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Research paper

Joint effects of management responses and online reviews on hotel financial performance: A data-analytics approach

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ABSTRACT

Hotels are increasingly shifting their online review strategy from passive listening to proactive engagement through management responses. This study investigates the joint effects of management responses and online reviews on hotel financial performance. Based on a large unique dataset of 22,483 management responses to 76,649 online consumer reviews on TripAdvisor over 26 quarters, matched with quarterly hotel financial performance, this study finds that providing timely and lengthy responses enhances future financial performance, whereas providing responses by hotel executives and responses that simply repeat topics in the online review lowers future financial performance. Moreover, review rating and review volume moderate the effects of management responses. When the average review ratings increase, more management responses of greater length should be provided. As review volume grows, the benefits of providing timely and lengthy responses diminish. The study findings generate new implications for managing responses to online reviews to increase hotel financial performance.

1. Introduction

The proliferation of third-party review sites such as Yelp and TripAdvisor significantly expands consumers' opportunities to generate publicly available commentaries on a hotel. As a result, scholars have called for hotel managers to respond to reviews (Chan and Guillet, 2011; Leung et al., 2013; Sparks et al., 2016; Wei et al., 2013) because management responses may help generate a more positive evaluation of the hotel than reviews without a response (Lee and Song, 2010). Furthermore, providing a response can reduce the likelihood that readers will draw negative, potentially erroneous, inferences (Sparks and Bradley, 2014) and may enhance potential customers' inferences of the hotel's concern for customers (Sparks et al., 2016).

Several studies have reported on the effectiveness of various forms of content or style of management responses. For example, potential hotel guests react more favorably to a rebuttal of a negative review posted by a fellow traveler than they do to a response posted by the hotel management (Litvin and Hoffman, 2012). Additionally, recent research examining the effects of hotel management responses on potential consumers' inferences regarding the hotel's trustworthiness and concern for customers has shown that using a human voice and posting a timely response lead to more favorable customer inferences (Sparks et al., 2016)

While these studies contribute significantly to the management of online reviews, a review of the literature suggests several critical research gaps of practical significance. First, most past studies have focused on reviews' influence on customer perceptions or intentions toward hotels. One exception examined the relationship between the number of management responses and hotel performance (Xie et al., 2014), but did not investigate aspects of management responses that contribute to financial performance—a critical omission, since managers would benefit greatly from information concerning what strategies and communication techniques would enhance their financial performance. Therefore, building on previous research (Sparks et al., 2016; Xie et al., 2014), our study investigates the effects of several important characteristics of management responses on hotel financial performance, including (1) job position of response providers (e.g., executives vs. functional staff/departments), (2) timeliness of the response, (3) length of the response (4) repetition of topics from the online review, and (5) number of responses (or response volume). To assess how each characteristic contributes to hotels' financial performance, we propose our first research question:

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RQ1: Do characteristics of a management response affect hotel financial performance?

Second, although prior research has generated overwhelming evidence supporting the significance of online review characteristics such as review valence (e.g., Browning et al., 2013; Sparks and Browning, 2011; Ye et al., 2009; Ye et al., 2011) and review volume (e.g., Duan et al., 2008; Liu, 2006; Zhang et al., 2010) in driving consumer-related outcomes such as booking intentions and trust, these studies fall short of examining the interactive effects of online reviews and management responses on the customer or financial performance. Researchers highlight the need to study the interactive effects of influential factors (Davis and Khazanchi, 2008) and posit that factors such as volume of reviews can change the impact of other word-of-mouth (WOM) relevant characteristics on a WOM message's persuasiveness (Khare et al., 2011). Similarly, research shows that the impact of organizational responses on consumers' external causal attribution and attitude change is moderated by review consensus (Lee and Cranage, 2014). These studies suggest that online reviews may moderate the effects of management responses on customer evaluations and thus the hotel's financial performance. However, such interactive effects have not been formally examined. Therefore, our study investigates the joint effects of two sets of characteristics of online reviews (1) ratings and volume and (2) management responses in terms of executive response, response time, response length, and repetition of topics between responses and reviews. On this basis, we propose a second research question:

RQ2: How do online review ratings and volume moderate the relationship between the characteristics of management responses and hotel financial performance?

Finally, much prior research has relied on data generated through survey methods. Our study departs significantly from previous research by adopting an innovative data analytics approach. We employ a large-scale granular dataset containing 22,483 management responses to 76,649 online consumer reviews on TripAdvisor for 3537 hotels in 427 cities over a period of 26 quarters, matched with quarterly hotel performance records at the individual hotel level. Because our data capture the actual behavior of consumers and managers on the social media platform, our analysis opens the door to new knowledge that may reshape understanding of the field as well as support decision making in the hospitality industry (Xiang et al., 2015). This so-called big-data analytics approach leverages researchers' capacity to collect and analyze data to solve real-life problems (Xiang et al., 2015).

Our study also differs from previous management response research (e.g., Gu and Ye, 2014; Sparks et al., 2016) by shifting the focus from customer perception or intention to the key financial performance indicators of revenue, average daily rate (ADR), and occupancy. Our econometric specification models future hotel performance as a function of a number of theoretically justified factors related to online reviews, yet controls for relevant hotel characteristics such as hotel age, size, and class. Examination of the various characteristics of management responses on financial performance is strategically and managerially relevant to hotels, as having employees dedicated to responding to online reviews requires substantial human and financial resources. Understanding how such investment leads to financial outcomes can provide strong justification for investment in offering management responses.

2. Hypotheses development

2.1. Characteristics of management response and hotel performance

2.1.1. Job position of response providers

Important information that affects customer evaluation of the organization is the job position of the person who responds to an online review. However, previous research on the effect of this key factor is inconclusive. On the one hand, researchers in the service recovery literature find that the lower the organizational level of the person performing the service recovery, the higher the level of customer satisfaction is likely to be (Boshoff, 1997), particularly if recovery is handled by front-line staff (Bowen and Lawler, 1992, 1995; Lewis and McCann, 2004; Miller et al., 2000).

On the other hand, recent empirical research shows that the source of responses (general manager vs. guest service agent) did not make a significant difference in potential consumers' inferences of the hotel's trustworthiness (Sparks et al., 2016). However, the potential effect of job position on customer evaluation and subsequently the hotel's financial performance can be established from literature relating to the credibility of the information source. For example, persuasion studies show that information from high credibility sources produces more attitude change than that from low credibility sources (Eagly et al., 1978; Hovland and Weiss, 1951; Xie et al., 2014). Attribution theory suggests that when source credibility is low, consumers tend to discount the arguments in a message (Eagly and Chaiken, 1975), whereas when source credibility is high consumers are more inclined to accept the message arguments (Mizerski et al., 1979). Credibility in turn leads to superior profit outcomes over time (Roberts and Dowling, 2002) and significantly influences future financial performance (Eberl and Schwaiger, 2005). Therefore, we hypothesize,

H1. An executive response is positively associated with future hotel financial performance.

2.1.2. Timeliness of response

Another important characteristic of management responses is the time between a consumer review and the posting of a manager's online reply. Response time is a critical factor, as it indicates the efficiency of the organization (Sparks et al., 2016). The service recovery literature holds that a service failure is more likely to be successfully resolved if the problem is addressed promptly (Hart et al., 1989), suggesting that the time management takes to respond directly affects satisfaction with the complaint handling and repurchase intentions (Mattila and Mount, 2003). Shorter response times result in positive consumer evaluations, such as favorable attributions of stability and controllability (Wirtz and Mattila, 2004), a greater propensity to share information and higher levels of customer praise and recommendations (Swanson and Kelley, 2001), as well as customers' satisfaction with the firm and their subsequent word-of mouth valence (Davidow, 2000). Recent research also supports the importance of speed of response in service recovery (Edvardsson et al., 2011; Mostafa et al., 2014). Importantly, however, all of these studies focus on response speed or timeliness in offline settings.

Increasingly, studies have examined the role of response time in cyberspace. For example, Sparks and Bradley (2014) report that most hotels examined in their study respond to online consumer reviews within one to three days. Min et al. (2015) find that the speed with which the hotel responds to an online complaint does not influence the participants' rating of the response. In contrast, Sparks et al. (2016) experimentally demonstrate that a timely response to a negative online review significantly improves consumer inferences of trustworthiness and concern for customers. Furthermore, Verhoef et al. (2002) find that trust leads to performance-related outcomes such as the number of referrals. We therefore propose:

H2. Response timeliness is positively associated with future hotel financial performance.

2.1.3. Length of response

Previous research has described the length of management response as an indication of the depth of the response (Mudambi and Schuff, 2010). While research on the potential effect of response length is scarce, some understanding can be developed from the online review literature. On the one hand, research shows that review message length is not as important as other attributes such as detailed description, date posted, and type of website where the online review is posted (Gretzel et al., 2007). One study finds that longer online reviews tend to decrease market share on average, as lengthy reviews might be seen as suspect by consumers (Duverger, 2013). On the other hand, length generally increases the helpfulness of the review because of the increased information diagnosticity of that review (Mudambi and Schuff, 2010). Although longer reviews do not necessarily stimulate sales, they may demonstrate more effort on the part of the reviewer (Chevalier and Mayzlin, 2006). Analogously, lengthy responses are likely to suggest that the hotel management takes consumers' feedback more seriously and places a greater effort in responding to the review, potentially resulting in higher customer satisfaction and thus leading to increased future financial performance of the hotel. On this basis, we hypothesize:

H3. Length of response is positively associated with future hotel financial performance.

2.1.4. Repetition of topics

The degree to which online review comments are paraphrased or repeated also represents an important aspect of management responses. Consumers support their purchase decision making by processing information from online communications such as consumer reviews and management responses. However, they may have difficulty extracting constructive information from online communications. Cognitive fit theory holds that information processing is more efficient and effective when individuals are able to use appropriate cognitive processes for given information (Vessey and Galletta, 1991). As cognitive fit occurs when the information type satisfies the consumer's information-processing needs, constructive management responses facilitate consumers' cognitive fit and subsequent purchase decisions. That is, rather than repeating the service failure descriptions in the consumer's online complaint, managers should react with new and constructive information such as specific service recovery solutions or actions the firm will take to address the problems raised. Echoing Davidov et al. (2010), we argue that if the topics appearing in a management response are largely identical to those in an online review, the information is less likely to result in cognitive fit and fails to help consumers identify the products (i.e., hotels) that suit their conditions for use (Chen and Xie, 2008), resulting in an unfavorable impact on the customer and potentially leading to negative financial performance. We therefore hypothesize:

H4. Repetition of topics between management responses and online reviews is negatively associated with future hotel financial performance.

2.1.5. Response volume

The number or volume of management responses also seems to affect hotel financial performance. However, the direction of the effect is inconclusive. On the one hand, taking no action in response to negative events can minimize blame for the organization (McLaughun et al., 1983), and strategic silence might be acceptable to people who have strong favorable feelings toward the company (Smith, 2013). Mauri and Minazzi (2013) show that hotel management responses to guests' reviews have an inverse relationship with purchase intentions, which is contrary to other findings. Xie et al. (2014) also report similar results. On the other hand, service recovery literature holds that failing to respond to guest complaints results in poor satisfaction ratings and low return purchase intentions (Baer and Hill, 1994; Bradley and Sparks, 2009; Mattila and Mount, 2003). In addition, in an online context, negative reviews represent customers' dissatisfaction or service failure, and responses to negative reviews are critical for mitigating customers' dissatisfaction or recovering service failure (Berry and Parasuraman, 1991; Smith and Bolton, 1998) as well as exerting a critical impact on customer satisfaction (Homburg and Fürst, 2007) and customer retention (Davidow, 2003). Furthermore, a firm's responses to online reviews help improve the firm's bottom line (Chen and Xie, 2008), and managerial response to negative comments is one of the most salient predictors of hotel performance (Kim et al., 2015). On this basis, we hypothesize:

H5. Response volume is positively associated with future hotel financial performance.

2.2. Moderation of online reviews on the effect of management responses on hotel performance

Scholars have criticized previous studies of online WOM as being limited because they tend to overlook the interactive effects of influential factors (Davis and Khazanchi, 2008). The two most commonly cited influential factors associated with online reviews are review rating and review volume. Ratings often critically affect product choice (Chen, 2008). Researchers suggest that when faced with a range of information and needing to make a quick and efficient decision, online customers may take shortcuts by using readily available information (Pennington, 2000), such as ratings (Browning et al., 2013). With respect to review volume, consumers may rationalize their purchase decisions by telling themselves that many other people also bought the same product (Zhang et al., 2010).

In light of prior research, we argue that rating and volume moderate the effects of the informational cues of management responses, which include executive response, response time, response length, and repetition of topics between responses and reviews. While the literature does not identify direct support for such interactive effects, parallel understanding can be established from results of relevant studies. For example, mere increase in the number of reviewer comments has no significant effect on sales—rather, the interaction of product category, volume, and product views and the interaction of product views and product category are the statistically significant factors in explaining changes in unit product sales (Davis and Khazanchi, 2008). Similarly, WOM volume alters the influence of other WOM-relevant characteristics on a WOM message's persuasiveness (Khare et al., 2011). Research shows that management responses contain important WOM characteristics (e.g., timeliness of response and voice of communication) that serve as informational cues for potential customers drawing inferences about the organization (Sparks et al., 2016). Therefore, a plausible postulation is that the magnitude of management response characteristics' impact on financial performance depends on review rating and review volume. For example, given that consumers often view a review rating as the direct indicator of an offering's quality, a high review rating motivates the consumer to make a quick and relatively effortless decision, thus diminishing the effects of other information cues in the management response. Such a process is also consistent with the heuristic-systematic information processing model (cf. Chaiken, 1980; Chaiken et al., 1989). Furthermore, with respect to the moderating effect of review volume, social influence literature holds that the majority's numerical dominance conveys the correctness of its position (Baker and Petty, 1994). Therefore, a high review vol-

ume is likely to override the effects of the attributes of management responses, reducing their impact. We therefore hypothesize:

H6. Review rating moderates the influence of job position of response providers, timeliness of the response, length of the response, repetition of topics, and response volume on future hotel financial performance.

H7. Review volume moderates the influence of job position of response providers, timeliness of the response, length of the response, repetition of topics, and response volume on future hotel financial performance.

3. Methodology

3.1. Data and sample

From TripAdvisor, the world's largest travel site, we obtained large-scale granular data of management responses to consumer reviews (comScore, 2014). We developed two web crawlers to auto-parse information of management response to online reviews on TripAdvisor. Then, we used a pre-coded Python program to remove the HTML formatting from the text and converted the information into an XML file, which separated the data into records (management responses) and fields (the data in each managerial response) on a server in an automated fashion. Our sample includes 22,483 management responses to 76,649 consumer reviews for 3537 hotels in 427 Texas cities over 26 quarters on a daily basis. The data collection is not random but exploits as many individual hotel properties as possible for analysis as long as the review/response and financial performance data is available. As such, in the current investigation, the potential for researcher's selection bias was substantially reduced. For each sampled hotel, we obtained quarterly financial performance records (revenue, ADR, and occupancy) and hotel attribute information (e.g., hotel class, size, age, and amenities) from a research firm reputable for the financial data services (e.g., revenue, loans, bank rating). We choose Texas as our study setting for two reasons. First, it is a major hotel market with a boom of hotel properties to meet the needs of the visitors in recent years (Dinges and Novak, 2013), providing a practically meaningful yet data-rich setting for us to explore how visitor's comments interact with managerial responses in influencing hotel performance, which is the central focus of this study. Second, emerging studies in recent years have investigated various issues of hotel performance in Texas (e.g., Xie et al., 2014; Zervas et al., 2015) due to data transparency and availability, making the hotel market in Texas of most empirical relevance. Results in this study can supplement the findings of prior studies and add more relevant insights. Because of the inconsistency of observation levels of the daily management response and consumer reviews and the quarterly financial performance, we first aggregate the daily-level management responses to consumer reviews into quarterly level data and then match the data with financial performance and hotel attributes at the individual hotel level. Our unit of analysis in the merged panel dataset is *Hotel* × *Quarter*, which enables us to explore the performance implications of management response to consumer reviews at a highly disaggregated level of individual hotels over time.

Fig. 1 shows the distribution of management responses analyzed in this study and reflects that when responding to consumer reviews on TripAdvisor, hotel managers tend to echo positive reviews but are less responsive to relatively negative reviews. For example, 45.62% of the management responses were provided for four-star consumer reviews, 23.98% for five-star reviews, 18.80% for three-star or neutral reviews, 6.16% for two-star reviews, and 5.44% for one-star reviews. The results are consistent with prior studies showing that managers respond not only to negative reviews with a strategy to recover service failure (Lee and Cranage, 2014; Sparks et al., 2016) but also to neutral and positive reviews to reinforce compliments and praise (Hennig-Thurau et al., 2004; Xie et al., 2014).

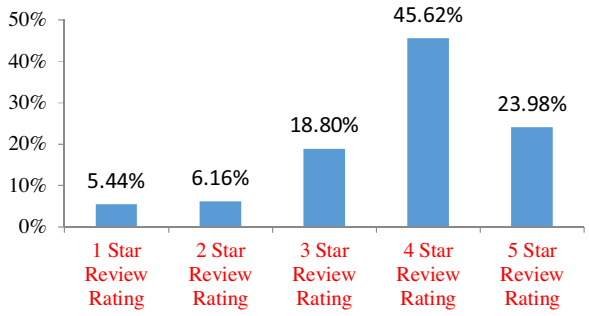

Fig. 1. Distribution of management responses by review rating.

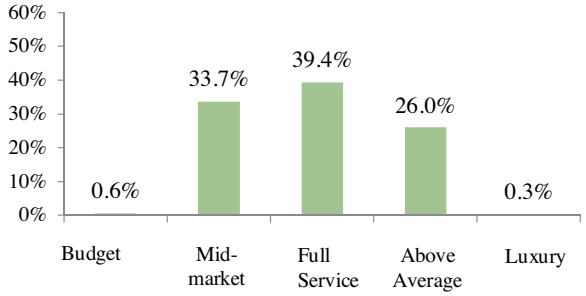

Fig. 2. Distribution of management responses by hotel class.

The dataset also reveals intriguing patterns of the management response across different hotel classes. As shown in Fig. 2, more than 99% of the management responses are provided by hotels in classes of mid-market economy (39.4%), full service (33.7%), and above average (26.0%). Less than 1% of the management response is from budget travel hotels (0.6%) and luxury hotels (0.3%).[3]

3.2. Measures

Our dependent variables include three financial performance indicators: revenue, ADR, and occupancy. Using different financial performance indicators not only enriches the performance implorations in various contexts but also testifies to the robustness of effect estimations. Our independent variables of interest comprise management responses (*ExeResponsePercent*, *ResponseDays*, *ResponseLength*, *TopicRepetition*, and *ResponseVolume*) and consumer review characteristics (*ReviewNumber* and *ReviewStar*). Besides the dependent variables and focal independent variables, we also control for hotel attributes, including *Class*, *Amenity*, *Age*, and *Size*. Table 1 presents the variable definitions and descriptive

[3] TripAdvisor.com provides hotel class segmentation information for each hotel being reviewed using a service segmentation scheme that awards hotels with "crowns" with the value of 5 for a luxury hotel, 4 for an above average hotel with some outstanding features and a broad range of services, 3 for a full service hotel, 2 for a mid-market economy hotel, and 1 for a budget traveler hotel.

[4] We checked the normality of the variables through skewness. A logarithm transformation is needed when the data are excessively skewed positively or negatively (Greene, 2012). Therefore, we take log transformations of some highly skewed variables (i.e., *ResponseDays*, *ResponseLength*, *ReviewNumber*, *TopicRepetition*, and *ResponseVolume*) to normalize the data in our regression analysis for effective estimation.

[5] We conduct textual mining and sentiment analysis of management responses, wherein we count the number of overlapping topics, including location, cleanliness, service, sleep quality, value, and room, between consumer reviews and management responses using keyword identification techniques. *TopicRepetition* is then

Table 1
Variable definition and descriptive statistics.

22,483 response to 76,649 reviews for 3537 hotels in 427 cities of Texas over 26 quarters (2005Q1–2011Q2)							
Dimensions	Variable	Description	Mean	Std. Dev.	Skewness[4]	Min.	Max.
Financial performance	*Revenue*	Average revenue in a given quarter	455307.80	853788.10	7.80	4997	2.02E+07
	ADR	Average daily rate in a given quarter	69.14	36.24	1.64	0	389.75
	Occupancy	Average occupancy rate (%) in a given quarter	58.25	14.63	−0.18	0	293.60
Response and review	*ExeResponsePercent*	Percentage of managerial responses posted by the executive team (General Manager, Assistant to General Manager, President, Owner, etc.) of the total number of managerial responses	0.08	0.25	3.15	0	1
	ResponseDays	Average number of days from when a customer posts a review until he/she receives a managerial response in a given quarter. The more response days, the less timely the response.	15.17	147.40	12.97	0	3459
	ResponseLength	Average length of manager response in a given quarter	19.61	121.64	11.99	0	6868
	TopicRepetition	Average repetition rate of topics between consumer reviews and managerial response in a given quarter[5]	0.08	0.04	11.08	0	1
	ResponseVolume	Average number of managerial responses in a given quarter	0.11	0.91	22.04	0	61
	ReviewNumber	Number of reviews (i.e., review volume) in a given quarter	0.74	2.58	21.96	0	188
	ReviewStar	Average consumer-generated review ratings on a scale of 1–5 stars, with 1 star for “terrible,2̈ stars for p̈oor,3̈ stars for “average,4̈ stars for “very good,änd 5 stars for “excellent¨	1.02	1.73	1.33	1	5
Hotel attributes (controls)	*Class*	TripAdvisor's hotel class scheme with the value of 5 for a luxury hotel, 4 for an above average hotel with some outstanding features and a broad range of services, 3 for a full service hotel, 2 for a mid-market economy hotel, and 1 for a budget hotel.	2.47	0.57	0.99	1	5
	Amenity	Number of internal amenities, such as indoor swimming pool, free high-speed Internet, fitness center, wheelchair access, and pets allowed in a given quarter.	6.72	3.16	−0.23	1	16
	Age	Number of years since the inception of a hotel in a given quarter	16.78	12.29	0.65	0	64
	Size	Number of guest rooms in a given quarter	96.87	92.18	5.57	0	1614

statistics. On average, the sampled hotels are approximately 17 years old and are mid-market economy hotels with 97 guest rooms and seven amenities. Table 2 shows that the correlation among variables are below 0.8 (Katz, 2006) indicating that the estimation is unlikely to be biased by collinearity of variables.

3.3. Model specification

As mentioned, our unit of analysis is Hotel × Quarter. Our panel data structure allows us to examine the effect of management response to consumer reviews on hotel financial performance in a time-series fashion, enabling us to observe the effect of responses successively over time. However, the analysis challenge is to control for potential bias owing to intrinsic, time-invariant unobservable hotel heterogeneity, which may distort the estimation. To address the heterogeneity issue, we use a blend of fixed-effects estimations to tease out the constant heterogeneity from the data through differencing. We examine the lagged rather than contemporaneous effect of management response on revenue for two reasons. First, the lagged effect reveals the potential reverse relationship between management response and hotel revenue in the same time period. Second, the regression model is able to predict revenue changes in quarter *t* based on the most recent information about management response in quarter *t*-1. Accordingly, the revenue performance or *log(Revenue)* for hotel *i* in quarter *t* is given by:

$$Log\left(Revenue_{i,t}\right) = \beta_0 + \gamma_{1:n1} MR_{t-1} + \delta_{1:n2} CR_{i,t-1} + \phi_{1:n3}\left(MR_{t-1} \times CR_{i,t-1}\right) + \beta_{1:n4} HA_i + \beta_{1:n5} HA_t + u_{i,t} \quad (1)$$

calculated as $\frac{|NumberofOverlapTopics|}{|NumberofTopicsinaReview|}$, where |*Overlaptopics*| denotes the topics appear in both an online review and a management response and |*Reviewtopics*| denotes the number of topics in an online review.

Table 2
Pearson Correlation of Variables.

	1	2	3	4	5	6	7	8	9	10	11
1. ExeResponsePercent	1.000										
2. ResponseDays	0.521	1.000									
3. ResponseLength	0.533	0.669	1.000								
4. TopicRepetition	0.389	0.516	0.637	1.000							
5. ResponseVolume	0.680	0.533	0.683	0.526	1.000						
6. ReviewNumber	−0.036	0.226	0.264	0.146	0.257	1.000					
7. ReviewStar	0.061	0.274	0.372	0.225	0.408	0.619	1.000				
8. Class	0.009	0.069	0.129	0.069	0.160	0.302	0.371	1.000			
9. Amenity	0.058	0.099	0.130	0.075	0.135	0.298	0.307	0.601	1.000		
10. Age	−0.009	−0.020	−0.003	0.010	0.009	−0.101	−0.020	−0.067	−0.166	1.000	
11. Size	0.005	0.063	0.107	0.065	0.135	0.222	0.304	0.568	0.508	0.147	1.000

On the right-hand side of the equations we have the following variables: MR_{t-1} is a vector of management response variables of hotel i in quarter t-1, including $ExeResponsePercent_{t-1}$, $logResponseDays_{t-1}$, $logResponseLength_{t-1}$, $log\ TopicRepetition_{t-1}$, and $logResponseVolume_{t-1}$, and CR_{t-1} is a vector of consumer review variables of hotel i in quarter t-1, including $ReviewStar_{t-1}$ and $logReviewNumber_{t-1}$. Additionally, we use $MR_{t-1} \times CR_{t-1}$ to capture the interaction term between management response and consumer reviews. We control for time-invariant hotel attributes, HA_i, such as *Class* and *Amenity* and time-variant hotel attributes, HA_t, such as $Size_t$ and Age_t. $u_{i,t}$ denotes the error term. This equation allows us to address the revenue implications of management response to consumer reviews, where $\gamma_{1:n1}$ and $\phi_{1:n3}$ are the parameters of interest with respect to the effect of management response to consumer reviews on revenue performance. In this vein, this study adds to previous research that focuses on the performance implications of consumer reviews (Xie et al., 2014; Ye et al., 2009; Ye et al., 2011) by shifting the research perspective from consumer centric to management proactive.

4. Results and findings

As shown in Table 3, we first estimate Eq. (1) for results of the revenue implications of management responses to consumer reviews in Model 1. We then develop similar estimations of the effect of management response to consumer reviews on ADR (Model 2) and Occupancy (Model 3). Through examination of three financial performance outcomes, we provide an integrated perspective with specific implications of the management response effects for multifaceted practical purposes. In addition, results of multifaceted financial performance outcomes can provide a robustness check of the estimated effects of managerial response strategies. Following the model estimations, we provide diagnostic tests of Breusch-Godfrey LM for autocorrelation (a.k.a. LM tests for serial correlation) (Breusch, 1978; Godfrey, 1978). The test results provide insufficient evidence to reject the null of no first-order serial correlation, suggesting that the estimations are without significant serial correlation from the errors. In addition, we provide the Portmanteau test for white noise (a.k.a. Ljung-Box test) (Ljung and Box, 1978). The results again provide insufficient evidence to reject the null that all autocorrelations up to a given lag are zero, supporting a realization of residuals from a white-noise process because the time series (residuals) pass the test.

4.1. Estimates of the effect of management responses on hotel financial performance

Model 1 presents the estimated effects of management response to consumer reviews on hotel revenue. The review valence (or *ReviewStar*) and volume (or *logReviewNumber*) positively affect hotel revenue (0.003*, $p = 0.053$ and 0.012*, $p = 0.094$, respectively). These findings are consistent with previous online review literature suggesting that higher reputation and popularity in the online review platform are likely to result in higher revenue to hotels (e.g., Xie et al., 2014). Estimation of management response reveals intriguing results. Specifically, we find that *logResponseDays* is negatively associated with revenue, reasonably indicating that the tardier the management response, the less the revenue (−0.003*, $p = 0.075$). This finding echoes previous studies advocating that responses to online reviews, especially complaints, should be immediate (Chan and Guillet, 2011; Sparks et al., 2016; Zheng et al., 2009). We further find that *logResponseVolume* (0.131*, $p = 0.055$) and *logResponseLength* (0.018*, $p = 0.062$) positively affect revenue, suggesting that in making their purchase decisions for hotels consumers are likely to appreciate not only the volume but also the length of the responses provided online. Interestingly, contrary to previous literature (Min et al., 2015), our results indicate that *logTopicRepetition* (−0.378***, $p = 0.006$) is negatively related to revenue. This result suggests that consumers do not perceive a management response more favorably when the response includes many paraphrases of the review but provides no additional content beyond the complaint or compliment in the review. In addition, we find that *ExeResponsePercent* has a negative impact on revenue (−0.007**, $p = 0.041$), implying that consumers do not necessarily appreciate responses from management in executive positions. Rather, consumers would likely perceive responses by functional staff or departments as more relevant, less generic, and more helpful in their decision making.

4.2. Estimates of the moderation of online WOM on the effect of management responses on hotel financial performance

Our focal interest is to estimate the moderation effects of consumer reviews' average ratings and volume on management response. As shown in Model 1, *ReviewStar* negatively moderates *logResponseDays* (−0.001, $p = 0.016$), mitigating the negative effect of *logResponseDays* on revenue. That is, as the average rating increases, a tardy response from managers is likely to be tolerated and perceived less negatively, while reviews with negative ratings need a more timely response. Similarly, *ReviewStar* further negatively moderates *logTopicRepetition* (−0.048**, $p = 0.043$) and *ExeResponsePercent* (−0.008**, $p = 0.018$). Specifically, the negative effect of *logTopicRepetition* on revenue tends to decrease in the presence of a higher rating, suggesting that consumers expect less relevancy of management response to a highly positive review. That is, the higher ratings play a more important role in influencing consumer purchase or firm performance as well as in mitigating the unfavorable effect of topic repetition.

In the same vein, in the presence of a positive consumer review, the negative effect of executive response on revenue tends to be mitigated and consumers are inclined to be forgiving of the generic executive response. Finally, we find additive or synergy effects between *ReviewStar* and *logResponseLength* (0.001*,

Table 3
Performance effects of management response to consumer reviews.

	Hotel Financial Performance		
	Model 1	Model 2	Model 3
	logRevenue	*Occupancy*	*ADR*
ExeResponsePercent $_{t-1}$	−0.007**	−1.012*	−1.217
	(0.041)	(0.087)	(0.400)
$logResponseDays_{t-1}$	−0.003*	−0.108*	−0.077
	(0.075)	(0.083)	(0.825)
$logResponseLength_{t-1}$	0.018*	0.314*	0.799*
	(0.062)	(0.079)	(0.074)
logTopicRepetition $_{t-1}$	−0.378***	−16.628***	−1.636
	(0.006)	(0.003)	(0.699)
$logResponseVolume_{t-1}$	0.131*	0.602**	6.766***
	(0.055)	(0.019)	(0.007)
$ReviewStar_{t-1}$	0.003*	0.169**	0.144*
	(0.053)	(0.021)	(0.076)
$logReviewNumber_{t-1}$	0.012*	0.733**	0.163
	(0.094)	(0.013)	(0.544)
$ReviewStar_{t-1} \times ExeResponsePercent_{t-1}$	−0.008**	−0.227*	0.119
	(0.018)	(0.053)	(0.740)
$ReviewStar_{t-1} \times logResponseDays_{t-1}$	−0.001**	−0.004**	−0.098
	(0.016)	(0.017)	(0.204)
$ReviewStar_{t-1} \times logResponseLength_{t-1}$	0.001*	0.025**	0.005
	(0.060)	(0.042)	(0.964)
$ReviewStar_{t-1} \times logTopicRepetition_{-1}$	−0.048**	−2.353*	−0.609
	(0.043)	(0.061)	(0.595)
$ReviewStar_{t-1} \times logResponseVolume_{t-1}$	0.025*	0.377*	0.510
	(0.077)	(0.058)	(0.335)
$logReviewNumber_{t-1} \times ExeResponsePercent_{t-1}$	0.036*	1.583*	1.098
	(0.062)	(0.088)	(0.331)
$logReviewNumber_{t-1} \times logResponseDays_{t-1}$	−0.007**	−0.442*	0.251
	(0.029)	(0.099)	(0.322)
$logReviewNumber_{t-1} \times logResponseLength_{t-1}$	−0.004**	−0.040**	−0.525*
	(0.036)	(0.021)	(0.054)
$logReviewNumber_{t-1} \times logTopicRepetition_{t-1}$	0.165*	6.258*	0.182
	(0.078)	(0.094)	(0.955)
$logReviewNumber_{t-1} \times logResponseVolume_{t-1}$	0.019*	0.020*	1.631**
	(0.073)	(0.078)	(0.042)
$Size_t$	0.759***	−14.239***	−1.095
	(0.000)	(0.000)	(0.720)
Age_t	−0.018**	0.434**	−2.967***
	(0.030)	(0.032)	(0.000)
Class	–	–	–
Amenity	–	–	–
Constant	9.674***	127.274***	118.249***
	(0.000)	(0.000)	(0.000)
Adjusted R-squared	0.955	0.591	0.952
Observations	13,757	13,757	13,757
Diagnostic Tests			
Breusch-Godfrey LM Test	*F* = 0.104	*F* = 0.158	*F* = 0.358
Ho: No serial correlation	*Prob* > *F* = 0.648	*Prob* > *F* = 0.707	*Prob* > *F* = 0.706
Portmanteau Test	*Portmanteau (Q)*	*Portmanteau (Q)*	*Portmanteau (Q)*
Ho: All autocorrelations up	*statistic = 48.098*	*statistic = 37.786*	*statistic = 51.786*
to a given lag	*Prob >Chi2 = 0.765*	*Prob >Chi2 = 0.466*	*Prob >Chi2 = 0.832*
are zero			

Note. (1) *p*-value in parentheses *** $p < 0.01$, ** $p < 0.05$, * $p < 0.1$. The typical values for the significant level are 0.1, 0.05, and 0.01 (Greene, 2012). Usually, a significance level of 0.05 works well. We choose a smaller significant level such as 0.01 to be more certain that we will only detect a difference that actually exists, whereas we choose a larger significant level such as 0.10 to be more certain that we will not fail to detect a difference that might exist (Greene, 2012). (2) As time-invariant hotel attributes, *Class* and *Amenity* are washed in fixed-effects estimations. (3) For robustness check we also created another dependent variable, RevPar (OCC × ADR) and re-estimated the model. The results remained largely consistent with those produced by the current models of *logRevenue, Occupancy*, and *ADR*.

$p = 0.060$) as well as between *ReviewStar* and *logResponseVolume* (0.025*, $p = 0.077$). The positive effect of management response (in terms of response length and number of responses) has been enhanced as the ratings average increases. This finding implies that managers may want to strategically focus response attention on relatively positive consumer reviews if they seek to magnify the effect of response length and volume on increased revenue performance. This result again lends support to the important role of ratings in making purchase decisions.

In examining the moderation effect of review volume on the relationship between management responses and revenue performance, we find that *logReviewNumber* negatively moderates *logResponseDays* (−0.007**, $p = 0.029$). Intuitively, the negative effect of *logResponseDays* on revenue is mitigated given increased volume of consumer reviews. Consumers understand that managers have difficulty providing managerial responses to a larger volume of consumer reviews in a timely fashion. However, a lengthy response is less desirable when the number of consumer

reviews increases, given that *logReviewNumber* also negatively moderates *logResponseLength* (−0.004**, $p = 0.036$). A plausible theoretical explanation of this result is information overload (Gross, 1964), in which a person can find decision making difficult owing to the presence of too much information. When a larger volume of consumer reviews is present, managers are wise not to provide lengthy responses so as to increase the revenue performance. In addition, we find the positive moderation effect of *logReviewNumber* with *logTopicRepetition* (0.165*, $p = 0.078$) and *ExeResponsePercent* (0.036*, $p = 0.062$), indicating that negative effects of *logTopicRepetition* and *ExeResponsePercent* are magnified when the number of consumer reviews increases. These findings have managerial implications with respect to how to respond to consumer reviews to avoid a possible decrease in revenue. Finally, we find an additive or synergy effect between *logReviewNumber* and *logResponseVolume* (0.019*, $p = 0.073$). In the case of an increased number of consumer reviews, it is in the managers' interest to provide more responses to leverage hotel revenue.

4.3. Robustness checks

Besides the effect estimation of management response on hotel revenue, we conduct two additional effect estimations using the financial performance indicators of occupancy and ADR. Overall, the estimation results of our focal variables are qualitatively consistent across different models, supporting the robustness of our estimation results. As Model 2 shows, the moderation effects of consumer reviews between management response and occupancy performance are qualitatively similar to those in the revenue model. Compared to revenue (Model 1) and occupancy (Model 2), ADR in Model 3 is less responsive to the effect of management response, given that most of the estimates are not significant. Plausibly, despite recent advocacy of incorporating online consumer reviews into pricing strategies, ADR is decided by hotels and is less likely to be influenced by feedback from consumer reviews (Cohen, 2013). Comparison of the three models suggests that the revenue driven by management response may mostly come from occupancy, which is more responsive to the effect of management response characteristics, rather than from price, which is less responsive. This observation also explains why the performance implications of managerial response are more salient in the revenue and occupancy models.

5. Discussion and implications

With the increasing influence of social media, hospitality businesses are shifting their social media strategy from passive listening to proactive engagement through management responses (Gu and Ye, 2014). However, little is known about how effective management responses are and how to provide management responses to online reviews to achieve increased hotel performance. We present a comprehensive and systematic analysis of the financial performance implications of management responses to online reviews, including the response attributes of timeliness, volume, length, repetition of review topics, and executive response percent. Our results, achieved through the data analytics approach, contribute to prior literature and offer performance implications for management response to online reviews.

Consistent with prior research (Sparks et al., 2016; Xie et al., 2014), our study shows that providing timely responses to online reviews enhances financial performance of hotels. We argue that timely response to online reviews should be the backbone of service recovery (Smith et al., 1999) or customer care efforts (Xie et al., 2014) that drive purchase decisions. Response volume and length have similar beneficial effects. Frequent longer responses to online reviews demonstrate management's attention to customer opinions and feedback, resulting in consumers' trust and appreciation and positively influencing subsequent decision making (Sparks et al., 2016). Given the transparency of the social media platform, customers who are shopping for a hotel can easily view the time stamp, volume, and length of a management response, making these three response aspects the most accessible information cues. Therefore, we argue that timeliness, volume, and length of responses should govern management strategy in responding to online reviews. In addition, managers should avoid merely repeating or paraphrasing topics in the online review. Rather, a constructive response with new information (e.g., an actionable service recovery plan for negative reviews and a commitment to continuous effort to maintain customer satisfaction for positive reviews) drives purchase decisions by subsequent consumers who view the response. Finally, functional staff/departments, rather than executives, are strong candidates for providing managerial responses because their operational insights allow them to address consumer comments relevantly and helpfully. Overall, our findings provide robust empirical evidence to reconcile the mixed understanding of the effect of management response (Min et al., 2015).

Furthermore, we argue that management intervention in social media should be strategic, as the effect of management responses depends on the average rating and the number of online reviews. When the average rating increases, a slower response from executives is less harmful to the hotel's performance, as increased positive average ratings become more influential in driving customer purchase decision. In addition, higher average ratings tend to mitigate the negative effect of topic repetition, implying that when the review is already quite positive, managers do not have to provide additional constructive information. Finally, results suggest that more management responses of longer length are warranted when the average ratings increase, as this additive effect is likely to result in increased hotel performance.

With respect to the number of online reviews, we find that in the face of a large volume of reviews, hotels are better off not providing responses from executives or that reflect a high repetition of topics. Similarly, to avoid information overload on the part of consumers, hotels should not provide lengthy responses in the presence of many online reviews (Gross, 1964). Rather, managers should intervene in social media conversations when online reviews are numerous so as to leverage the hotel's popularity toward increased hotel performance. Finally, consumers tend to forgive slow responses when a large number of online reviews appear, suggesting that the unfavorable effect of slow response to online reviews can be mitigated by a large buzz from consumers. Overall, the study's results show that the average ratings and volume of online reviews are important information cues to moderate the effects of management responses, and the appropriate characteristics for the response depend on the specific conditions of the online reviews.

5.1. Theoretical contributions

While online reviews have been thoroughly studied in the hospitality literature, research on management response is sparse (Proserpio and Zervas, 2015). This study adds to a research stream that shifts the emphasis from online reviews or WOM to management response. Results contribute to social media research in several important ways. First, although a few studies have investigated the influence of management response to consumer perceptions or intentions (Lee and Cranage, 2014; Min et al., 2015; Sparks et al., 2016), the financial performance implications of management response have been largely unexplored. In this study, we explicitly focus on hotels' bottom line and question how the mul-

tifaceted characteristics of management responses can leverage hotels' financial performance.

This study has also addressed the call in the literature by theorizing and empirically testing the interactive effects of influential factors (Davis and Khazanchi, 2008). Specifically, our results contribute to the extant literature by demonstrating, for the first time, that rating and volume significantly moderate the effects of the informational cues of management responses, which include executive response, response time, response length, and repetition of topics between responses and reviews. Our results reinforce prior assertions that factors such as volume of reviews and ratings can change the impact of other word-of-mouth (WOM) relevant characteristics (e.g., management responses) on a WOM message's persuasiveness (Khare et al., 2011). Such results also suggest that the influences of online reviews or management responses on consumers cannot be interpreted in isolation of the other. Examination of the impacts of management responses without the consideration of the online reviews provide an incomplete picture of such impacts. As such, a comprehensive understanding of how online reviews and management responses contribute to any consumer or firm outcomes, as suggested in this study, require a dual consideration.

Finally, using a data analytics approach to analyzing large-scale granular data from the field, we present a comprehensive and systematic analysis of the joint effects of management responses and online reviews on hotel financial performance. Our analytics models with econometric estimations provide a time-series perspective on the performance effect of management responses, supplementing prior management-response research that has largely adopted an experimental design (Lee and Cranage, 2014; Mauri and Minazzi, 2013; Min et al., 2015; Sparks et al., 2016; Wei et al., 2013). In doing so, we demonstrate the importance of data analytics in developing new knowledge to deepen understanding of the field and to support data-informed decision making in the hospitality industry (Radojevic et al., 2015).

5.2. Practical contributions

This study informs the practice of social media management by providing specific managerial implications to managers. First, we show that management responses have distinctive effects that represent opportunities and challenges to hospitality managers. Management responses on social media platforms vary considerably in their effectiveness and require cautious customization (Levy et al., 2013; Park and Allen, 2013). Second, our findings yield explicit recommendations on how to respond given average ratings and volume, which help managers craft a response that best leverages the business performance. Specifically, more management responses of greater length should be offered when the average ratings of online reviews increase. Responses that are less timely, are provided by executives, and are repetitive of topics in the online reviews will reduced impact on hotel performance when the average rating of online reviews increases. When the number of online reviews is large, managers should refrain from providing lengthy responses from executives that contain repetition of topics. Third, to allow hotels to thrive in the social media era, managers should use the data from this study to re-examine their social media strategies for their impact on hotel performance and to assess the role management responses have in defining the online presence of their hotels among consumers.

5.3. Limitations and future research

This study has some limitations. First, as our investigation is an empirical data analytics study, we examine only the quantitative aspects of management responses. We do not address the operational details or textual content of reviews mentioning service failure or compliments to service. Future studies using a qualitative approach can provide additional insights into the effect of management responses. Another productive research direction is to combine econometric methods with natural language processing to analyze the textual content of management responses to estimate heterogeneity arising from the various ways managers handle praise and complaints (Proserpio and Zervas, 2015). Such analyses can yield prescriptive guidelines for managers communicating with consumers in various customer service scenarios.

Second, we have not included certain unobservable or unavailable factors that may influence the effect of management responses. For example, managers' capability and skills, hotels' brand culture, and internal training or incentive programs can affect the identification of the effect of management responses. In addition, consumers' heterogeneity owing to, for example, unobservable personal preferences and tastes may influence the perception of management response and subsequent purchase decisions and firm performance. Although our estimation approach has eliminated such confounding effects of time-invariant factors and our robustness check in various performance contexts confirms our results, our results may be subject to estimation bias. Future research might collect data not included in this study and develop alternative approaches to identify the impact. One possible approach is to use controlled experiments that examine the interactive effects of management responses and customer reviews (Gu and Ye, 2014). Given the increasing number of hotels that wish to engage with their reviewers and to actively participate in producing information that shapes their online reputation (Proserpio and Zervas, 2015), we look forward to seeing more exciting work in the area of management response.

Third, this study focuses on the Texas hotel market given the availability of proprietary data, especially hotel performance records. Although the proprietary data provide a unique and in-depth perspective of the interrelationships among consumer reviews, managerial response, and hotel performance, findings from a single Texas market may not be generalizable to other hotel markets. As such, future research could investigate these relationships using hotel data from other cities in the United States or other countries in order to enhance the generalizability of the results.

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