t	2.200	I	2	-2.315	II	2	-2.874 ***	I	5							2	
Yamanashi	R_t	-3.833 **	IV	10													0	2
	E_t	-3.799 *	IV	10	-0.999	I	3	-3.951 ***	I	2							2	
Nagano	R_t	-3.872 **	IV	10													0	0
	E_t	-5.281 ***	IV	10													0	
Gifu	R_t	-2.477	IV	9	0.505	I	8	-1.920 *	I	7	-3.109 ***	I	7				3	3
	E_t	-3.316	IV	10	0.495	I	10	-1.343	I	9	-2.006 **	I	10				3	
Shizuoka	R_t	2.347	I	4	-1.659	II	3	-3.465 ***	I	2							2	2
	E_t	-2.732	IV	10	-1.566	II	3	-3.908 ***	I	3							2	
Aichi	R_t	-0.488	I	4	-1.673	II	3	-4.053 ***	I	2							2	2
	E_t	-0.579	I	4	-1.637	II	3	-4.235 ***	I	2							2	
Mie	R_t	-2.720	IV	5	-1.742	II	9	-2.732 ***	I	8							2	2
	E_t	0.583	I	5	-1.860	II	10	-3.445 ***	I	3							2	
Shiga	R_t	-2.415	IV	7	-1.859	II	2	-2.785 ***	I	4							2	2
	E_t	-2.586	IV	6	-1.806	II	2	-3.147 ***	I	3							2	
Kyoto	R_t	-2.047	IV	4	-1.895	II	2	-4.114 ***	I	2							2	2
	E_t	-2.181	IV	4	-1.991	II	2	-4.510 ***	I	2							2	
Osaka	R_t	-2.491	IV	2	-2.037	II	2	-4.156 ***	I	3							2	2
	E_t	2.615	I	2	-2.019	II	2	-4.140 ***	I	3							2	
Hyogo[a]	R_t	-2.432	IV	10	0.953	I	2	-2.150	IV	5	-2.846 ***	I	7				3	3
	E_t	-3.001	IV	10	1.198	I	2	-2.725 ***	I	2							2	
Nara	R_t	-3.225	IV	10	-1.728	II	2	-4.236 ***	I	3							2	2
	E_t	-4.018 **	IV	10													0	
Wakayama	R_t	0.996	I	4	-2.278	II	5	-2.884 ***	I	2							2	2
	E_t	1.039	I	6	-2.280	II	5	-2.191 **	I	4							2	
Tottori	R_t	1.024	I	7	0.207	I	10	-2.208 **	I	10							2	2
	E_t	0.968	I	7	-1.694	II	10	-2.146 **	I	10							2	
Shimane	R_t	2.995	I	2	-2.661	II	2	-3.586 ***	I	5							2	2
	E_t	2.632	I	2	-2.669	II	2	-5.136 ***	I	3							2	
Okayama	R_t	0.173	I	3	-1.987	II	2	-3.848 ***	I	2							2	2
	E_t	0.183	I	3	-1.990	II	2	-2.858 ***	I	3							2	
Hiroshima	R_t	0.524	I	4	-2.304	II	3	-2.986 ***	I	2							2	2
	E_t	0.112	I	4	-2.115	II	3	-3.167 ***	I	2							2	
Yamaguchi	R_t	-2.557	IV	4	-1.487	II	3	-4.359 ***	I	2							2	2
	E_t	-2.992	IV	6	0.179	I	3	-4.560 ***	I	2							2	
Tokushima	R_t	0.443	I	10	0.767	I	10	-1.671 *	I	9	-2.607 ***	I	8				3	3
	E_t	-1.965	IV	6	-1.548	II	6	-2.214 **	I	3							2	
Kagawa	R_t	-0.237	I	10	-2.660	III	8	-2.779 *	II	10	-4.828 ***	IV	10				3	3
	E_t	-0.017	I	10	-1.362	II	10	-1.843 *	I	10	-3.736 ***	I	10				3	

Dependent Variable		R_t, E_t			$\Delta R_t, \Delta E_t$			$\Delta^2 R_t, \Delta^2 E_t$			$\Delta^3 R_t, \Delta^3 E_t$			$\Delta^4 R_t, \Delta^4 E_t$			Order of	d_{max}
Prefecture		t statistic	Model	p	t statistic	Model	p	t statistic	Model	p	t statistic	Model	p	t statistic	Model	p	Integration	
Ehime	R_t	-2.695	IV	6	-3.141	III	7	-2.300 **	I	5							2	2
	E_t	-2.849	IV	5	0.627	I	10	-2.372 **	I	4							2	
Kochi	R_t	1.024	I	3	-1.910	II	10	-1.598	I	10	-2.240 **	I	10				3	3
	E_t	1.095	I	3	-2.205	II	2	-4.277 ***	I	2							2	
Fukuoka	R_t	0.658	I	4	-2.075	II	4	-4.439 ***	I	2							2	2
	E_t	0.497	I	4	-2.174	II	2	-5.218 ***	I	2							2	
Saga	R_t	1.164	I	3	-2.238	II	2	-5.112 ***	I	2							2	2
	E_t	1.350	I	3	-2.157	II	2	-5.019 ***	I	2							2	
Nagasaki	R_t	-1.057	I	10	-1.577	II	9	-2.914 ***	I	8							2	2
	E_t	-1.301	I	10	-1.540	II	9	-3.148 ***	I	8							2	
Kumamoto	R_t	0.900	I	5	-1.793	II	4	-3.318 ***	I	3							2	2
	E_t	-2.747	IV	5	-1.607	II	4	-3.417 ***	I	3							2	
Oita	R_t	0.996	I	4	-1.699	II	10	-2.085 **	I	10							2	2
	E_t	0.602	I	3	-2.149	II	2	-3.632 ***	I	2							2	
Miyazaki	R_t	0.624	I	4	-1.748	II	7	-4.825 ***	I	2							2	2
	E_t	-0.364	I	10	0.145	I	3	-2.856 ***	I	8							2	
Kagoshima	R_t	1.085	I	7	-2.993	III	7	-2.579 ***	I	5							2	3
	E_t	-0.815	I	10	-1.717	II	10	-1.775 *	I	10	-2.164 **	I	10				3	

Notes: [a] Its sample period is FY1956-FY1994 because the great Hanshin-Awaji earthquake occurred in FY1995.

***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

The above t statistic is that of the following ϕ_1.

Model I: $Y_t = \phi_1 Y_{t-1} + \lambda_1 \Delta Y_{t-1} + \lambda_2 \Delta Y_{t-2} + \cdots + \lambda_p \Delta Y_{t-p} + u_t$

II: $Y_t = \alpha + \phi_1 Y_{t-1} + \lambda_1 \Delta Y_{t-1} + \lambda_2 \Delta Y_{t-2} + \cdots + \lambda_p \Delta Y_{t-p} + u_t$

III: $Y_t = \alpha + \beta t + \phi_1 Y_{t-1} + \lambda_1 \Delta Y_{t-1} + \lambda_2 \Delta Y_{t-2} + \cdots + \lambda_p \Delta Y_{t-p} + u_t$

IV: $Y_t = \alpha + \beta t + \gamma t^2 + \phi_1 Y_{t-1} + \lambda_1 \Delta Y_{t-1} + \lambda_2 \Delta Y_{t-2} + \cdots + \lambda_p \Delta Y_{t-p} + u_t$

where Y_t denotes the dependent variable and p denotes the lag length of the above regression.

Table 1 (continued)

Unit Root Tests

Sample Period: FY1956-FY1995

The significance level is 5%.

Dependent Variable		T_t, G_t			$\Delta T_t, \Delta G_t$			$\Delta^2 T_t, \Delta^2 G_t$			$\Delta^3 T_t, \Delta^3 G_t$			$\Delta^4 T_t, \Delta^4 G_t$			Order of Integration	d_{max}
Prefecture		t statistic	Model	p	t statistic	Model	p	t statistic	Model	p	t statistic	Model	p	t statistic	Model	p		
Hokkaido	T_t	-3.177	IV	10	0.253	I	10	-1.139	I	10	-2.156 **	I	10				3	3
	G_t	0.764	I	5	-1.987	II	4	-2.991 ***	I	3							2	
Aomori	T_t	1.083	I	3	-2.470	II	2	-3.078 ***	I	4							2	2
	G_t	-0.374	I	10	-0.136	I	10	-2.662 ***	I	9							2	
Iwate	T_t	0.090	I	3	-1.148	I	2	-3.153 ***	I	3							2	2
	G_t	1.099	I	3	-2.265	II	2	-3.370 ***	I	2							2	
Miyagi	T_t	1.402	I	3	-2.317	II	2	-4.435 ***	I	2							2	2
	G_t	0.320	I	10	-3.021	III	6	-2.011 **	I	8							2	
Akita	T_t	0.790	I	2	-2.187	II	2	-3.625 ***	I	2							2	2
	G_t	1.577	I	6	-2.067	II	5	-2.689 ***	I	3							2	
Yamagata	T_t	1.140	I	3	-2.552	II	2	-4.179 ***	I	2							2	3
	G_t	1.380	I	6	-2.156	II	5	-0.686	I	10	-2.253 **	I	10				3	
Fukushima	T_t	0.645	I	3	-2.186	II	2	-3.652 ***	I	3							2	2
	G_t	1.105	I	3	-1.859	II	2	-3.625 ***	I	3							2	
Ibaraki	T_t	0.166	I	3	-1.696	II	7	-2.510 **	I	6							2	2
	G_t	0.168	I	3	-1.848	II	2	-2.341 **	I	3							2	
Tochigi	T_t	1.950	I	3	-2.534	II	2	-4.417 ***	I	2							2	2
	G_t	1.673	I	3	-1.922	II	2	-3.626 ***	I	2							2	
Gunma	T_t	1.102	I	4	-2.215	II	2	-3.508 ***	I	2							2	2
	G_t	0.762	I	3	-1.870	II	2	-3.343 ***	I	3							2	
Saitama	T_t	0.806	I	5	-2.544	II	2	-4.639 ***	I	2							2	2
	G_t	-2.184	IV	5	-1.660	II	3	-3.092 ***	I	3							2	
Chiba	T_t	0.827	I	5	-2.000	II	4	-3.766 ***	I	2							2	2
	G_t	-2.514	IV	4	-1.835	II	3	-3.930 ***	I	2							2	
Tokyo	T_t	-3.215	IV	9	0.518	I	8	-1.112	I	10	-1.138	I	10	-2.914 ***	I	10	4	4
	G_t	-3.199	IV	10	-2.491	III	10	-0.912	I	10	-1.946 **	I	10				3	
Kanagawa	T_t	1.247	I	3	-1.734	II	10	-1.178	I	10	-7.962 ***	I	10				3	3
	G_t	-1.024	I	10	-1.308	II	10	-1.865 *	I	10	-2.112 **	I	10				3	
Niigata	T_t	1.446	I	3	-2.466	II	2	-4.493 ***	I	2							2	2
	G_t	0.290	I	10	0.491	I	10	-2.075 **	I	9							2	
Toyama	T_t	1.624	I	3	-2.742	II	2	-3.322 ***	I	4							2	2
	G_t	1.325	I	4	-2.334	II	2	-4.147 ***	I	2							2	
Ishikawa	T_t	1.532	I	3	-2.425	II	2	-4.522 ***	I	2							2	2
	G_t	0.985	I	8	-1.365	II	6	-2.492 **	I	6							2	

Dependent Variable / Prefecture		T_t, G_t t statistic	Model	p	$\Delta T_t, \Delta G_t$ t statistic	Model	p	$\Delta^2 T_t, \Delta^2 G_t$ t statistic	Model	p	$\Delta^3 T_t, \Delta^3 G_t$ t statistic	Model	p	$\Delta^4 T_t, \Delta^4 G_t$ t statistic	Model	p	Order of Integration	d_{max}
Fukui	T_t	1.285	I	3	-2.462	II	2	-5.130 ***	I	2							2	2
	G_t	2.059	I	2	-1.962	II	3	-5.377 ***	I	2							2	
Yamanashi	T_t	1.935	I	3	-2.693 *	II	2	-3.973 ***	I	2							2	2
	G_t	-3.738	IV	10	-1.257	I	3	-3.850 ***	I	2							2	
Nagano	T_t	1.803	I	3	-2.321	II	2	-5.039 ***	I	2							2	2
	G_t	-4.873 ***	IV	10													0	
Gifu	T_t	1.125	I	4	-2.337	II	3	-3.359 ***	I	2							2	3
	G_t	-3.404	IV	10	-2.352	III	10	-1.312	I	9	-1.973 **	I	10				3	
Shizuoka	T_t	2.259	I	4	-2.688	II	2	-3.767 ***	I	2							2	3
	G_t	-2.260	IV	10	-1.710	II	3	-1.631	I	8	-3.287 ***	I	9				3	
Aichi	T_t	0.766	I	3	-1.844	II	10	-1.796 *	I	10	-4.033 ***	I	10				3	3
	G_t	-0.373	I	4	-1.700	II	3	-4.308 ***	I	2							2	
Mie	T_t	0.916	I	4	-2.139	II	2	-4.507 ***	I	2							2	2
	G_t	0.691	I	3	-1.916	II	2	-3.296 ***	I	3							2	
Shiga	T_t	2.153	I	2	-2.240	II	2	-2.720 ***	I	4							2	2
	G_t	-2.801	IV	6	-2.020	II	2	-3.380 ***	I	3							2	
Kyoto	T_t	1.391	I	3	-2.580 *	II	2	-4.532 ***	I	2							2	2
	G_t	-2.229	IV	4	-2.123	II	2	-4.434 ***	I	2							2	
Osaka	T_t	1.701	I	3	-1.695	II	10	-2.952 ***	II	10							2	2
	G_t	-2.895	IV	5	-1.900	II	2	-3.982 ***	I	3							2	
Hyogo[a]	T_t	3.285	I	3	0.985	I	6	-2.739 ***	I	5							2	3
	G_t	-3.028	IV	10	1.044	I	2	-2.537	IV	5	-3.862 ***	I	5				3	
Nara	T_t	1.501	I	3	-2.037	II	3	-1.978 **	I	8							2	2
	G_t	-3.898 **	IV	10													0	
Wakayama	T_t	0.953	I	3	-2.265	II	2	-4.624 ***	I	2							2	2
	G_t	1.259	I	6	-2.309	II	5	-2.487 **	I	4							2	
Tottori	T_t	0.887	I	4	-2.139	II	3	-1.859 *	I	10	-2.794 ***	I	10				3	3
	G_t	1.185	I	7	-1.729	II	10	-2.399 **	I	10							2	
Shimane	T_t	2.604	I	2	-3.239 **	II	2										1	2
	G_t	2.663	I	2	-2.839 *	II	2	-5.139 ***	I	3							2	
Okayama	T_t	0.789	I	3	-2.396	II	2	-4.861 ***	I	2							2	2
	G_t	0.168	I	3	-2.073	II	2	-2.753 ***	I	3							2	
Hiroshima	T_t	0.835	I	4	-2.460	II	3	-4.036 ***	I	2							2	2
	G_t	0.312	I	4	-2.226	II	3	-3.145 ***	I	2							2	
Yamaguchi	T_t	1.999	I	3	-2.592	II	2	-4.804 ***	I	2							2	2
	G_t	-2.452	IV	7	0.025	I	3	-4.284 ***	I	2							2	
Tokushima	T_t	0.125	I	4	-1.993	II	10	-3.277 ***	I	2							2	2
	G_t	-1.930	IV	6	-1.864	II	6	-2.188 **	I	9							2	
Kagawa	T_t	0.694	I	4	-2.178	II	2	-4.946 ***	I	2							2	3
	G_t	0.072	I	10	-2.708	III	8	-1.765 *	I	10	-3.621 ***	I	10				3	

Dependent Variable		T_t, G_t			$\Delta T_t, \Delta G_t$			$\Delta^2 T_t, \Delta^2 G_t$			$\Delta^3 T_t, \Delta^3 G_t$			$\Delta^4 T_t, \Delta^4 G_t$			Order of Integration	d_{max}
Prefecture		t statistic	Model	p	t statistic	Model	p	t statistic	Model	p	t statistic	Model	p	t statistic	Model	p		
Ehime	T_t	0.893	I	5	-1.819	II	2	-2.863 ***	I	3							2	2
	G_t	-2.658	IV	6	-1.337	II	6	-2.440 **	I	5							2	
Kochi	T_t	1.014	I	3	-2.364	II	2	-1.577	I	10	-3.249 ***	I	10				3	3
	G_t	1.121	I	3	-2.323	II	2	-3.815 ***	I	2							2	
Fukuoka	T_t	1.006	I	4	-2.491	II	2	-4.347 ***	I	2							2	2
	G_t	1.101	I	3	-2.228	II	2	-4.909 ***	I	2							2	
Saga	T_t	1.389	I	3	-2.777	II	2	-5.077 ***	I	2							2	2
	G_t	1.392	I	3	-2.202	II	2	-4.822 ***	I	2							2	
Nagasaki	T_t	2.054	I	3	-2.329	II	4	-2.452 **	I	8							2	2
	G_t	-0.910	I	10	-1.552	II	9	-3.127 ***	I	8							2	
Kumamoto	T_t	1.476	I	2	-2.107	II	2	-3.192 ***	I	3							2	2
	G_t	0.583	I	5	-1.179	II	4	-2.428 **	I	3							2	
Oita	T_t	0.871	I	3	-2.569	II	2	-4.223 ***	I	2							2	2
	G_t	-0.118	I	10	-1.757	II	9	-2.859 ***	I	8							2	
Miyazaki	T_t	0.749	I	4	-2.221	II	2	-4.198 ***	I	2							2	2
	G_t	-0.178	I	10	-1.781	I	9	-2.882 ***	I	8							2	
Kagoshima	T_t	0.372	I	4	-1.973	II	2	-3.501 ***	I	2							2	3
	G_t	-0.517	I	10	-1.685	II	10	-1.659 *	I	10	-2.424 **	I	10				3	

Notes: [a] Its sample period is FY1956-FY1994 because the great Hanshin-Awaji earthquake occurred in FY1995.

***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

The above t statistic is that of the following ϕ_1.

Model I: $Y_t = \phi_1 Y_{t-1} + \lambda_1 \Delta Y_{t-1} + \lambda_2 \Delta Y_{t-2} + \cdots + \lambda_p \Delta Y_{t-p} + u_t$

II: $Y_t = \alpha + \phi_1 Y_{t-1} + \lambda_1 \Delta Y_{t-1} + \lambda_2 \Delta Y_{t-2} + \cdots + \lambda_p \Delta Y_{t-p} + u_t$

III: $Y_t = \alpha + \beta t + \phi_1 Y_{t-1} + \lambda_1 \Delta Y_{t-1} + \lambda_2 \Delta Y_{t-2} + \cdots + \lambda_p \Delta Y_{t-p} + u_t$

IV: $Y_t = \alpha + \beta t + \gamma t^2 + \phi_1 Y_{t-1} + \lambda_1 \Delta Y_{t-1} + \lambda_2 \Delta Y_{t-2} + \cdots + \lambda_p \Delta Y_{t-p} + u_t$

where Y_t denotes the dependent variable and p denotes the lag length of the above regression.

Table 2

The Order of Integration
(Summary)
Sample Period: FY1956-FY1995

The significance level is 5%.

Prefecture	R_t, E_t d_{max}	T_t, G_t d_{max}
Hokkaido	3	3
Aomori	2	2
Iwate	2	2
Miyagi	3	2
Akita	2	2
Yamagata	2	3
Fukushima	2	2
Ibaraki	2	2
Tochigi	2	2
Gunma	2	2
Saitama	2	2
Chiba	2	2
Tokyo	2	4
Kanagawa	2	3
Niigata	2	2
Toyama	2	2
Ishikawa	2	2
Fukui	2	2
Yamanashi	2	2
Nagano	0	2
Gifu	3	3
Shizuoka	2	3
Aichi	2	3
Mie	2	2
Shiga	2	2
Kyoto	2	2
Osaka	2	2
Hyogo [a]	3	3
Nara	2	2
Wakayama	2	2
Tottori	2	3
Shimane	2	2
Okayama	2	2
Hiroshima	2	2
Yamaguchi	2	2
Tokushima	3	2
Kagawa	3	3
Ehime	2	2
Kochi	3	3
Fukuoka	2	2
Saga	2	2
Nagasaki	2	2
Kumamoto	2	2
Oita	2	2
Miyazaki	2	2
Kagoshima	3	3

Note: [a] See Table 1

Table 3

Granger Causality Tests

Period	1956-1995			1956-1995		
Revenues	R_t			T_t		
Expenditures	E_t			G_t		
Causality		$R_t \rightarrow E_t$	$E_t \rightarrow R_t$		$T_t \rightarrow G_t$	$G_t \rightarrow T_t$
Prefecture	lag length	Wald statistic	Wald statistic	lag length	Wald statistic	Wald statistic
Hokkaido	4	22.847 ***	20.933 ***	6	15.190 **	21.239 ***
Aomori	4	24.881 ***	23.204 ***	6	49.334 ***	20.292 ***
Iwate	3	4.089	5.367	6	41.241 ***	16.597 **
Miyagi	6	40.345 ***	32.388 ***	4	32.602 ***	16.663 ***
Akita	4	4.766	2.805	6	47.790 ***	19.982 ***
Yamagata	3	20.015 ***	16.737 ***	5	14.308 **	33.706 ***
Fukushima	3	6.355 *	4.820 *	5	11.019 *	12.172 *
Ibaraki	3	34.305 ***	12.643 ***	6	53.325 ***	10.523 **
Tochigi	5	15.456 ***	6.615 **	4	63.726 ***	12.110 **
Gunma	3	4.581	3.136	4	8.448 *	9.866 *
Saitama	5	7.201	7.013	4	1.971	1.527
Chiba	6	36.653 ***	29.616 ***	5	13.466 **	3.489 **
Tokyo	5	130.059 ***	83.097 ***	6	51.813 ***	27.561 ***
Kanagawa	4	16.896 ***	12.810 **	6	10.641	15.555
Niigata	3	9.557 **	6.004 **	4	34.116	12.293
Toyama	5	29.977 ***	20.647 ***	3	18.156 ***	11.098 **
Ishikawa	4	11.272 **	7.814 **	6	10.432	12.249
Fukui	4	23.432 ***	27.939 ***	3	3.505	7.966
Yamanashi	6	63.507 ***	50.129 ***	3	8.402 **	6.132 **
Nagano	3	7.172 *	10.641 *	3	9.674 **	3.862 **
Gifu	6	37.210 ***	40.745 ***	4	34.313 ***	54.413 ***
Shizuoka	3	5.151	1.431	6	9.737	4.231
Aichi	3	13.152 ***	7.303 **	6	20.446 ***	56.020 ***
Mie	4	21.351 ***	37.095 ***	3	6.604 *	2.346 *
Shiga	4	10.047 **	8.987 **	3	2.756	5.635
Kyoto	5	47.629 ***	34.067 ***	3	17.499 ***	11.612 ***
Osaka	3	8.789 **	7.864 **	6	24.729 ***	10.799 **
Hyogo [a]	4	21.324 ***	18.044 ***	5	86.570 ***	27.235 ***
Nara	3	7.841 **	5.894 **	4	15.297 ***	10.855 **
Wakayama	3	7.855 **	2.247 **	5	31.006 ***	13.839 **
Tottori	3	7.807 *	7.248 *	5	24.218 ***	21.020 ***
Shimane	3	20.942 ***	16.927 ***	5	17.871 ***	14.456 **
Okayama	3	22.406 ***	9.449 **	3	10.900 **	2.257 **
Hiroshima	3	1.173	2.517	4	13.630 ***	18.202 ***
Yamaguchi	3	5.517	2.758	5	41.977 ***	24.570 ***
Tokushima	6	35.338 ***	55.816 ***	4	26.819 ***	20.351 ***
Kagawa	4	13.652 ***	8.899 ***	6	22.544 ***	14.498 **
Ehime	6	14.338 **	8.713 **	6	25.519 ***	74.440 ***
Kochi	4	9.410 *	10.219 *	4	11.046 **	3.569 **
Fukuoka	5	31.299 ***	23.445 ***	4	15.095 ***	1.284 **
Saga	3	2.821	6.114	4	16.707 ***	10.470 **
Nagasaki	6	50.281 ***	63.742 ***	6	62.606 ***	37.836 ***
Kumamoto	4	7.836 *	7.753 *	4	9.255 *	14.287 ***
Oita	3	0.841	1.559	6	70.662 ***	39.716 ***
Miyazaki	3	9.065 **	5.837 **	3	12.041 ***	4.424 **
Kagoshima	4	15.564 ***	5.058 **	4	30.640 ***	11.428 **

Notes: [a] See Table 1

***, **, and * denote significance at 1%, 5%, and 10% level, respectively.

Table 3
(continued)

Granger Causality Tests

Period	1960-1991			1960-1991		
Revenues	R_t			T_t		
Expenditures	E_t			G_t		
Causality		$R_t \rightarrow E_t$	$E_t \rightarrow R_t$		$T_t \rightarrow G_t$	$G_t \rightarrow T_t$
Prefecture	lag length	Wald statistic	Wald statistic	lag length	Wald statistic	Wald statistic
Hokkaido	5	88.081 ***	61.147 ***	5	37.002 ***	83.259 ***
Aomori	4	25.894 ***	25.307 ***	5	58.428 ***	43.854 ***
Iwate	4	6.080	2.182	5	61.391 ***	85.504 ***
Miyagi	4	16.866 ***	18.821 ***	4	54.428 ***	50.422 ***
Akita	4	6.391	5.994	5	67.560 ***	43.964 ***
Yamagata	3	18.454 ***	11.084 **	5	25.580 ***	60.226 ***
Fukushima	4	10.464 **	4.712 **	5	20.205 ***	31.121 ***
Ibaraki	5	41.596 ***	26.959 ***	5	35.990 ***	26.051 ***
Tochigi	5	13.625 **	9.212 **	4	39.743 ***	28.839 ***
Gunma	5	22.364 ***	21.488 ***	4	5.051	8.680
Saitama	5	8.055	7.947	4	20.122 ***	6.104 **
Chiba	5	38.741 ***	27.762 ***	5	21.037 ***	27.347 ***
Tokyo	5	187.024 ***	108.972 ***	5	36.330 ***	14.656 **
Kanagawa	3	11.887 ***	11.766 ***	5	8.903	14.586
Niigata	3	8.081 **	2.398 **	4	19.779 ***	27.521 ***
Toyama	4	44.049 ***	40.343 ***	3	11.295 **	16.672 ***
Ishikawa	5	14.970 **	12.270 **	5	30.673 ***	25.672 ***
Fukui	4	24.632 ***	27.404 ***	3	2.948	7.885
Yamanashi	5	26.462 ***	21.749 ***	3	6.279 *	2.594 *
Nagano	5	36.013 ***	42.442 ***	3	2.052	6.642
Gifu	5	31.959 ***	31.010 ***	4	44.270 ***	50.339 ***
Shizuoka	3	4.722	0.977	5	7.107	5.485
Aichi	3	15.787 ***	10.196 **	5	23.009 ***	54.832 ***
Mie	5	29.745 ***	40.839 ***	3	7.929 **	14.607 ***
Shiga	5	45.461 ***	27.668 ***	3	2.994	7.385
Kyoto	3	26.367 ***	19.687 ***	3	24.680 ***	4.912 **
Osaka	3	14.124 ***	11.483 ***	5	29.158 ***	11.911 **
Hyogo [a]	5	32.774 ***	36.752 ***	5	11.076 **	28.280 ***
Nara	5	20.855 ***	15.892 ***	4	15.523 ***	10.959 **
Wakayama	3	8.056 **	1.596 **	5	27.446 ***	28.579 ***
Tottori	5	9.058	9.045	5	86.621 ***	87.237 ***
Shimane	3	35.933 ***	29.053 ***	5	19.328 ***	17.290 ***
Okayama	3	22.050 ***	11.315 **	3	27.289 ***	22.992 ***
Hiroshima	3	9.670 **	16.190 ***	4	11.676 **	41.948 ***
Yamaguchi	5	7.603	3.510	5	35.967 ***	47.513 ***
Tokushima	5	29.731 ***	19.945 ***	4	24.561 ***	27.833 ***
Kagawa	4	13.957 ***	11.845 **	5	10.548 *	8.398 *
Ehime	3	11.481 ***	9.237 **	5	28.910 ***	67.881 ***
Kochi	4	16.845 ***	12.347 **	4	43.969 ***	22.530 ***
Fukuoka	5	39.010 ***	26.747 ***	4	15.730 ***	1.808 **
Saga	3	2.556	4.975	4	17.149 ***	26.736 ***
Nagasaki	5	46.564 ***	53.645 ***	5	52.582 ***	20.868 ***
Kumamoto	4	3.898	3.169	4	12.923 **	19.079 ***
Oita	5	21.698 ***	20.442 ***	5	150.702 ***	134.109 ***
Miyazaki	3	8.357 **	3.247 **	3	28.732 ***	27.084 ***
Kagoshima	5	4.762	2.360	4	62.048 ***	42.946 ***

Notes: [a] See Table 1
***, **, and * denote significance at 1%, 5%, and 10% level, respectively.