

The Impact of the Great East Japan Earthquake on Inbound Tourism Demand in Japan

Lihui WU¹ and Haruo HAYASHI²

¹ Graduate School of Informatics, Kyoto University

² Disaster Prevention Research Institute, Kyoto University

The Great East Japan Earthquake struck Tohoku, Japan seriously, and caused deadly tsunami wide-spreading the whole east Japan coast. Soon after this earthquake, the inbound tourist arrivals to Japan went down dramatically. The purpose of this study is to examine how severe the impact of the disaster on inbound tourism demand and estimate whether tourist arrivals have recovered to normal up to November 2012 by applying auto-regression integrated moving average (ARIMA) models incorporating one-off events to estimate inbound tourist arrivals after the disaster and, then compare the predicted data with actual ones. This work will be useful for understanding the impact and tourism recovery process after the earthquake. It is also applicable and shed light on the estimation of tourism recovery level for other disasters.

Keywords: *the Great East Japan Earthquake, inbound tourism demand in Japan, ARIMA analysis, disaster recovery*

1. Introduction

The Japanese government has positioned ‘tourism’ as a strategic industry to revitalize Japan's economy and enhance inter-regional communication, and has been making efforts to promote Japan as a ‘Tourism-based Country’¹⁾. According to the 2010 survey report²⁾ by Ministry of Land, Infrastructure, Transport and Tourism (MLIT), tourism industry made a great contribution to Japan's economy: tourism expenditure was 23.8 trillion Yen; the spread effect of tourism industry was 49.4 trillion Yen, which accounted for 5.5% of the production in national economic counting; the inducement effect in employment was 424 thousand people.

The 2011 earthquake off the Pacific coast of Tohoku that occurred on March 11, 2011 at 05:46 (UTC) offshore of the east coast of Honshu, Japan, had a magnitude of 9.0 on the Richer Scale and triggered a devastating tsunami resulting in serious nuclear disaster. The earthquake is also known as the Great East Japan Earthquake, 2011 Tohoku Earthquake or 3.11 Earthquake. The huge earthquake accompanying with tsunami and the accident of the nuclear plant in Fukushima caused considerable loss of casualties: 18,131 dead, 2,829 missing and 6,194 injured³⁾.

The earthquake has also impacted inbound tourism demand in Japan severely. The report⁴⁾ released by Japan National Tourism Organization (JNTO) suggests that soon after the huge earthquake during the period between 12 March and 31 March, the international visitor arrivals to Japan fell off sharply by 72.7% as compared with the same period in 2010. The visitor arrivals from abroad for the whole year (2011) decreased by 27.8 %, compared with that in the previous year (2010), which is the highest reduction in Japan's recorded history.

MLIT has been taking aggressive tourism promotion measures^{5),6)} aiming at recovering and stimulating international travel demand, for example, by promoting MICE

(Meetings, Incentives, Conferences, Exhibitions) in the affected areas, further reinforcing the framework for accommodating visitors from overseas and implementing new visa policies for Chinese, etc.

The number of international tourist arrivals has a direct impact on tourism industry and government agency investment. Therefore, policymakers either in tourism industry or in administrative organizations need to have a clear understanding of how disasters on inbound tourism demand. Though tourism has been regarded as a strategic industry and Japan has experienced many kinds of natural disasters, especially earthquake due to its geological location, little research on Japan's inbound tourism demand has been taken to understand the impact of disasters on inbound tourism demand to Japan. The purpose of this study is to make a better understanding of the changes and trends in the inbound tourism demand by examining how severe the impact of one of the deadliest earthquakes, the Great East Japan Earthquake, on inbound tourism demand and estimate whether tourist arrivals have returned to normal up to November 2012.

In this study we apply ARIMA analysis introduced by Box and Jenkins⁷⁾ to explore the impact of the disaster on the demand for inbound tourism and estimate the recovery level of inbound tourism demand from the devastating earthquake.

2. Disaster and tourism demand

The literature on the impact of disaster on tourism can be divided into two correlative aspects: the impact on tourism demand (e.g. domestic visitors, international visitors including inbound visitors and outbound visitors) and the impact on tourism supply (e.g. tourism destination as a whole, tourism authorities, tourism enterprises such as hotels, travel agencies). This study examines the impact of the disaster on inbound tourism demand in Japan by investigating the volatility of the number of inbound tourists. According to the historical

statistics of visitors to Japan from overseas released by JNTO, visitors from abroad consists of four types by purpose of visit to Japan: tourist, business, others and short excursion. Here we focus on inbound tourist arrivals.

Several methods are available in assessing the impact of disasters on tourism flows, such as Chow test (Chow⁸⁾), intervention or interrupted time series analysis (Box and Tiao⁹⁾; McCain and McCleary¹⁰⁾), forecasting methods based on models (e.g. Mazzocchi and Montini¹¹⁾; Huang and Min¹²⁾; Mendoza et al.¹³⁾). Chow test is widely used in time series analysis to test for the presence of a structural break but cannot identify the pattern of structure change. Intervention analysis mainly focuses on estimating change pattern by observing the variation in parameters.

Previous studies relevant to the field commonly applied forecasting method to examine the impact of disasters on tourism demand by investigating difference between estimated and actual values. The method mentioned above mainly consists of two kinds: one is based on regression analysis (e.g. Wang¹⁴⁾) and the other is on account of time series forecasting (e.g. Huang and Min¹²⁾). Time series forecasting uses a model to predict future values based on previously observed data. Regression analysis often applies models to test the relationship between a dependent variable and one or more independent variable changes. It is suggested that time series analysis often generates acceptable forecasts at low cost with reasonable benefits in testing the accuracy of different forecasting models for tourist arrivals (Chu¹⁵⁾). So we will employ time series model to examine the impact of the Great East Japan Earthquake on inbound tourism demand in Japan.

There are a number of literatures relating to the impact of disasters on tourism demand by applying time series analysis. Mazzocchi and Montini¹¹⁾ evaluated the statistical relevance of the earthquake that stroke the Umbria region in central Italy on September 26, 1997, using the data of monthly time series of tourist arrivals and stays. Huang and Min¹²⁾ built up seasonal ARIMA model based on the data of monthly inbound visitor arrivals before the 921 earthquake (M7.3) to forecast the inbound visitor arrivals after it (September 1999 to July 2000), then compared the volume forecast and actual values, and got

the conclusion that up to the 11th month after the earthquake, the inbound tourism demand had not rebounded completely. Mendoza et al.¹³⁾ also focused on monthly visitor arrivals to measure the impact of the earthquakes in Chile (the earthquake in the north on 21 April 2007 with magnitude of 6.2; the earthquake in the south on 14 November with a magnitude of 7.7 and the earthquake in the center of Chile on February 2010 with a magnitude of 8.8) by seasonal ARIMA analysis and the results inferred that the impacts depended on the magnitude of the earthquake and the perception of safety. Kuo et al.¹⁶⁾ estimated the impacts of Avian Flu and severe acute respiratory syndrome (SARS) on international tourist arrivals in Asia countries by using the autoregressive moving average model with exogenous variables (ARMAX) model. McAleer et al.¹⁷⁾ also evaluated the impact of SARS and Avian Flu on international tourist arrivals to Asia, utilizing static line fixed effect and difference transformation dynamic models.

This study will apply time series forecasting analysis to assess the impact the huge earthquake by comparing the out-of-sample forecast arrivals with actual ones. There are numerous of time-series methods for forecast available, such as smoothing methods, exponential smoothing and ARIMA. As ARIMA analysis requires time series data to be tested for stationarity in identification step before undertaking estimation, diagnosis and forecasting. If a time series is nonstationary, the time series must be transformed to a stationary series by differencing before the ARIMA modeling process can proceed. The forecasts by using a model that has been transformed to apply in stationary series are expected to be more accurate and reliable forecasts than using a model with nonstationary series. ARIMA also considers tests for unit roots before estimation, diagnosis and forecasting exercise. Therefore, ARIMA analysis has been diffusely applied and usually outperforms other forecasting approaches in forecasting tourism demand (Lin et al.¹⁸⁾; Lim and McAleer¹⁹⁾; Gonzalez and Moral²⁰⁾). Furthermore, in order to improve forecast accuracy, one-off events will be taken into ARIMA through the use of dummy variables. We would establish a Box-Jenkins ARIMA model incorporating dummy variables for Japan's inbound tourism demand based on the data before the devastating earthquake to

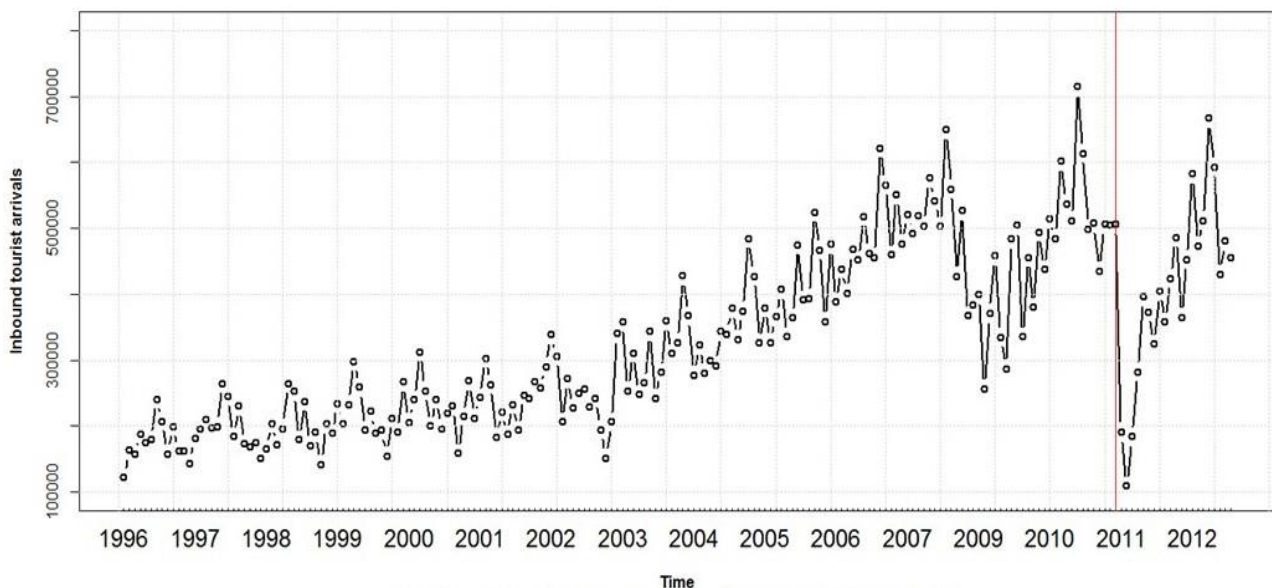


Fig.1. Inbound tourist arrivals to Japan from January 1996 to November 2012. (Source: JNTO)

estimate the inbound tourist arrivals after the disaster.

3. Data and methodology

The data used in this study is monthly international tourist arrivals to Japan ²¹⁾ between January 1996 and November 2012 collected by JNTO (see figure 1). Here international tourists mean the people who come to Japan for the purpose of tourism rather than business or others.

The ARIMA time series analysis uses lags and shifts in the historical data to uncover patterns (e.g. moving averages, seasonality) and predict the future values. The ARIMA model was first developed in the late 60s but it was systemized by Box and Jenkins ⁷⁾. ARIMA processes provide a wide range of models for univariate time series modeling and forecasting and have been successfully applied in economic, social issues and also in forecasting tourism demand (e.g. Gonza lez and Moral ²⁰⁾; Lim and McAleer ¹⁹⁾; Kulendran and Shan ²²⁾).

One-off events such as global financial crisis and deadliest disasters may distort the estimation and diagnosis, and then impact the accuracy of forecast. In order to account for the impact of one-off events, the method by using dummy variables to represent one-off events is often applied in tourism research (e.g. Witt et al ²³⁾; Lim and McAleer ¹⁹⁾; Kulendran and Witt ²⁴⁾; Song and Witt ²⁵⁾; Salleh ²⁶⁾; Lim et al ²⁷⁾; Kuo et al ¹⁶⁾; Lim et al ²⁸⁾; Wang ¹⁴⁾; Yang ²⁹⁾; Nishimura et al ³⁰⁾. Therefore, in this study the impact of the exogenous shocks will be incorporated in ARIMA models by using deterministic dummy variables in order to improve forecasting accuracy.

To examine the impact of the Great East Japan Earthquake on inbound tourism demand to Japan, we employ ARIMA model with deterministic dummy variables to forecast the inbound tourist arrivals and investigate the difference of predicted and actual values. Figure 2 shows the framework of the methodology in this study.

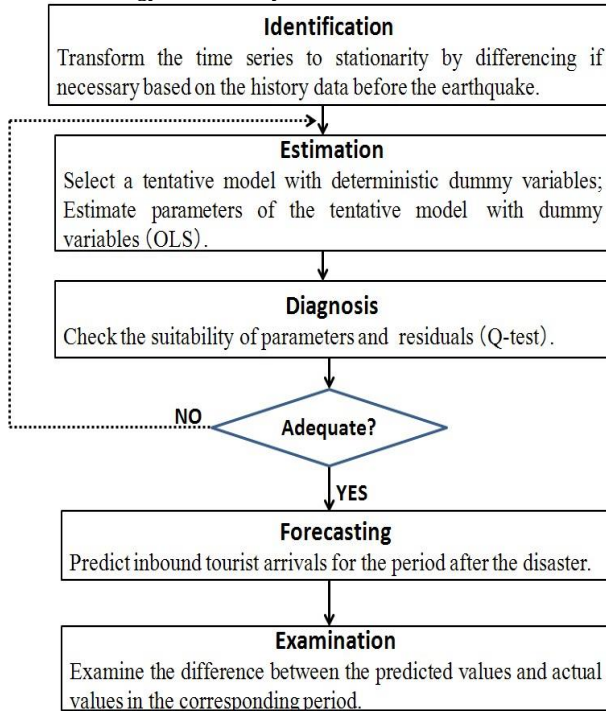


Fig.2. The framework in this study.

ARIMA model is described as follows:

$$Y_t = c + \phi_1 Y_{t-1} + \phi_2 Y_{t-2} + \dots + \phi_p Y_{t-p} + \theta_1 \varepsilon_{t-1} + \theta_2 \varepsilon_{t-2} + \dots + \theta_q \varepsilon_{t-q} + \varepsilon_t \quad [1]$$

where Y_t is the actual value at time of t ; ϕ_i ($i=1,2,\dots,p$) and θ_j ($j=1,2,\dots,q$) are parameters; ε_t is random error at time of t and is assumed to be independently. Equation1 can also be presented shortly in the following form

$$\phi(L)Y_t = C + \theta(L)\varepsilon_t \quad [2]$$

where

$$\phi(L) = 1 - \phi_1 L - \phi_2 L^2 - \dots - \phi_p L^p$$

ϕ is a polynomial of the lag operator representing the auto-regression (AR) model that calculates the present value from past values; and

$$\theta(L) = 1 + \theta_1 L + \theta_2 L^2 + \dots + \theta_q L^q$$

θ represents the moving average (MA) model that calculates the present value from past error terms.

The stationarity of the time series can be tested by the figures of autocorrelation function (ACF) and partial autocorrelation function (PACF), and unit root test such as Dickey-Fuller test (Dickey and Fuller ³¹⁾). Differencing (regularly or/and seasonally) is often applied to the time series to remove the trend and stabilize the variance before an ARIMA model is identified. Usually the differentiated ARIMA model can be presented as follows:

$$\phi(L)\Delta^d Y_t = \theta(L)\varepsilon_t \quad [3]$$

where d is a degree of difference. As this study uses an ARIMA model with dummy variables to account for the impact of one-off events, the ARIMA model incorporating dummy variables is presented as follows:

$$\phi(L)\Delta^d Y_t = \theta(L)\varepsilon_t + \sum_{i=1}^M \beta_i D_i \quad [4]$$

where D_i is a dummy variable and β_i is a parameter of the dummy variable. M is the number of the dummy variables.

Based on the above procedure we can identify a likely ARIMA (p,d,q) model or ARIMA(p,d,q)(P,D,Q)s model if seasonality is indicated, with dummy variables.

In diagnosis procedure, Ljung-Box test (Ljung and Box ³²⁾) is used to test if the residuals of the fitted ARIMA model are white noise. The Ljung-Box Q test can be defined as follows: Hypothesis: H_0 : The data are independently distributed; H_1 : The data are not independently distributed.

$$Q = n(n+2) \sum_{k=1}^h \frac{\rho_k^2}{n-k} \quad [5]$$

where n is the sample size, ρ_k is the sample autocorrelation at lag k , and h is the number of lags being tested. At significance level α , the critical region for rejection of the hypothesis of randomness is

$$Q > X^2_{1-\alpha, h} \quad [6]$$

where $X^2_{1-\alpha, h}$ is the α -quantile of the chi-squared distribution with h degrees of freedom.

If the fitted model is adequate, it can be used to estimate the inbound tourism arrivals after the disaster. Then the impact level of the earthquake on inbound tourism demand is available from the difference between the estimated and the actual values.

4. Empirical results

(1) Identification

Figure 1 suggests that international tourist arrivals went

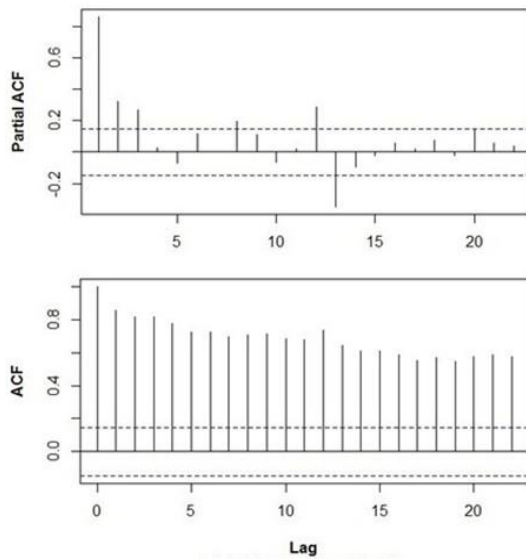


Fig.3. Correlogram of $\text{Log}Y_t$.

down sharply after the Great East Japan Earthquake. As the time series has an upward trend as a whole (see figure 1), we take logarithm to deal with this issue (see figure 3). The ACF in figure 3 shows there are spikes at several lags, so the new time series is nonstationary. So regularly first- time difference is necessary and the result is shown in figure 4.

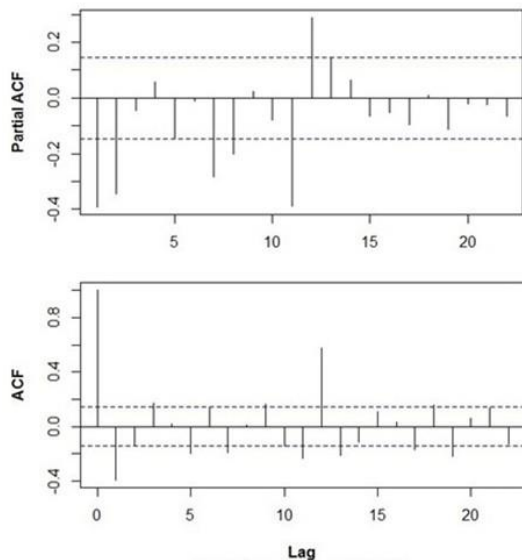


Fig.4. Correlogram of $D\text{Log}Y_t$.

From the ACF in figure 4, there is a spike at lag 12. So seasonally first- time difference is taken (see figure 5) and ACF suggests the time series seems stationary. We use a unit root test (Dickey and Fuller ³¹⁾) as a diagnostic tool to test whether the time series is stationary.

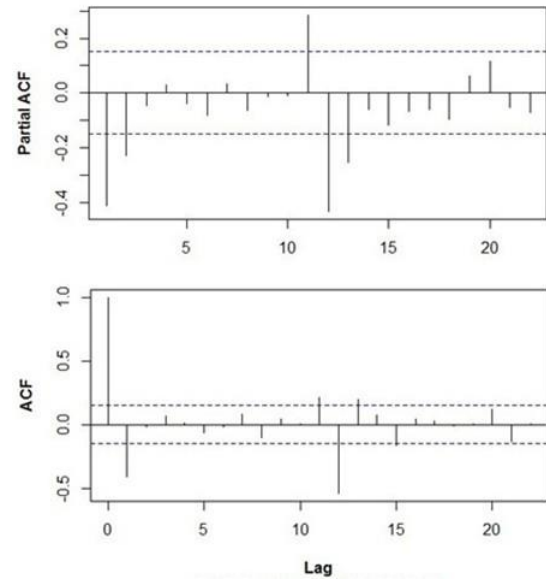


Fig.5. Correlogram of $D12D\text{Log}Y_t$.

ADF test results propose that the t-value of ADF test statistic is smaller than the t-value of test critical values at 1% level significance (see figure 6). So the time series after transforming and differencing is stationary.

	t-Statistic	Prob.*
Augmented Dickey-Fuller test statistic	-4.160237	0.0010
Test critical values: 1% level	-3.472259	
5% level	-2.879846	
10% level	-2.576610	

Fig.6. ADF test result.

(2) Estimation

During the period from January 1996 to February 2011, Japan mainly experienced the SARS global health crisis in 2003, Lehman shock of 2008, the movement of the Lunar year and the H1N1 Flu epidemic. Therefore, the ARIMA model incorporating dummy variables in this study can be presented as follows:

$$\phi(L)\Delta^d \text{LOG}Y_t = \theta(L)\varepsilon_t + \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \beta_4 D_4 \quad [7]$$

where D_1 is a dummy variable with a value 1 for the SARS epidemic from April 2003 to June 2003 and is 0 otherwise ³³⁾. D_2 is a dummy variable with a value 1 for Lehman shock of 2008 in the period between September 2008 and October 2009, and is 0 otherwise. D_3 is a dummy variable with a value 1 for the movement of the Lunar year in February 2009, and is 0 for the otherwise. D_4 is a value 1 for the H1N1 Flu epidemic from May 2009 to June 2009. ³⁴⁾

The ACF and PACF in figure 5 show that there are spikes at some lags. The dummy variables were incorporated into the ARIMA specifications and ARIMA (2, 1, 3) (1, 1, 1)₁₂ model seems appropriate by investigating the spikes at several lags. The tentative model (without a constant) based on the data before the disaster is presented as follows:

$$\begin{aligned} & (1 - \phi_1 L - \phi_2 L^2)(1 - \phi_1 L^{12})(1 - L)(1 - L^{12}) \text{LOGY}_t \\ & = (1 + \theta_1 L + \theta_2 L^2 + \theta_3 L^3)(1 + \theta_1 L^{12}) \varepsilon_t + \\ & \quad \beta_1 D_1 + \beta_2 D_2 + \beta_3 D_3 + \beta_4 D_4 \end{aligned} \quad [8]$$

In this study, we apply Eviews 6.0 statistics software to estimate the parameters of the tentative model by using Ordinary Least Square (OLS), which is a method for estimating the unknown parameters in a linear regression model. The t-statistics of all parameters are significant at 5% level. The dummy variables, D1, D2, D3, are not significant at the level, therefore they are not included in this model. The estimation result is as follows (with absolute t-ratios in parentheses)

$$\begin{aligned} & (1 + 0.48L + 0.22L^2)(1 + 0.22L^{12})(1 - L) \\ & \quad (-5.91) \quad (-2.44) \quad (-2.78) \\ & \times (1 - L^{12}) \text{LOGY}_t = (1 - 0.19L^3)(1 - 0.94L^{12}) \varepsilon_t \\ & \quad (-2.09) \quad (-44.40) \\ & -0.12D_4 \\ & \quad (-2.17) \end{aligned} \quad [9]$$

(3) Diagnosis

Autocorrelation	Partial Correlation	AC	PAC	Q-Stat	Prob
		1	0.004	0.004	0.0019
		2	0.004	0.004	0.0043
		3	0.010	0.010	0.0200
		4	-0.047	-0.047	0.3817
		5	-0.065	-0.065	1.0663
		6	-0.044	-0.043	1.3783
		7	0.061	0.063	1.9962
		8	-0.028	-0.029	2.1300
		9	-0.046	-0.052	2.4804
		10	0.023	0.014	2.5688
		11	0.007	0.008	2.5761
		12	-0.018	-0.014	2.6294
		13	0.018	0.015	2.6857
		14	0.007	-0.004	2.6946
		15	-0.190	-0.191	8.9862
		16	-0.063	-0.060	9.6874

Fig.7. Estimation results by Eviews6.0 statistics software.

There are no marginally significant spikes at lag 1 and the seasonal lag in the ACF shown in figure 7. The Q-statistic for the ACF reinforces this judgment. $Q=8.986 < X^2_{0.05}(15) = 24.996$, and this value of Q corresponds with a 0.533 level of significance. So we accept residuals as white noises and apply the fitted model for forecasting tourist arrivals.

(4) Forecasting and examination

In this section we use ARIMA (2, 1, 3) (1, 1, 1)₁₂ model incorporating statistically significant one-off events to generate forecasts of inbound tourist arrivals to Japan for the period from March 2011 to November 2012, and mixed results are obtained (see table 1). The results show that the H1N1 Flu epidemic has negatively and significantly distorted inbound tourism demand to Japan. The other shocks had no significant impact on tourism demand. Actual values, estimated values, the difference of them and the percentage of difference are shown in table 1. The results suggest that the earthquake did impact inbound tourism demand severely (in the first three months after the earthquake dropped by 63.62%, 82.42%, and 64.66% respectively). Up to November 2012, the percentage of difference between the estimated and actual values hovered near the normal level. The largest difference (-510243) came in the following month of the catastrophe occurring and the smallest difference (-2978) was in June 2012.

Figure 5 and figure 8 provide graphical presentations of empirical findings. According to table 1 and figure 8, the differences between the predicted and actual numbers of tourist arrivals for the 21 months have decreased significantly on the whole. Though tourist arrivals are bouncing back from the devastating earthquake, the figures for March 2011, April 2011, February 2012, June 2012, and October 2012 need further discussion. As the Great East Japan Earthquake occurred in mid-March 2011, the total number of tourist arrivals in March was not lowest. The largest difference in the forecast period falls in April 2011 with the data of 510243. The difference in this month demonstrates the volume of decreased tourist arrivals caused by the earthquake. For the entire forecast period, the smallest difference falls in June 2012 with the data of 2978, during which actual arrivals are very close to the estimated ones. Figure 9 illustrates the trend of convergence between actual and estimated arrivals following the earthquake. It should be noted that February is usually shoulder season for the inbound tourism, however, the actual number of tourist arrivals decreased as Chinese Spring festival, during which Chinese tourist arrivals to Japan are usually numerous, moved to January in 2012.³⁵⁾ It should also be noted that the actual number of tourist arrivals in October, usually boom season for the inbound tourism market, increases, though the difference is still large as the actual tourist arrivals has been impacted by nuclear pollution problem, the problem of the Senkaku Islands between China and Japan and so on.³⁶⁾

According to the recovery process (see figure 8, 9), the entire forecast period from March 2011 to November 2012 can be divided into two stages and January 2012 is the cut-off point of recovery process. Before the month, inbound tourist arrivals recovered quickly, but after the point, the difference percentage fluctuated and was close to the normal level. Figure 8 also indicates that the forecast model follows the overall trend in inbound tourism demand.

If compared with the case of September 21 Earthquake in Taiwan (Huang and Min¹²⁾, 2002), the convergence is much faster in the case of Japan. In the case of Taiwan with the magnitude of 7.3, which is lower than that of 9.0 in the case of Japan, after 11 months there was still a 5% decrease in international tourist arrivals. The recovery process of Japan reached 0.7% decrease after 11 months.

Table 1 Actual and forecasting values of inbound tourist arrivals after the Great East Japan Earthquake

Year/Month	Actual value	Estimated value	Difference (Act-Est)	% Diff (Diff/Est*100%)
2011/03	190730	524337	-333607	-63.62%
2011/04	108820	619063	-510243	-82.42%
2011/05	183799	520107	-336308	-64.66%
2011/06	282118	494469	-212351	-42.95%
2011/07	396559	674542	-277983	-41.21%
2011/08	373195	615213	-242018	-39.34%
2011/09	323947	452787	-128840	-28.45%
2011/10	404377	562356	-157979	-28.09%
2011/11	358056	456797	-98741	-21.62%
2011/12	423650	508098	-84448	-16.62%
2012/01	485860	489081	-3221	-0.66%
2012/02	364537	485069	-120532	-24.85%
2012/03	452568	511008	-58440	-11.44%
2012/04	582511	609030	-26519	-4.35%
2012/05	473662	520959	-47297	-9.08%
2012/06	511483	514461	-2978	-0.58%
2012/07	666623	678085	-11462	-1.69%
2012/08	592810	610593	-17783	-2.91%
2012/09	430025	459122	-29097	-6.34%
2012/10	480254	546065	-65811	-12.05%
2012/11	455665	458829	-3164	-0.69%

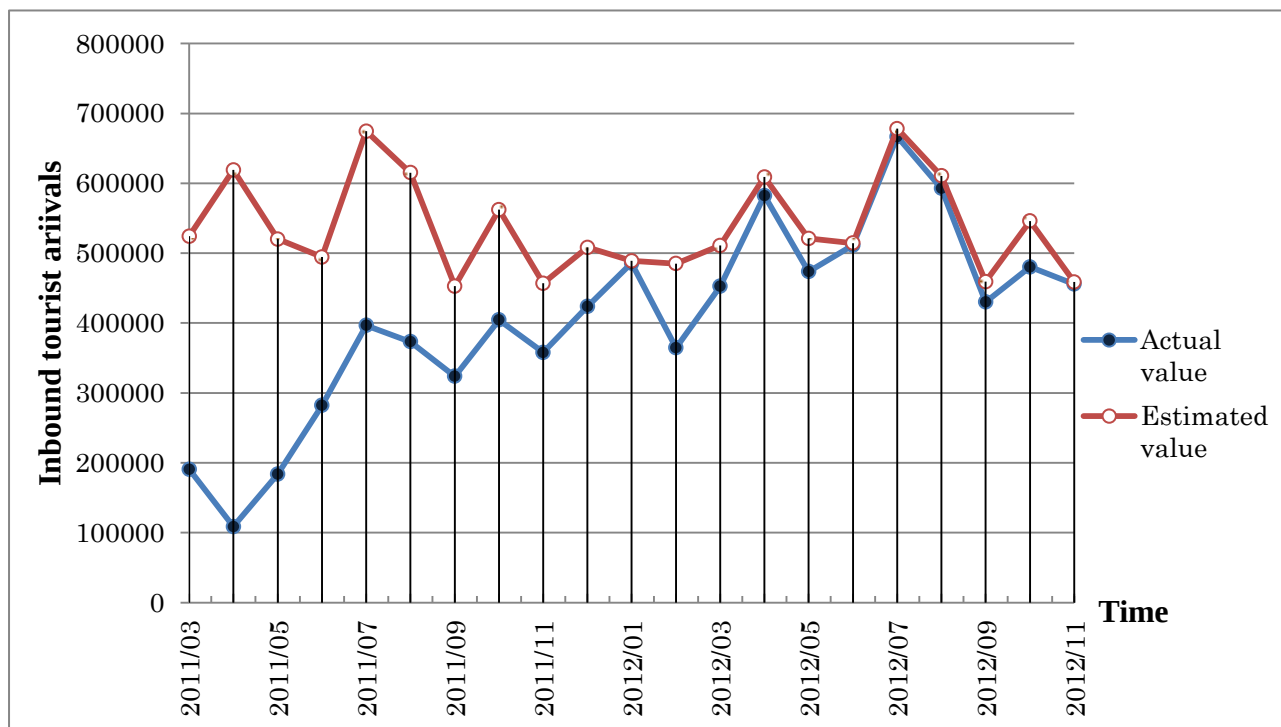


Fig.8. Actual and estimated values of inbound tourist arrivals.

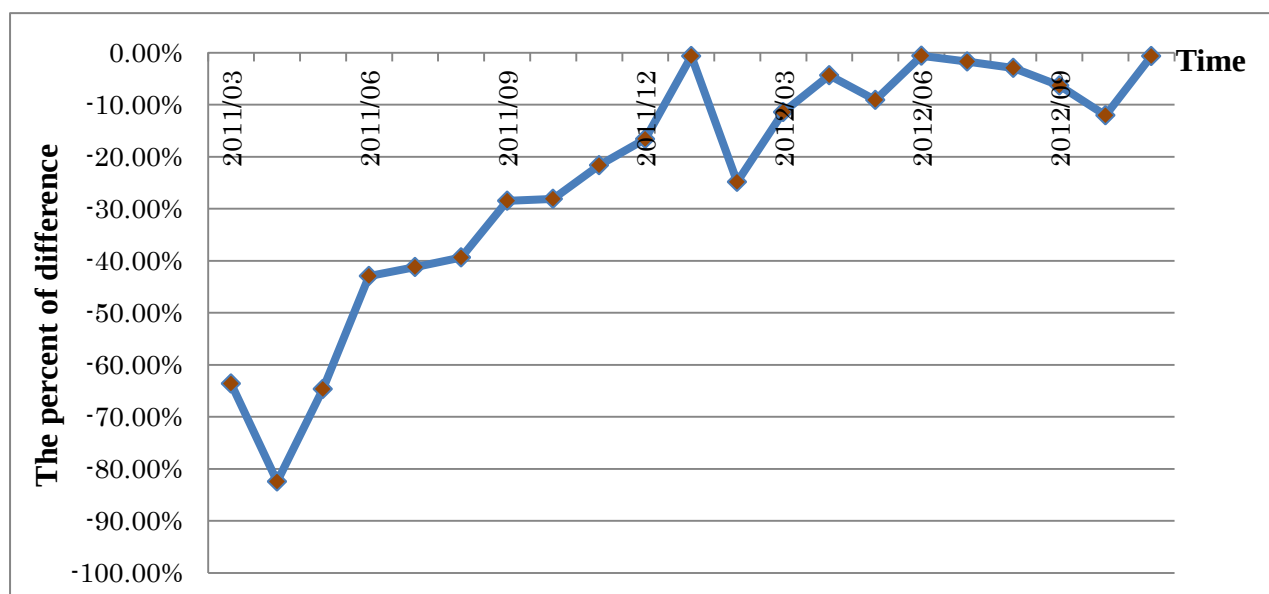


Fig.9. Difference percentage between actual and estimated values.

5. Conclusion and discussion

The number of inbound tourist arrivals directly impacts the tourism industry and the investments of government agencies therein. Therefore, policymakers need to make a better understanding of how natural disasters affect inbound tourism demand. This study finds that the devastating earthquake affected inbound tourism demand in Japan most negatively, and the inbound tourism demand in Japan has not yet fully recovered from sharply decreased inbound tourist arrivals due to the earthquake after 21 months. It is also found that the number of inbound tourist arrivals recovers rapidly in the early part of the recovery process; however, the difference percentage fluctuates and is close to the normal level later.

Faced with the fierce competition on tourism market, having a high market share is critical for the economic prospects of destination countries. It is suggested that the policymakers in Japan keep a close watch on the recovery level of inbound visitors, including the segments of the market such as tourist market and business travel market, in order to adopt appropriate incentives in timely manner. According to the message from the Director General, Japan tourism agency ³⁷⁾, inbound visitor arrivals has recovered to the normal level up to July 2012, however, it does not mention the recovery level of inbound tourist arrivals. It may lead the tourism industry and policymakers to launching the strategies with the aim of keeping or developing inbound tourism demand rather than recovery strategies.

In regards to time-series analysis, this study finds that exogenous variables may have significant impact on forecast. Unlike the other time-series models that just take time series data into consideration, in order to improve forecast accuracy, our study incorporates actual known periods of one-off shock events in ARIMA model through the use of dummy variables. During the observation time period, Japan mainly experienced the shocks of SARS, the Lehman shock, and the Lunar year movement and the H1N1 Flu epidemic occurring in the period

of Lehman shock. The results find that the H1N1 Flu epidemic in the period of the Lehman shock has negatively impacted inbound tourism, as the estimation parameter is negative 0.12 and the other dummies had no significant impact on tourism demand as they are significant at the 5% level. This study presents contributions to the research regarding the effective use of forecasting models to estimate the recovery status of tourism demand from disasters.

This study is limited to investigating the recovery status of inbound tourism demand. It does not explore the impact of the disaster on domestic tourism demand, as the statistics of domestic tourist in Japan is limited. It would be interesting to compare the recovery status of domestic and inbound tourism demand after disasters. This study only focuses on inbound tourist arrivals. It does not attempt to uncover the inbound tourists' travel motivations, and furthermore, examine the factors that affect the travel demand in Japan.

Hayashi ³⁸⁾ indicates that the recovery from recent disaster is a long term recovery process which is a time consuming and complicated process. This study finds that the recovery process is complex rather than simple linear recovery. As it is estimated that there will be Large-scale earthquakes such as Tokyo inland earthquake and Nankai Trough earthquake in the near future in Japan (Cabinet Office, Government of Japan ³⁹⁾), hence, this study suggests that to improve the resilience of tourism industry, the Japanese government and tourism industry put crisis management in tourism on agendas. Though the researchers such as Faulkner ⁴⁰⁾ and Ritchie ⁴¹⁾ provide tourism disaster management frameworks for all tourism industries, international tourists are not homogeneous and the conditions of destination countries are also diverse, so a common crisis management framework will not achieve the expected outcome. It will be especially interesting to study and develop tourism crisis management framework for Japan in the future.

Acknowledgments

We are grateful to academic committees of Institute of Social Safety Science (ISSS) and the two anonymous reviewers for helpful comments and suggestions. We also thank Dr. Norio MAKI for his useful comments that have greatly improved the manuscript.

References

- 1) Japan Tourism Agency, Ministry of Land, Infrastructure, Transport and Tourism: White Paper on Land Infrastructure Transport in Japan (2003),
<http://www.mlit.go.jp/english/white-paper/mlit03/p2c2.pdf>.
- 2) Japan Tourism Agency, Ministry of Land, Infrastructure, Transport and Tourism: Economic Ripple Effect (2012. 8.13),
<http://www.mlit.go.jp/kankochu/siryou/toukei/kouka.html>.
- 3) Fire and Disaster Management Agency of the Government of Japan: About the 2011 earthquake off the Pacific coast of Tohoku (The Great East Japan Earthquake), the 146th report (2012.9.28),
<http://www.fdma.go.jp/bn/higaihou/pdf/jishin/146.pdf>.
- 4) Japan Tourism Agency, Ministry of Land, Infrastructure, Transport and Tourism: the message from the Director General (2012.7.20),
http://www.mlit.go.jp/kankochu/topics08_000085.html.
- 5) Ministry of Land, Infrastructure, Transport and Tourism: The submitted materials (tourism policy) from the Minister of Land, Infrastructure, Transport and Tourism (2012.7.5),
<http://www.cas.go.jp/jp/seisaku/npu/policy04/pdf/20120705/shiryo4.pdf>.
- 6) Ministry of Land, Infrastructure, Transport and Tourism: MLIT Recovery and Rehabilitation Plan in response to the Great East Japan Earthquake (2012.6),
<http://www.mlit.go.jp/common/000161202.pdf>.
- 7) Box, G.E. and Jenkins, G.M.: Time Series Analysis: Forecasting and Control, San Francisco: Holden Day, 1976.
- 8) Chow G C.: Tests of equality between sets of coefficients in two linear regressions, *Econometrica: Journal of the Econometric Society*, pp.591-605, 1960.
- 9) Box, G. E., and Tiao, G. C.: Intervention analysis with applications to economic and environmental problems. *Journal of the American Statistical Association*, Vol. 70, pp. 70-79, 1975.
- 10) McCain, Leslie J. and Richard McCleary: "The Statistical Analysis of the Simple Interrupted Time-Series Quasi-Experiment," in *Quasi-Experimentation Design and Analysis Issues for Field Settings*, Thomas D. Cook and Donald T. Campbell, eds. Boston: Houghton Mifflin Co. pp.233-93, 1979.
- 11) Mazzocchi, M. and Montini, A.: Earthquake effects on tourism in central Italy, *Annals of Tourism Research*, Vol. 28, pp.1031-1046, 2001.
- 12) Huang, J. H. and Min, J. C.: Earthquake devastation and recovery in tourism: the Taiwan case, *Tourism Management*, Vol. 23, pp.145-154, 2002.
- 13) Mendoza, C. A., Brida, J. G. and Garrido, N.: The impact of earthquakes on Chile's international tourism demand, *Journal of Policy Research in Tourism, Leisure and Events*, Vol. 4, pp.48-60, 2012.
- 14) Wang, Y. S.: The impact of crisis events and macroeconomic activity on Taiwan's international inbound tourism demand, *Tourism Management*, Vol. 30, pp. 75-82, 2009.
- 15) Chu, F. L.: A fractionally integrated autoregressive moving average approach to forecasting tourism demand, *Tourism Management*, Vol. 29, pp. 79-88, 2008.
- 16) Kuo, H. I., Chen, C. C., Tseng, W. C., Ju, L. F. and Huang, B. W.: Assessing impacts of SARS and Avian Flu on international tourism demand to Asia, *Tourism Management*, Vol. 29, pp. 917-928, 2008.
- 17) McAleer, M., Huang, B. W., Kuo, H. I., Chen, C. C. and Chang, C. L.: An econometric analysis of SARS and Avian Flu on international tourist arrivals to Asia, *Environmental Modelling and Software*, Vol. 25, pp. 100-106, 2010.
- 18) Lin, C. J., Chen, H. F. and Lee, T. S.: Forecasting tourism demand using time series, artificial neural networks and multivariate adaptive regression splines: evidence from Taiwan, *International Journal of Business Administration*, Vol. 2, pp. 15-24, 2011.
- 19) Lim, C. and McAleer, M.: Time series forecasts of international travel demand for Australia, *Tourism Management*, Vol. 23, pp. 389-396, 2002.
- 20) Gonza lez, P. and Moral, P.: An analysis of the international tourism demand in Spain, *International Journal of Forecasting*, Vol.11, pp. 233-251, 1995.
- 21) Japan National Tourism Organization: monthly visitor arrival reports,
http://www.seejapan.co.uk/JNTO_Consumer/media/statistics
- 22) Kulendran, N. and Shan, J.: Forecasting China's monthly inbound travel demand, *Journal of Travel and Tourism Marketing*, Vol. 13, pp. 5-19, 2002.
- 23) Witt, C. A., Witt, S. F. and Wilson, N.: Forecasting international tourist flows, *Annals of Tourism Research*, Vol. 21, pp. 612-628, 1994.
- 24) Kulendran, N. and Witt, S. F.: Leading indicator tourism forecasts, *Tourism Management*, Vol. 24, pp. 503-510, 2003.
- 25) Song, H. and Witt, S. F.: Forecasting international tourist flows to Macau, *Tourism Management*, Vol. 27, pp. 214-224, 2006.
- 26) Salleh, M., Hanim, N., Othman, R. and Ramachandran, S.: Malaysia's tourism demand from selected countries: The ARDL approach to cointegration, *International journal of economics and management*, Vol. 1, pp. 345-363, 2007.
- 27) Lim, C., Min, J. C. and McAleer, M.: Modelling income effects on long and short haul international travel from Japan, *Tourism Management*, Vol. 29, pp. 1099-1109, 2008.
- 28) Lim, C., McAleer, M. and Min, J. C.: ARMAX modelling of international tourism demand, *Mathematics and Computers in Simulation*, Vol.79, pp. 2879-2888, 2009.
- 29) Yang, C. H., Lin, H. L. and Han, C. C.: Analysis of international tourist arrivals in China: the role of World Heritage Sites, *Tourism Management*, Vol.31, pp. 827-837, 2010.
- 30) Nishimura, T., Kajitani, Y. and Tatano, H.: Damage assessment in tourism caused by an earthquake disaster, *IDRIM Journal*, Vol. 3, 2013.
- 31) Dickey, D. A. and Fuller, W. A.: Distribution of estimators for autoregressive time-series with a unit root, *The American statistical association*, Vol. 74, pp. 427-431, 1979.
- 32) Ljung, G. M. and Box, G. E.: On a measure of lack of fit in time series models, *Biometrika*, Vol. 65, pp. 297-303, 1978.
- 33) World Health Organization: SARS: Chronology of a serial killer,
http://www.who.int/csr/don/2003_07_04/en/
- 34) Japan National Tourism Organization Press release,
<http://www.jnto.go.jp/jpn/downloads/100125monthly.pdf>
- 35) Japan's Hotel Market after the Quake,
[http://www.joneslanglasalle.co.jp/Japan/ja-jp/Documents/FocusOn_Japan_April2012\(JP\).pdf](http://www.joneslanglasalle.co.jp/Japan/ja-jp/Documents/FocusOn_Japan_April2012(JP).pdf)
- 36) Japan National Tourism Organization Press release,
http://www.jnto.go.jp/jpn/news/data_info_listing/pdf/121116_monthly.pdf
- 37) Japan Tourism Agency, Ministry of Land, Infrastructure, Transport and Tourism: the message from the Director General (2012.7.20),
http://www.mlit.go.jp/kankochu/topics08_000085.html.
- 38) Hayashi, H.: Long-term recovery from recent disasters in Japan

and the United States, Journal of Disaster Research, Vol. 2, pp. 413-418, 2007.

39) Director General for Disaster Management, Cabinet Office, Government of Japan.: Disaster management in Japan (2011), <http://www.cao.go.jp/en/disaster.html>

40) Faulkner, B.: Towards a framework for tourism disaster

management, Tourism Management, Vol. 22, pp. 135-147, 2001.

41) Ritchie, B. W.: Chaos, crises and disasters: a strategic approach to crisis management in the tourism industry, Tourism management, Vol. 25, pp. 669-683, 2004.

(原稿受付 2013.5.24)

(登載決定 2013.9.7)