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The swine flu and its impacts on tourism in Brunei

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1. Introduction

This study shows how to disentangle the effects of swine flu (SF) from the effects of earlier global financial crisis (GFC) on tourism and economy in Brunei. This may be a useful contribution to both policy makers, practitioners and to the tourism literature. Brunei is a small country with a population of 400,000 people. It is situated on the north-west side of the Island of Borneo and it has oil and gas reserves. The country is quite safe and tolerant for all types of ethnic people and it attracts many foreign tourists every year from various countries. For example, 226,000 tourists visited Brunei in 2008 (Brunei Tourism Development Department, 2010).

Brunei lost a significant number of tourists due to the 2008 GFC and this declining trend intensified until mid-2009, which can be seen by comparing tourist arrival numbers: 198,338 and 139,684 respectively during the 10 months pre- and post-GFC periods (Brunei Tourism Development Department, 2010). Then a small window of world economic recovery was observed. But then the world faced another crisis by the news of outbreak of A (H1N1) virus which is popularly known as swine flu (SF). Swine Flu occurs when people are in contact through talking or sitting or walking near the infected person/s and in contact with infected secretions produced through sneezing, coughing, spitting or transfer after touching infected areas. This is a serious infectious disease which people have every reason to fear (Denoon & Hitti, 2010; and Ministry of Health: Brunei Darussalam, 2010). The presence of the A (H1N1) virus affected Brunei sharply and its effect on tourism was serious across the world including Brunei.

Mexico recorded the first known SF case on March 17, 2009. Like the rest of the world, Brunei was not immune from the fear of SF. Mahdini (2010) described how Brunei’s government took every possible preventative measure to avoid SF and to boost the confidence of the people. Brunei’s government was prepared to face the outbreak as early as May 2, 2009 but Brunei’s residents were already panicking by the end of May 2009.

These measures failed to protect some of the people of Brunei from SF. A student was identified with positive A (H1N1) virus on June 20, 2009. A 12 year old girl became the first fatality on July 2, 2009. The recorded infected numbers were increasing at a rapid pace and by the reopening time of schools the total number of SF infected cases reached 142 which is a very high rate in a country of less than 400,000 people (Ministry of Health: Brunei Darussalam, 2010).

2. The effects of swine flu

The swine flu is a very serious threat to the tourism industry because the number of tourists visiting any country is directly related to the number of tourists visiting that country. The number of tourists visiting a country is also affected by various factors such as the presence of swine flu (SF).

This study shows how to disentangle the effects of swine flu (SF) from the effects of earlier global financial crisis (GFC) on tourism and economy in Brunei. This may be a useful contribution to both policy makers, practitioners and to the tourism literature. Brunei is a small country with a population of 400,000 people. It is situated on the north-west side of the Island of Borneo and it has oil and gas reserves. The country is quite safe and tolerant for all types of ethnic people and it attracts many foreign tourists every year from various countries. For example, 226,000 tourists visited Brunei in 2008 (Brunei Tourism Development Department, 2010).

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Tourism has become an important global industry since 1970 and it is growing rapidly. The World Tourism Organization (2008) mentioned that in 2007 there were nearly 900 million international tourists and it was growing at over 6% per year. Tourism has wide spread implications and this has been the subject of considerable public and academic interest. There is a huge amount of literature on tourism among which Turner (2015), Zhang, Lin, and Newmann (2016), Nawjin, Mitas, Lin, and Kerstetter (2013), UNWTO (2016) can be mentioned. More importantly, an extensive review of literature can be seen in Witt and Witt (1995), Song and Li (2008), Lee, Lowry, and Delconte (2015), Merinero-Rodriguez and Pulido-Fernandez (2016), Goh and Law (2011), Chen and Peterson (2013), Phuchan and Suntikul (2016), and Getz and Page (2016).

There are two main approaches to evaluate the effects of crisis events. These are: (i) the pre-post method, and (ii) the forecasting approach. The pre-post method attempts to evaluate the effects of a crisis by comparing the number of the tourists in the same period of the pre- and post-crisis event (Chen & Chen, 2005). However, it fails to incorporate the pre-trend of the data, which might affect the actual change of the crisis and hence it cannot accurately measure the effects of the crisis event.

In contrast, forecasting methods can predict the tourist numbers for the post-event period as if the crisis event had not occurred. This predicted tourist number is then subtracted from the actual number for a certain post-event period and this is usually interpreted as the effect of the crisis. Most forecasting methods have the advantage of controlling long-term trends. Quantitative forecasting methods are mainly divided into two groups. First, time series (TS) methods (basic, intermediate, and advanced) which have many advantages. It is based on the assumption that the present and past behavior of the data will continue in the future, and observations at different points in time are statistically dependent. The ARIMA model is the most popular TS forecasting model. One can fit an ARIMA model to almost any TS data with the desired precision. However, there are some disadvantages for the ARIMA model such as (i) there is no way to know where to start the ARIMA model; (ii) it cannot be used for non-stationary data; (iii) it requires a large number of data points; and (iv) it is a univariate TS forecasting method and cannot be used for a multivariate TS data analysis. The ITS model is a further development of the ARIMA model and it can measure and test the effects of intervention/s. It uses both the pre-and post-intervention data, whereas the ARIMA model uses only the pre-intervention data. It provides better forecasts than the ARIMA model for interrupted TS data. The vector auto-regression (VAR) model is one of the most successful, flexible, and easy to use models for the analysis of multivariate TS data and can provide better forecasts than the ARIMA model. It can be considered as one type of econometric model and it possesses all the advantages of the regression method. Also, the size of the model is not a concern. However, it can be estimated by various ways and hence it can give a wide variety of different forecasts.

On the other hand, causal methods (Regression method and Structural method) are concerned with methodologies for identifying relationships between dependent and independent variables and attempt to incorporate the interdependence of various variables in the real world. However, the difficulty of applying the causal methods is identifying the appropriate independent variables that affect the forecast variable. Structural models are more transparent as they can check if the predicted behavior by the model for each component corresponds to what is expected from the data. The structural forecasting method is relatively straightforward, and missing observations are easier to treat. It can also manipulate multivariate series by direct extension of the univariate structural formulation which is not possible with the ARIMA model. Many researchers forecast with structural models for economic analysis and use the term “econometric model forecasts” and these are routinely used for econometric policy analysis. The main advantages of econometric models are: (i) this method possesses all the advantages of the regression method, (ii) the size of the model is not a problem; and (iii) to estimate and solve the model using software packages is easy. However, the accurate forecasting of these two causal models depends on the quality of independent variables that affect the forecast variable (see Chen, Bloomfield, & Cubbage, 2008 for comparing forecasting models in tourism).

In the past, researchers used various methods as mentioned above to evaluate the impacts of uncertain events such as diseases, earthquake, etc., on tourism, using the ARIMA, ITS, Structural Time Series, VAR and many other methods. For example, the Severe Acute Respiratory Syndrome (SARS) is a serious disease which affected tourism in most Asian countries. Many authors have analyzed the impacts of various disease outbreaks on travel and tourism for various countries using econometric methods (Chen, Jang, & Kim, 2007; Chien & Law, 2003; Kou, Chen, Tseng, Ju, & Huang, 2008; McAleer, Huang, Kuo, Chen, & Chang, 2010; McKercher & Chon, 2004; WTT, 2003; Wilder-Smith, 2006; Tung & Chao, 2011; Oukil, Channouf, & Al-Zaidi, 2016; Cuhadar, 2014). By contrast, Cankurt and Subasi (2016), Song, Li, Witt, and Athanasopoulos (2011), Turner (2015), and many others used structural TS analysis to model and forecast tourist demand. On the other hand, many authors such as Aboagye-Sarfo, Cross, and Mueller (2016), Zheng, Farrish, and Ketterlin (2016), Wu and Hayashi (2013, 2014), Chung, Ip, and Chan (2009) and many...
others used the ARIMA and ITS model methods to evaluate the impacts of various crisis events. An excellent survey of the literature on the evaluation of crisis events can be found in Hall (2010) and Goh and Law (2011).

Most advanced TS methods use present and past values and deal with specification, estimation, forecasting and evaluation and they often provide better forecasts than causal methods. Forecasts based on TS methods help in making forward planning, marketing, and resource allocation in the tourism industry, which are now discussed here. Min (2008a) evaluated how Taiwan’s inbound tourism was affected by the September 21st, 1999 Earthquake and SARS in 2003, using the ARIMA and ITS methods. She showed that Taiwan was hit hard by these two calamities. Min (2008b) and Min and Kung (2007) analyzed inbound tourism demand for Taiwan using the ARIMA and ITS models. Min, Wu, and Wu (2006) also forecasted outbound tourist arrivals using the ITS model. Bonham and Gangnes (1996) used the ITS to measure the effect of Hawaii hotel and room tax on tourism. Coshall (2003); Lee, Oh, and O’Leary (2005) and Ismail, Suhartono, Yahaya, and Efendi (2009) evaluated the threat of terrorism on international travel flow using the ITS model. Goh and Law (2002) also used the ITS model to forecast tourism demand, Chen (2011), Engin (2015) and many others have evaluated the effects of various crisis events on tourism, using the ARIMA and ITS techniques. Page, Song, and Wu (2012) also evaluated the impacts of the global economic crisis and swine flu on inbound tourism demand in the United Kingdom using the ITS model. Many other authors including Min, Lim, & Kung, 2011; Hultkrantz & Olsson, 1997; Allbattat, Mat Som, Ghaderi, & Abukhalifeh, 2013; Kim & Jun 2016; Tung & Chao, 2011; Baker, 2014; Aboagye-Sarfo et al., 2016; Wu & Hayashi, 2014; Nor et al., 2016; Mihalic, Kester, & Dwyer, 2013; Peng, Song, & Crouch, 2014; and Smeral, 2010) have also used the ARIMA and ITS techniques for modelling and forecasting tourism demand.

In this study, we have used the Box and Jenkins (1970) ARIMA and Box and Tiao (1975) ITS model methods to measure the effect of swine flu in Brunei. This is because the ITS model is appropriate for explaining the dynamics and the impact of interruptions and changes of TS in a more detailed and accurate manner (Baldigara & Mamula, 2015; Park, Lee, & Song, 2016; Aboagye-Sarfo et al, 2016; Chang & Lin, 1997; Biglan, Ary, & Wagenaar, 2000; Ferrand, Kelton, Guo, Levine, & Yu, 2011; Chung et al., 2009; Wu & Hayashi, 2014). The ARIMA and ITS methods can provide an appropriate measure of the impacts of crisis events, which advise practical actions to overcome problems associated with tourism, economic and other business matters.

3. Data

Brunei Tourism Development Department provided monthly foreign tourist arrivals to Brunei from January 2005 to May 2010. It should be noted that 126,000 tourists arrived in 2005 and it increased to 226,000 in 2008 just before the GFC, and then declined to 157,000 tourists after the occurrence of both the GFC and SF (Brunei Tourism Development Department, 2010). The department only considered entry for overnight transit, government exhibition, business, holidays, visiting friends and relatives as foreign tourists. These are generally considered as the most accurate, complete, and authentic data and are used to estimate the number of tourists lost during the first 12 months post-SF period. At present, there is no information about the activities of tourists in Brunei. In order to get information about the activities of the tourists, we have randomly surveyed a representative sample of 600 (200 and 400 respectively in pre- and post-SF periods) eligible departing adult tourists from Brunei Airport as well as from various shopping centers and restaurants, who did not work and stayed at least one night in Brunei such that each person was selected only once. We then collected information from each of the selected foreign tourists about their length of stay and other costs associated with food, accommodation, transport, shopping and sight-seeing which can be seen from Table 6, and these are used to estimate their spending while they stayed in Brunei. These are then used to estimate the total amount of money lost by the country due to the loss of tourists during the first 12 months post-SF period.

4. Evaluation methods

In this study, we used the Box and Jenkins (1970); ARIMA and Box and Tiao (1975) ITS model methods to predict the number of tourists which will then be used to estimate the loss of tourists during the 1st 12 months post-SF period. First, we use the ARIMA model to predict the number of tourists using the pre-SF data on the assumption that the past and present behavior of the data will continue. The data series should be stabilized before forecasting. It is a general practice to plot the raw data to see if there is any irregular variation, trend, seasonality, and/or other behavior that can be observed. Most often differentiating the data can be used to achieve stationarity. Otherwise more sophisticated techniques of TS data analysis such as the ARIMA model should be applied to predict the number of tourists for the post-SF period.

The ARIMA model is accomplished with the autocorrelation function (acf) and partial autocorrelation function (pacf). By matching the known properties of the model with the observed acf and pacf and undertaking various tests of the stability of the data tentative models are identified, estimated, and checked (see Box & Jenkins, 1970). The Minimum Akaike (1973) Information Criterion Estimate (MAICE) is used to select the best model if several models satisfy the Ljung and Box (1978) Portmanteau test on residuals. Using the estimated parameters of the chosen model, forecasts are made for the post-SF period. In practice TS data are subject to various interventions and hence the ARIMA model alone cannot produce accurate forecasts. Under this situation, the ITS method can incorporate various interventions with the ARIMA model and can produce a more reliable and accurate forecast. The ITS method can also control the long-term trend and is more potentially sensitive. More importantly it can test the intervention coefficients to see whether the interventions significantly reduced the tourist numbers by using a one-tailed t-test.

In this study, we should use two ARIMA models. First, for the SF to predict tourist numbers for the post-SF period based on pre-SF data, which can be used to measure the loss of tourists during the post-SF period by comparing the actual and predicted numbers (or ITS estimate), based on the occurrence of the GFC without SF. Second, we also should use another ARIMA model for the GFC which occurred and affected tourist numbers prior to SF based on the pre-GFC data to predict the number of tourists for the post-SF period due to the GFC.

One ITS model was then redesigned with the best ARIMA fitted to the SF by incorporating two intervention variables: one for SF and another for the GFC. Now this newly developed ITS model was estimated using the entire data set from January 2005 to May 2010. This model allows us to test the intervention coefficients for SF and the GFC to investigate whether they significantly reduced tourist numbers. The robustness of the ITS method can be examined by comparing the predicted tourist numbers with the actual numbers. In this study both the ARIMA and ITS models are used to estimate the loss of tourists for the post-SF period from June 2009 to May 2010 whose empirical illustrations are given below.
5. Empirical illustrations

Before fitting the ARIMA and ITSA models we plot the monthly tourist arrival data in Fig. 1 which shows that the data has irregular variation as well as an upward trend until July 2008. It then declined until June 2009 and then it showed a rising trend after the GFC, which can be seen from the tourist arrival numbers: 29,868 (July and August 2009) compared to 24,466 (May and June 2009).

Just at that time SF emerged in Brunei and it further reduced, which can be seen from tourist arrival numbers: 61,047 and 48,959 during December in 2008 and 2009 respectively (Brunei Tourism Development Department, 2010). This is just another negative shock when the economy can least afford negative shock (Wachovia Corporation, 2009). Thus, two interventions disturb our data: the GFC and SF. The behavior of the acf and pacf also showed that the data are non-stationary. To test the non-stationarity of the data we used the Augmented Dickey Fuller (1979) test for the model with constant and trend: under the null hypothesis that our data has unit root against the alternative hypothesis that data has

$$
\text{Table 1}
$$

| Frequency | 0 | π | π/6 | π/3 | π/2 | 2π/3 | 5π/6 |
|-----------|---|---|-----|-----|-----|-------|------|
| Test Statistic | -1.452 | 3.203 | 2.981 | 4.123 | -1.316 | -1.341 | -1.586 |
| 5% critical Values* | -2.760 | -1.850 | -3.250 | -3.250 | -1.850 | -1.850 | -2.760 |

* 5% critical values are taken from Beauilieu and Miron (1993). Source: Brunei Tourism Development Department, Government of Brunei.

$$
\text{Table 2}
$$

| Different Frequency Levels | L π | L π/2 | L 2π/3 | L π/3 | L 5π/6 | L π/6 | L joint |
|----------------------------|-----|-------|--------|-------|--------|-------|--------|
| Calculated Test statistics | 0.400 | 0.460 | 0.640 | 0.550 | 0.380 | 0.680 | 2.250 |
| 5% critical values* | 0.470 | 0.749 | 0.749 | 0.749 | 0.749 | 0.749 | 2.750 |

* The 5% critical values are taken from Hansen (1990). Source: Brunei Tourism Development Department, Government of Brunei.

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\text{Table 3}
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Best ARIMA models selected for the (a) Swine Flu, and. (b) Global Financial Crises based on pre-intervention data.

| Number of models | Best model selected | Estimated best model | χ²a | Q |
|------------------|---------------------|----------------------|-----|---|
| (a) 20           | (1, 1, 0) (1, 1, 2) | (1 - B)(1 - B^12) (1 - 0.728 (0.23) (1 - 1 - 0.558/2) (0.18) (1 - 0.238^2) (0.09)) \(\hat{\theta} = (1 - 0.48^{12} (0.15) + 0.238^{24} (0.06)) Z_t \) | 28.42 | 0.962 |
| (b) 20           | (1,1,1) (1,1,1),12  | (1 - B)(1 - B^12) (1 - 0.5208) (0.11) (1 - 0.358) (0.12) (1 - 0.358) (0.14) Z_t | 25.4 | 0.525 |

* Estimated standard errors are provided in brackets [ ]. Source: Brunei Tourism Development Department, Government of Brunei.

$$
\text{Table 4}
$$

Estimated intervention model for Swine Flu incorporating SF and. The GFC dummies, using the entire data set: January 2005—May 2010.

$$
\hat{\theta} = -3.615 (0.18) - 7.33 (1 - 0.7506 (0.35) + (1 - 0.518^{12} (0.11) + 0.198^{24} (0.14)) Z_t
$$

| a Estimated standard errors are provided in brackets [ ]. Source: Brunei Tourism Development Department, Government of Brunei.

$$
\text{Table 5}
$$

| Scenario | Tourist Numbers |
|----------|-----------------|
| June 2009—May 2010 |
| ARIMA Forecast if GFC and SF did not happen | 322,177 |
| ITSA if both the GFC and SF happened | 198,440 |
| Number of tourists visited | 170,085 |
| Number of tourist lost due to the GFC | 169,258 |
| Number of tourist lost due to the SF | 123,737 |
| Total number of tourist lost | 29,182 |
| Estimated spending per tourist (B$) (from Table 6) | 152,919 |
| Money lost (B$) due to the GFC | 510 |
| Money lost (B$) Due to the SF | 63,105,870 |
| Total Money lost (B$) due to the GFC and SF | 164,882,820 |
| Total Money lost (B$) due to the GFC and SF | 77,988,690 |

Source: Brunei Tourism Development Department, Government of Brunei.

Just at that time SF emerged in Brunei and it further reduced, which can be seen from tourist arrival numbers: 61,047 and 48,959 during September—December in 2008 and 2009 respectively (Brunei Tourism Development Department, 2010). This is just another negative shock when the economy can least afford negative shock (Wachovia Corporation, 2009). Thus, two interventions disturb our data: the GFC and SF. The behavior of the acf and pacf also showed that the data are non-stationary. To test the non-stationarity of the data we used the Augmented Dickey Fuller (1979) test for the model with constant and trend: under the null hypothesis that our data has unit root against the alternative hypothesis that data has
no unit root. Our test statistic of $-1.98$ is greater than the interpolated Dickey and Fuller critical value $-3.49$ for 66 observations indicating that the null hypothesis cannot be rejected. This means our data has unit root and it is non-stationary.

It is also seen from Fig. 1 that our monthly tourist arrival data has seasonal variation which can be deterministic or stochastic (Hylleberg, 1995; Osborn, Heravi, & Birchenhall, 1999 and Taylor, 1998, 2003). The regression model handles the deterministic process using seasonal dummies. Stochastic process can be stationary or non-stationary which can be investigated by testing the null hypothesis that the data has a seasonal unit root. Thus, the data should be made stationary to make reliable forecasts. In this study, we investigate the seasonal aspects of the data by various tests of seasonality and efforts are made to eliminate the seasonality to make the data stable before making forecasts.

Our data suffer from seasonality which can be seen from the estimated acf and pacf and is confirmed by the sinusoidal form of the correlogram of our data. We then used the HEGY test due to Hylleberg, Engle, Granger, and Yoo (1990) to test the null hypothesis of a certain number of seasonal and non-seasonal unit roots in a TS against the alternative hypothesis that the data has no unit roots. The results of the HEGY test are provided in Table 1 and show that all the test statistics at various frequency levels are higher than the corresponding critical values and hence the null hypothesis $H_0$ cannot be rejected at all frequency levels. This indicates that the data has a non-seasonal unit root corresponding to zero frequency and hence our data is non-stationary. Therefore, its differentiation with filter $(1 - B)$ is required. Moreover, the test accepts the null hypothesis $H_0$ at all frequency levels showing the presence of unit roots at all seasonal frequencies. Hence, the filter $(1 - B^{12})$ is required as recommended by Box and Jenkins (1970) depending on the fact that the series is integrated at the seasonal frequency at all levels of frequencies including zero. Because of this, the product of the non-seasonal and seasonal filters: $(1 - B) (1 - B^{12})$ is applied to stabilize the seasonal and non-seasonal variation of the data. The Canova and Hansen (1995) test is then employed to test the stability of the data. The Canova-Hansen test results are presented in Table 2 which shows that all calculated...
statistics are less than the corresponding critical values. Further, this shows that the data has no seasonal unit root and is now stable, although our original data had a stochastic trend and seasonality. To avoid these problems, we differenced our data at non-seasonal and seasonal levels and apply various tests showing that our data became stationary after first differencing at non-seasonal and seasonal levels with lag length one (Ng & Perron, 2001).

The ARIMA and ITS models are used in the present analyses to evaluate the impacts of SF on tourism and economy. The general ARIMA model is redesigned incorporating two transfer functions for two crises events: the GFC and SF. This model consists of one pulse dummy to consider the effect of the GFC which was long lived and gained a slow recovery. A linear step dummy was used for SF which was a temporary deviation from the slow recovery of the GFC. We use the combination of pulse (for the GFC) and step (for SF) functions as Wei (1990) and add to the general ARIMA \((p, d, q) (P, D, Q)_t\) model in formulating our ITS model, which can be written as follows.

\[
A_t = W_1S_t + \left( \frac{W_2}{1-\theta D} \right) P_t + \frac{\theta_q(B)\theta_D(B)}{\phi_p(B)\phi_P(B)(1-B^d)(1-B^D)} D_t
\]

(1)

5.1. Fitting the ARIMA models using pre-intervention data

Fig. 1 shows that there is a sharp decline of tourist numbers from April 2008 that might happen due to the financial crises in the USA which spread in most countries in September 2008. We notice that there is a downturn of tourist arrivals but without allowing for the effects of SF. The estimated parameters of these newly fitted models are very similar to our original fitted models and certainly none of the parameters of these newly fitted models are significantly different from those of the originally fitted models. Sometimes it is difficult to know the exact point of intervention and as such eliminating the last five points from each of our data series meaning that first we allow the SF to start from January 2009 instead of September 2008. It also allows us to start the GFC from April 2008 instead of September 2008. Eliminating the last five points from each of the original data series means that even if we choose an earlier intervention point for the SF and the GFC even then our original fitted models are still robust and can produce good forecasts.

Re-estimating each of the models without the last five observations from each of the data series allows us to investigate the predictive performance evaluation for each of the best selected models. For the best selected fitted SF model the minimum Absolute Deviation (MAD) and Minimum Mean Sum of Squares of Errors (MSE) are 110.05 and 12,520 respectively. The Percentage of Correct Prediction for this model is 95.2% which shows that the estimated best fitted model for SF is close to the actual number. Similarly, the MAD, MSE and percentage of correct prediction values for the best GFC model are 95; 8504 and 96.4% respectively.

It is thus expected that the pre-intervention model for each of the best ARIMA models given in Table 3 will continue to be adequate for making good post-SF forecasts. The estimated model (a) is used to predict the number of tourist arrivals during the first 12 months post-SF with the knowledge that the GFC affected tourist arrivals but without allowing for the effects of SF. The estimated model (b) is used to forecast the number of tourist arrivals during the first 12 months post-SF as if neither the GFC nor SF occurred.

5.2. Intervention model

The best selected ARIMA model for SF is now redesigned to develop an intervention model since our main objective is to estimate the loss of tourists due to SF incorporating two intervention variables: GFC = 0 for pre-GFC months and GFC = 1 for post-GFC months; and SF = 0 for pre-SF months and SF = 1 for post-SF months. It is noted that the impacts of the GFC is long lived or, in other words, the recovery was prolonged and as such a pulse function is appropriate for the GFC. Thus, the SF shock was really a temporary deviation from the slow recovery of the GFC and hence a step function is appropriate for the SF shock. Thus, a combination of pulse and step functions were added to the best selected ARIMA model for the SF and used to estimate an intervention model of type (1), using the entire data set: January 2005—May 2010. A summary of the estimated ITS model is presented in Table 4.

The parameters of this intervention model were also estimated by the SAS/ETS (2011) computer software which are not significantly different from the pre-SF estimated ARIMA model. Diagnostic checks in terms of residuals, autocorrelations and partial autocorrelations indicate that this model is quite satisfactory. This is reconfirmed by the Q-statistic showing that the null hypothesis cannot be rejected meaning that the model does not exhibit lack of fit since the calculated value of Q is less than 1, which is \(\chi^2_{0.05,5} = 11.05\). Also, the predictive performance of our ITS model is.

\[\text{prediction error} = \frac{\text{actual value} - \text{predicted value}}{\text{actual value}}\]

\[\text{MAD} = \frac{\text{sum of absolute errors}}{\text{number of observations}}\]

\[\text{MSE} = \frac{\text{sum of squared errors}}{\text{number of observations}}\]
excellent which can be seen from Table 5 where our ITSA model forecasts the tourist number as 170,085 compared to 169,258 who came to Brunei during June 2009 to May 2010. This means that the percentage of correct prediction of our ITSA model is more than 99.5%. The estimated intervention coefficients $W_1$ and $W_2$ are both negative and one-tailed t-tests reconfirm that both the SF and the GFC have reduced the number of tourists visiting Brunei.

The loss of tourists due to SF at a post-SF month is estimated by taking the difference between the actual (or ITSA forecasts) and ARIMA forecasts. Thus, the loss of total number of tourists from June 2009 to May 2010 is estimated by summing the number of tourists lost for those 12 months post-SF period. The ARIMA, ITSA forecasts together with the actual number of tourists lost are presented in Table 5. This table shows that the ARIMA forecasts indicate that if SF would not occur, we would have expected 198,440 instead of 169,258 actual tourists, showing a loss of 29,182, (14.7%) tourists during June 2009 to May 2010.

A summary of the tourist survey results is presented in Table 6. It is seen from this table that on average each tourist spent 3.4 days and spent B$150 per day, implying on average each tourist spent B$510 while they stayed in Brunei during September 2008 to May 2010. When we multiply B$510 with the number of tourists lost (29,182) it indicates that Brunei lost B$14,882,820. In a separate study Haque (2010) has shown that tourists spent B$77 less during post-SF compared to the pre-SF period because of shorter stay and lower accommodation costs due to high hotel vacancies in 2009 and 2010. Brunei lost nearly 15% of tourists during the first 12 months post-SF period: June 209 to May 2010, which can be estimated from Table 5 and was explained earlier. To recover from this exogenous shock, the Brunei Tourism Development Department undertook several promotional and marketing initiatives by the end of 2009 to establish Brunei as a desirable holiday destination. These initiatives covered acquisition of a new set of iconic images, brochures, information kit, re-branding new websites, promotional materials, media, and TV advertisements, creating search, and booking engines, attending trade events and social networking. Marketing activities are more intense and wider reaching, giving a message of a safe, peaceful, stable, friendly, and hospitable place blessed by nature protected from disasters, healthy clean and free of topical disease, and easily accessible to modern and efficient in fracture: Brunei as ‘South-East Asia’s best kept secret’.

Group/individual familiarization trips for wholesalers, retailers, organizing sales missions and product updates in all major markets, appointing specialized companies in key markets, financial support for local and overseas industry partners to feature Brunei tourism products in their brochures/websites/fliers; joint marketing activities with local and overseas industry partners for specific technical promotions of tour packages; joint activities with wholesalers to increase destination awareness and sales among retailers; promotion of Brunei tourism initiated thematic packages in short haul markets (such as golf tours and Islamic packages).

The results of all these promotional and marketing initiatives are highly effective which can be seen from Table 7 indicating that there is an overall 20% increase of tourists and hotel accommodations in the first half of 2010 compared to 2009, a similar number to the previous three years’ average. These are reconfirmed by the $\chi^2$-test based on the pre-post method. The actual numbers are well below than the predicted numbers which are supposed to be achieved without crisis events such as the SF, the GFC etc. Increased expected number of tourists can be achieved through increasing promotional and marketing activities in Far-East (China) and Australia/New Zealand marketing areas, providing safety and security information for Brunei, which are currently significantly lower than the three years’ average. Only a few tourists (0.4% of the total) are coming from the Middle-East, despite religious and cultural bonds, who can be persuaded to visit Brunei if Islamic tour packages can be arranged.

6. Discussion

This study shows how the impacts of the SF and the GFC can be separately evaluated. It is important for policy makers and practitioners and is an important contribution to the tourism literature. More importantly, the techniques developed here can be used to disentangle the effects of multiple interventions in a variety of fields including tourism.

In this paper, we investigated how the SF affected tourism in Brunei using the ARIMA and ITSA models. The techniques used here successfully separate the effects of the SF from the GFC on tourism, which occurred earlier and continued after the occurrence of the SF for the period from June 2009 to May 2010. The use of a control group which is free from SF and the GFC may have produced better estimates, but it is difficult to find an appropriate control group.

We did not consider other possible interventions that might have affected tourism in Brunei such as the 1997–98 East Asian Economic Crisis (particularly currency crisis in Indonesia and Malaysia), the 2007–2008 Oil shock, the 2010 Arab Spring, etc., (Hamilton, 2011). It seems none of these factors, other than the GFC and SF affected tourism in Brunei during our study period. This is

| Market Areas     | Average of last Three (3) Years: 2007–2009 | 2009   | 2010   | Percentage Change of 2010 compared to previous Year |
|------------------|-------------------------------------------|--------|--------|-----------------------------------------------------|
|                  |                                           |        |        | 2009       | 2007–2009                                      |
| Malaysia         | 22,045 (23%)                              | 18,536 (23%) | 24,233 (26%) | 31         | 9.90                                          |
| (1) ASEAN        | 43,326 (45%)                              | 38,973 (49%) | 48,584 (51%) | 24.7       | 12.10                                         |
| China            | 13,281 (14%)                              | 7711 (10%)  | 10,157 (11%) | 31.7       | -23.50                                        |
| (2) FAR EAST     | 21,841 (23%)                              | 11,478 (14%) | 14,716 (16%) | 28         | -32.60                                        |
| (3) AUSTRALIA/NZ | 12,150 (13%)                              | 11,820 (15%) | 11,074 (12%) | -6.3       | 8.90                                          |
| UK/Ireland       | 7242 (8%)                                 | 7177 (9%)  | 8076 (8%)  | 12.53      | 11.52                                         |
| Middle East      | 228 (0.24%)                               | 239 (0.3%)  | 397 (0.4%)  | 66.12      | 74.12                                         |
| (4) LONG HAUL    | 13,920 (15%)                              | 13,396 (14%) | 15,106 (16%) | 12.76      | 8.52                                          |
| Total Market Areas| 91,237 (96%)                           | 75667 (96%) | 89480 (95%) | 18.25      | 12.10                                         |
| Non-Market Areas | 4256 (4%)                                 | 2970 (4%)  | 4907 (5%)  | 65.21      | 15.32                                         |
| GRAND TOTAL      | 95,492 (100%)                             | 78,637 (100%) | 94,387 (100%) | 20.03      | -1.16                                         |

a Tourists staying in hotels in first six months of 2009 & 2010 are presented in brackets [ ]. Percentage Market Shares are presented in Parentheses ( ).

Source: Brunei Tourism Development Department, Government of Brunei
because a wide range of tourist attractions across the region drew 81 million tourists to ASEAN in 2011, up by 30% compared to 62 million tourists in 2007. In 2010, 47% (34 million) of 73 million 81 million tourists to ASEAN in 2011, up by 30% compared to 62 because a wide range of tourist attractions across the region drew

The ITSA model requires many data points. The model developed here is useful for evaluating planned policy change and/or unexpected events. It is also useful for scenario analysis. The impact of the uncertain events can be tested and measured with great reliability but these models are based on a single parameter throughout the period. More importantly, the techniques used here can easily be extended to disentangle the effects of many interventions which may occur during a certain time-period. On the other hand, structural time series models provide a broader framework and allow the parameters to change over time which is not yet used widely to measure uncertain events. It is also flexible and can be generalized to a multivariate setting without extra effort. Thus, the structural time series model is highly recommended to measure the crisis event such as the SF. More details for the structural time series models can be seen in Durbin and Koopman (2012) among others.

7. Conclusions

This study investigates the effects of one major crisis event: SF on tourism in Brunei, using forecasting based on the ARIMA and ITSA methods. The effects of SF on tourism in Brunei overlap with the effects of the GFC that occurred earlier and hence we develop a technique to disentangle the effects of SF from the effects of the GFC. This is a useful contribution to the policy makers and to the tourism literature. In fact, the method developed here can be easily extended to disentangle the effects of multiple interventions. It is a useful sophisticated method which could be applied to a wide range of fields. For example, this can be used to evaluate the impacts of other policy/program changes such as to evaluate the impacts of tourism marketing programs. We have successfully used the technique developed here to disentangle the effects of SF and the GFC on tourism and it is shown that Brunei lost 123,737 and 29,919 tourists due to the GFC and SF events respectively during the first 12 months post-SF period.

A survey of tourists in Brunei indicates that on average each tourist spent B$150 per day and stayed 3.4 days in Brunei indicating that each tourist spent B$ 510 while they stayed in Brunei. When this figure is multiplied by the number of tourists lost, it shows that a small country like Brunei lost B$14,882,820 within the first 12 months’ post-SF period due to SF alone.

The presence of major international and local events such as the GFC and SF that might produce a shortage of tourists may lead us to believe that the uncertainties caused by the SF are still casting doubts in the minds of tourists. Misunderstanding the situation may impede the flow of tourists since perceptions of risk and safety towards a destination are likely to influence travel decisions (Sommez & Graefe, 1998).

To recover from these crises, the Brunei Tourism Development Department launched several promotional and marketing initiatives by the end of 2009 to establish Brunei as a desirable holiday destination. The outcome of these activities was promising and there is an overall 20% increase in tourists and hotel bookings in the first half of 2010 compared to 2009, but this is still far short of predicted numbers. Increased expected numbers can be achieved through promotional activities in Far-East (China), Australia/New Zealand and the Middle-East marketing areas.

The propensity for ‘family tours’ is strong among Muslims, which should be emphasized, encompassing the ‘family holidays’ by establishing an attractively priced family package and/or offering a package with a variety of highly desirable and unique features to attract them (Kozak, 2016). Muslims travel with family who require special arrangements such as isolated accommodations. Printed advertisement with family-package offerings through travel agents could emphasize the fact that Brunei is one of the best tourism destinations in the world to attract Muslim families particularly from the Middle-East. These are more likely to be responsive to prompt marketing strategies and messages, which could increase higher number of Middle-East tourists.

There are some limitations of this study which could be addressed in future research. This study used only 66 monthly data points and had difficulties in modelling the rebound of foreign tourists. It is recommended to undertake future studies when more data will be available. Other forecasting techniques such as the structural time series, ARMAX, VAR models which consider the dynamic relationship between variables such as gross domestic product, exchange rate and other factors that might influence a rebound such as fading memories, are recommended for future studies.

Despite these limitations, the method developed here is one of the techniques which may be confidently applied to get accurate forecasts even after negative shocks such as the GFC and SF crises. This can be applied to disentangle the effects of two (or more) crisis events when one overlaps the other and this is useful to both policy makers and practitioners and to tourism analysts. Our forecasting models help tourism authorities to make operational, tactical, and strategic decisions (Wang & Lim, 2005; and; Law & Au, 1999), which can be used by practitioners and policy makers to prepare more sophisticated forward planning. This research will potentially benefit researchers of tourism in Brunei and its surrounding countries such as Malaysia, Singapore, Thailand, and other countries which attract many tourists. These countries will benefit by adopting the methods presented in this study to measure the effects of unforeseen events for successful and sustainable tourism development. Marketers of these countries can continuously monitor the changes of attitudes in tourists and can develop appropriate policies accordingly. Thus, this study will help Brunei and other similar countries in South East Asia to improve tourist numbers by various marketing strategies such as advertisements, tour packages etc. To evaluate these strategies for a certain post-campaign period they can use the techniques developed here to measure any associated changes in tourism. Also, it is recommended that the tourism authority should strongly advertise about the safety and security of the environment and accommodation together with recreational facilities and the natural beauty of the country to minimize feelings of uncertainty, which helps tourists to overcome their fears in travelling to Brunei.

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