Discussion Papers In Economics And Business

Impacts of Tourism and Fiscal Expenditure on Remote Islands in Japan: A Panel Data Analysis

Noriko ISHIKAWA

Mototsugu FUKUSHIGE

Discussion Paper 06-21

Graduate School of Economics and
Osaka School of International Public Policy (OSIPP)
Osaka University, Toyonaka, Osaka 560-0043, JAPAN

Impacts of Tourism and Fiscal Expenditure on Remote Islands in Japan: A Panel Data Analysis

Noriko ISHIKAWA

Mototsugu FUKUSHIGE

Discussion Paper 06-21

July 2006

この研究は「大学院経済学研究科・経済学部記念事業」
基金より援助を受けた、記して感謝する。

Graduate School of Economics and
Osaka School of International Public Policy (OSIPP)
Osaka University, Toyonaka, Osaka 560-0043, JAPAN

Impacts of Tourism and Fiscal Expenditure on Remote Islands in Japan:

A Panel Data Analysis

Noriko ISHIKAWA
Graduate School of Science and Technology, Kobe University
1-1, Rokkodai-cho, Nada-ku, Kobe, 657-8501, JAPAN

Mototsugu FUKUSHIGE*
Graduate School of Economics, Osaka University
1-7, Machikaneyama-cho, Toyonaka, Osaka, 560-0043, JAPAN

Abstract

Japan consists of many small inhabited islands in addition to four main islands. We examine the impact of fiscal expenditure and the number of tourists on per capita taxable income in remote islands using panel data analysis. The results show that both fiscal expenditure and population size have significant positive impacts on per capita taxable income, whereas the number of tourists does not have statistically significant impact. They indicate that tourism development would not work as a substitute for financial support from the government. In other words, continuous financial support may be needed to maintain the islands' economies.

Running Title: Impacts of Tourism and Fiscal Expenditure in Japan

Keywords: Tourism Multiplier, Fiscal Multiplier, Remote Islands, Panel Data Analysis

***JEL classification*:** O23, R58, Q56, L83.

* Correspond to: Mototsugu FUKUSHIGE
Graduate School of Economics, Osaka University
1-7, Machikaneyama-cho, Toyonaka, Osaka, 560-0043, JAPAN
Phone. & fax: +81-6-6850-5248;
E-mail: mfuku@econ.osaka-u.ac.jp (M. Fukushige)

INTRODUCTION AND BACKGROUND

There is a large body of empirical analyses of the impact of international economic support or tourism on internal economic growth in some island states; for example, GANI, 1998, examined the macroeconomic determinants of economic growth in the South Pacific island states using cross-country data and GOUNDER, 2001, demonstrated the relationship between foreign aid and economic growth in the Fiji islands using time series data. We propose several reasons why the economies of most island states seem unable to grow very rapidly. First, the economies of most island states depend largely on agriculture, fisheries, and forestry. Second, due to the constraints of small populations, it is hard to foster the manufacturing industry, which has economies of scale and agglomeration externalities. Some developed countries, however, also face these issues and try to deal with them to develop the local economy.

Japan is an island state. It consists of about 6,800 small inhabited islands in addition to the four main islands (Hokkaido, Honshu, Shikoku, and Kyushu) and Okinawa Main Island located in the southwest of the Japanese Archipelago[1]. As many of these islands are located far from the main islands or lack affordable transportation, their economies are isolated from the mainland; that is, there is a difference in affluence between the people living in small islands and those living on the mainland.

The Japanese government has been implementing a wide variety of measures at the national level to promote the development of remote islands. The Improvement of Sea Routes to Remote Islands Act enacted on July 4, 1952 (hereafter referred to as the "Remote Islands Act"), was the first measure toward assisting the remote islands. It laid down some guidelines for economic development in remote islands: under this Act, the central government would provide public funds to maintain and improve access from remote islands to the mainland. The Law for Development of Remote Islands was enacted on July 22, 1953, as temporary legislation with a limit of 10 years following the Remote Islands Act; it has been amended four times and extended five times during the past 50 years. The Law for Development of Remote Islands aims to improve fundamental conditions in remote islands, focusing on improving and upgrading social as well as industrial infrastructure. The role of remote islands in protecting an exclusive economic zone was also specified through an amendment to the Law for Development of Remote Islands in 2003. There are also other measures promoting economic development in each region: the Special Measures Act for the Promotion and Development of the Amami Oshima Islands (enacted June 21, 1954); the Special Measures Act for the Promotion and Development of the Ogasawara Islands (enacted December 8, 1969); and the Special Measures Act for the Promotion of Okinawa Prefecture (enacted December 31, 1971)[2]. All these laws lay down the basic principles for promoting economic development in each region: the municipalities that supervise remote islands under these Acts had to lay down to develop their own regional plan and have been provided with financial and legal support for industrial development from the central government. The funds for public works projects under the Remote Islands Development Laws are provided as part of the budget of the Japanese Ministry of Land, Infrastructure, and Transport and are distributed among all the government ministries, agencies, and municipalities concerned. The remote islands also benefit from other programs, such as financial support for economic development in depopulated areas, which is a grant program providing a higher proportion of grants for projects under the Remote Islands Development Laws and municipal bond funds. Most projects are implemented by local municipalities, although some projects, such as shore protection, flood control, conservation reserves, airport development, and harbor improvement, are carried out by the central government.

According to the Handbook of Remote Islands Development 2004, the Remote Islands Development Laws cover 315 islands, with more than 737,000 people (0.6% of the total population) as of April 2001. The total project cost for economic development in remote islands amounts to around 160 billion yen annually, which is equal to 1.7% of total public works expenditure. This shows that the government invests quite a large sum of money per capita in remote islands. However, the population in remote islands has been decreasing. The National Census reports that the population of remote islands declined by 7.2% from 1995 to 2000 whereas the total population grew by 1.1%.

Since Japan's economic bubble burst in 1991, the Japanese government's severe financial difficulties seem to have worsened, due to the effect of the aging population[3]. This has resulted in a drastic reduction in financial assistance for promoting economic development in remote islands: the share of general expenditure for public works in remote islands decreased from 1.70% in 2001 to 1.57% in 2004. We also note that decentralization, which has been driven rapidly by the merger of municipalities since 1999[4], is intended to cut financial expenditure by local governments. The number of municipalities that supervise remote islands decreased from 221 in April 1998 to 210 in April 2003 in accordance with the promotion of amalgamating municipalities.

On the other hand, the Japanese government has kicked off a nationwide tourism campaign named "YOKOSO! JAPAN (Welcome to Japan!)" to attract millions of inbound tourists. According to the Japan National Tourist Organization, there is a large gap between the number of outbound and inbound tourists: in 2005, there were about 17.4 million outbound tourists, whereas the number of inbound tourists was estimated at approximately 6.7 million. The Japanese government has pushed forward with policies to attract foreign tourists in order to revitalize the local and national economies. This indicates that tourism development is expected to be an important and effective economic measure for local regions including remote islands. However, there has been no empirical analysis of whether tourism development in remote islands can be a substitute for financial assistance from the central government.

In this paper, we investigate the effectiveness of tourism development in remote islands as an economic measure. In particular, we examine the impact of fiscal expenditure of municipalities that supervise remote islands[5] and the number of tourists on per capita taxable income in remote islands using a panel data analysis.

The results show that the number of tourists has no significant and positive impact on per capita taxable income in remote islands. In other words, continuous financial support may be needed to maintain islands' economies. Furthermore, shrinking populations also have a large negative impact on the islands' economies. This indicates that the islands' economies would worsen if the residents were forced to relocate to the mainland as a result of a further decrease in financial aid to remote islands.

The paper consists of three sections. In the next section, we explain the panel data used in this study and conduct an empirical analysis to estimate the impact of fiscal expenditure on municipalities and the number of tourists on per capita taxable income in remote islands. The final section presents conclusions based on demographic, social, and economic trends, and discusses implications for further research.

EMPIRICAL ANALYSIS

We conducted an empirical analysis of the islands under the Remote Islands Development Laws. There are 315 islands and 214 municipalities (54 cities, 115 towns, and 45 villages) that supervise the islands as of April 2002[6]. We use a linear regression model, in which per capita taxable income is expressed as a linear combination of dependent variables such as per capita fiscal expenditure, the number of tourists per capita, and population size[7]. We also note that taxable income and fiscal expenditure are deflated by the national consumer price index (based on 2000 figures).

There is a need for a careful examination of the data before an empirical analysis. We had to analyze two kinds of data: municipality-based data (population size, fiscal expenditure, and taxable income) and island-based data (the number of tourists). We show further details of each type of data in Table 1. To analyze these more easily and clearly, we defined the "island regions" as outlined below to make the island authorities correspond to the municipal authorities, and use the data recalculated by each island region.

To assist understanding, we provide an illustration of two islands (Islands 1 and 2) that are divided into three parts (A, B, and C) and two parts of the mainland (D and E) in Fig. 1. We also assume that both Islands 1 and 2 are under the Remote Islands Development Laws.

First, we consider the case in which one or more municipalities take charge only of islands. If one municipality supervises Island 1 (A), we define the island region as Island 1 (A) itself. If two municipalities share parts of two islands (A + B and C), the island region is defined as both Islands 1 and 2 (A + B + C).

If a municipality supervises Island 1 as well as a part of the mainland (D), we denote the island region as Region (A + D). We also note that there are some cases in which two municipalities share parts of two islands and each of them supervises a part of the mainland (A + B + D and E + C). Then the island region is defined as Region (A + B + C + D + E).

We obtain 165 island regions using all of the available data, 124 after excluding missing values. We show the list of islands in Table A1. Note that we conducted a panel data analysis of data from 1975 to 2001 (26 years).

In this paper, we adopt a partial adjustment model and its modification to analyze the data. First, we set up the following partial adjustment model (note that the subscript *i* denotes individual islands and the subscript *t* denotes time):

$$Y_{it} - Y_{it-1} = \theta\left(Y_{it}^{*} - Y_{it-1}\right) + u_{it} \tag{1}$$

where Y is the per capita taxable income, θ is the partial adjustment coefficient, and Y^{*} is the ideal per capita taxable income given by $Y_{it}^{*} = \alpha + \beta G_{it} + \gamma T_{it} + \delta N_{it}$ where G is the per capita fiscal expenditure, T is the per capita number of tourists, and N is the population size. Substituting this formula into (1) and adding an error term, we have the following equation for an empirical analysis in this study:

$$Y_{it} = (1-\theta)Y_{it-1} + \theta\alpha + \theta\beta G_{it} + \theta\gamma T_{it} + \theta\delta N_{it} + u_{it}.$$

If we assume Y^{*} is given by a distributed lag model with *M* lags[8], we have

$$\begin{aligned} Y_{it}^{*} = \alpha + \beta_0 G_{it} + \beta_1 G_{it-1} + \beta_2 G_{it-2} \cdots + \beta_M G_{it-M} + \gamma_0 T_{it} + \gamma_1 T_{it-1} + \gamma_2 T_{it-2} \cdots + \gamma_M T_{it-M} \\ + \delta_0 N_{it} + \delta_1 N_{it-1} + \delta_2 N_{it-2} \cdots + \delta_M N_{it-M}. \end{aligned}$$

If we introduce a parameter that represents the difference between a variable at time *t* and that at time *t-1*, that is, $\Delta G_{it} = G_{it} - G_{it-1}$, $\Delta T_{it} = T_{it} - T_{it-1}$ and $\Delta N_{it} = N_{it} - N_{it-1}$, we then rewrite the above equation as follows:

$$\begin{aligned} Y_{it}^{*} = \alpha + \beta G_{it} + \phi_0 \Delta G_{it} + \phi_1 \Delta G_{it-1} + \phi_2 \Delta G_{it-2} \cdots + \phi_{M-1} \Delta G_{it-M+1} \\ + \gamma T_{it} + \psi_0 \Delta T_{it} + \psi_1 \Delta T_{it-1} + \psi_2 \Delta T_{it-2} \cdots + \psi_{M-1} \Delta T_{it-M+1} \\ + \delta N_{it} + \xi_0 \Delta N_{it} + \xi_1 \Delta N_{it-1} + \xi_2 \Delta N_{it-2} \cdots + \xi_M \Delta N_{it-M+1}. \end{aligned}$$

Thus, the fiscal and tourism multipliers and the effect of population size in the long run are denoted by β, γ, and δ, respectively[9]. Using this formula, (1) is then modified as:

$$\begin{aligned} Y_{it} = (1-\theta)Y_{it-1} + \theta\alpha + \theta\beta G_{it} + \theta\phi_0 \Delta G_{it} + \theta\phi_1 \Delta G_{it-1} \cdots + \theta\phi_{M-1} \Delta G_{it-M+1} \\ + \theta\gamma T_{it} + \theta\psi_0 \Delta T_{it} + \theta\psi_1 \Delta T_{it-1} \cdots + \theta\psi_{M-1} \Delta T_{it-M+1} \\ + \theta\delta N_{it} + \theta\xi_0 \Delta N_{it} + \theta\xi_1 \Delta N_{it-1} \cdots + \theta\xi_{M-1} \Delta N_{it-M+1} + u_{it}. \end{aligned}$$

Applying this model to panel data allows us to relax the constancy of the intercept α. In particular, the variable α can be divided into three separate components as follows:

$$\alpha_{it} = \mu + \eta_i + \tau_t$$

where μ is a constant over all time and islands, η_i is a variable depending only on the individual island *i*, τ_t is a variable depending only on the time *t*. We have two popular models for this specification. One is a fixed effects model that treats both η_i and τ_t as nonstochastic variables, and the other is a random effects model that assumes both η_i and τ_t are random variables with zero means. Positive variances such as σ_η^2 and σ_τ^2, and u_{it}, η_i, and τ_t are mutually independent. First, we consider a fixed effects model for the specification of α using individual and/or time dummy variables.

In this paper, we use two kinds of models in terms of variable transformation: a linear model using all of the original variables and a log-linear model with logarithmic transformation of all variables. The following is the procedure for the choice of lag length and model selection.

First, we assume four kinds of α in terms of their components: α with only the individual dummy variable η_i, with only the time dummy variable τ_t, and with both/neither η_i and/nor τ_t. We set the maximum lag length to five, and chose one model from both linear and log-linear models where the SBIC was minimized. Next, we conducted nonnested tests (P_E tests), as proposed by MACKINNON et al., 1983, between these two models, and examined which model the data better supported[10]. We have annual data for 26 years from 124 regions. As data from the first five years was used only as explanatory variables to estimate lag length, 2,604 observations were available for this survey (2,604=124*(26–5)).

In the first procedure, we chose the model that had only a time dummy and 0 lag in each case of linear and log-linear models as "the selected model" (see Table 2). We also show the results of nonnested tests between these selected models in Table 3. We then finally select the log-linear model that has only a time dummy and 0 lag since the null hypothesis is rejected if we set the null hypothesis that the true model is a linear model and the null hypothesis is not rejected if we set the null hypothesis that the true model is a log-linear model, simultaneously.

The results of the selected log-linear model in Table 4 indicate that the estimated coefficient of the tourism (per capita tourists) is not statistically significant. We then defined "the minimum SBIC model" as the log-linear model that has only a time dummy and 0 lag estimated without a tourism variable. Table 3 shows that we also selected the minimum SBIC model rather than the selected linear model, as the null hypothesis is not rejected if we set the null hypothesis to be that the minimum SBIC model is optimal.

Since we used panel data, we had to examine whether the random effects model could be applied. In Table 5, we show the estimated results of the random effects model with time-variant error components (τ_t)[11]. Although the value of SBIC of the random effects model is smaller than that of the fixed effects model (see Tables 4 and 5), the Hausman specification test statistics are significant, which indicates a correlation between the error term and the explanatory variables. Then we conclude that the fixed effects model is preferred to the random effects model. We should also note that there is little difference in any of the estimated coefficients, excluding the constant term, between the fixed effects model and the random effects model. In the column "transformed" in Table 5, we show the corresponding coefficients calculated from original estimates of the random effects model.

Now, we examine the impacts of government expenditure and tourism in accordance with the results of the selected log-linear model in Table 4. The R-squared value for this model is very high, at almost 0.98, due to dummy variables. There is not much difference between the estimated coefficients of government expenditure and tourism: their elasticity values are estimated to be between 0.23 and 0.24. Tourism, however, has a t-value of 1.14, which is not statistically significant. On the other hand, the t-value for government expenditure is statistically significant. Taking into account the minimum SBIC model, which is estimated without the tourism variable, the government expenditure in Japanese island regions has a significant positive impact on the per capita taxable income, whereas the number of tourists does not. Table 4 also shows that the population size has a positive and statistically significant coefficient. It indicates that population growth also increases the productivity of the local economy in the island regions. We also note that the adjustment coefficient is estimated to be 0.026, which indicates a relatively slow adjustment of taxable income: it takes 88 years to achieve 90% of the "ideal income", or 27 years to reach 50%.

We conclude by discussing the following implications of these findings for economic development in the remote islands in Japan. First, the government expenditure can be considered an effective method for economic development in remote islands. Second, there is some doubt about whether tourism development may be regarded as an effective method for economic development in remote islands. Last, the expected population decrease in remote islands will have a negative impact on economic development.

CONCLUSIONS

In this paper, we examine the impacts of fiscal expenditure, the number of tourists, and the population size on the per capita taxable income of 124 island regions in Japan by conducting an empirical analysis using panel data. A log-linear partial adjustment model that has only a time dummy and 0 lag is selected as the optimal model by the SBIC and a nonnested test. The estimated results indicate that both fiscal expenditure and population size have a significant positive impact on the per capita taxable income, whereas the number of tourists has no statistically significant impact. We discuss the political implications of these results: (1) the taxable income in the remote islands would decrease if financial support from the central government to local governments decreases; and (2) the tourism development expected to be an effective measure for economic development would not work as a substitute for financial support from the government. There is a possibility that further reduction of taxable income would result if declines in population size and government expenditure are both taken into account, although we have not adequately analyzed this effect in this paper.

There is a possibility that the t-value for tourism may be underestimated if the coefficient for tourism is different in each island region. Taking into account the results for the Amami Oshima Islands, which were shown by ISHIKAWA and FUKUSHIGE, 2006, we cannot deny the possibility that either a linear or a log-linear model would be appropriate in particular island regions. To resolve this issue, we have to conduct the above model selection procedure in each island region. However, we have to interpret the results of this procedure with caution because of the lack of sufficient annual data.

If the estimated results are different in each island region, then the appropriate measures for each island region should be implemented. In particular, the economic development issues in the remote islands should be addressed according to the islands' individual economic and social conditions rather than the entire island region being administered by the Law for Development of Remote Islands.

Acknowledgments: Financial support from the Japan Society for the Promotion of Science (Grant-in-Aid for Scientific Research A(2) 16203020) is gratefully acknowledged. We are also grateful to Toru Nagahashi for his helpful comments.

NOTES

[1] The 6,847 "islands" other than the mainland (Hokkaido, Honshu, Shikoku, Kyushu, and Okinawa) are defined as remote islands in Japan in the Handbook of Remote Islands Development, which is published by the National Institute for Japanese Islands. This also says that "island" has to satisfy all the following requirements based on the survey conducted by the Hydrographic and Oceanographic Department in 1986: (1) they must have a girth of over 0.1 km; (2) they must have a narrow structure such as bridge or pier if they have a fixed link to the mainland; and (3) they must not be reclamation lands.

[2] We hereafter refer to these three Special Laws and Law for Development of Remote Islands as "Remote Islands Development Laws."

[3] According to the Annual Report on the Japanese Economy and Public Finance 2005 published by the Cabinet Office, the total amount of outstanding national and local long-term debts was estimated at 774 trillion yen (the budget deficit in relation to GDP is almost 150%) at the end of 2005.

[4] The merger of municipalities has been promoted under the Special Law on the Merger of Municipalities, enacted on March 29, 1965, and amended July 26, 1999. The number of municipalities decreased from 3,232 at the end of March 1999 to 1,822 at the end of March 2006.

[5] Most financial aid to remote islands from the central government and prefectures is provided to each municipality that controls remote islands. We therefore equated fiscal expenditure of municipality with financial aid to remote islands. It is difficult to calculate expenditure in each island as each has some projects that the central government subsidizes directly.

[6] This data is from Handbook of Remote Islands Development published by the National Institute for Japanese Islands.

[7] Many studies have been conducted to determine a tourism multiplier, such as ARCHER, 1982,

LUNDBERG et al., 1995, VANHOVE, 2005. BALAGUER and CANTAVELLA-JORDA, 2002, estimated the long-run effect of tourism on economic growth by applying some recent time series techniques, and BAAIJENS and NIJKAMP, 2000, and BAAIJENS et al., 1998, adopted a meta-analytic approach to empirical research on this topic. We also refer to MURINDE and RARAWA, 1996, who examined the effectiveness of stabilization policy on the Solomon Islands' economy using a macroeconomic model, and JOHNSON and THOMAS, 1990, who estimated the impact of a major tourist attraction on local employment in the north of England.

[8] We can definitely set different lag lengths to each variable. In this paper, however, we set all the lag lengths equal (M) for simplicity.

[9] This model is considered a distribution lag model, which is more flexible than the Koyck distributed lag model given by a partial adjustment model.

[10] All parameter estimates were calculated using TSP 5.0.

[11] If we assume that the error term in the partial adjustment model follows an error component structure with individual effect, there exists a correlation between the error term and the explanatory variables. In this paper, a model can be estimated using the Maximum Likelihood Estimation method because the error term is supposed to be composed of only a time effect. The dynamic panel data model, which is seen in BALTAGI, 2005, also has an individual effect on the error term. In terms of estimation of tourism demand, SONG and WITT, 2000, comment on the model and provide some applications.

REFERENCES

ARCHER, B. (1982) The value of multipliers and their policy implications, Tourism Management **3**, 236–241.

BAAIJENS, S. and NIJKAMP, P. (2000) Meta-analytic methods for comparative and exploratory policy research: an application to the assessment of regional tourist multipliers, Journal of Policy Modeling **22**, 821–858.

BAAIJENS, S.R., NIJKAMP, P., and MONFORT, K.V. (1998) Explanatory meta-analysis for the comparison and transfer of regional tourist income multipliers, Regional Studies **32**, 839–849.

BALAGUER, J. and CANTAVELLA-JORDA, M. (2002) Tourism as a long-run economic growth factor: the Spanish case, Applied Economics **34**, 877–884.

BALTAGI, B.H. (2005) Econometric Analysis of Panel Data, 3rd edition, John Wiley & Sons, New York.

GANI, A. (1998) Macroeconomic determinants of growth in the South Pacific island economies, Applied Economics Letters **5**, 747–749.

GOUNDER, R. (2001) Aid-growth nexus: empirical evidence from Fiji, Applied Economics **33**, 1009–1019.

ISHIKAWA, N. and FUKUSHIGE, M. (2006) Impacts of tourism and fiscal expenditure to remote islands: the case of the Amami islands in Japan, Applied Economics Letters, forthcoming.

JOHNSON, P. and THOMAS, B. (1990) Measuring the local employment impact of a tourist attraction: an empirical study, Regional Studies **24**, 395–403.

LUNDBERG, D.E., KRISHNAMOORTHY M., and STAVENGA, M.H. (1995) Tourism Economics, John Wiley & Sons, New York.

MACKINNON, J.G., WHITE, H., and DAVIDSON, R. (1983) Tests for model specification in the presence of alternative hypotheses: some further results, Journal of Econometrics **21**, 53–70.

MURINDE, V. and RARAWA, D.H. (1996) Modelling the potency of stabilization policy for the Solomon Islands 1978:1Q–1992:4Q, Applied Economics **28**, 309–319.

SONG, H. and WITT, S.F. (2000) Tourism Demand Modelling and Forecasting: Modern Econometric Approaches, Pergamon, Amsterdam.

VANHOVE, N. (2005) Economics of Tourism Destinations, Elsevier, Amsterdam.

Table 1. Island regions

Variables	Definition	Sources
Taxable income	Total taxable income of cities, towns, and villages	Survey of taxation of cities, towns, and villages
Population size	Total population of cities, towns, and villages	Account book based on inhabitants
Local government expenditure	Total fiscal expenditure of cities, towns, and villages	Survey of statements of accounts of cities, towns, and villages
Number of tourists	Total numbers of tourists in cities, towns, and villages	National Institute for Japanese Islands
Price level	Consumer Price Index	Statistics Bureau, Ministry of Internal Affairs and Communications

Table 2 SBIC for Model Selection

	Linear Model	Log-linear Model
Without Dummies		
Lag = 0	19904.5	–3702.85
Lag = 1	19900.7	–3709.04
Lag = 2	19911.0	–3701.22
Lag = 3	19922.3	–3690.84
Lag = 4	19933.2	–3683.38
Lag = 5	19943.8	–3672.27
With Individual Dummy		
Lag = 0	20133.3	–3544.78
Lag = 1	20134.3	–3557.78
Lag = 2	20137.2	–3548.42
Lag = 3	20142.5	–3539.28
Lag = 4	20151.2	–3538.62
Lag = 5	20153.7	–3525.31
With Time Dummy		
Lag = 0	**19581.9**	**–4004.08**
Lag = 1	19587.0	–3998.87
Lag = 2	19592.6	–3991.41
Lag = 3	19602.6	–3980.79
Lag = 4	19613.9	–3969.87
Lag = 5	19624.6	–3959.11
With Individual & Time Dummies		
Lag = 0	19801.7	–3830.26
Lag = 1	19812.7	–3819.33
Lag = 2	19808.0	–3824.41
Lag = 3	19811.0	–3824.02
Lag = 4	19819.4	–3824.31
Lag = 5	19820.3	–3832.20

Note: Minimum SBIC cases are indicated in bold face type in each model.

Table 3 Results of Nonnested Test

Nonnested test between selected models

	Null Hypothesis	
Alternative Hypothesis	Linear Model	Log-Linear Model
Linear Model	–	1.86178
Log-Linear Model	7.7387**	–

Note: **= the null hypothesis is rejected at a significance level of 1%.

Nonnested test between the linear selected model and minimum SBIC model (see Table 4)

	Null Hypothesis	
Alternative Hypothesis	Linear Model	Minimum SBIC Model
Linear Model	–	1.77553
Minimum SBIC Model	7.63997**	–

Note: **= the null hypothesis is rejected at a significance level of 1%.

Table 4 Estimated Results of Selected Model

	Selected Log-Linear Model	Minimum SBIC Model
Tourism	0.023400	
	(1.1405)	
Government Expenditure	0.239760*	0.256613*
	(2.0454)	(2.2069)
Population	0.109877**	0.091558**
	(3.2424)	(2.8534)
θ	0.026027**	0.025977**
	(5.9840)	(5.9788)
Constant	5.48255**	5.51734**
	(4.4867)	(4.5018)
Dummies	Time	Time
R^2	0.98049	0.98040
Standard Error	0.050311	0.050311
Log Likelihood	4102.39	4101.89
SBIC	–4004.08	–4007.51

Note: t-values are given in brackets.
**= the null hypothesis that this coefficient is zero is rejected at a significance level of 1%.
*= the null hypothesis that this coefficient is zero is rejected at a significance level of 5%.

Table 5 Estimated Results

Random Effects Model		
	Estimated	Transformed
Tourism	0.000635186	0.023710
	(1.0350)	
Government Expenditure	0.00601940*	0.224688
	(2.2165)	
Population	0.00288659**	0.107749
	(2.4650)	
Lagged Income / θ	0.973210**	0.026790
	(281.103)	
Constant	0.176233**	6.578313
	(4.6254)	
Error Components	Time	
Hausman's Specification Test	14.519**	
σ^2	0.00306801	
ρ_i	0.176233	
Log Likelihood	4057.0	
SBIC	–4033.4	

Note: See Note in Table 4.

Table A1 List of Islands

No	Islands	Cities, Towns, and Villages	Region	Prefecture
1	Rebun-to	Rebun-cho	Rebun-to	Hokkaido
2	Rishiri-to	Rishiri-cho, Rishirifuji-cho	Rishiri-to	Hokkaido
3	Yagishiri-to, Teuri-to	Haboro-cho	Teuri/Yagishiri	Hokkaido
4	Okushiri-to	Okushiri-cho	Okushiri-to	Hokkaido
5	O-shima	Kesennuma-shi	O-shima	Miyagi
6	Izu-shima, E-no-shima	Onagawa-cho	Oshika-shoto	Miyagi
7	Aji-shima	Oshika-cho	Oshika-shoto	Miyagi
8	Tashiro-jima	Ishinomaki-shi	Oshika-shoto	Miyagi
9	Sabusawa-jima, Nono-shima, Katsura-jima, Ho-jima	Shiogama-shi	Urato-shoto	Miyagi
10	Tobi-shima	Sakata-shi	Tobi-shima	Yamagata
11	O-shima	Oshima-cho	Izu-shoto	Tokyo
12	To-shima	Toshima-mura	Izu-shoto	Tokyo
13	Nii-jima, Shikine-jima	Niijima-mura	Izu-shoto	Tokyo
14	Kozu-shima	Kozushima-mura	Izu-shoto	Tokyo
15	Hachijo-shima	Hachijo-cho	Izu-shoto	Tokyo
16	Chichi-jima, Haha-jima, Io-jima, Minamitori-shima	Ogasawara-mura	Ogasawara-shoto	Tokyo
17	Awa-shima	Awashimaura-mura	Awa-shima	Niigata
18	Hegura-shima	Wajima-shi	Hegura-shima	Ishikawa
19	Hatsu-shima	Atami-shi	Hatsu-shima	Shizuoka
20	Saku-shima	Isshiki-cho	Aichi-mishima	Aichi
21	Himaka-jima, Shino-jima	Minamichita-cho	Aichi-mishima	Aichi
22	Kami-shima, Toshi-jima, Suga-shima, Sakate-jima	Toba-shi	Shima-shoto	Mie
23	Watakano-jima	Isobe-cho	Shima-shoto	Mie
24	Mazaki-jima	Shima-cho	Shima-shoto	Mie
25	Nu-shima, Awaji-shima	Nandan-cho, Sumoto-shi	Nu-shima/Nada	Hyogo
26	Tanga-shima, Ie-shima, Boze-jima, Nishi-jima	Ieshima-cho	Ieshima-gunto	Hyogo
27	Dogo	Saigo-cho, Fuse-mura, Goka-mura, Tsuma-mura	Oki-shima	Shimane
28	Naka-no-shima	Ama-cho	Oki-shima	Shimane
29	Nishi-no-shima	Nishi-no-shima-cho	Oki-shima	Shimane
30	Chiburi-jima	Chibu-mura	Oki-shima	Shimane
31	Kakui-jima, Otabu-jima, Kashira-jima, Ko-jima	Hinase-cho	Hinase-shoto	Okayama
32	Inu-jima	Okayama-shi	Inu-jima	Okayama
33	Matsu-shima, Muguchi-jima	Kurashiki-shi	Kojima-shoto	Okayama
34	Taka-shima, Shiraishi-jima, Kitagi-shima, Manabe-shima, Kobi-shima, Obi-shima, Mu-shima	Kasaoka-shi	Kasaoka-shoto	Okayama
35	Hashiri-jima	Fukuyama-shi	Hashirijima-gunto	Hiroshima
36	Hoso-jima	Innoshima-shi	Geibi-gunto	Hiroshima
37	Sagi-jima, Kosagi-jima	Mihara-shi	Geibi-gunto	Hiroshima
38	Osaka-shimo-shima, Mikado-jima, Toyo-shima, Itsuki-shima	Yutaka-machi, Toyohama-cho	Shimo-osaki-gunto	Hiroshima
39	Atada-shima	Otake-shi	Aki-gunto	Hiroshima
40	Ha-shima, Hashira-jima, Kuro-shima	Iwakuni-shi	Hashirajima-gunto	Yamaguchi
41	Kasasa-shima	Oshima-cho	Suo-oshima-gunto	Yamaguchi
42	Iwai-shima, Ya-shima	Kaminoseki-cho	Kumage-gunto	Yamaguchi
43	Futaoi-jima, Mutsure-jima	Shimonoseki-shi	Hibikinada-shoto	Yamaguchi
44	Uma-shima	Tabuse-cho	Kumage-gunto	Yamaguchi
45	Nasake-jima	Towa-cho	Suo-oshima-gunto	Yamaguchi
46	Mi-shima, O-shima, Hitsu-shima, Ai-shima	Hagi-shi	Hagi-shoto	Yamaguchi
47	Sago-jima	Hirao-cho	Kumage-gunto	Yamaguchi
48	No-shima	Hofu-shi	Shunan-shoto	Yamaguchi
49	Heigun-to	Yanai-shi	Heigun-to	Yamaguchi
50	U-shima	Hikari-shi	Shunan-shoto	Yamaguchi
51	I-shima	Anan-shi	I-shima	Tokushima
52	Teba-jima	Mugi-cho	Teba-jima	Tokushima
53	Ode-shima, Te-shima	Tonosho-cho	Naoshima-shoto	Kagawa
54	Nao-shima, Ushigakubi-jima, Byobu-jima, Muku-shima	Naoshima-cho	Naoshima-shoto	Kagawa
55	Ogi-jima, Megi-jima	Takamatsu-shi	Naoshima-shoto	Kagawa
56	Hitsuishi-jima, Iguro-shima, Yo-shima, Oyo-shima	Sakaide-shi	Shiwaku-shoto	Kagawa
57	Hon-jima, Ushi-jima, Hiro-shima, Te-shima, Ote-shima	Marugame-shi	Shiwaku-shoto	Kagawa
58	Sanagi-jima, Takami-shima	Tadotsu-cho	Shiwaku-shoto	Kagawa

Table A1 List of Islands (continued)

No	Islands	Cities, Towns, and Villages	Region	Prefecture
59	Awa-shima, Shishi-jima	Takuma-cho	Shiwaku-shoto	Kagawa
60	Ibuki-jima	Kan-onji-shi	Ibuki-jima	Kagawa
61	Takaikami-shima, Uo-shima	Uoshima-mura	Uoshima-gunto	Ehime
62	Yuge-shima, Sa-shima, Toyo-shima	Yuge-cho	Kamijima-shoto	Ehime
63	Ikina-jima	Ikina-mura	Kamijima-shoto	Ehime
64	Iwagi-jima	Iwagi-mura	Kamijima-shoto	Ehime
65	U-shima, Tsu-shima	Miyakubo-cho, Yoshiumi-cho	Ochi-shoto	Ehime
66	Oge-shima, Koge-shima, Okamura-jima	Sekizen-mura	Sekizen-shoto	Ehime
67	O-shima, Kuru-shima, Uma-shima, Hiki-jima	Imabari-shi	Kurushima-gunto	Ehime
68	O-shima	Niihama-shi	Nii-oshima	Ehime
69	Ai-jima	Hojo-shi	Ai-jima	Ehime
70	Nogutsuna-jima, Muzuki-jima, Naka-jima, Nuwa-shima, Tsuwaji-shima, Futagami-jima	Nakajima-cho	Kotsuna-shoto	Ehime
71	Ao-shima	Nagahama-cho	Ao-shima	Ehime
72	O-shima	Yahatahama-shi	Uwakai-shoto	Ehime
73	Ku-shima, Ka-shima, To-jima, Hiburi-jima	Uwajima-shi	Uwakai-shoto	Ehime
74	Take-ga-shima	Tsushima-cho	Uwakai-shoto	Ehime
75	Oki-no-shima, Uguru-shima	Sukumo-shi	Oki-no-shima	Kochi
76	Uma-shima, Ai-no-shima	Kitakyushu-shi	Chikuzen-shoto	Fukuoka
77	O-shima	Oshima-mura	Chikuzen-shoto	Fukuoka
78	Ai-no-shima	Shingu-machi	Chikuzen-shoto	Fukuoka
79	Genkai-jima, Oro-no-shima	Fukuoka-shi	Chikuzen-shoto	Fukuoka
80	Hime-shima	Shima-machi	Chikuzen-shoto	Fukuoka
81	Taka-shima, Kashiwa-jima	Karatsu-shi	Genkai-shoto	Saga
82	Ogawa-shima	Yobuko-cho	Genkai-shoto	Saga
83	Karara-shima, Matsu-shima, Madara-shima	Chinzei-machi	Genkai-shoto	Saga
84	Muku-shima	Hizen-machi	Genkai-shoto	Saga
85	Taka-shimaKuro-shima	Takashima-cho, Ashibe-cho, Katsumoto-cho, Gonoura-cho	Hirado-shoto	Nagasaki
86	Ao-shimaTobi-shima	Matsushima-shi	Hirado-shoto	Nagasaki
87	O-shima	Oshima-mura	Hirado-shoto	Nagasaki
88	Uku-shima, Tera-shima	Uku-machi	Hirado-shoto	Nagasaki
89	Mu-shima, Nozaki-jima, No-shima, Ojika-jima, Kuro-shima, O-shima	Odika-cho	Hirado-shoto	Nagasaki
90	Taka-shima, Kuro-shima	Sasebo-shi	Hirado-shoto	Nagasaki
91	Nakadori-jima, Kashira-ga-shima, Kiri-no-ko-jima, Wakamatsu-jima, Hino-shima, Arifuku-jima, Ryozegaura-shima	Shinuonome-cho	Goto-retto	Nagasaki
92	Naru-shima, Mae-shima	Naru-machi, Kamigoto-cho, Arikawa-cho, Wakamatsu-cho, Narao-cho	Goto-retto	Nagasaki
93	Hisaka-jima, Warabi-ko-jima, Kaba-shima, Fukue-jima, Aka-shima, O-shima, Kuro-shima, Shimayama-jima, Saga-no-shima	Fukue-shi	Goto-retto	Nagasaki
94	Kakinoura-shima, Sakito-jima, E-no-shima, Hira-shima	Sakito-cho	Kakiura-oshima	Nagasaki
95	Matsu-shima	Oseto-cho	Matsu-shima	Nagasaki
96	Io-jima, Oki-no-shima	Iojima-machi	Io-jima	Nagasaki
97	Ike-shima	Sotome-cho	Matsu-shima	Nagasaki
98	Yokoura-jima, Maki-shima, Goshonoura-shima	Goshoura-machi	Amakusa-shoto	Kumamoto
99	Hime-shima	Himeshima-mura	Hime-shima	Oita
100	Jimuku-shima, Hodo-jima	Tsukumi-shi	Bungo-shoto	Oita
101	Onyu-jima	Saeki-shi	Bungo-shoto	Oita
102	O-shima	Tsurumi-machi	Bungo-shoto	Oita
103	Yakata-jima, Fuka-shima	Kamae-cho	Bungo-shoto	Oita
104	Shimanoura-shima	Nobeoka-shi	Shimanoura-shima	Miyazaki
105	O-shima	Nango-cho	Minaminaka-gunto	Miyazaki
106	Tsuki-shima	Kushima-shi	Minaminaka-gunto	Miyazaki
107	Shishi-jima	Higashi-cho	Naga-shima	Kagoshima
108	Katsura-jima	Izumi-shi	Katsura-jima	Kagoshima
109	Kamikoshiki-jimaNakakoshiki-jima	Sato-mura, Kamikoshiki-mura	Koshiki-jima	Kagoshima
110	Shimokoshiki-jima	Kashima-mura, Shimokoshiki-mura	Koshiki-jima	Kagoshima

Table A1 List of Islands (continued)

No	Islands	Cities, Towns, and Villages	Region	Prefecture
111	Tane-ga-shima, Mage-shima	Nishinoomote-shi, Nakatane-cho, Minamitane-cho	Tanega-shima	Kagoshima
112	Yaku-shima, Kuchinoerabu-jima	Kamiyaku-cho, Yaku-cho	Yaku-shima	Kagoshima
113	Take-shimaIo-jima, Kuro-shima	Mishima-mura	Nansei-shoto	Kagoshima
114	Iheya-jima, Noho-jima	Iheya-son	Hokubu-ken-iki	Okinawa
115	Izena-jima	Izena-son	Hokubu-ken-iki	Okinawa
116	Minna-shima	Motobu-cho	Hokubu-ken-iki	Okinawa
117	Tsuken-jima	Katsuren-cho	Chunanbu-ken-iki	Okinawa
118	Kudaka-jima	Chinen-son	Chunanbu-ken-iki	Okinawa
119	Zamami-jima, Aka-shima, Geruma-jima	Zamami-son	Chunanbu-ken-iki	Okinawa
120	Tokashiki-jima	Tokashiki-son	Chunanbu-ken-iki	Okinawa
121	Miyako-jima, Ikema-jima, Ogami-jima, Kurima-jima	Hirara-shi	Miyako-ken-iki	Okinawa
122	Ishigaki-jima	Ishigaki-shi	Yaeyama-ken-iki	Okinawa
123	Taketomi-jima, Iriomote-jima, Hatoma-jima, Yubu-shima, Kohama-jima, Kuro-shima, Aragusuku-jima-kamichi, Aragusuku-jima-shimochi, Hateruma-jima, Sotopanari-jima, Kayama-jima	Taketomi-cho	Yaeyama-ken-iki	Okinawa
124	Yonaguni-jima	Yonaguni-cho	Yaeyama-ken-iki	Okinawa

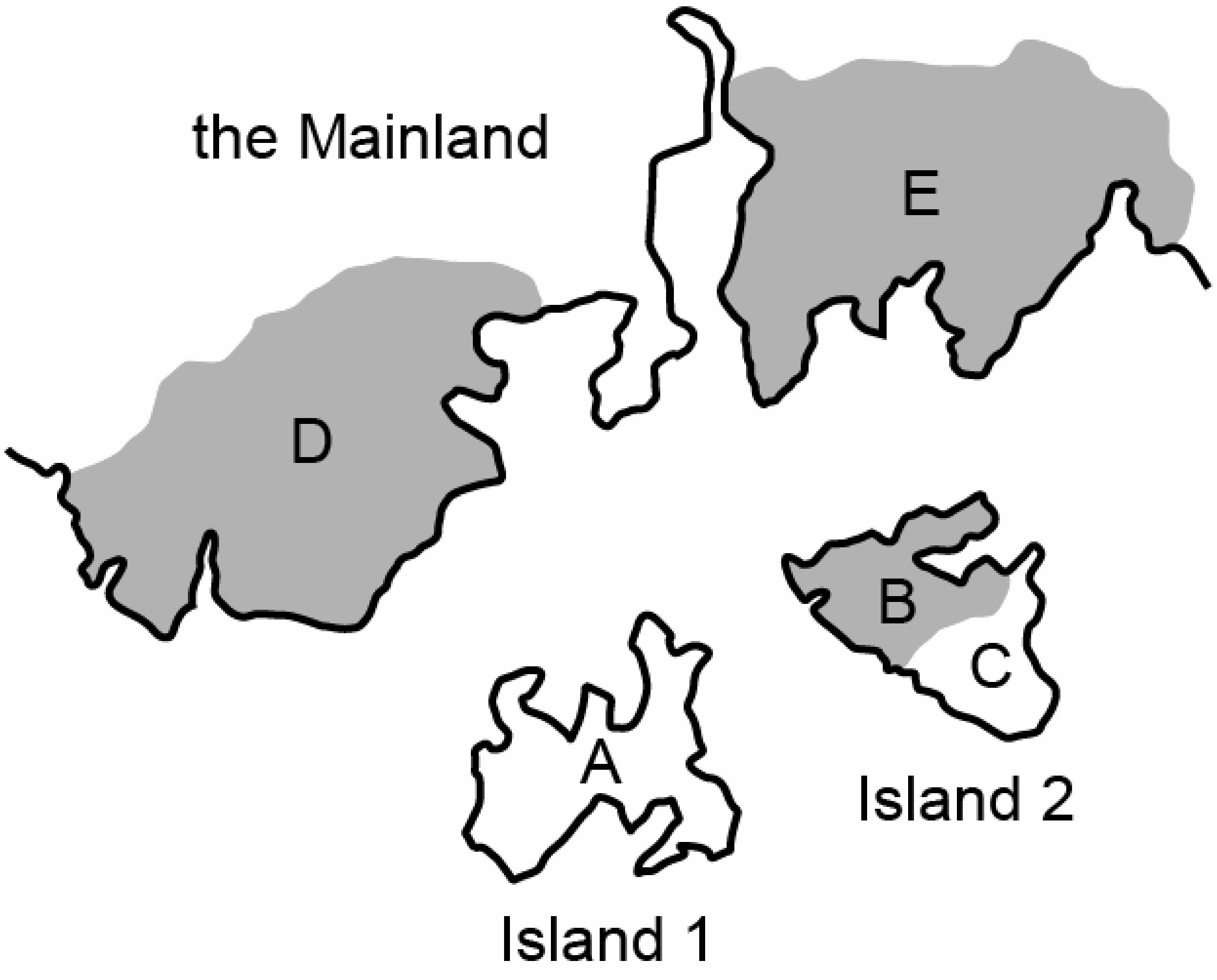

Fig. 1. Illustration of Islands