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The impact of the SARS outbreak on Taiwanese hotel stock performance: An event-study approach

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Abstract

The severe acute respiratory syndrome (SARS) outbreak in 2003 weakened the Taiwanese economy. The tourism industry suffered the most, experiencing the highest stock price decline (approximately 29 percent) within a month of the SARS outbreak. This research examined the effect of the SARS epidemic on Taiwanese hotel stock price movements using an event-study approach. Seven publicly traded hotel companies experienced steep declines in earnings and stock price during the SARS outbreak period. On and after the day of the SARS outbreak, Taiwanese hotel stocks showed significantly negative cumulative mean abnormal returns, indicating a significant impact of the SARS outbreak on hotel stock performance. Empirical findings could be used to prepare businesses for the similar epidemics, such as a deadly bird-flu epidemic.

Keywords: Severe acute respiratory syndrome (SARS); Hotel stocks; Taiwan; Event study

1. Introduction

Severe acute respiratory syndrome (SARS), a respiratory illness with pneumonia-like symptoms, received worldwide attention in 2003. SARS originated in the southern Chinese province of Guangdong in mid-November 2002. Almost 3 months later, on February 11,

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2003, the Chinese Ministry of Health reported that there had been 300 cases of SARS, five of them fatal, in the province (BBC News, 2003). Meanwhile, a physician from Guangdong Province who had treated patients with the atypical pneumonia visited Hong Kong and stayed at a hotel, infecting at least six other guests (Chien and Law, 2003; Pine and McKercher, 2004). The infected people carried the disease to Singapore, Vietnam, Canada, Thailand, and Taiwan. The doctor who was identified as the carrier died at a hospital in Hong Kong on March 2, 2003.

The World Health Organization (WHO) issued a global alert about the SARS on March 12. On April 2, it recommended postponing all but essential travel to the SARS-infected areas, including Hong Kong and Guangdong Province, China (WHO, 2003a). Nevertheless, this highly contagious and potentially fatal disease infected 8437 people worldwide and killed 813 (WHO, 2003b). On July 5, 2003, the WHO announced that the SARS outbreak had finally been contained (Taipei Times, 2003a; WHO, 2003c).

Taiwan was especially vulnerable to the SARS because of the 70,000 passengers who passed through its two international airports each day. Many of these travelers came from SARS-infected areas. Since the first case of SARS was reported on April 22, 2003, passengers arriving from SARS-infected areas were subject to home quarantine. On May 8, Taipei, the capital city of Taiwan, was included in the WHO travel advisory list. WHO extended its advisory list to all of Taiwan on May 21, 2003. Until the WHO removed Taiwan from the list of SARS-infected areas on July 5, there were 674 confirmed cases and 84 deaths in Taiwan (WHO, 2003c). Ninety percent of the cases in Taiwan were related to healthcare settings, so more than 150 doctors and nurses left their jobs to protest the lack of safeguards (BBC News, 2003).

Along with the loss of life, SARS caused severe economic losses (Taipei Times, 2003b). The epidemic had the most serious impact on the tourism industry: hotels, restaurants, theme parks, and airlines (China Post, 2003a; Taipei Times, 2003c; Taiwan Headlines, 2003). Thousands of business meetings and vacations were cancelled (Economist, 2003). Conference calls and travels to neighboring tourism destinations by cars became the norm. SARS had an immediate and devastating impact on Taiwan's hotel industry (Taipei Times, 2003d). The situation was exacerbated when hotels offered discounts and special promotions in the midst of a sharp business decline, which had been triggered by the spread of the SARS. For example, the Ambassador Hotel Taipei charged New Taiwan Dollar (NT$) 3300 for a room, over 50 percent below the regular rate of NT$6800 (China Post, 2003b).

Much attention has been devoted to the seriousness of SARS and some research has been conducted to examine the impact of SARS (Chien and Law, 2003; Pine and McKercher, 2004; Sujithamrak, 2004; Tse, 2004). However, most economic impact studies focused on the demands of vacationers and business travelers, not on the reaction of stock investors or of the stock market. Thus, there is a niche for further research to examine the impact of the disease on the financial performance of hotel firms. It is important to investigate the magnitude of the SARS' impact not only through its effects on tourist-related industries but also through the stock market's reactions. This study analyzes the impact of SARS on stock prices of publicly traded hotel companies in Taiwan. The objective of this study is to examine whether or not SARS had a significant influence on the stock price movements of Taiwanese hotel companies. This study will shed light on the impact of this serious disease on hotel stock prices and prepare businesses for the similar epidemics.

2. Impacts of the SARS outbreak

2.1. Change in daily life

A study indicated that 73 percent of Taiwanese feared SARS (Taipei Times, 2003e). Concerns about local transmission had made mask-wearing mandatory in many public areas. Some doctors blamed the government for the growing public panic, claiming that its draconian anti-SARS measures have only undermined attempts to control the disease. For example, Taipei officials proposed an automatic 3-day quarantine for anyone with a fever. The Department of Health banned the sale of anti-fever pills at drugstores in hopes of encouraging possible SARS sufferers consult their doctors. Most Taipei roads were gridlocked by 7:00 a.m., since a government order that required all subway and train passengers to wear masks caused commuters to avoid using public transportation.

Although the government reported 65 possible new cases of SARS each day (WHO, 2003d), doctors claimed that the virus had killed only 84 people nationwide, making it less dangerous than tuberculosis or car accidents. Tuberculosis, which is spread through sneezes or saliva, infects 15,000 people in Taiwan every year and kills 1500. In the first 3 months of 2003, car accidents killed 680 people and injured 35,000 (Taipei Times, 2003e). McKercher and Chon (2004) also pointed out the over-reaction to SARS and the unnecessary damage to Asian tourism.

Since SARS is a respiratory disease that can be transmitted through direct exposure to infected people, people either voluntarily or involuntarily limited the amount of time that they spent in public, thus the amount of consumer spending decreased (Taipei Times, 2003f). The tourism-related sectors were particularly hard hit, as travelers cancelled their trips and consumers shunned shops, restaurants and entertainment venues (Ali, 2003). SARS was responsible for an enormous loss of tourist revenue since tourism services are a perishable commodity (Min and Wu, 2004). Thus, SARS devastated the hotel industry in Taiwan.

2.2. Economic impacts

There was a great reduction in the number of tourists arriving in Taiwan during the SARS epidemic. Arrivals from abroad decreased by 50 percent during April and May 2003 compared to the corresponding period a year earlier, and the occupancy rates of international tourist hotels plummeted by approximately 40 percent (Min and Wu, 2004). The SARS outbreak also tarnished Taiwan's international image and brought about social disorder, both of which harmed its economic growth. The impact of SARS on the national economy appeared to be a short-term phenomenon, but the magnitude of the impact was not minimal. For example, SARS was estimated to reduce Taiwan's economic growth in 2003 by 0.5 percent (Waugh, 2003).

According to the Taiwan Stock Exchange, there are six companies included in the tourism industry. Five of the six operate hotels: Ambassador Hotel, First Hotel, Grant Formosa Regent Taipei, Hotel Holiday Garden, and Leofoo Hotel. Those five companies are known as large hotel companies. In addition, the stocks of two other hotel companies, Hotel Landis Taipei and Hotel Royal Chihpen, are traded in the over-the-counter (OTC) market. More detailed financial information of those seven hotel companies is shown in Table 1.

Table 1
Hotel companies listed in the Taiwan stock exchange (TSE) and over-the-counter (OTC) market

Company	Market listed	Date of being listed	Price per share (in NT dollar)	Shares outstanding (in million)	Market capitalization (in million NT dollar)
Ambassador Hotel	TSE	November 10, 1982	8.2	358	2936
First Hotel	TSE	June 25, 1991	16.6	142	2358
Grant Formosa Regent Taipei	TSE	March 9, 1998	30.9	216	6663
Hotel Holiday Garden	TSE	June 1, 1965	8.3	64	529
Leofoo Hotel	TSE	December 24, 1988	8.4	265	2236
Hotel Landis Taipei	OTC	June 15, 1999	14.9	70	1043
Hotel Royal Chihpen	OTC	December 21, 1999	15	59	885

Note: Date of stock issued is the beginning date of company's stock traded on the Taiwan Stock Exchange or over-the-counter market. All numbers are figures as of the end of August 2003. All data are taken from the financial database of the Taiwan Economic Journal (TEJ).

Table 2
The impact of SARS outbreak on monthly stock price of various industry sectors

Industry	Tourism	Textiles	Automobile	Construction	Foods	Chemicals
One-month return (April 2003–May 2003)	−28.91%	−14.97%	−13.85%	−11.95%	−11.66%	−10.03%
Industry	Plastics	Transportation	Composite	Department Stores	Banking and Insurance	Electrical
One-month return (April 2003–May 2003)	−8.18%	−7.52%	−5.56%	−5.39%	−3.91%	−1.36%

Note: One-month stock returns (SR), computed based on changes in monthly closing stock price (P), are given as: $SR = \ln(P_{May}/P_{April}) - 100$, where P_{May} and P_{April} are the closing prices at the end of April and May, respectively. The Composite stock price index is the Taiwan capitalization-weighted stock index of the Taiwan Stock Exchange. Data for the stock price index of each industry were taken from the TEJ database.

SARS did not have a major impact on the manufacturing industry or the export–import industry (China Post, 2003d). As noted earlier, however, the tourism industry suffered considerably. As presented in Table 2, the tourism industry experienced the highest decline in overall stock prices in the month after the SARS outbreak among all of the industries in the Taiwan Stock Exchange.

Traditionally, springtime is the high season for the hotel business in Taiwan as the majority of international trade shows and exhibitions are scheduled during the months of April and May (China Post, 2003b). However, due to the plunge in travel and business meetings, following the outbreak of SARS, the average occupancy rate of local five-star

Table 3
The impact of SARS outbreak on monthly earnings of hotel companies

Company	One-month change in earnings ΔCH_1 (%)	Two-month change in earnings ΔCH_2 (%)
Ambassador Hotel	−49.81	−73.55
First Hotel	−16.29	−26.40
Grant Formosa Regent Taipei	−40.13	−75.46
Hotel Holiday Garden	−18.47	−76.89
Leofoo Hotel	−25.07	−69.75
Hotel Landis Taipei	−47.25	−61.89
Hotel Royal Chihpen	−11.14	−20.00

Note: One-month change of earnings (ΔCH_1) were calculated from changes in monthly earnings (E) given as: $\Delta CH_1 = [(E_{May} - E_{April})/E_{April}] \times 100$, where E_{April} and E_{May} are the monthly earnings on April and May, respectively. Similarly, 2-month change of earnings (ΔCH_2) were computed based on: $\Delta CH_2 = [(E_{June} - E_{April})/E_{April}] \times 100$, where E_{June} denotes the earnings on June. Monthly earnings data were taken from the TEJ database.

hotels fell from the normal 70 percent to less than 30 percent (China Post, 2003b). Several hotels catering to Japanese visitors, the primary international tourist market, lost as much as half of their Japanese bookings, and resorted to a price reduction program to lure more tourists, thus resulting in an even greater loss of their sales revenue. Thus, many hotels tried to cut costs by closing unoccupied floors or ordering employees to take unpaid leave (China Post, 2003c).

Table 3 demonstrates the serious impact of the SARS outbreak on monthly earnings of those seven hotel companies. In terms of the 1-month change in earnings, the hotel companies experienced drops in earnings in a range of −49.81% to −11.14%. The Ambassador Hotel showed the greatest decrease, followed by Hotel Landis Taipei, Grant Formosa Regent Taipei, and Leofoo Hotel. Considering the 2-month change in earnings, the Hotel Holiday Garden experienced the sharpest decline in earnings, followed by the Grant Formosa Regent Taipei and the Ambassador Hotel.

3. Data and methodology

To examine the impact of the SARS outbreak on hotel stock performance in Taiwan, we applied the event-study methodology (ESM), which has been widely used to measure the effect of an economic event on the value (or stock returns) of a firm.[1] We first estimated what Taiwanese hotel stock returns would have been if the SARS event had not occurred. The ESM allows us to separate the component of hotel stock price movement due to firm-specific events from that due to market-wide movements. The component attributed to firm-specific events like the SARS event is called "abnormal" return (AR), which is

[1] Campbell et al. (1997) provided a good description of the ESM and some examples on the general applicability of ESM to the fields of accounting, finance and economics. In the fields of hospitality and tourism, Chen and Bin (2001) applied the ESM to examine the relationship between US gaming stock returns and federal and state legislation events regarding casino regulation and deregulation. Nicolau (2002) applied the same methodology to examine the impact of announcement of the opening of a new hotel on the stock performance of its chain in Spain.

computed as the difference between actual return and expected return around the time of the event. If an announcement of an event is good news, we expect *AR*s to be positive, indicating that the market believes that the event will increase the firm's value. On the contrary, a negative *AR* signals bad news and the market believes that the event would decrease the firm's future profitability.

Accordingly, we calculate the mean abnormal return and the cumulative mean abnormal return (*CAR*) on an event date for sampled firms experiencing the same firm-specific event to capture the valuation impact of that event. We then test the statistical significance of the *CAR*s. If the cumulative abnormal return is statistically different from zero, we can say that the event significantly influences stock prices.

3.1. Measuring abnormal returns and hypothesis

To measure the *AR*s of hotel stocks, we need to estimate the expected returns (*ER*) of hotel stocks. First of all, based on the so-called market model (MM), we regressed the hotel stock return against return of the market index to control for overall market effects. The regression is given as

$$R_{j,t} = \alpha_j + \beta_j R_{m,t} + \varepsilon_{j,t}, \tag{1}$$

where $R_{j,t}$ is the return of hotel stock j on day t:

$$R_{j,t} = \ln(P_{j,t}/P_{j,t-1}) \times 100, \tag{2}$$

where P_t is the closing price of stock j on day t; $R_{m,t}$ represents the market return on day t, the average of returns for all firms included in the market index; the market index is the Taiwan Stock Exchange Index (TAIEX), which is a value-weighted index based on a broad cross-section of the market; $\varepsilon_{j,t}$ is a random error term for hotel stock j on day t, and the α_j and β_j are regression parameters to be estimated.

All of hotel stock prices and market index were taken from the financial database of the Taiwan Economic Journal (TEJ). For the analysis, we used 232 trading days for the estimation period, which is from May 2, 2002 to April 7, 2003, and a $[-t_1, t_2]$ event window: t_1 trading days before and t_2 trading days after the event on April 22, 2003 when the SARS was first reported in Taiwan. We then employed the estimated coefficients from the regression Eq. (1) to calculate the *ER* of hotel stocks over the $t = [-t_1, t_2]$ event window.

The *AR* in the window is computed based on Eqs. (3) and (4):

$$AR_{j,t} = R_{j,t} - ER_{j,t}, \tag{3}$$

$$ER_{j,t} = \hat{\alpha}_j + \hat{\beta}_j R_{m,t}, \tag{4}$$

where the coefficients $\widehat{\alpha}_j$ and $\widehat{\beta}_j$ are estimates of the true parameters obtained via an ordinary least squares (OLS) regression analysis and $AR_{j,t}$ is abnormal return for hotel stock j on day t. As discussed in the methodology section, abnormal returns on stock j from Eq. (3) are broken down into two components: a market component and a firm-specific component. While the market component reflects general market movements, the firm-specific component reflects price variations caused by firm-specific events, such as the SARS outbreak in this study.

Consequently, the standardized abnormal return (SAR) can be determined by using the following statistic (Dodd and Warner, 1983):

$$SAR_{j,t} = \frac{AR_{j,t}}{s_{j,t}} \tag{5}$$

and $s_{j,t}$ is the estimated standard error of the abnormal returns for firm stock j in event period t:

$$s_{j,t} = \left(s_j^2 \left[1 + \frac{1}{T} + \frac{(R_{m,t} - \bar{R}_m)^2}{\sum_{i=1}^{T} (R_{m,i} - \bar{R}_m)^2} \right] \right)^{1/2} \tag{6}$$

and

$$s_j^2 = \left[\sum_{t=1}^{T} (\varepsilon_{j,t} - u_j)^2 \right] \Big/ (T - 1), \tag{7}$$

where s_j^2 is the residual variance for stock j from the market model regression, T is the number of days in the estimation period, $R_{m,t}$ is the market return for day t of the event period, $\bar{R}_m$ is the mean market return during the estimation period, $R_{m,i}$ is the market return for day i of the estimation period, $\varepsilon_{j,t}$ is the residual as in Eq. (1), and u_j is the mean residual over the estimation period.

We then calculate the standardized CAR over the event period interval $t = [-t_1, t_2]$ by aggregating the SARs, i.e. the sum of SAR_j between t_1 and t_2, adjusted for the number of days (m) within the window period:

$$CAR_j = \frac{1}{\sqrt{m}} \sum_{t=-t_1}^{t_2} SAR_t. \tag{8}$$

The expected value ofCAR is zero in the absence of abnormal returns. CARs enable us to measure the reaction of stock return over an event window that can encompass the longer period of SARS outbreak.

To determine whether CARs are significant, the test statistic on any day t in the event window for all n hotel stocks is constructed as in Eq. (9):

$$t\text{-statistic} = \frac{1}{\sqrt{n}} \sum_{i=1}^{n} CAR_i. \tag{9}$$

The t-statistic as the test statistic follows a standard normal distribution (Campbell et al., 1997). If the SARS outbreak caused abnormal returns, the t-statistic should be significantly different from zero. Thus, we test the null hypothesis H_0 against the alternative hypothesis H_1:

H_0. The SARS outbreak had no impact on hotel stock prices.

H_1. The SARS outbreak had a significant impact on hotel stock prices.

3.2. Estimating abnormal returns

To compute abnormal returns in the event window as shown in Eq. (3), we obtained the OLS parameter estimates $\widehat{\alpha}_j$ and $\widehat{\beta}_j$ based on the regression in Eq. (1). However, the OLS

residuals in the market model usually failed to satisfy the basic assumptions of the linear regression, especially the assumption of homoscedasticity that the distribution of the OLS residuals has a constant variance. Many studies pointed out that the standard tests to measure the effect of a specific event on stock prices must be adjusted due to the presence of heteroskedasticity (Giaccoto and Ali, 1982; Akgiray, 1989; Corhay and Tourani Rad, 1994). These studies showed that Autoregressive Conditional Heteroskedastic (ARCH) model developed by Engle (1982) and Generalized ARCH (GARCH) model developed by Bollerslev (1986) could address the empirical characteristics of stock return series. Diebold et al. (1988) observed that residuals obtained using the standard market model exhibit strong ARCH properties and Bera et al. (1988) showed that market model estimates under GARCH processes are more efficient. Therefore, we used the market model under GARCH process (MM-GARCH) as alternative model to model the conditional variance of hotel stock returns. The MM-GARCH (p, q) can be depicted as

$$R_{j,t} = \alpha_j + \beta_j R_{m,t} + \varepsilon_{j,t}, \tag{10}$$

$$\varepsilon_{j,t} | \Omega_{t-1} \sim N(0, h_{j,t}), \tag{11}$$

$$h_{j,t} = c_j + \sum_{i=1}^{q} \lambda_{j,i} \varepsilon_{j,t-i}^2 + \sum_{k=1}^{p} \gamma_{j,k} h_{j,t-k}, \tag{12}$$

where h_t is the conditional variance of errors ε_t conditional on the information set available at day $t-1$, Ω_{t-1}; q is the number of lags of ε_t and p is the number of lags of h_t; parameters λ and γ denote the sensitivity of h_t to the lags of square ε_t and h_t itself, respectively. We call Eq. (10) the mean equation and Eq. (12) the variance equation.

Moreover, asymmetry of news impact is often observed in the stock market. Engle and Ng (1993) found that downward movements in the stock market were followed by higher volatilities than upward movements of the same magnitude. The GARCH framework does not effectively explain this attribute of asymmetric news. The Threshold GARCH (TGARCH) by Glosten et al. (1993) and Exponential GARCH (EGARCH) by Nelson (1991) were ways of accounting for the asymmetry. The variance equation of EGARCH(p, q) process is

$$\log h_{j,t} = \left\{ c_j + \sum_{i=1}^{q} \left(\lambda_{j,i} \left| \frac{\varepsilon_{j-i}}{h_{j,t-i}^{1/2}} \right| + \delta_{j,i} \frac{\varepsilon_{t-i}}{h_{j,t-i}^{1/2}} \right) + \sum_{k=1}^{p} \gamma_{j,k} \ln(h_{j,t-k}) \right\}, \tag{13}$$

and the variance equation of TGARCH(p, q) process is

$$h_{j,t} = c_j + \sum_{i=1}^{q} \lambda_{j,i} \varepsilon_{j,t-i}^2 + \delta_j \varepsilon_{j,t-1}^2 D_{j,t-1} + \sum_{k=1}^{p} \gamma_{j,k} h_{j,t-k}. \tag{14}$$

For both specifications, the parameter δ represents asymmetric effect on the conditional variance h_t and asymmetry occurs if $\neq 0$. For TGARCH, the asymmetry arises from the inclusion of a dummy variable D, which is equal to one when $\varepsilon_{t-1} \leqslant 0$ and zero otherwise, which in turn allows good news (positive return shocks) and bad news (negative return shocks) to have a different impact on volatility.

Based on the Akaike information criterion (Judge et al., 1985), Schwartz Bayesian criterion (Schwarz, 1978) and the likelihood ratio test, we found that the GARCH(1,1), EGARCH(1,1) and TGARCH(1,1) representations were the most parsimonious models

for each respective variance equation. We modeled higher-order processes but the higher-order model did not appear superior to the GARCH (1,1), EGARCH(1,1) and TGARCH(1,1) specifications.

4. Results and discussion

The SARS outbreak devastated several industry sectors of the Taiwan economy. The tourism industry was seriously damaged during the SARS period, while the manufacturing, retail trade, and banking industries were less influenced (see Table 2). The findings of the study confirmed that the tourism industry experienced the most serious damage in terms of stock price decline (approximately 29 percent) among many industries on the Taiwan Stock Exchange in the month following the SARS outbreak.

As part of the tourism industry, hotel business in Taiwan was also severely affected by SARS during the first half of 2003. Due to the large decrease in leisure and business visitors, the occupancy rates of five-star hotels dropped by as much as 40 percent and average room rates also plummeted during the SARS outbreak. To offset the dramatic losses of revenue, most hotel management adopted cost-reduction strategies: closing some floors, reducing operating hours of food and beverage facilities, asking employees to take non-paid leave, and stopping all overtime payments (Pine and McKercher, 2004).

This research examined the effect of the SARS outbreak on Taiwanese hotel stock performance. Seven publicly traded hotel companies had significant declines in their earnings and stock prices during the SARS period. Such a finding indicated that hotel stocks, on average, were exposed to above-market-average risk during the SARS outbreak period, which is consistent with the common perception that the hotel industry is most vulnerable to a decrease in the number of tourists. It suggests that investors expect hotel stock prices to react negatively to a future epidemic and ask for a higher return to compensate for higher risk.

Table 4 presents the *CAR*s for four models and ten industries within the 10-day event windows before the SARS outbreak. As shown in Table 4, the estimated *CAR*s during the 10-day period prior to the SARS outbreak were not statistically significant across all the models and industries. Thus, these results indicated that the value of *CAR* for the hotel industry as well as the other industries was not different from zero in the absence of the SARS influence and no significant abnormal returns were witnessed before SARS outbreak (Table 5)

In comparison, the estimated *CAR*s over the event window (0, 10), i.e. the 10-day period after SARS outbreak, the negative *CAR*s were found to be statistically significant at the 5% level for seven out of ten industry sectors. However, only for the hotel and foods industries among those seven sectors, the negative *CAR*s of all four models were statistically significant at the 5% level. Among the four models, the market model showed the weakest results for most industries in general.

Moreover, we estimated *CAR*s during the 20-day period after SARS outbreak (see Table 6). Only in the hotel sector the *CAR*s were statistically negative at the 5% level for all four models. These results evidenced that the SARS outbreak did have a negative impact on the hotel stock performance in Taiwan.

The results of this research clearly showed that a tragic event like the SARS outbreak dampened the Taiwan stock market. Due to the widespread global panic about SARS and intensive news coverage, the catastrophic event could result in an irrational market

Table 4
Cumulative abnormal returns (CAR) over the event window (−10, 0)

Sector	Hotel [7]	Automobile [23]	Banking [39]	Chemicals [35]	Construction [31]
Market Model (MM)	2.22 (.56)	−1.55 (−.46)	1.77 (.75)	−.17 (−.04)	.21 (.06)
MM-GARCH(1,1)	2.68 (.57)	−1.98 (−.75)	2.19 (.84)	−.18 (−.04)	.29 (.07)
MM-TGARCH(1,1)	1.89 (.27)	−1.42 (−.45)	1.59 (.55)	−.51 (−.12)	.32 (.08)
MM-EGARCH(1,1)	.83 (.15)	−1.30 (−.40)	1.04 (.32)	−.38 (−.11)	.06 (.01)
Sector	Department stores [10]	Foods [20]	Plastics [9]	Textiles [44]	Transportation [18]
Market Model (MM)	.80 (.48)	−.61 (−.16)	−1.14 (−.30)	−.98 (−.28)	−2.72 (−.56)
MM-GARCH(1,1)	1.27 (.81)	−.49 (−.14)	−1.22 (−.40)	−.96 (−.26)	−2.94 (−.64)
MM-TGARCH(1,1)	1.29 (.92)	−.42 (−.12)	−2.08 (−.64)	−1.19 (−.32)	−3.13 (−.66)
MM-EGARCH(1,1)	1.54 (1.11)	−.62 (−.18)	−1.52 (−1.04)	−1.17 (−.32)	−3.21 (−.68)

Note: The number of total firms included in each sector is in bracket. *t*-statistics are in parentheses.

Table 5
Cumulative abnormal returns (CAR) over the event window (0, 10)

Sector	Hotel [7]	Automobile [23]	Banking and Insurance [39]	Chemicals [35]	Construction [31]
Market Model (MM)	−4.49 (−1.94)*	−3.01 (−1.04)	−3.12 (−1.33)	−3.19 (−1.79)	−5.04 (−1.86)
MM-GARCH(1,1)	−5.13 (−2.01)*	−4.39 (−3.03)**	−3.01 (−1.31)	−3.73 (−2.49)**	−6.09 (−2.35)*
MM-TGARCH(1,1)	−8.38 (−3.54)**	−8.59 (−3.00)**	−2.24 (−1.04)	−3.99 (−2.58)**	−5.96 (−2.33)*
MM-EGARCH(1,1)	−6.83 (−2.72)**	−5.96 (−2.07)*	−2.26 (−1.09)	−3.46 (−2.38)*	−6.19 (−2.44)**
Sector	Department Stores [10]	Foods [20]	Plastics [9]	Textiles [44]	Transportation [18]
Market Model (MM)	−2.51 (−1.77)	−3.53 (−2.10)*	−2.00 (−0.93)	−4.09 (−1.90)	.72 (.23)
MM-GARCH(1,1)	−2.60 (−2.16)*	−4.39 (−2.15)*	−2.06 (−1.34)	−5.01 (−2.64)**	−.17 (−.07)
MM-TGARCH(1,1)	−3.04 (−2.66)**	−4.10 (−2.16)*	−2.66 (−1.80)	−4.38 (−2.38)**	−.19 (−.08)
MM-EGARCH(1,1)	−3.01 (−2.37)**	−3.34 (−2.07)*	−2.69 (−1.84)	−5.41 (−2.96)**	−1.61 (−.72)

Note: The number of total firms included in each sector is in bracket. *t*-statistics are in parentheses.
*Significant at the .05 level.
**Significant at the .01 level.

response (e.g., a sell-off, a panic, or a contagion effect). A contagion effect prevails in case that unpredictability concerning some stocks is transferred to other stocks in the same or related industry. Among different segments of the tourism industry, stock prices of hotels could have immediate negative reaction right after the SARS outbreak, and other industry segments such as restaurant, travel agency, rental car companies could also be directly exposed to significantly negative stock market returns. The influence of the SARS outbreak on the tourism industry was quickly assimilated into declining stock prices in reality. Thus, accompanied by a sharp decline in sales revenue and cash flow due to significant decrease in occupancy and average daily rate, a widespread panic caused stakeholders who invested in hotels to perceive higher risk and to require higher rate of

Table 6
Cumulative abnormal returns (CAR) over the event window (0, 20)

Sector	Hotel [7]	Automobile [23]	Banking and Insurance [39]	Chemicals [35]	Construction [31]
Market Model (MM)	−5.20 (−3.20)**	−2.04 (−.76)	−.91 (−.58)	−2.05 (−1.66)	−3.07 (−1.33)
MM-GARCH(1,1)	−7.56 (−7.53)**	−3.34 (−2.67)**	−1.35 (−.85)	−2.42 (−1.78)	−3.16 (−1.46)
MM-TGARCH(1,1)	−7.26 (−6.03)**	−3.35 (−2.76)**	−.54 (−.36)	−3.99 (−1.76)	−3.04 (−1.34)
MM-EGARCH(1,1)	−7.40 (−6.26)**	−2.26 (−1.76)	−.91 (−.58)	−1.96 (−1.60)	−2.97 (−1.23)
Sector	Department Stores [10]	Foods [20]	Plastics [9]	Textiles [44]	Transportation [18]
Market Model (MM)	−1.36 (−1.17)	−2.66 (−1.60)	−1.91 (−.98)	−3.05 (−1.77)	−1.26 (−.56)
MM-GARCH(1,1)	−1.03 (−1.02)	−1.72 (−.97)	−1.99 (−1.40)	−3.26 (−1.98)*	−1.74 (−.75)
MM-TGARCH(1,1)	−1.06 (−1.04)	−1.65 (−.96)	−2.03 (−1.60)	−2.80 (−1.67)	−1.64 (−.72)
MM-EGARCH(1,1)	−1.04 (−1.04)	−1.74 (−1.16)	−2.12 (−1.65)	−2.87 (−1.67)	−1.76 (−.80)

Note: The number of total firms included in each sector is in bracket. *t*-statistics are in parentheses.
*Significant at the .05 level.
**Significant at the .01 level.

return for their investment in Taiwan. Therefore, hotel investors considered their stocks over-valued, resulting in sell-off of their stocks.

To give some insights into how hotel stock prices reacted to the SARS epidemic, the event-study methodology (ESM), which examined the pattern of stock prices and returns under unusual conditions, was adopted in this research. By measuring the cumulative abnormal hotel returns 10 days prior to the SARS outbreak (days −10 and −1) and comparing the results to those after the 10 days (days 1 and 10) and 20 days (days 1 and 20) of the SARS outbreak, the impact of the SARS outbreak on hotel stock prices was examined. The results indicated that the estimated cumulative abnormal returns before the SARS outbreak were not statistically different from zero, supporting that there would be no abnormal return when the SARS was not an issue.

On the other hand, market evidence showed that after the 10 days of the SARS outbreak, there were significantly negative cumulative abnormal returns among Taiwanese hotel stocks. These results confirmed that the SARS outbreak had a significantly negative impact on the hotel stocks in Taiwan. It is also noteworthy that the negative cumulative abnormal hotel returns after the 20 days of the SARS outbreak became intensified when compared to the models of the ten calibration days. The results indicate that since the first case was found, more infected and death cases were reported and these cases reinforced the debilitating impact on the stock values of hotel companies.

The findings of this study showed that the hotel stocks were sensitive to the SARS outbreak and the hotel stock performance would react to the occurrence of similar diseases. The SARS outbreak demonstrated the fragility of the hotel business toward an epidemic and a new epidemic could likely depress stock markets in Taiwan and South-East Asia. Thus, in order to minimize the possible negative impact on the firm's financial performance or stock prices if a similar epidemic like the bird-flu occurs, hotel management in Taiwan and other South-East Asian countries should prepare preventive remedies to improve the stock market's negative response to the crisis. Top management should sustain the confidence level of hotel investors by reducing their uncertainty of hotel

stocks in the market; thus an irrational market response such as panic or stock sell-offs may not be as severe or durable as before. Thus, it may be important for hotel management to widely advertise, on the occurrence of a similar disease, that the abnormal impact would be a temporary phenomenon as evidenced in this study.

5. Future research directions

An event study approach provides hotel managers, owners, and investors with further insights into how hotel stock returns react to a crisis like SARS. International media coverage of the outbreak of a highly contagious disease could change the pattern of stock returns for the entire hospitality industry. If an event like the SARS epidemic is interpreted as a disaster, investors might believe that hospitality firms would have poor future performance and the firm's stock price would go down as a result, thus eventually depressing the firm's stock returns.

In the field of hospitality finance, future researchers could adopt the ESM as an excellent vehicle to understand the extent to which stock returns can change in response to good or bad news disseminated from special events such as mega sports events, political events, natural disasters, war, financial crisis, and terrorist attacks. Additionally, further research may examine the effect of announcements of new information (e.g., capital structure changes in hospitality firms and mergers and acquisitions) on hospitality stock price movements.

This study examined the impact of the SARS event on stock returns of hotel companies in Taiwan. Future studies can compare several sectors of the hospitality industry (e.g., hotel, restaurant, airline, and travel agencies) and the result will show the sensitivity of their respective stock returns to the SARS outbreak. An answer to this question will not only make an academic contribution but also benefit managers in all sectors of the hospitality industry, investors, and government officials facing new outbreaks of disease.

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