Empirical Analysis on the Dynamics of Tourists with a Simple Stochastic Model: Case of Okinawa

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Abstract

Departing from the conventional theoretical approach, which explains tourism demand by various kinds of determinants, this paper proposes a model in which the dynamics of the number of tourists is explained by probabilistic behaviors. More specifically, the model assumes two different probabilities—one for first-time travelers and the other for frequent travelers. Based on this theoretical framework, the paper empirically examines the dynamics of the number of tourists to Okinawa, Japan. We find that income and transport costs explain the probability of first-time visitors, but that they do not explain for that of repeat visitors. Instead, the congestion index, which reflects the busy lifestyle in large cities, does so. This suggests that tourism policy should differ depending on how well-established the location is as a tourist destination. Given that Okinawa is acknowledged as the foremost resort destination among the Japanese, the priority for the resources allocation of tourism promotion should be on the preservation of the natural environment and the original culture, thereby offering unusual experiences to the visitors.

1 Introduction

This study explains the dynamics of the number of tourists with a simple stochastic model. In our model, decision of making a journey is determined stochastically which depends on economical factors such as income and transportation cost. Assuming that the probability of making a journey differs between first travelers and frequent travelers, the model captures the tendency that can be typically seen for the dynamics of tourists where the exogenous shock persists for the subsequent periods. Based on our theoretical model, we empirically examine the dynamics of travelers using the data of travelers to Okinawa during 1998-2011.

Okinawa island is located at the southern end of Japan, 400 miles away from the main island. Because of its tropical climate, clear blue ocean and unique natural environment, Okinawa is known as one of the foremost resort destinations among Japanese. In addition, Okinawa has a unique history. Until the 19th century, Okinawa was an independent kingdom called "Ryukyu", thus, today still preserves the traditional exotic culture and unique customs and habits of the past. After the second world war, Okinawa was occupied and under control of the American government until 1972, therefore, influenced by American culture. The mixed customs and culture of this land are particularly popular among visitors. Thus, it is not surprising that tourism has been the main industry in Okinawa. Figure 1 shows the time series of the annual number of domestic tourists to Okinawa, and revenue from tourism. Since its reinstatement to Japan, the number of travelers

to Okinawa has been growing consistently - today, nearly 6 million Japanese visit Okinawa every year[1]. Likely, the revenue from tourism now represents a large part of GDP at Okinawa - 10.5% of GDP, which is the largest among Japanese prefectures. The multiplier effect of tourism industry in Okinawa in 2009 is estimated to be 662 billion yen, which is equivalent to 17.8% of GDP of Okinawa Prefecture (Okinawa Prefectural office), whereas its employment creation effect amounts to approximately 80 thousand employees, which is 12.8% of total employment in Okinawa. Also, given the recent economic growth of East Asian countries and the entries of direct flights to Okinawa[2], those who visit Okinawa particularly from East Asia is increasing dramatically. While the number of international visitors was 96,800 at 2006, it was 301,400 at 2011, which accounts for 5.0% of total visitors. Apart from the need of a study on Okinawa tourism, an advantage of taking Okinawa as our study subject is that, unlike Tokyo, Kyoto or other touristic places in Japan, the number of visitors is correctly and easily recorded, because air transport is practically the only way to reach Okinawa.

An ever increasing importance of tourism industry for the economy of Okinawa calls for studies on the subject. Umemura (2004, 2007) analyzes the dynamics of tourists to Okinawa according to the traditional method of

[1]Given the population of Okinawa (1.4 million), the number of visitors is remarkably large. For example, Hokkaido - the northernmost of Japan and another foremost resort destination among Japanese - has also 6 million domestic visitors while its population is four times as large as that of Okinawa. The situation of Okinawa much resembles that of Hawaii who has approximately 1.4 million population and 7 million visitors (including both domestic and international visitors).

[2]At present, there are six foreign cities that operate direct flights between Okinawa - that are Taipei, Taichung, Soul, Shanghai, Beijing, and Hong Kong.

economics of tourism. They conclude, using data during 1998-2003, that distance to Okinawa and per capita income well explain the number of visitors to Okinawa, estimating that 1% increase of distance decreases approximately 1.8% of visitors while 1% increase of income increases 2.7% of visitors. However, updating the data for 1998-2011, we found that either per capita income or distance (also transportation cost) no longer explains the number of tourists, which is the motivation of our study. We suspect two reasons for that. One stems from the way of data mining. While Umemura (2007) restricts its analysis only to prefectures where there are direct flights to Okinawa, we cautiously categorized Japanese 46 prefectures (except Okinawa) into 16 areas, in which direct flights to/from Okinawa are operated, according to how citizens at each prefecture make access to Okinawa. The other stems from the periods that we have updated. Although both per capita income and transportation costs are stable[3] in Japan for recent years, the number of tourists toward Okinawa shows clear upward tendency. This inconsistency between the dynamics of travelers and economic factors motivated us to take a distinct approach to explain the mechanism of tourism demand[4].

Departing from the conventional approaches, we introduce a simple stochas-

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[3]Income and transportation costs are even slightly decreasing and increasing respectively during the period.

[4]Initially, we thought that the entry of low cost carrier (L.C.C) explains the puzzle. As for Okinawa airport, Skymark Airlines has operated between Narita since 2006, Fukuoka since 2008, Kobe since 2009, and Nagoya since 2011, whose fare is approximately 40% lower than the traditional full service airlines (F.S.A). However, we did not find any empirical evidence that the entry of Skymark Airlines has contributed to the increase of visitors to Okinawa. The data rather suggests that the number of L.C.C users are absorbed by the decrease of F.S.A. users.

tic model[5]. In our model, income and transportation cost do not directly determine the number of travelers but they explain the probability of making a journey, and thus, indirectly influence the number of travelers. It is also assumed that the probability of making a journey differs between first travelers and frequent travelers. With this feature, the exogenous shock persist for the subsequent periods, therefore, possible to maintain upward tendency even if income or transportation costs are constant. The distinction of the probabilities between first travelers and frequent travelers is important because the number of people who visited Okinawa at least once has reached 43 million persons according to our estimation from the data on repeater rates complied by the Okinawa prefectural office, which represents approximately one-third of the population of Japan, and thus, a further increase of first travelers cannot be largely expected. Given the decreasing total population of Japan, the focus on frequent visitors is even more called on. In line with the theoretical model we develop, the dynamics of tourists toward Okinawa during 1998-2011 is studied. We found that, for those who first travel to Okinawa, per capita income and transportation cost to Okinawa affects possibility of making a journey, while they have nothing to do with frequent travelers. We found that citizens at large cities are more likely to become frequent visitors to Okinawa, therefore, variable such as congestion index more explains the

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[5]We mention the conventional approaches as studies in which the determination of tourism demand is directly explained by various determinants. Gray (1966) and Barry and O'Hagan (1971) are pioneering works that study tourism demand with econometric methods. Stabler, Papatheodorou, and Sinclair (2010) and Vanhove (2010) survey various approaches that used for the quantitative analysis of tourism demand.

decision of frequent travelers rather than income and transportation cost.

This paper is organized as follows. The theoretical model is developed in Section 2. The data we use are explained in Section 3. The empirical analyses are done in Section 4.

2 Model

In this section, we develop a theoretical model that explains the dynamics of the number of travelers. The model consists of two regions which we denote as region i and j. We assume that decisions of citizens at region i on whether they travel to region j at each period are taken stochastically. Those who have never visited region j at period t are assumed to travel to region j with probability p_t, while the probability differs for those who have ever traveled to region j, which we denote as q_t. One way of justifying this assumption is the imperfect information. Since we only have limited information about unfamiliar places, the experience at destination updates our information, thus, changes our aptitude to visit the place again. Note that, in principle, q_t can either be larger or smaller than p_t.

Let us denote the population of region i at period t as N_t, the population of those who have not visited region j yet at period t as N_t^0, and the population of those who have ever visited region j at period t as N_t^1. Then, a_t, which denotes the number of visitors from region i to j at period t, can be expressed as

$$a_t = N_t^0 p_t + N_t^1 q_t. \tag{1}$$

In the case where p_t, q_t, and N_t are constant over time, it holds

$$N_t^0 = (1-p)^{t-1}N, \tag{2}$$

$$N_t^1 = (1-(1-p)^{t-1})N. \tag{3}$$

thus,

$$a_t = (1-p)^{t-1}Np + (1-(1-p)^{t-1})Nq. \tag{4}$$

Equation (4) can be rewritten as

$$\frac{a_t}{N} = q - (q-p)(1-p)^{t-1}, \tag{5}$$

thus, the number of visitors to region j is initially (when $t = 1$) pN, increases exponentially over time, and converges to qN at the steady state (when $t \to \infty$) as shown in Figure 2 (benchmark). Note that the larger the p is the faster the number of visitors converges to the steady state while the larger the q is the larger the number of visitors at the steady state is.

Figure 2 also exhibits the impact of the changes in p and q on the dynamics of the number of tourists. Notice that N_t^0 and N_t^1 are not affected by the marginal change of p and q at period t. Therefore, it holds that

$$\frac{da_t}{dp} = N_t^0, \tag{6}$$

$$\frac{da_t}{dq} = N_t^1. \tag{7}$$

Thus, given the marginal change of p and q, the number of travelers at next period increases $N_t^0 \Delta p$ and $N_t^1 \Delta q$ respectively. As shown in Figure 2, the

increase of p does not change the number of travelers at steady state though it makes faster to converge to the steady state. On the other hand, the increase of q raises the number of travelers at the steady state. In addition, it is obvious that the marginal impact of p on a_t $(\frac{da}{dp})$ is decreasing while that of q on a_t $(\frac{da}{dq})$ is increasing. Therefore, it is reasonable to pursue strategies that increase p (try to make the transportation cost cheaper or try to send attractive publicity, for example.), when N_t^0 is small enough, thus when the region is not yet acknowledged as a major tourist spot. As the region become popular among travelers, on the other hand, it gets reasonable to pursue strategies that increase q (try to plan facilities or events that satisfy frequent visitors, for example).

The repeat ratio (the ratio of repeated travelers) is often regarded as a target of importance for policy maker on tourism[6]. However, our model tells that policies of increasing p and q respectively have quite different impacts on the repeat ratio. The repeat ratio (denotes as R) can be expressed, by definition, as

$$R_t = \frac{N_t^1 q}{N_t^0 p + N_t^1 q}. \tag{8}$$

Figure 3 captures the impact of the marginal increase in p and q on R_t. Given that N_t^0 and N_t^1 are independent of the change of p and q, the repeat ratio jumps downward when p increases, while the opposite holds when q increases. However, the repeat ratio approaches to an unity much faster when p increases since the speed of convergence to the steady state is much

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[6]See Miyagi (2009), for example, on the discussion of repeat ratio.

faster then.

3 Data

This section explains the data used for our empirical study. At present, 16 regions have direct domestic flights between Okinawa, which are Tokyo, Kansai, Nagoya, Fukuoka, Sendai, Niigata, Komatsu, Shizuoka, Hiroshima, Okayama, Takamatsu, Matsuyama, Nagasaki, Miyazaki, Kumamoto, and Kagoshima. Tourism Policy Division at Okinawa Prefecture publishes monthly statistics for the number of visitors to Okinawa for each of these regions since 1998[7].

We have classified Japanese 46 prefectures (except Okinawa) into 16 regions according to which airport citizens at each prefecture are supposed to use so as to reconstruct figures such as population and GDP per capita. Table 1 shows how we classified 46 prefectures into 16 regions which have direct flights between Okinawa. While there are two airports at Tokyo area (Haneda airport, Narita airport) and three airports at Kansai area (Kansai airport, Itami airport, Kobe airport), we aggregated these multiple airports into a synthesized one in each area. Citizens at some prefectures need to make transfer in order to reach Okinawa. For example travelers from Hokkaido, since there is no direct flight between Hokkaido and Okinawa, need to make

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[7]On our study, the number of travelers is used as an indicator of tourism demand. Generally, other indexes such as average expenditure or average length of stay per capita can be an indicator of tourism demand. However, we found that both average expenditure and average length of stay are fairly stable for the past 20 years (approximately 70,000 yen and 3.8 days). Moreover, these data are only available as aggregate data for all the visitors, but not by regions.

transfer at Tokyo. In this case, we have categorized Hokkaido into Tokyo region as we can not distinguish who are from Hokkaido via Tokyo and who are directly from Tokyo. Citizens at other prefectures have a possibility of using distinct airports. For example those who live in Nagano prefecture may use either Niigata airport or Tokyo airport (While Niigata is nearer, Tokyo is more convenient). In this case, we assume that half of the citizens at Nagano prefecture use Niigata airport while the other half use Tokyo airport (shown in the parentheses at Table 1).

Explanatory variables that we use are transportation cost (including both air fare and inland fare), income per capita, population, and index of congestion for each region. As for the air fare, we use the average of normal fare during 1998-2011. Ministry of Land, Infrastructure, Transport and Tourism publishes air fare for each of the flight, which is updated every half a year. As is well known, there are various kinds of discount air fares. Out of these airfares, normal fares are used in our analysis because choosing one or several discount airfares from many kinds of the fares is arbitrary, and more importantly the discount rates of various kinds of discount fares from normal fares are almost constant across airports and time. Thus, the choice of the type of airfares does not affect the elasticity this paper examines[8]. We have also

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[8]Given the common feeling among Japanese citizens of ever decreasing prices of package tours, probably because of advertisement of super cheap package tours, we have meticulously checked the prices of package tours to Okinawa by perusing the pamphlets of JTB (Japan Travel Bureau) and by checking the data provided to us by Okinawa prefectural office for the past 15 years. Somewhat surprisingly, we have found the package tour prices have not shown a decreasing tendency at all, or even increasing in recent years (probably because of the increase of airfares). In addition to this, given that the number of super cheap tickets is extremely limited, we believe that our use of normal fares is innocuous.

derived inland fare by calculating the fare that one is supposed to pay when he travels from prefectural capital to the airport he uses[9]. As an index of congestion, we use the time loss per km caused by traffic jams. Descriptive statistics of the explanatory variables are summarized in Table 2.

We have restricted our analysis only to the domestic travelers. International travelers are excluded not because they are unimportant but because of the data limitation. It is only five years or less since the direct international flights have operated to Okinawa, thus the number of samples is not enough for the analysis. Actually, we did not get significant results using the data of international travelers.

4   Empirical Analysis

In this section, in line with our theoretical model, p and q for each of the region are estimated. Then, we attempt to explain the difference of p and q among regions so as to understand the dynamics of tourists.

Given that p and q are sufficiently small, we approximate $(1-p)^{t-1}$ as $1-p(t-1)$ to get

$$\frac{a_{i,t}}{N_{i,t}} = (1 - q_i + p_i)p_i + p_i(q_i - p_i)t \tag{9}$$

from Equation (5), where i corresponds to each of the region, and t correspond to the monthly period. Thus, p and q for 16 regions that have direct flight between Okinawa are estimated by the linear Ordinary Least Squares

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[9]As for regions that consists of multiple prefectures, inland fairs are computed as a weighted-average of the population size of each prefecture.

(OLS) estimation where proportion of monthly visitors to Okinawa is explained by time. As $a_{i,t}$ are monthly data during 1998-2011, January 1998 is regarded to be $t = 1$, and December 2011 to be $t = 168$. Then, the estimated coefficient corresponds to $p_i(q_i - p_i)$ and the estimated constant corresponds to $(1 - q_i + p_i)p_i$, which enables us to identify p_i and q_i.

Table 3 summarizes the estimation results. The estimated values of p are statistically significant for all 16 regions while that of q are statistically significant for 14 regions with exception of Shizuoka and Nagasaki. Kagoshima has the largest p (0.00758), meaning that 0.76% of citizens at Kagoshima region who have not yet traveled to Okinawa are predicted to visit Okinawa within a month (or 9.12 % within a year), followed by Fukuoka (0.0063), Kansai (0.00324), Tokyo (0.00285) and Nagoya (0.00249). Regions with low p contain Sendai (0.00062), Matsuyama (0.00067), Shizuoka (0.00087), and Okayama (0.00089). The estimated values of q are much more dispersed from the largest 0.01289 (Takamatsu) to a negative value of -0.00085 (Niigata). Niigata observes the only negative value of q, which is hard to interpret. The gap between p and q are also tabulated at Table 3. Within 14 regions with significant p and q, 4 regions (Niigata, Hiroshima, Kumamoto, Kagoshima) observe small q compared to p. Thus, once citizens at these regions travel to Okinawa, they tend to be more unwilling to visit Okinawa again. Rest of 10 regions observe positive $q - p$, meaning that people at these region are more likely to travel again once they visit Okinawa.

Then, what causes the difference of p and q among regions? Our finding

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is that the difference of p can be explained by economic factors such as per capita income and transportation cost while q can not. Table 4 shows the regression results of p on per capita income and transportation cost by the OLS. Transportation cost is defined as the sum of both air fare and inland fare. As for the place where one has not been yet, it makes sense that the decision of whether one chooses there for his vacation largely depends on how rich he is and how much it costs. According to Table 4, both 1% increase of income and 1% decrease of transportation cost result in 3%-4% increase in p. However, the same estimation for q or $q - p$ has yielded statistically insignificant coefficients, thus indicates that income and transportation costs are no longer important for the decision of frequent visitors. Then, what makes the tourists return to Okinawa again? The regions at which the gap between p and q is large are Takamatsu (0.0119), Tokyo (0.0041), Nagoya (0.0032), and Kansai (0.0024), indicating that citizens especially at large cities are more likely to become frequent visitor to Okinawa. This result makes us conjecture that some factors which differentiate between Okinawa and big cities are the drivers of the gap between p and q. Namely, people who first visit Okinawa appreciate something far from everyday life, such as the now-well-known slow and easy life style of Okinawa. Thus, the citizens of busy cities may be more likely to appreciate the slow life of Okinawa and become frequent visitors. To test this hypothesis, $q - p$ is regressed on congestion index. As Table.5 shows, the index has shown statistically significant coefficient.

Robustness check (Seemingly Unrelated Regressions)

When we estimate many equations, regressions per each equation (termed "limited information model" in econometrics literature) may not be the best linear unbiased estimator. When there is a contemporaneous correlation of errors across equations, regressions of the whole system (termed "full information model" or "seemingly unrelated equations model (SUR model)" by the generalized least squares yields the best linear unbiased estimator. To see if there is a correlation of errors across equations, we have estimated a SUR model for the system of equations. Breusch-Pagan test of independence was rejected at 0.1% significance level, which indicates that there is indeed a correlation across errors. Our estimation satisfies a necessary condition for SUR that the number of observations must be larger than the number of equations of the system. Otherwise, the variance-covariance matrix will be singular, and thus non-invertible, rending estimations impossible. However, this is only a necessary condition. Depending on the data, the variance-covariance matrix might still be singular[10]. Although SUR of 16 airports encounters the problem of non-singularity, that with 14 airports without two airports which exhibit statistically insignificant coefficient by OLS have yielded the estimation results. The coefficient estimates of p and q by SUR are in Table 6. Coefficient estimates for the determinants of p and q are in Table 7 and Table 8, respectively. They are statistically significant and show similar numbers to the cases of OLS.

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[10]For mote detail, see Srivastava and Giles (1987), for example.

5 Conclusion

Because of the poor explanatory power of the existing models in the literature for the recent number of tourists to Okinawa, which attempts to explain the number of tourists by GDP, GDP per capita, and transport costs, this study proposes a model in which the dynamics of the number of tourists is explained by probabilistic behaviors. More specifically, the model assumes two different probabilities, the one for first travelers and the other for frequent travelers. Based on this theoretical framework, the paper empirically examines the dynamics of the number of tourists to Okinawa, Japan. We find that whereas income and transport costs explain the probability of first visitors, they do not explain the probability of repeated visitors, but congestion index, which represents how much busy life-style each region has. This suggests a policy implication for Okinawa. Now that the number of people who visited Okinawa at least once reaches 43 million persons, it is widely accepted in the society of Okinawa that the further promotion of tourism in Okinawa rests not on first visitors but on so called "repeaters". The above finding of ours suggests that the priority for the resources allocation of tourism promotion should be on the preservation of natural environment and original culture of Okinawa and thereby solidifying the image of a peaceful, natural environment rich, slow life style island.

Acknowledgments

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Table 1: Classification of 16 Regions

16 Regions	46 Prefectures			
Tokyo	Hokkaido	Aomori	Ibaraki	Tochigi
	Gunma	Saitama	Chiba	Tokyo
	Kanagawa	Yamanashi	(Iwate)	(Nagano)
Kansai	Osaka	Kyoto	Hyogo	Shiga
	Nara	Wakayama		
Nagoya	Aichi	Gigu	Mie	
Fukuoka	Fukuoka	Yamaguchi	Oita	
Sendai	Miyagi	Akita	Yamagata	Fukushima
	(Iwate)			
Niigata	Niigata	(Nagano)		
Komatsu	Toyama	Ishikawa	Fukui	
Shizuoka	Shizuoka			
Hiroshima	Hiroshima			
Okayama	Okayama	Tottori	Shimane	
Takamatsu	Kagawa	Tokushima		
Matsuyama	Ehime	Kochi		
Nagasaki	Nagasaki			
Miyazaki	Miyazaki			
Kumamoto	Kumamoto			
Kagoshima	Kagoshima			

Table 2 :Descriptive statistics of the explanatory variables

Regions	air fare (yen)	inland fare (yen)	population (thousand)	GDP capita (1000 yen)	congestion (min/km)
Tokyo	35456	1581	44000	4446	25.8
Kansai	30208	897	20814	3863	30.3
Nagoya	32910	1515	11380	4389	32.1
Fukuoka	23453	1838	7703	3831	17.4
Sendai	45145	2835	7321	3553	353
Niigata	44645	1399	3458	3692	11.5
Komatsu	36096	3141	3068	4033	15.3
Shizuoka	39800	1000	3792	4330	34.4
Hiroshima	27977	1300	2863	3977	13.7
Okayama	29975	2843	3251	3526	8.7
Takamatsu	29920	1996	1788	3581	14.5
Matsuyama	27075	1413	2202	3258	9.2
Nagasaki	24673	800	1430	2997	11.8
Miyazaki	24468	340	1132	3123	7.2
Kumamoto	23716	670	1814	3060	11.6
Kagoshima	22725	1400	1708	3272	7.8

Table 3 :Estimated value of p and q

Regions	$\hat{p}$	$\hat{q}$	$\hat{q} - \hat{p}$
Tokyo	0.00285**	0.00690**	0.00405
Kansai	0.00324**	0.00559**	0.00235
Nagoya	0.00249**	0.00573**	0.00324
Fukuoka	0.00633**	0.00740**	0.00107
Sendai	0.00062**	0.00178**	0.00116
Niigata	0.00094**	−0.00085**	-0.00179
Komatsu	0.00097**	0.00171**	0.00074
Shizuoka	0.00087**	-0.00071	-0.00158
Hiroshima	0.00230**	0.00153**	-0.00077
Okayama	0.00089**	0.00247**	0.00158
Takamatsu	0.00100**	0.01289**	0.01189
Matsuyama	0.00067**	0.00252**	0.00185
Nagasaki	0.00139**	0.00169	0.00030
Miyazaki	0.00210**	0.00279**	0.00069
Kumamoto	0.00241**	0.00066**	-0.00175
Kagoshima	0.00758**	0.00647**	-0.00111

* and ** indicate statistical significance at 10 % and 5 % respectively

Table 4 :Estimation results for p by OLS

Log of p	Coef.	std. err.	t
Log of GDP per capita	3.21**	1.21	2.66
Log of transport cost	−3.23**	0.73	−4.80
Constant	8.11	7.39	0.47

Number of observations = 14

R-squared = 0.540

* and ** indicate statistical significance at 10 % and 5 % respectively

Table 5 :Estimation results for $q - p$ by OLS

$q - p$	Coef.	std. err.	t
Congestion	0.00223**	0.00064	3.48
Constant	-0.00409^*	0.00019	-2.20

Number of obs. $= 14$
R-squared $= 0.104$
* and ** indicate statistical significance at 10 % and 5 % respectively

Table 6 :Estimated value of p and q by SUR

Regions	$\hat{p}$	$\hat{q}$	$\hat{q} - \hat{p}$
Tokyo	0.00370**	0.00727**	0.00357
Kansai	0.00273**	0.00583**	0.00310
Nagoya	0.00200**	0.00700**	0.00501
Fukuoka	0.00634**	0.00750**	0.00116
Sendai	0.00059**	0.00274**	0.00215
Niigata	0.00052**	-0.00229^{**}	-0.00281
Komatsu	0.00081**	0.00182**	0.00101
Hiroshima	0.00177**	0.00071**	-0.00106
Okayama	0.00068**	0.00332**	0.00264
Takamatsu	0.00082**	0.01289**	0.01189
Matsuyama	0.00067**	0.00253**	0.00170
Miyazaki	0.00206**	0.00282**	0.00076
Kumamoto	0.00229**	0.00087**	-0.00142
Kagoshima	0.00671**	0.00574**	-0.00097

* and ** indicate statistical significance at 10 % and 5 % respectively

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Table 7 :Estimation results for p by SUR

Log of p	Coef.	std. err.	t
Log of GDP per capita	3.24*	1.63	1.98
Log of transport cost	-3.51**	0.79	-4.44
Constant	10.80	9.19	1.18

Number of observations = 14

R-squared = 0.563

* and ** indicate statistical significance at 10 % and 5 % respectively

Table 8 :Estimation results for $q - p$ by SUR

$q - p$	Coef.	std. err.	t
Congestion	0.00290**	0.00080	3.63
Constant	-0.00529**	0.00242	-2.19

Number of obs. = 14

R-squared = 0.076

* and ** indicate statistical significance at 10 % and 5 % respectively

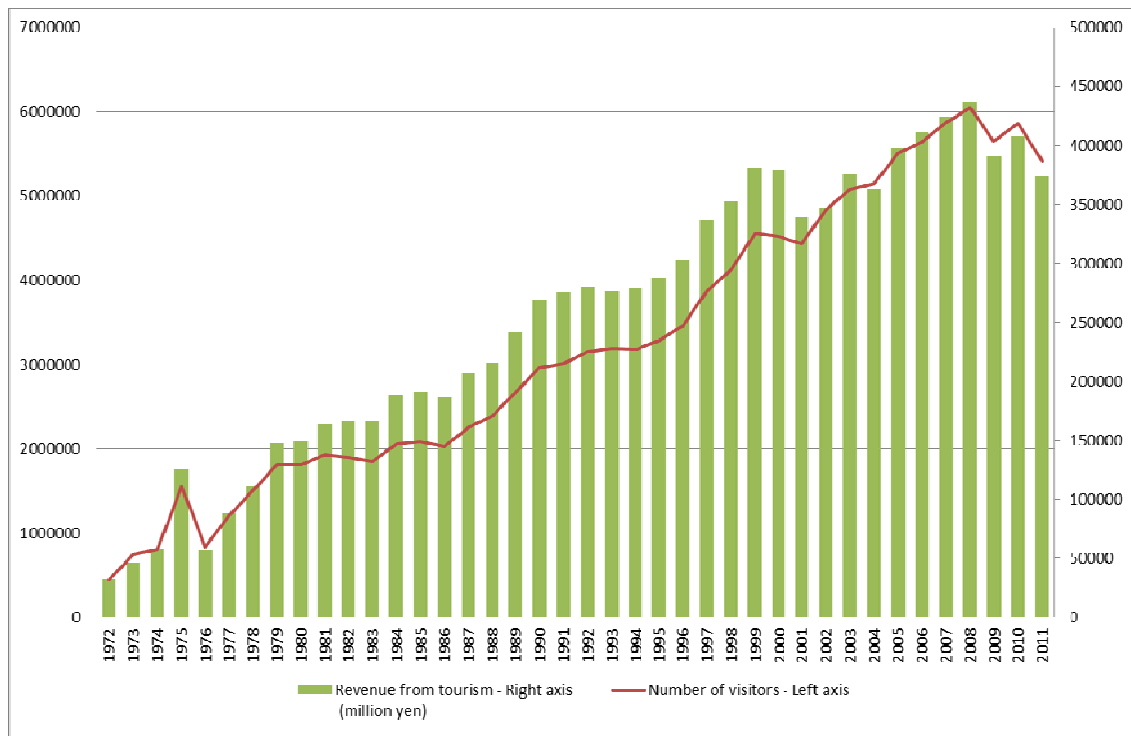Figure 1: The number of visitors and the revenue from tourism to Okinawa (1972-2011)
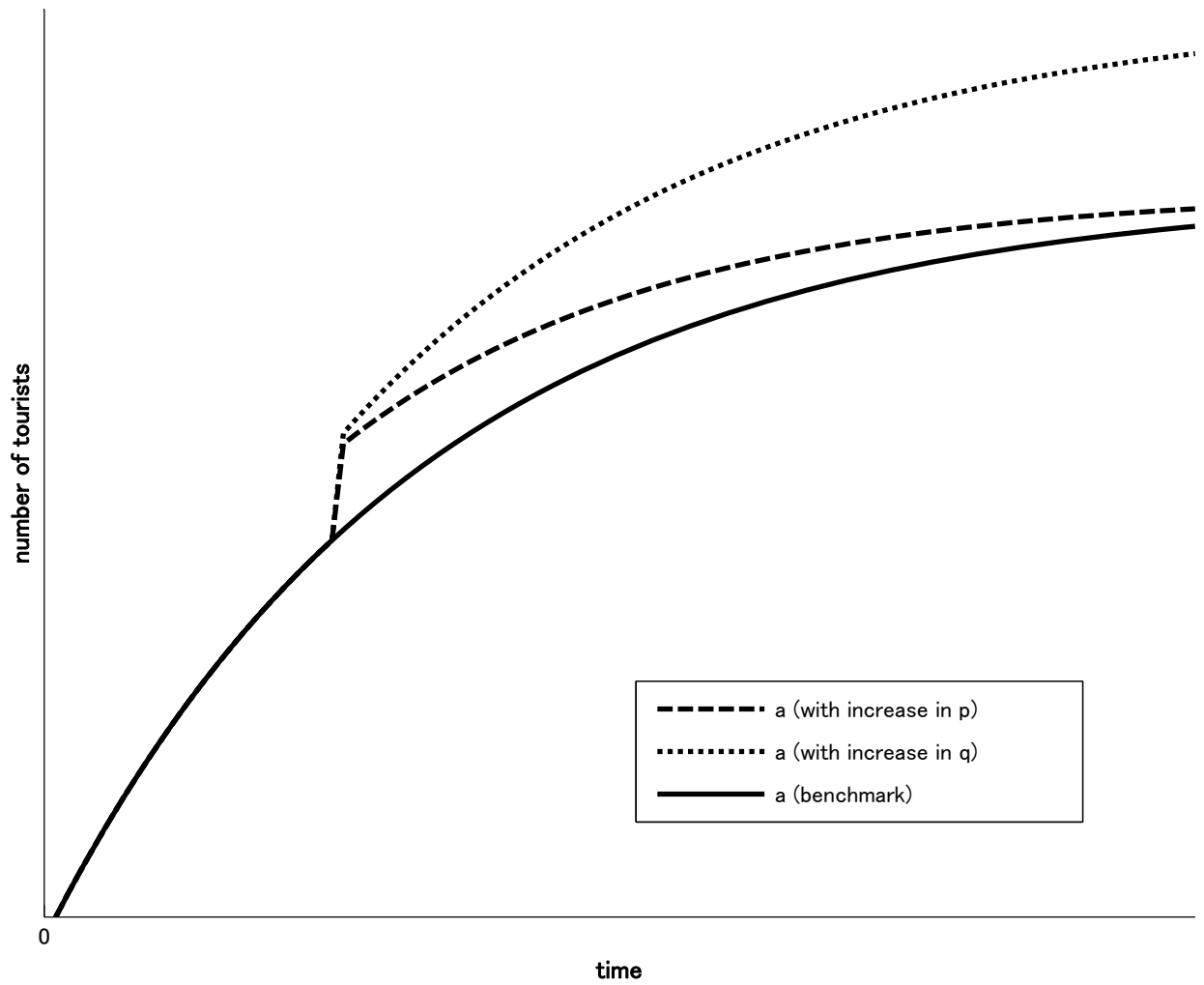
Figure 2: Dynamics of the number of tourists by changes in p and q

Figure 3: Dynamics of repeat ratio by changes in p and q