Earthquake devastation and recovery in tourism: the Taiwan case

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Abstract

The most serious earthquake in Taiwan of the 20th century struck the central region of the island on September 21, 1999. The so-called September 21 Earthquake, measuring 7.3 on the Richter scale, dealt a sharp blow to the Taiwanese tourism industry, with the worst impact being suffered by the international tourism sector. To revitalize the dramatic decline in inbound tourist flows, the government of Taiwan implemented a series of swift countermeasures. The purpose of this study is to evaluate whether Taiwan tourism has rebounded completely from the crisis. This research establishes a model for Taiwan's inbound demand to predict the volume of visitor arrivals after the quake (September 1999 to July 2000). The forecasts are based on the seasonal autoregressive integrated moving average (SARIMA) model which are then compared with the actual volume of visitor arrivals to analyze the recovering status. Empirical results indicate that the island's inbound arrivals have not yet fully recovered from the earthquake's devastation after 11 months. © 2002 Elsevier Science Ltd. All rights reserved.

Keywords: September 21 earthquake; Tourism industry; Visitor arrivals; Seasonal autoregressive integrated moving average (SARIMA)

1. Introduction

The most serious earthquake in Taiwan of the 20th century struck the central region of the island on September 21, 1999. The so-called September 21 Earthquake, measuring 7.3 on the Richter scale, rocked Taiwan and flattened several towns. Human casualties and infrastructure damages mounted: more than 2400 people were killed, over 13,000 people were injured, in excess of 10,000 were left homeless, many buildings were destroyed, and roadways, water, sewage, gas and power systems were cut (National Fire Administration, 1999). The detrimental effects of the 7.3-magnitude tremor sapped the island's economy and led government officials to cut the estimated growth of the 1999 gross domestic product in the fourth quarter to 5.3% from 5.7% (Directorate-General of Budget, Accounting and Statistics, 2000).

The island's most severe natural disaster in the 20th century dealt a sharp blow to the Taiwanese tourism industry, with the worst impact being suffered by the international tourism sector. The post-quake rescue operations diminished many individuals' desire to travel during the initial period following the disaster. The media frenzy and misleading reports that the quake had engulfed the entire island also frightened away many potential tourists. According to the Tourism Bureau report, during the January–August period of 1999, visitor arrivals recorded a 15% growth as compared with the same period the year before, which had been reviving as Asia recovered from the financial turmoil of 1997–98. However, there was a dramatic reduction in tourist arrivals during the post-quake period. The number of visitors from abroad declined by 15% during the period from September to December when compared with the same period in 1998, and the number of visitors to 230 major scenic spots dropped by 27% (Tourism Bureau, 2000). The room occupancy rates of hotels for international tourist plummeted by an average of about 60%, and international airline reservation cancellations soared to 210,000 for the September–December period of 1999. Products in the tourism industry are quite perishable (Athiyaman & Robertson, 1992; Witt & Witt, 1995; Chu, 1998a; Law & Au, 1999; Law, 2000), so cancellation of hotel rooms, airline seats, concert hall seats, coach seats, dining, banquet, etc. caused a tremendous loss in tourism revenue.

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To reinvigorate the dramatic decline in inbound tourist flows, the government of Taiwan adopted a series of swift countermeasures. A year since the September 21 Earthquake, it is an appropriate time to evaluate the recovery efforts made by the government and to see whether the Taiwanese tourism industry has rebounded from the crisis. This can be accomplished by comparing the actual tourist arrivals against a theoretically predicted value. Therefore, the primary objective of the study is to propose a method for estimating the impact of the September 21 Earthquake on visitor arrivals by using the fitted model, which is based on the tourist arrivals in Taiwan during the period from January 1979 to August 1999. Forecasting based on the model is then compared with the actual data from official publications to evaluate the recovering status of visitor arrivals. Previous research in forecasting tourism demand has tended to compare the performance of different techniques (Witt & Witt, 1995; Turner, Kulendran, & Fernando, 1997). In contrast, the present study assesses the impact of this event.

2. Background

The largest natural disaster in Taiwan of the 20th century hit the island on September 21, 1999. The 7.3-magnitude earthquake shook the island's economy and resulted in tragic loss of life and property. The greatest effects of the September 21 Earthquake were felt instantly by the tourism industry, since it damaged tourist facilities at numerous popular destinations. The worst damage was in central Taiwan, near the epicenter in Nantou County. Nearby theme parks such as the Formosan Aboriginal Culture Village were hurt badly during the peak season for tours in the quarter. The internationally renowned Sun Moon Lake scenic area, normally attracting throngs of visitors, was severely damaged. The short-term reconstruction cost has been estimated to be more than US$16 million. Statistics showed that government-operated scenic spots suffered losses amounting to approximately US$19.5 million, and privately operated tourist enterprises suffered losses of about US$119 million (Tourism Bureau, 2000).

In order to attract tourists back to the island, the Tourism Bureau has adopted swift countermeasures to revitalize the tourism industry. However, tourism recovery from natural disaster is not straightforward; it may take several years to rebuild the industry to pre-disaster levels as destroyed roads are reconstructed and ruined tourist facilities are brought back into operation (Durocher, 1994). Tourists will be seriously impeded if transportation is not available (Tzeng & Chen, 1998), and they will look for alternative destinations where tourist facilities are more accommodating.

The earthquakes in Turkey in August 1999 and in Japan in January 1995 have resulted in similar setbacks in the respective regional tourism. Turkey tourism suffered when a catastrophic quake hit the area near Istanbul, with tourist arrivals cut sharply in the succeeding months. The Turkish government, eager to draw American visitors back, immediately focused on its target market of North America which had sent 2.5 million visitors to Turkey in 1998. The messages of "Safety" and "Turkey, the center of world history." were prominently launched through the cable networks in New York and Los Angeles. The success of this campaign is evident. Figures from the Turkish tourist office show travel from North America nowadays exceeds pre-earthquake levels (Dickey & Kohen, 1999; Goetzl & Healy, 2000). Another great earthquake measuring 7.2 on the Richter scale, the worst post-World War II disaster in Japan, devastated the cities of Kobe and Kyoto. Tourism in Kyoto, the ancient Japanese capital for more than one thousand years, declined sharply after the earthquake. Efforts were made immediately by the Kyoto Tourism Association to send out the message "Kyoto is OK" (Fukunaga, 1995; Kristof, 1995; Horwich, 2000). Because tourists do not tend to thoroughly evaluate the reality behind delivered images through the media (Mansfeld, 1999), it is important to counter the negative images by providing timely information to make current and prospective visitors feel safe during the recovery period after the earthquake (Durocher, 1994).

The accuracy of media coverage is essential for shaping potential visitors' attitude toward the destination during the aftermath of a disaster. However, accurate coverage is often the exception rather than the rule during these times. Instead, news organizations may exaggerate the situation to attract attention to their media and publications. As a result, the media coverage not only complicates the process during the recovery stage, but also lessens the willingness of tourists, or potential tourists, to visit (Milo & Yoder, 1991). The image of a destination is a critical factor in the tourists' destination selection process (Sirgy & Su, 2000). A positive image of destination results in more visitations (Gartner & Hunt, 1987; Gartner & Shen, 1992; Dimanche & Lepetic, 1999), but changing a negative one requires long and costly marketing efforts. Since the tourists' perceptions of safety concerning a destination will influence their intentions to visit (Dimanche & Lepetic, 1999; Sonmez & Graefe, 1998), it is important to reintroduce a destination by providing up-to-date information (Durocher, 1994). Furthermore, it is also desirable to establish a good relationship with the media (Milo & Yoder, 1991; Drabek, 1995).

The Tourism Bureau of Taiwan implemented a series of measures to reinvigorate island tourism. In order to mitigate the negative media coverage, more than 400

representatives of overseas media and major foreign tour wholesalers were invited for familiarization tours of the areas affected by the earthquake. Moreover, international promotion based on the theme of "tour Taiwan at ease" was carried out to entice foreigners to visit the island. Additional promotional activities were carried out to encourage tourism. The annual Taipei International Travel Fair was held at Taipei in November. The four-day fair featured 520 booths manned by tourism professionals from 40 countries and areas throughout the world, and attracted more than 60,000 visitors. Being held during the aftermath of the earthquake, the fair not only had a significant positive effect on the revitalization of domestic tourism but also immensely enhanced the overall image and position of Taiwan on the international tourism stage. Another positive development was the Johnnie Walker Classic golf tournament held in Taiwan during the same month. The tournament attracted reporters from more than 20 major golfing magazines and tourism media from Japan, Hong Kong, Singapore, Australia, and the United States. The Tourism Bureau took advantage of the tournament and placed "Goodwill Taiwan" and "After the quake, Taiwan goes on." a 30-second commercial on the CNN cable news network in Asia and North America. Since the visitors from Japan have been the Taiwan's major inbound market segment, the placement of "easy heart publicity" advertisements in major Japanese media was strengthened. Furthermore, promotion seminars were held jointly with large Japanese air carriers in Tokyo, Fukuoka, Osaka, and Nagoya, and posters were posted throughout Tokyo railways and bus stations. Finally, a marketing program of "Go, Taiwan" was carried out in cooperation with China Airlines and Japan Asia Airways.

The Taiwanese government has made other efforts to stem the dramatic decline in inbound tourist flows. The government played a significant role to help bring facilities in scenic areas back into operation efficiently. The Tourism Bureau has assisted in the reconstruction of public facilities under a program of relief loans for tourist industries in the stricken areas. This program permits large and small tourism operators to apply for low interest loans from small and medium business banks. Operating capital loans are also provided by the Central Bank of China. Furthermore, assistance has been provided for carrying out nation-wide inspections of scenic and recreational areas. An announcement had been made of those that had passed safety inspections so that the public could travel without safety concerns. Nevertheless, to attract tourists to Taiwan, there was still a need to substantially reduce the overall prices of taking a trip to Taiwan during the early recovery stage. Since tourists from Japan and Hong Kong dominated the inbound market in Taiwan, there were significant discounts of ticket fares for routes from the above

regions. In addition, many Taiwan's international tourist hotels mailed promotional materials to every previous Japanese guest to rescue the sharply declining Japanese market (Travel Trend News, 1999).

In order to recapture international tourism, the Taiwan government made strong recovery efforts. The objective of this study is to evaluate whether Taiwan tourism has rebounded completely from the crisis. This research establishes a model for the inbound demand of Taiwan to predict the volume of visitor arrivals after the quake (September 1999 to July 2000). The forecasts from the fitted model are then compared with the actual volume of visitor arrivals to analyze the recovery status. To date, there exists no published article in tourism that makes such an attempt.

Due to the perishable nature of the tourism industry, an accurate tourism forecast is crucial to the planning of government bodies and private sectors for tourism development efforts and investments (Uysal & Crompton, 1985; Martin & Witt, 1989; Morley, 1991; Chan, 1993; Sheldon, 1993; Dharmaratne, 1995; Pattie & Snyder, 1996; Lee, Var, & Blaine, 1996; Wong, 1997; Chu, 1998a; Law & Au, 1999). Thus, the forecasting techniques have been widely adopted in international tourist arrival demand forecasting. Among many forecasting approaches, multiple regression analysis is commonly used in the tourism literature (Morley, 1993; Turner, Kulendran, & Pergat, 1995), and time-series models generate relatively accurate forecasts for tourism demand (Athiyaman & Robertson, 1992). Univariate ARIMA analysis tends to be superior to the more data-demanding multiple-series regression models in terms of forecasting accuracy (Pankratz, 1983). Previous time-series studies in tourism literature often applied the forecasting techniques to tourism data and sometimes also analyzed the accuracy of the forecasts. As a result, Univariate Box–Jenkins (UBJ) forecasting has outperformed the others in this respect (Witt & Witt, 1995). For instance, it was employed by the Canadian Government Office of Tourism (1977) to forecast Canadian foreign tourist receipts and expenditures, and arrivals to Canada from the US. Therefore, the Box–Jenkins seasonal ARIMA (SARIMA) model, which incorporates seasonal and nonseasonal differencing, is used to represent international tourism demand regarding Taiwan.

3. Methodology

3.1. Data

The data adopted in this study is monthly aggregate visitor arrivals in Taiwan from the period January 1979 to July 2000. Among the 259 observations, the first 248 observations (January 1979 to August 1999) were

utilized to establish a model to forecast the visitor arrivals in Taiwan for the following 11 months (September 1999 to July 2000). Estimated visitor arrivals were compared with actual visitor arrivals. In this study, the visitor arrivals are defined as incoming foreign visitors and overseas Chinese visitors who indicated their purpose for visiting as falling under at least one of the following headings: *business, pleasure, visiting relatives or friends, attending conferences* or *study*. This set of data is obtained from the *Monthly Report on Tourism* published by the Tourism Bureau of Taiwan.

3.2. Forecast methods

A variety of forecasting techniques have been developed. The quantitative technique of predicting tourist arrivals has received considerable attention and is more popular (Chan, 1993; Chu, 1998a, c) than the qualitative approach centered on Delphi studies and scenarios in tourism (Witt & Witt, 1995). Quantitative approaches use mathematics for the systematic treatment of historical series of data, and are further split into causal and time series models (Chan, 1993; Witt & Witt, 1995; Lee et al. (1996); Chu, 1998a, b). Compared with causal models, time series models are more likely to generate better accuracy for projection of two years or less (Choy, 1984; Chan, 1993). Time series analysis, also called *historical* or *chronological series*, provides modeling approach which requires a sequence of observations on a particular variable referring to different moments or periods, which are equally spaced time intervals. Univariate time-series is used to build a model that describes the behavior of a time series for the past and enables one to make satisfactory forecasts for the future (Makridakis & Wheelwright, 1989; Gonzalez & Moral, 1996; Wong, 1997; Law, 2000). It can save the

researchers the trouble of not only determining influential variables but also suggesting a form for the relation between them. Using monthly or quarterly data, rather than the more often used annual data, to forecast international tourism flows is also recommended (Witt & Witt, 1992; Coshall, 2000).

3.3. Box–Jenkins models

Univariate Box–Jenkins autoregressive integrated moving average (ARIMA) analysis (Box & Jenkins, 1976) has been widely used for modeling and forecasting. It has been successfully applied in economic, marketing, financial, environmental, and other decision-making processes.

4. Results

4.1. Identification

The research is based on data from successive months over a 20-year period (January 1979 to July 2000). The first step is to plot the data, and this has been done in Fig. 1. Initial plot of the data revealed irregular variation as well as upward trend. The pattern contains the clearly observable decline from the 249th observation (September, 1999). For Box–Jenkins modeling, it requires a substantial amount of data for the identification and estimation processes, so the first 248 observations (January 1979 through August 1999) were used for the identification process. These 248 observations were utilized to predict observations at times 249 through 259 (September 1999 through July 2000). The forecasted 11 values are used to compare with the actual numbers.

Since the time series plot of the first 248 observations is clearly nonstationary, therefore, some sort of
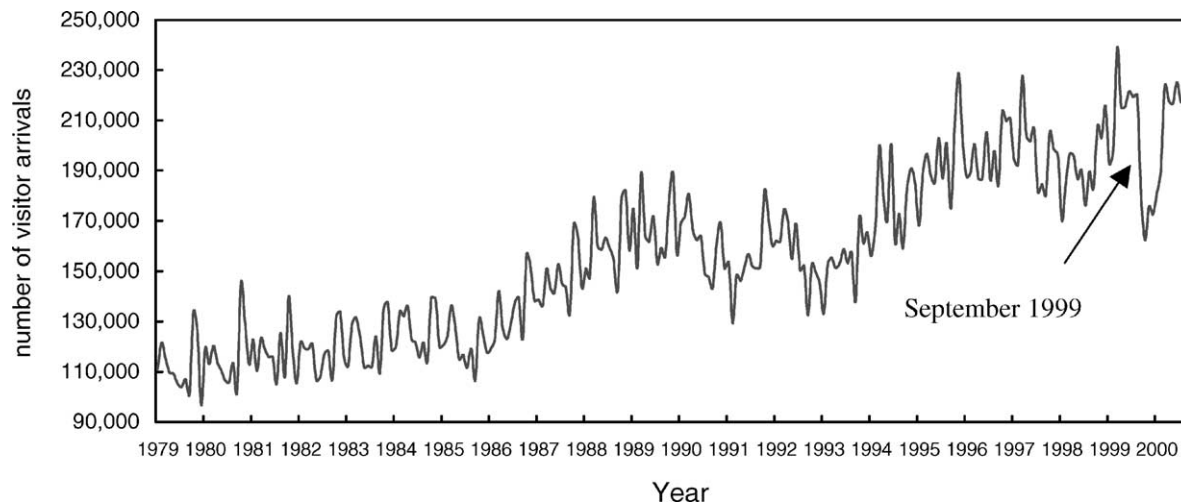

Fig. 1. Time series plot of the January 1979 to July 2000.

differencing is required. To confirm this, the autocorrelation function (ACF) was calculated and, as expected, showed it to be positive and high for a number of lags; and decays fairly slowly. It indicates that the first 248th time series is nonstationary. Thus, differencing is required. The use of a first differencing alone does not remove the effects of nonstationarity from the data, since the autocorrelations at lags 12, 24, 36, 48 are still significant. The seasonally differenced, at lag 12 alone, series is also not stationary.

In view of the above indications, it becomes desirable to employ both of the nonseasonal and seasonal differencing operator in the multiplicative form $(1-B)(1-B^{12})$ to achieve stationarity. The ACF plotted in Fig. 2 has significant negative values at lags 1 and 12. The pattern is indicative of a multiplicative MA(1) and MA(12) model, that is, $(1-\theta_1 B)(1-\theta_{12} B^{12})$. Therefore, the tentatively multiplicative model $(0,1,1)(0,1,1)_{12}$ for the first 248th visitor arrival is obtained:

$$(1-B)(1-B^{12})Z_t = C + (1-\theta_1 B)(1-\theta_{12} B^{12})a_t.$$

4.2. Estimation

Initially, various models are fitted to determine the most appropriate SARIMA process to describe visitor arrivals from first 248 observations. The parameter estimates are significant based on their *t*-value. The conditional likelihood algorithm is used to estimate the parameters. Since the exact likelihood algorithm is for MA parameters only and the model consists entirely of MA parameters, hence, the exact likelihood algorithm is used for final estimation presented (Hillmer & Tiao, 1979). Table 1 presents the result of estimating the SARIMA for the conditional and exact likelihood algorithms.

As indicated in Table 1, the exact likelihood algorithm provides the smaller residual standard error. Thus, the best fitting model for visitor arrivals from January 1979 to August 1999 was as follows:

$$(1-B)(1-B^{12})Z_t = 48.2731 + (1-0.5332B)$$
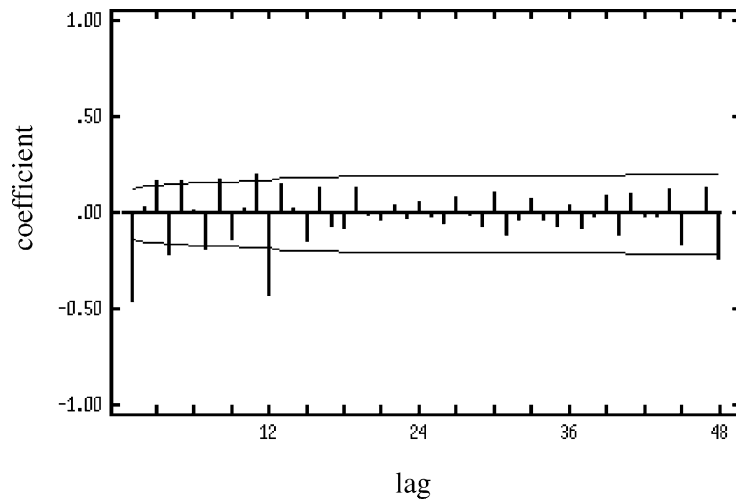$$\times (1-0.6950B^{12})a_t. \qquad (1)$$

Fig. 2. ACF after nonseasonal and seasonal first differencing.

Table 1
Estimated SARIMA$(0,1,1)(0,1,1)_{12}$ for visitor arrivals by conditional and exact likelihood algorithms

	Parameter label	Value	Standard error	*T*-value
Conditional	Constant	32.1191	97.471	0.34
	θ_1	0.5343	0.0554	9.64
	θ_{12}	0.6701	0.0517	12.97
$R^2 = 0.934$ Residual standard error $= 0.834073E+04$				
Exact	Constant	48.2731	89.3971	0.54
	θ_1	0.5332	0.0556	9.58
	θ_{12}	0.6950	0.0487	14.26
$R^2 = 0.937$ Residual standard error $= 0.816970E+04$				

4.3. Diagnostic checking

Once a SARIMA model is fitted, it is important to investigate how well the tentative model fits the given time series. This comprises the step of diagnostic checking in model building. Investigation of the behavior of residuals is a useful tool in this regard. Plot of the estimated residual ACF is showed in Fig. 3, and it is evident from the figure that the residuals are not autocorrelated, and reveal no apparent patterns or aberrations. PACF is also employed to check the residuals and indicates that the residuals are approximately white noise. Moreover, a time series plot of the residual is displayed in Fig. 4. The residual plot looks random, and no evidence of heteroscedasticity is present.

According to Box–Jenkins modeling (1976), one technique which can be employed for diagnostic checking is overfitting. One alternative model found worth considering for fitting to time series is SARIMA$(0,1,2)(0,1,1)_{12}$. The model fitting results are presented in Table 2 which are quite similar to those presented in Table 1 except that in the above model the nonseasonal MA(2) parameter θ_2 ($|t - value| > 2.00$) has been included. After diagnostic checking for the alternative model, it indicates that the behavior of residuals in both the models is quite similar. The alternative model may be represented by the following equation:

$$(1 - B)(1 - B^{12})Z_t = 53.0207 + (1 - 0.6136B + 0.1568B^2)$$
$$\times (1 - 0.6918B^{12})a_t. \tag{2}$$

After comparing the above two models, we found that when θ_2 is added, the value of R^2 shows a negligible increase of 0.001. In addition, as seen, residual standard error shows an insignificant decrease. Furthermore, one of the basic principles of ARIMA model building (Box & Jenkins, 1976) is that the model should be parsimonious (i.e. the model which adequately
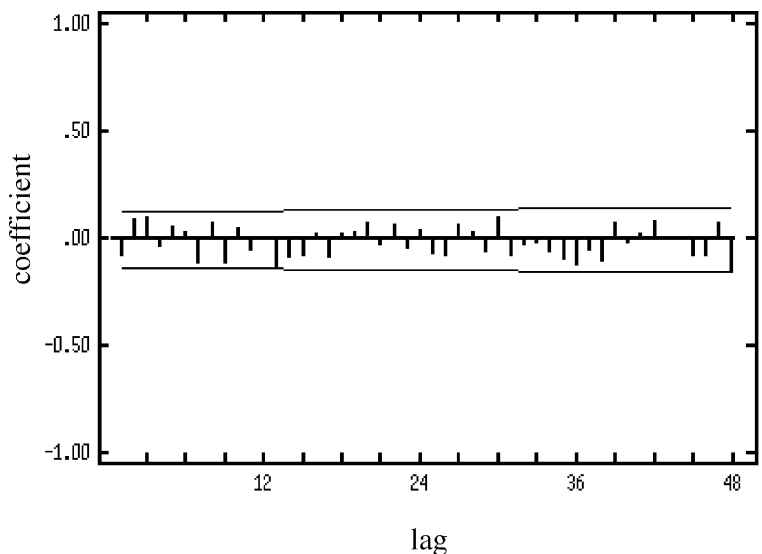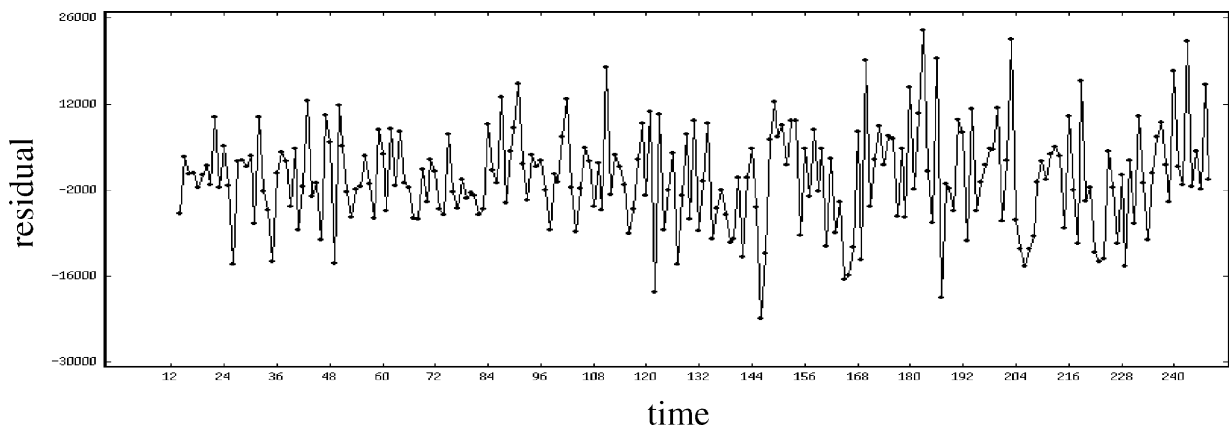

Fig. 3. Estimated residual ACF.

Fig. 4. Plot of the residual time series.

Table 2
Alternative model SARIMA(0,1,2)(0,1,1)$_{12}$ for visitor arrivals by conditional and exact likelihood algorithms

	Parameter label	Value	Standard error	T-value
Conditional	Constant	36.1083	107.6654	0.34
	θ_1	0.6110	0.0647	9.45
	θ_2	−0.1431	0.0653	−2.19
	θ_{12}	0.6633	0.0516	12.85

$R^2 = 0.936$ Residual standard error $= 0.826431E + 04$

	Parameter label	Value	Standard error	T-value
Exact	Constant	53.0207	102.9140	0.52
	θ_1	0.6136	0.0645	9.52
	θ_2	−0.1568	0.0648	−2.42
	θ_{12}	0.6918	0.0488	14.18

$R^2 = 0.938$ Residual standard error $= 0.807739E + 04$

Table 3
Actual and predicted values of visitor arrivals between September 1999 and July 2000

Year/month	Predicted	Actual	Difference (Act−Pred)	% Diff (Diff/Pred × 100%)
1999/09	209,848	179,392	−30,456	−14.5
1999/10	236,726	162,282	−74,444	−31.4
1999/11	235,598	175,481	−60,117	−25.5
1999/12	234,654	172,595	−62,059	−26.4
2000/01	216,736	180,922	−35,814	−16.5
2000/02	223,971	190,108	−33,863	−15.1
2000/03	248,818	223,654	−25,164	−10.1
2000/04	234,308	217,576	−16,732	−7.1
2000/05	231,127	216,692	−14,435	−6.2
2000/06	240,010	225,069	−14,941	−6.2
2000/07	226,782	217,302	−9480	−4.2

describes the time series with the smallest possible number of parameters). Keeping in view the above principle, it can be concluded that the model represented by Eq. (1) is the more appropriate one for the observed time series. It is also sound practice to try SARIMA(0,1,3)(0,1,1)$_{12}$ and SARIMA(0,1,1)(0,1,2)$_{12}$. The results show that the extra parameters θ_3 and Θ_2, respectively, are not significant. Based on the above examinations, the fitted seasonal ARIMA(0,1,1)(0,1,1)$_{12}$ model is appropriate for the series.

4.4. Forecasting

Finally, the SARIMA(0,1,1)(0,1,1)$_{12}$ model was used to forecast the 11 future values of September 1999 to July 2000, and the forecasts were compared with the known values. Table 3 shows the empirical findings of the forecasts and actual visitor arrivals, and Fig. 5 provides a graphical presentation of these findings.

According to Table 3 and Fig. 5, the differences between the actual and predicted numbers of visitor arrivals for the 11 months have gradually decreased. In other words, the island visitor arrivals are bouncing back from the disaster, indicating the government's efforts have proved effective. However, the figures for September, October, March, and July require further discussion. Since September 21 Earthquake occurred in late September, the total number of visitor arrivals in September was not significantly lower. Obviously, the largest difference (74,444) throughout the entire period falls in October 1999. The difference in this month reveals the volume of consequently declined tourist arrivals as a result of September 21 Earthquake. For the entire period, the smallest difference (9480) falls in July, during which actual arrivals are very close to the predicted value. Fig. 6 illustrates the gradual convergence between actual and predicted tourist arrivals following the September 21 Earthquake. The result has demonstrated that inbound tourist flows have apparently been rebounding. This is particularly meaningful, since July is the last month of our observation. It should also be noted that the actual number of visitor arrivals in March, usually peak season for the tourists, increases and ranks as the second highest among the 11 months, albeit still being below the predicted value of 25,164. It indicates that the forecast model follows the overall
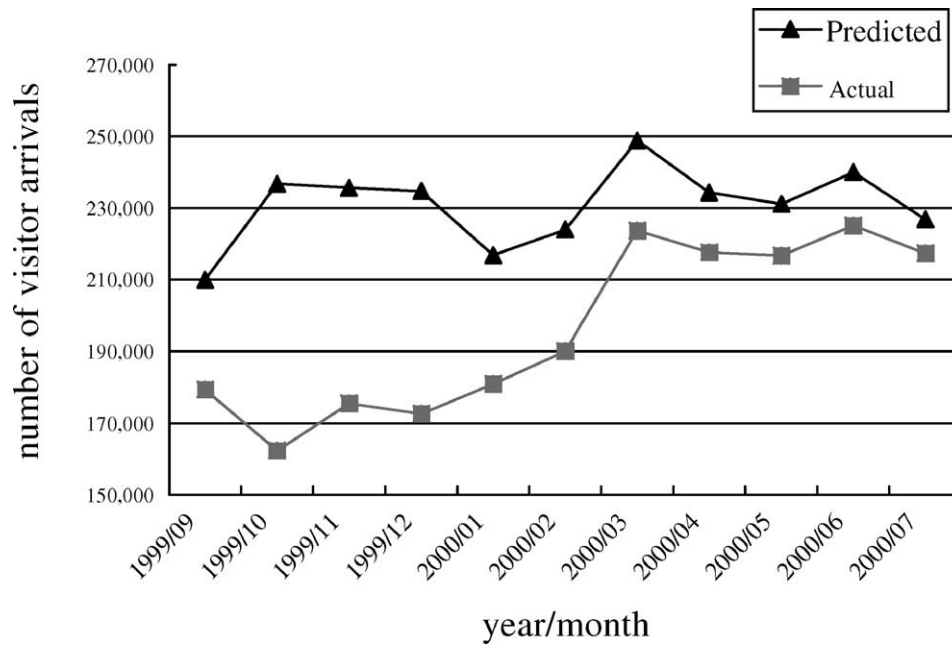
Fig. 5. Graphical presentation of actual and predicted values of visitor arrivals.
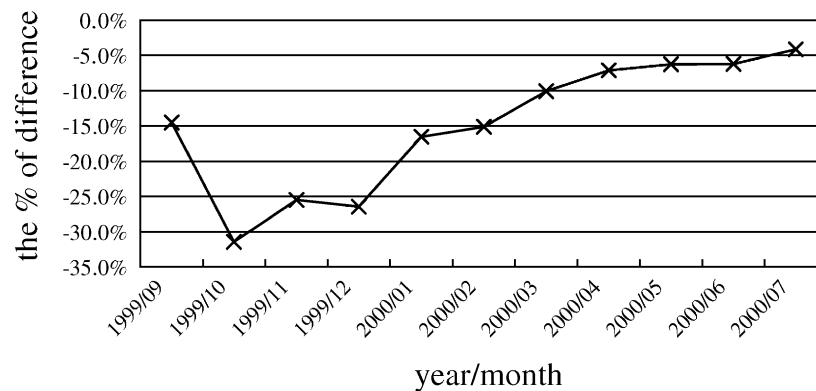

Fig. 6. The percentage of difference between actual and predicted values of visitor arrivals.

trend in tourism demand, and it does capture the cyclic fluctuations for the September 1999–July 2000 period.

5. Conclusions and discusssion

The study has applied a forecasting model to evaluate the recovering status of visitor arrivals in Taiwan after the September 21 Earthquake. The results reported above indicate that after 11 months Taiwan has not yet fully recovered from sharply reduced inbound arrivals due to the earthquake. Nevertheless, the arrivals to the island have proven resilient. The efforts are continuing apace, but the effects have not been able to be realized immediately. Full recovery for visitor arrivals may take longer than expected, and it will require significant effort. As previously indicated, it may take several years to rebuild the industry to pre-disaster levels for any tourism destination after a natural disaster (Durocher, 1994). It is reasonable to believe that the government's policies and attitudes play a vital role in the recovery process when earthquakes occur. It appears that the prompt and effective efforts of the Taiwan government contributed greatly to the recovery and enhanced awareness about Taiwan around the globe. It could well be that, without the major government efforts thus far, the situation following this calamity would have deteriorated even further. Being that the September 21 Earthquake was the greatest natural disaster of the century in Taiwan, no effort can be spared. Furthermore, although the damage was limited mainly to the central region, tourists may have the perception that the

entire island was devastated. The consequences of the misunderstanding may impede the flow of tourism, since perceptions of risk and safety toward a destination are likely to influence travel decisions (Sonmez & Graefe, 1998). Thus, the government should take further steps to carry out more promotions to enhance the desire of tourists for travel in Taiwan.

This paper has attempted to highlight, on a macro level, measures taken by the government in Taiwan to spur recovery from disaster. In doing so, it can serve as a reference for other destinations in similar circumstances. The study employed the methods appropriately to analyze the status of recovery when earthquakes occur. In doing so, it presents another contribution to literature regarding the effective use of forecasting models to evaluate and assess the recovering status of visitor arrivals from crisis, extending to an "ad hoc" status.

The study is limited to a univariate approach which considered only visitor arrivals. It does not seek to uncover the inbound visitors' traveling motivations. Hence, tourism researchers can study the factors that affect the inbound travel demand in Taiwan. With meaningful and accurate estimates of tourism demand, the government, local authorities and private sectors can efficiently plan for and use scarce resources such as the environment, infrastructures, airline seats and accommodations. There are other factors that might have cast an impact on the rebound, such as people's fading memory. Whether this aspect might constitute a confounding factor in this study could provide a basis for further study. Another possibility for future research would be to assess the recovering status in different regions or countries, such as Japan, the United States and Hong Kong, which dominate the Taiwan inbound market. It will be especially interesting to see the impact of the strong promotional efforts in the Japanese market during recovery stage. Finally, yet another avenue of research employs intervention analysis, which is a useful technique when the effects of exogenous interventions occurred at some known time points (Box & Tiao, 1975). In this regard, intervention analysis can provide a useful stochastic modeling tool that can be used to rigorously analyze the impact of the September 21 Earthquake intervention in the mean level of time-series. Such analysis can be achieved in the future when more post-quake observations are obtained.

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