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The stock price reaction of the COVID-19 pandemic on the airline, hotel, and tourism industries

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ABSTRACT

This paper investigates the stock market performance from the second half of February through the latter portion of March 2020 for U.S. travel-related firms (airlines, restaurants, and hotels) in response to the COVID-19 pandemic. Clearly the reduction in travel was negative news for the travel industry; however, we focus on the factors used by market participants to price the information into stock prices. We find that larger firms with greater cash reserves and higher market-to-book ratios experienced less negative returns, while firms with greater leverage were penalized more. Additionally, we find that cash reserves were particularly important for hotels.

1. Introduction

In late December of 2019, a string of pneumonia-like cases began to emerge in Wuhan, China and despite efforts such as travel restrictions and quarantines to contain the virus, by the end of January the virus managed to spread across the globe. On March 11, 2020 the WHO officially declared the coronavirus (COVID-19) outbreak a pandemic (see [World Health Organization, 2020](https://www.who.int/news-room/feature-stories/coronavirus)). At the time of this writing, there have been over 108 million COVID-19 cases reported worldwide with more than 27 million cases in the U.S. alone ([John Hopkins University, \(2021, February 12\)](https://www.jhu.edu/)).

The economic effect of the pandemic in the U.S. was significant, with real GDP plunging by about 33% by the end of the second quarter of 2020 and the unemployment rate reaching 14.7% in April 2020.¹ The effect on firms in the travel and hospitality industries was dramatic. By mid-April, air passenger traffic was only about 4 percent of what it had been a year earlier.² Hotel occupancy during April 2020 was under 25 percent, compared to about 68 percent for April 2019 ([Luther, 2020](https://www.hoteliers.com/news/hotel-occupancy)). According to the Bureau of Labor Statistics, the leisure and hospitality industry lost 7.7 million jobs in April, in addition to 459,000 jobs lost in March.³ While the pandemic had implications on the market value of nearly every firm, the more interesting question is what are the valuation implications for firms that would realize a direct impact by travel restrictions, social-distancing, and stay-at-home orders.

In this paper, we investigate firms from the travel and tourism industries (airlines, hotels, and restaurants) which are most likely to experience significant negative returns due to the pandemic. Our rationale for selecting these firms is to determine how investors priced the effect of the pandemic into industries likely to be severely affected.

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¹ Federal Reserve Economic Data (FRED), *Federal Reserve Bank of St. Louis* (<https://fred.stlouisfed.org>).

² <https://www.tsa.gov/coronavirus/passenger-throughput>.

³ Bureau of Labor Statistics News Release (https://www.bls.gov/news.release/archives/empsit_05082020.pdf).

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We contribute to the literature by studying these industries to understand how investors incorporated new information related to the COVID-19 pandemic. Our results suggest that the market reaction was not the same for all firms and show evidence of efficient markets. Furthermore, we find evidence that firms that were larger, had greater cash reserves, and higher market-to-book ratios were penalized less by investors, while firms with greater leverage were penalized more. Additionally, we find that cash reserves were particularly important for hotels.

The paper proceeds as follows. [Section 2](#) describes the timeline of events and the economic impact on the firms adversely affected by the crisis. [Section 3](#) describes the event dates, data sources, and empirical methodology. [Section 4](#) presents our results and in [Section 5](#), we conclude.

2. Firm value and COVID-19 related events affecting the travel and tourism industry

Firm value is the present value of the firm's expected future free cash flows, discounted at the appropriate discount rate. The COVID-19 pandemic can affect firm valuation by changing the expectation of future cash flows or by changing the required rate of return, due to changes in risk. Due to the effect of the pandemic on the travel and tourism industry, we expect the events described below to reduce firm value by reducing future expected cash flows. For example, travel restrictions and stay-at-home orders reduced the number of airline passengers, reducing revenue and ultimately free cash flow. This combined with increased risk due to uncertainty about the duration of the pandemic produced significant decreases in the stock prices for firms in the travel and tourism industry.⁴ Below, we discuss the timeline of events during February and March 2020 as COVID-19 spread worldwide and resulted in an economic shutdown in the U.S. and other countries.

2.1. Events surrounding the COVID-19 pandemic

The Dow Jones Industrial Average (DJIA) closed above 29,000 for the first time on January 15, 2020. The DJIA bounced around in the vicinity of 29,000 until February 24 when it dropped over 3.5 percent in response to an announcement by the World Health Organization (WHO) that the spread of COVID-19 may not be contained (see [McKay et al., 2020](#)). By the end of February, the DJIA had declined by 14 percent from its peak level of 29,551 on February 12th. By March 23, the DJIA had declined by another 27 percent from its February close.

We identify several critical events during March 2020 related to the outbreak of COVID-19 in the United States. Refer to Appendix A.1 for a description of these event dates.

2.2. Economic impact of COVID-19 pandemic on airlines, hotels, and restaurants

Travel restrictions, stay-at-home orders, and general fear related to COVID-19 led to significant declines in revenue and profitability for the travel and tourism industries. While activity in these industries has rebounded somewhat since April, it is still well below levels for 2019.

Airlines: Travel restrictions and stay-at-home orders had a direct impact on the airline industry. Before the outbreak, air travel was at an all-time high. The year-over-year declines in airline passenger traffic from March through June were -51%, -96%, -90%, and -80%, respectively, according to data reported to the Bureau of Transportation Statistics (BTS). The IATA estimates that airlines have lost \$419 billion so far in 2020 (8/14/2020). In April, it was reported that some carriers had cut as much as 90% of their anticipated routes through September ([Bachman and Schlagenstein, 2020](#)). Although airline traffic has increased, it will likely be years before passengers feel comfortable enough to approach pre-pandemic levels.

Hotels/Motels and Restaurants: Travel restrictions and stay-at-home orders also directly impacted the leisure and hospitality sector. Leisure and hospitality had the most significant one-month net decline in payrolls during the outbreak. The effect of the pandemic is estimated to be nine times worse than the impact of 9/11 ([Oxford Economics, 2020](#)). Hotels and motels (hereafter referred to as hotels for simplicity) and restaurants are subsectors of leisure and hospitality. Hotels have lost more than \$46 billion in revenue since February, and nearly 50% of all available hotel rooms are currently vacant. Hotel traffic bottomed in February and has been increasing slowly since then. It is unlikely that demand will outpace hotel re-openings, leading to projected occupancies in the 20% range.

For restaurants, the story is very similar in the sense that they are operating far below capacity. During March and April, when the majority of Americans were on stay-at-home orders, restaurants were either forced to close entirely or provide take-out services. Even today, they are still not allowed to operate at full capacity in most states and according to the National Restaurant Association (NRA), it will be awhile before sales reach pre-pandemic levels. Interestingly, some restaurants have seen an increase in sales. For example, pizza chains such as Dominos and Pizza Hut have seen an increase in demand in response to stay-at-home orders.

⁴ For example, using data from Yahoo! Finance, February 10, 2020 to May 11, 2020, the stock price of Southwest Airlines decreased by 59% and that of American Airlines declined by 69%.

Table 1
Descriptive Statistics

This table presents the summary statistics of the key variables used in our study. Panel A, B, and C report the summary statistics of the full sample, airline industry, and hotel-motel and restaurant industry, respectively. Debt to mkt equity is the book value of total debt scaled by the market value of equity. EBIT scaled by sales measures profitability. Market value to book value is the market value of assets over book value of assets. Panel D reports the correlation matrix of the variables used in the cross-sectional regressions.

	Mean	p10	p25	p50	p75	p90	N
<i>Panel A: Summary Statistics for Full Sample</i>							
Total Asset (million)	8884.962	246.518	730.721	3079.000	8417.000	25895.000	75
Cash/Assets	0.101	0.011	0.021	0.067	0.150	0.199	75
Debt to Mkt Equity	0.817	0.126	0.277	0.561	1.008	1.682	75
EBIT/Sales	0.128	0.013	0.050	0.116	0.180	0.275	75
Mkt value/ Book value	2.488	1.058	1.207	1.605	2.809	4.514	75
<i>Panel B: Summary Statistics for Airline Industry</i>							
Total Asset (million)	21263.89	3010.80	4126.62	12455.50	40957.19	59995.00	18
Cash/Assets	0.112	0.006	0.066	0.114	0.157	0.195	18
Debt to Mkt Equity	1.364	0.241	0.459	1.019	2.322	3.227	18
EBIT/Sales	0.121	0.037	0.101	0.128	0.141	0.181	18
Mkt value/ Book value	1.312	0.977	1.065	1.204	1.605	1.749	18
<i>Panel C: Summary Statistics for Hotel & Motel and Restaurant Industry</i>							
Total Asset (million)	4975.824	94.652	548.108	1581.225	5104.604	14957.000	57
Cash/Assets	0.098	0.011	0.021	0.050	0.132	0.238	57
Debt to Mkt Equity	0.645	0.123	0.244	0.507	0.862	1.303	57
EBIT/Sales	0.130	-0.001	0.046	0.098	0.188	0.298	57
Mkt value/ Book value	2.859	1.093	1.407	1.897	3.101	5.172	57
<i>Panel D: Correlation Matrix</i>							
Variables	(1)	(2)	(3)	(4)	(5)		
(1) Size(Ln(Total Assets))	1.000						
(2) Cash/Assets	-0.231	1.000					
(3) Debt to Mkt Equity	0.123	-0.248	1.000				
(4) EBIT/Sales	0.169	0.238	-0.273	1.000			
(5) Mkt value/ Book value	-0.135	0.242	-0.348	0.338	1.000		

3. Data and methodology

3.1. Sample construction

Appendix 1 provides a description of our variables and data sources. For the airline, hotel, and tourism industries, we collect data for firms in the GIC sub-industries: Airlines (20302010), Hotels, Resorts, and Cruise Ships (25301020), and Restaurants (25301040). There are 176 firms in these three industries. We obtain the daily stock price data for the 256-trading day period from June 1, 2019 to June 8, 2020.⁵ Following Mazumder (2020) and Mazumder and Saha (2021), we adjust prices for dividends (adjustment factor cumulative ex-ante) and the daily total return factor. We apply several standard filters to clean the data. First, we drop penny stocks from our study. Second, to eliminate illiquid firms, we drop firms that trade less than 150 days (out of 256 trading days) in our sample period. Finally, we only include firms for which 2019 financial data is available. Our final sample consists of 75 firms from the three industries (18 airlines, 18 hotel, resort, and cruise line firms, and 39 restaurants).

Table 1 presents the descriptive statistics for sample firms. Panel A presents the summary statistics of the variables used in our study. The mean (median) size of firms is USD 8,884.96 (3,079) million. The average leverage (debt to market equity) is 81.7%, while the fifty percentile is 56.1%. The mean and median profitability are 12.8% and 11.6%, respectively. The firms in the sample are growth firms with average market to book ratio of 2.488. Panel B and Panel C report the summary statistics for Airline and Hotel, Motel, & Restaurant industry separately. Expectedly, the average size of airline firms are larger than that of hotel, motel, and restaurant firms. Airline firms use more leverage than hotel, motel, and restaurant firms. However, the average market to book ratio of Hotel, Motel, and Restaurant industries is greater than that of Airline industries. Panel D reports the correlation coefficients for all the control variables. None of the control variables are highly correlated with each other.

⁵ Eq. (1) is estimated for 256 days period beginning June 01, 2019 (t-188) and continuing through June 08, 2020 (t+45). We believe that one year data can sufficiently capture the variation of the observations. We take more pre-event dates observation than post-event dates observation for two reasons. First, pre-event dates observations are less-biased of the COVID-19 crisis and work in our model as control samples, while the post-event dates observations work as treatment samples. Second, the availability of post-event dates data at the time of the study. We restricted post-event dates sample upto t+45 because there are other events that might be related to the COVID-19 during the post-event dates, such as declaration of stimulus, declaration of vaccines initiation, and so on. Thus, including more post-event dates observations in our sample may affect the regression outcomes.

3.2. Empirical methodology and hypothesis development

Following existing literature of Gibbons (1980), Schipper and Thompson (1983), Binder (1985a, 1985b), Malatesta (1986), Sinkey Jr. and Carter (1999), Carter and Simkins (2004), and Humphrey et al. (2016), we use the multivariate regression model (MVRM) to examine the effect of COVID-19 on the stock performance of Airline, Hotels, and Tourism industries. MVRM methodology is an application of the seemingly unrelated regression (SUR) techniques of Zellner (1962) that examines the events that simultaneously affect all the firms in the same industry. In this situation, the residuals of the stock returns are not independently and identically distributed.⁶ Thus, we estimate the following equation for our sample firms:

$$\tilde{R}_{i,t} = \alpha_i + \beta_i * \tilde{R}_{m,t} + \sum_{j=1}^n \gamma_{i,j} * D_j + \tilde{\epsilon}_{i,j} \tag{1}$$

Where, $\tilde{R}_{i,t}$ is the return of the firm or portfolio i on day t , $\tilde{R}_{m,t}$ is the return of the S&P 500 index on day t , α_i and β_i are the market model parameters, D_j is the dummy for event date j , $\gamma_{i,j}$ is the abnormal return for the firms/ portfolio i on day j , and $\tilde{\epsilon}_{i,j}$ is the standard error term.

To capture the effect of the COVID-19 crisis, we test the following hypotheses. First, we test the market reaction of our sample firms with various events during the COVID-19 crisis period. Thus, the first hypothesis tests whether the event dates produce significant abnormal returns for each of the firms. Hypothesis 1 (H_1) can be stated as follows:

$$H_1 : \gamma_{i,j} = 0 \forall i \text{ and } j$$

Rejection of H_1 suggests that stock prices of our sample industries react from the COVID-19 crisis periods and the prices incorporate the information. Since some events are bad news for the investors, the abnormal returns for that news are expected to be negative, and *vice versa*. To determine whether the price reactions are the same for all firms, we examine the following two joint hypotheses:

$$H_2 : \gamma_{1,j} = \gamma_{2,j} = \gamma_{3,j} = \dots = \gamma_{n,j} = 0$$

$$H_3 : \gamma_{1,j} = \gamma_{2,j} = \gamma_{3,j} = \dots = \gamma_{n,j}$$

By rejecting H_2 , we can conclude that the abnormal returns for firms are jointly non-zero. On the other hand, rejection of H_2 may result in a contagion effect, meaning that the abnormal returns for each of the firms in the industries are not uniform. By rejecting H_3 , we can conclude that the responses to each of the events for each of the firms are unique. Rejection of H_3 also suggests that the market participants distinguished the firms and the prices of the stocks are rational. Next, we will perform the pair-wise test of the industry portfolios to investigate whether the differences by industry from the announcements or events. Lastly, if the rational pricing by the market is supported from our result, then we perform the cross-sectional regression to see which of the firm-level factors are important to explain the cumulative abnormal returns (CARs) of the event days.

4. Results

We present our empirical results in Tables 2 through 4. Due to the large volume of result from estimating abnormal returns for 75 firms with 14 event dates, we place the individual firm results in Appendix A.2 for airlines and in Appendix A.3 for hotels and restaurants.

Table 2 reports the CARs for three event windows: February 19-28, March 2-24, and February 19-24 March. As shown, airlines had the largest negative mean CAR during the period February 19-24 (-0.125) and the entire period of February 19 to March 24 (-0.393) while hotels performed slightly worse during March. Interestingly, for restaurants, the 90th percentile over the entire period under

Table 2

Cumulative Returns for COVID-19 Related Event Windows

This table presents the summary statistics of the cumulative abnormal returns for event windows related to the emergence of COVID-19 and the related economic shutdowns.

Event Window	Industry	Mean	p10	p25	p50	p75	p90	N
February 19 – 28	Airline	-0.125	-0.258	-0.148	-0.126	-0.103	0.110	18
	Hotel	-0.041	-0.18	-0.099	-0.036	-0.01	0.082	18
	Restaurant	-0.007	-0.093	-0.054	-0.009	0.022	0.096	39
March 2 – 24	Airline	-0.269	-0.742	-0.395	-0.261	-0.052	-0.011	18
	Hotel	-0.287	-0.591	-0.392	-0.250	-0.230	0.018	18
	Restaurant	-0.223	-0.581	-0.424	-0.261	0.023	0.098	39
February 19 to March 24	Airline	-0.393	-0.914	-0.575	-0.396	-0.155	-0.006	18
	Hotel	-0.330	-0.74	-0.477	-0.289	-0.209	0.100	18
	Restaurant	-0.230	-0.658	-0.455	-0.225	0.009	0.148	39

⁶ Fama et al. (1969) also apply MVRM to examine the stock price reactions for certain events.

Table 3

Industry returns during the COVID-19 crisis period

This table presents the market reaction of COVID-19 events on equally weighted industry portfolio returns. We consider three industries: Airlines, Hotels, and Restaurants. Market returns are S&P 500 index returns. The t-statistics are reported in parenthesis beneath the parameter estimates. We use robust standard errors, corrected for heteroscedasticity and autocorrelation, in the computation of the t-statistics. Significance at the 10%, 5%, and 1% levels are indicated by *, **, ***, respectively.

Variables	(1) Airline	(2) Hotel & Motel	(3) Restaurant
Market Return	1.297*** (9.496)	1.746*** (10.414)	1.515*** (11.256)
γ_1	-0.045 (-1.396)	-0.086** (-2.157)	-0.028 (-0.879)
γ_2	-0.127*** (-3.700)	0.066 (1.569)	0.082** (2.413)
γ_3	-0.037 (-1.090)	-0.053 (-1.266)	-0.077** (-2.284)
γ_4	0.088** (2.467)	0.121*** (2.751)	0.024 (0.677)
γ_5	-0.163*** (-4.974)	-0.173*** (-4.283)	-0.154*** (-4.747)
γ_6	-0.227*** (-6.951)	-0.105*** (-2.607)	-0.035 (-1.089)
γ_7	-0.011 (-0.330)	0.052 (1.319)	0.210*** (6.669)
γ_8	0.049 (1.511)	0.225*** (5.644)	0.109*** (3.401)
γ_9	0.002 (0.048)	-0.021 (-0.521)	-0.079** (-2.486)
γ_{10}	0.091*** (2.658)	0.034 (0.813)	0.099*** (2.922)
γ_{11}	-0.073** (-2.297)	-0.091** (-2.328)	0.007 (0.232)
γ_{12}	0.096*** (2.985)	0.013 (0.322)	-0.121*** (-3.823)
Constant	-0.000 (-0.148)	-0.001 (-0.244)	0.001 (0.367)
Observations	256	256	256
Adjusted R-squared	0.551	0.435	0.537

examination was +14.8%, likely the result of restaurants with carryout and delivery business models. At the other end of the spectrum, 10th percentile for airlines was a negative 91.4%, which reflects how badly some airlines we hit by the travel restrictions and shut downs.

In Table 3, we report estimates of abnormal returns using Eq. (1) for equally-weighted portfolios for the three industries we examine in this study: airlines, hotels, and restaurants. For March 11 (γ_2), airlines experienced a 12.7 percent decline in value in response to the announcement by the WHO that COVID-19 was a pandemic, and that the U.S. was suspending entry by travelers from Europe. Interestingly, restaurants exhibited a positive 8.2 percent positive abnormal return the same day. On back-to-back days, March 16 (γ_5) and 17 (γ_6), both airlines and hotels had significant, negative abnormal returns. On the 16th, European nations closed their borders to non-citizens and airlines experience negative abnormal returns of 16.3 percent on the 16th and 22.7 percent on the 17th. Hotels had negative abnormal returns of 17.3 percent and 10.5 percent on the same days, respectively. Restaurants had a significant, negative abnormal return of 15.4 percent on the 16th but an insignificant abnormal return on the 17th. While the S&P 500 index was down around 12 percent on the 16th, it was up 6 percent on the 17th.

Hotels and restaurants were up significantly on the 19th (γ_8) with statistically significant abnormal returns of 22.5 percent and 10.9 percent, respectively. Interestingly, on this day Domino's Pizza said they expected to hire around 10,000 workers in response to increased delivery services brought on by the pandemic.⁷

On March 23rd (γ_{10}), both airlines and restaurants experienced significant positive returns of almost 10 percent. On this day, the Federal Reserve announced that it was committed to using its full range of tools to support the U.S. economy. However, on the very next day airlines and hotels saw significant negative abnormal returns of 7.3 percent and 9.1 percent respectively. On balance, even though there were some days during March with significant positive abnormal returns, the overall trend was down, at least through the 23rd. While Table 3 shows some significant positive abnormal returns during March, the CARs shown in Table 2, paint a picture of significant market pessimism in the travel and hospitality industries due to travel restrictions and shutdowns.

⁷ Budryk, Zack. "Domino's to hire 10,000 new employees in response to coronavirus." *The Hill*, 19 March 2020. <https://thehill.com/blogs/blog-briefing-room/news/488473-dominos-to-hire-10000-new-employees-in-response-to-coronavirus>.

Table 4

Cross-sectional regressions of abnormal returns

This table presents the cross-sectional regression of firm characteristics on cumulative abnormal returns (CAR). Abnormal returns are S&P 500 index returns adjusted. Three CARs are calculated: (1) February 19-28, (2) March 2-24, and (3) February 19 – March 24. The t-statistics are reported in parenthesis beneath the parameter estimates. We use robust standard errors, corrected for heteroscedasticity and autocorrelation, in the computation of the t-statistics. Significance at the 10%, 5%, and 1% levels are indicated by *, **, ***, respectively.

Variables	Model (1) CARFebruary 19 – 28	Model (2) CARMarch 2 – 24	Model (3) CAR February19 – March 24
Airline Dummy	0.027 (0.084)	-0.399 (-0.530)	-0.372 (-0.427)
Hotel Dummy	-0.006 (-0.031)	-0.290 (-0.579)	-0.296 (-0.451)
SIZE	-0.006 (-0.769)	0.041*** (2.828)	0.035* (1.928)
CASHTA	0.123 (1.289)	0.467*** (3.318)	0.590*** (3.212)
LEVERAGE	0.026 (1.042)	-0.158*** (-4.411)	-0.131*** (-3.016)
MKTBOOK	0.005 (0.583)	0.020*** (4.378)	0.025** (2.169)
Airline Dummy x SIZE	0.001 (0.039)	0.046 (0.684)	0.047 (0.602)
Airline Dummy x CASHTA	-0.950 (-1.374)	-0.405 (-0.232)	-1.356 (-0.608)
Airline Dummy x LEVERAGE	-0.048 (-1.233)	0.149* (1.909)	0.100 (1.118)
Airline Dummy x MKTBOOK	0.017 (0.226)	-0.147 (-0.645)	-0.130 (-0.444)
Hotel Dummy x SIZE	-0.006 (-0.331)	-0.009 (-0.206)	-0.015 (-0.250)
Hotel Dummy x CASHTA	0.404** (2.570)	0.836** (2.364)	1.241** (2.639)
Hotel Dummy x LEVERAGE	-0.062 (-1.050)	0.175 (1.005)	0.113 (0.513)
Hotel Dummy x MKTBOOK	0.015 (0.938)	0.035 (1.137)	0.050 (1.144)
Constant	-0.011 (-0.179)	-0.510*** (-3.983)	-0.522*** (-3.589)
Observations	75	75	75
Adjusted R-squared	0.315	0.323	0.310
Ind. FE	NO	NO	NO

An examination of the results for individual firms in the Appendix reveals that we reject the null hypotheses that all returns are equal and all equal to zero (H_2 and H_3). This suggests rational pricing for the stocks of airline and hospitality firms during the emergence of COVID-19 in February and March. Because of this, we perform cross-sectional regressions in which the dependent variable is the CARs, to better understand the factors involved by market participants to price travel and hospitality firms. We identify several variables reflecting firm characteristics, that we expect to be important in the valuation of firms in the travel and hospitality industries. We include measures of size, liquidity, leverage, and valuation in our cross-sectional analysis.

In general, because larger firms have greater resources and the ability to raise funds when needed, we expect a positive relation between abnormal returns and the variable, SIZE. Even under normal circumstances, adequate liquidity is important for a firm to ensure coverage of its recurring cash obligations. However, given the likelihood of severe financial stress related to the pandemic, firms would need a large reserve of cash and equivalents to avoid financial distress. We measure liquidity with the variable CASHTA and hypothesize a positive relation between abnormal returns and liquidity for our sample firms (i.e., firms with greater cash availability would have less negative abnormal returns).

We include the effect of leverage (variable LEVERAGE) in our cross-sectional regressions because firms with less debt, and thus lower fixed debt payments, would have a greater chance of surviving any financial stress brought on by the pandemic. Therefore, we expect an inverse relationship between LEVERAGE and abnormal returns. Finally, we use the market value to equity market value, MKTBOOK, to measure the perceptions of investors for each firm and expect a positive relation with abnormal returns.

Table 4 presents the results of our cross-sectional analysis in which the CARs from the estimation of Eq. (1) are regressed against the above firm characteristics. We report the results of three models:

Model (1): the dependent variable is the CARs for February 19-28.

Model (2): the dependent variable is the CARs for March 2-24.

Model (3): the dependent variable is the CARs for February19 – March 24.

Additionally, we include airline and hotel dummy variables in our analysis. The airline dummy is equal to one if the firm is in the airline industry and zero otherwise. The same method is used for the hotel dummy. Dummy variables allow us to test whether there are

differences in the relation between the CARs and the independent variables based on industry.

In Models (2) and (3), we find a significant positive relation between the CAR and SIZE, CASHTA, and MKTBOOK but a significant negative relation between the CAR and LEVERAGE. This suggests that larger firms with more resources, firms with greater cash reserves, and firms with higher market to book ratios performed better in response to the pandemic-related downturn. However, investors penalized firms with greater levels of debt.

We find positive and significant coefficient estimates for the interaction between the hotel dummy and CASH for Models (2) and (3), suggesting that investors particularly valued cash reserves associated with hotels. In Model (2), we find a significant positive relation between debt and returns for airlines, suggesting that during March, leverage was less of a negative factor for airlines than for hotels and restaurants. Perhaps, the interaction effect is positive because the bailout talks of the Airline industry began at that time.

5. Conclusion

A dramatic curtailment of domestic and international travel was a major effect of the COVID-19 pandemic. To better understand how investors used new information, we investigate the stock market performance from the second half of February through the latter portion of March 2020 for U.S. travel-related firms (airlines, restaurants, and hotels) in response to the pandemic. We focus on the factors used by market participants to price the information into stock prices. Our results suggest that larger firms with greater cash reserves and higher market-to-book ratios were associated with less negative returns over the period, while firms with greater leverage were penalized more. Additionally, we find that cash reserves were particularly important for hotels. Overall, this research is important because it adds to the literature supporting rational pricing during crisis periods as new, negative information is revealed incrementally over time.

Appendix

Table A1, A2, A3

Appendix A.1

Variable Description and Event Dates.

	Description	Source
Cumulative Abnormal Return (CAR)	S & P 500 index return adjusted cumulative returns.	COMPUSTAT North America Security Daily.
LEVERAGE	(Long-term debt (dltt)+ short-term debt (dlc)) / Market value of equity	COMPUSTAT
MKTBOOK	(price*share outstanding+ Total Assets- book value of equity)/Total Assets	COMPUSTAT
Mkt Return	S & P 500 index return	Yahoo Finance
Return ($\bar{R}_{i,t}$)	Return= ((adj_ret-l.adj_ret)/l.adj_ret)*(1+trfd/100). Where adj_ret= prccd / ajexdi. Prccd is daily stock closing price. ajexdi is dividend adjustment factor. trfd is daily total return factor.	COMPUSTAT North America Security Daily.
SIZE	Ln(Total Assets)	COMPUSTAT
Event Date and Description		
Event Dummy	Description	Event date
γ_1	The US reported its first death by Coronavirus	March 02, 2020
γ_2	WHO declared the coronavirus outbreak a pandemic. NBA suspends season. The US announced level 3 travel advisory and suspended entry to all foreign nationals traveling from 26 European countries.	March 11, 2020
γ_3	US stocks record the worst trading date since 1987. NYC declares state of emergency	March 12, 2020
γ_4	Trump declared a state of National Emergency under Stafford Act. 16 states announced school closures.	March 13, 2020
γ_5	Fed cut rates to zero. Dow recorded the worst drop in history. European countries closed borders to non-citizens and residents. Airlines requested \$50B in assistance packages.	March 16, 2020
γ_6	The US economy begins to shut down.	Mach 17, 2020
γ_7	"Joe Biden swept three states and took a commanding lead"- New York Times	March 18, 2020
γ_8	US State Department issued level-four " Do Not Travel " advisory	March 19, 2020
γ_9	Trump invokes the Defense Production Act to disperse medical supplies to hospitals. US stocks close the worst week since the 2008 Financial Crisis.	March 20, 2020
γ_{10}	Fed announces unlimited QE to support the economy.	March 23, 2020
γ_{11}	US National Guard activated in all 50 states. 2020 Summer Olympics postponed. The US reaches 50K cases. China lifts lockdown in Hubei Province. Nearly 1/3 of the world's population affected by lockdowns.	March 24, 2020
γ_{12}	6.6 Million Americans file unemployment claims. Total claims over 10 million. Almost 91 percent of Americans stay at home orders.	April 02, 2020

Appendix A.2

Stock price responses to the COVID 19 crisis in various event dates: Airline Industry

This table presents the market reaction of COVID-19 events on the stock prices of the Airline industry. There are 14 events in our study during the COVID-19 crisis period. The events are reported in Appendix A.1. Market returns are S&P 500 returns. T-values are reported in parenthesis. Standard errors are heteroscedasticity and autocorrelation adjusted robust. *, **, *** represent the coefficients are significant at 10%, 5%, and 1% level.

Company Name	Mkt Ret	γ_1	γ_2	γ_3	γ_4	γ_5	γ_6	γ_7	γ_8	γ_9
AMERICAN AIRLINES GROUP	1.611*** (8.333)	-0.084* (-1.872)	0.035 (0.785)	-0.021 (-0.439)	-0.084* (-1.785)	0.307*** (6.184)	-0.118** (-2.596)	-0.171*** (-3.795)	-0.125*** (-2.851)	0.079* (1.773)
ALASKA AIR GROUP INC	1.332*** (11.126)	-0.070** (-2.547)	0.041 (1.480)	-0.109*** (-3.700)	-0.041 (-1.414)	0.014 (0.471)	-0.080*** (-2.866)	-0.162*** (-5.803)	-0.045* (-1.660)	0.031 (1.129)
DELTA AIR LINES INC	1.192*** (10.114)	-0.032 (-1.181)	-0.004 (-0.142)	-0.099*** (-3.401)	0.029 (1.000)	0.076** (2.501)	-0.186*** (-6.742)	-0.201*** (-7.316)	-0.091*** (-3.392)	0.044 (1.625)
SOUTHWEST AIRLINES	1.015*** (10.658)	-0.029 (-1.328)	-0.018 (-0.803)	-0.056** (-2.367)	0.053** (2.263)	0.030 (1.237)	-0.040* (-1.807)	-0.029 (-1.288)	-0.127*** (-5.899)	0.080*** (3.646)
UNITED AIRLINES HLDG	1.510*** (9.604)	-0.074** (-2.044)	0.012 (0.342)	-0.107*** (-2.760)	-0.015 (-0.399)	0.032 (0.787)	-0.227*** (-6.152)	-0.227*** (-6.206)	-0.011 (-0.315)	0.219*** (6.026)
SKYWEST INC	1.903*** (13.986)	-0.128*** (-4.053)	0.040 (1.251)	-0.090*** (-2.693)	-0.128*** (-3.856)	0.064* (1.820)	-0.161*** (-5.065)	-0.355*** (-11.214)	0.434*** (14.059)	0.252*** (8.005)
MESA AIR GROUP	1.779*** (7.721)	-0.051 (-0.960)	-0.079 (-1.481)	-0.008 (-0.138)	0.100* (1.769)	0.001 (0.015)	-0.193*** (-3.576)	-0.058 (-1.085)	-0.075 (-1.426)	0.236*** (4.431)
HAWAIIAN HOLDINGS INC	1.118*** (6.552)	-0.097** (-2.447)	-0.046 (-1.160)	-0.118*** (-2.811)	0.049 (1.181)	0.064 (1.449)	-0.143*** (-3.565)	-0.211*** (-5.307)	-0.043 (-1.124)	0.050 (1.262)
CHINA EASTERN AIRLINES	0.885*** (8.328)	-0.040 (-1.640)	0.018 (0.736)	-0.015 (-0.581)	-0.023 (-0.866)	0.014 (0.506)	-0.046* (-1.837)	-0.037 (-1.483)	0.021 (0.869)	-0.028 (-1.125)
RYANAIR HOLDINGS PLC	0.939*** (8.651)	-0.065** (-2.587)	-0.016 (-0.647)	0.025 (0.927)	-0.060** (-2.242)	-0.092*** (-3.287)	-0.068*** (-2.682)	-0.052** (-2.040)	0.038 (1.550)	0.038 (1.530)
JETBLUE AIRWAYS CORP	1.096*** (7.269)	-0.065* (-1.861)	-0.017 (-0.481)	-0.050 (-1.351)	-0.130*** (-3.520)	0.079** (2.044)	-0.170*** (-4.798)	-0.140*** (-3.978)	-0.014 (-0.413)	-0.013 (-0.368)
GOL LINHAS AEREAS	2.147*** (9.735)	-0.072 (-1.410)	-0.026 (-0.510)	-0.156*** (-2.875)	-0.088 (-1.621)	-0.111* (-1.953)	-0.093* (-1.799)	-0.216*** (-4.201)	0.117** (2.333)	0.252*** (4.940)
COPA HOLDINGS SA	1.278*** (9.373)	-0.016 (-0.510)	-0.053* (-1.677)	-0.102*** (-3.039)	0.066** (1.974)	-0.034 (-0.966)	-0.267*** (-8.352)	-0.228*** (-7.186)	0.162*** (5.231)	0.018 (0.556)
ALLEGiant TRAVEL CO	1.073*** (8.778)	-0.036 (-1.261)	-0.004 (-0.138)	-0.045 (-1.501)	0.006 (0.205)	-0.098*** (-3.105)	0.114*** (3.964)	-0.231*** (-8.125)	-0.029 (-1.031)	-0.005 (-0.183)
SPIRIT AIRLINES INC	1.465*** (7.268)	-0.108** (-2.320)	0.003 (0.073)	-0.188*** (-3.788)	-0.063 (-1.272)	-0.050 (-0.974)	-0.082* (-1.734)	-0.155*** (-3.291)	-0.075 (-1.638)	0.100** (2.147)
CHINA SOUTHERN AIRLINES	0.978*** (9.964)	-0.048** (-2.100)	0.035 (1.540)	-0.019 (-0.782)	-0.020 (-0.833)	0.002 (0.082)	-0.079*** (-3.429)	-0.063*** (-2.755)	0.008 (0.371)	0.030 (1.310)
LATAM AIRLINES GROUP SA	1.712*** (6.421)	-0.061 (-0.987)	-0.018 (-0.288)	-0.019 (-0.296)	-0.080 (-1.223)	-0.082 (-1.198)	-0.144** (-2.310)	-0.397*** (-6.395)	0.115* (1.897)	0.210*** (3.406)
CONTROLADORA VUELA	1.498*** (10.963)	-0.041 (-1.310)	-0.023 (-0.714)	-0.056* (-1.668)	-0.104*** (-3.117)	-0.232*** (-6.600)	0.015 (0.481)	-0.068** (-2.136)	0.070** (2.251)	0.046 (1.465)
<i>Joint tests for all firms</i>										
H2	822.45***	822.45***	176.50***	315.44***	225.67***	274.60***	1936.44***	5839.15***	62145.12***	3011.78***
H3	163.64***	163.64***	176.38***	119.10***	191.69***	274.21***	954.17***	1934.36***	61659.91***	1875.33***
Company Name	γ_{10}	γ_{11}	γ_{12}	γ_{13}	γ_{14}	Constant	Observations	Adj R-sq		
AMERICAN AIRLINES GROUP	0.035 (0.793)	0.211*** (4.458)	-0.096** (-2.174)	-0.109** (-2.488)	0.043 (0.962)	-0.001 (-0.190)	256	0.442		
ALASKA AIR GROUP INC	0.059** (2.141)	0.080*** (2.729)	-0.096*** (-3.515)	-0.070** (-2.561)	0.093*** (3.379)	0.001 (0.317)	256	0.606		

(continued on next page)

Appendix A.2 (continued)

Company Name	γ_{10}	γ_{11}	γ_{12}	γ_{13}	γ_{14}	Constant	Observations	Adj R-sq
DELTA AIR LINES INC	0.076*** (2.826)	0.101*** (3.487)	-0.078*** (-2.885)	-0.072*** (-2.692)	0.103*** (3.826)	-0.000 (-0.067)	256	0.622
SOUTHWEST AIRLINES	0.087*** (4.005)	0.024 (1.008)	-0.039* (-1.815)	-0.071*** (-3.288)	0.105*** (4.835)	-0.001 (-0.602)	256	0.586
UNITED AIRLINES HOLDINGS INC	0.117*** (3.252)	0.119*** (3.083)	-0.122*** (-3.398)	-0.124*** (-3.475)	0.167*** (4.631)	-0.001 (-0.262)	256	0.597
SKYWEST INC	0.086*** (2.765)	0.034 (1.018)	-0.049 (-1.573)	-0.080*** (-2.605)	0.063** (2.025)	-0.000 (-0.142)	256	0.763
MESA AIR GROUP	0.017 (0.314)	-0.032 (-0.559)	-0.209*** (-3.987)	-0.170*** (-3.254)	-0.034 (-0.647)	0.000 (0.128)	256	0.383
HAWAIIAN HOLDINGS INC	0.046 (1.171)	0.060 (1.436)	-0.056 (-1.449)	-0.088** (-2.271)	0.158*** (4.058)	0.001 (0.412)	256	0.428
CHINA EASTERN AIRLINES CORP	-0.010 (-0.407)	0.012 (0.447)	0.021 (0.852)	-0.018 (-0.753)	0.013 (0.532)	-0.001 (-0.592)	256	0.351
RYANAIR HOLDINGS PLC	0.018 (0.734)	0.048* (1.800)	-0.030 (-1.210)	-0.048* (-1.943)	0.141*** (5.693)	0.001 (0.689)	256	0.492
JETBLUE AIRWAYS CORP	-0.010 (-0.278)	0.266*** (7.207)	-0.085** (-2.483)	-0.058* (-1.682)	0.054 (1.570)	0.001 (0.509)	256	0.487
GOL LINHAS AEREAS	0.022 (0.442)	0.043 (0.797)	-0.042 (-0.827)	-0.046 (-0.917)	0.119** (2.351)	0.001 (0.222)	256	0.539
COPA HOLDINGS SA	0.198*** (6.353)	0.004 (0.110)	-0.052* (-1.668)	-0.041 (-1.340)	0.069** (2.214)	-0.000 (-0.097)	256	0.629
ALLEGiant TRAVEL CO	0.074*** (2.629)	0.195*** (6.502)	-0.050* (-1.804)	-0.074*** (-2.664)	0.100*** (3.587)	0.000 (0.200)	256	0.651
SPIRIT AIRLINES INC	0.175*** (3.791)	0.240*** (4.852)	-0.102** (-2.230)	-0.088* (-1.917)	0.202*** (4.374)	-0.001 (-0.265)	256	0.504
CHINA SOUTHERN AIRLINES	-0.026 (-1.140)	0.039 (1.632)	0.013 (0.567)	-0.007 (-0.329)	0.030 (1.347)	-0.001 (-0.536)	256	0.470
LATAM AIRLINES GROUP SA	0.102* (1.668)	-0.024 (-0.374)	0.019 (0.307)	-0.011 (-0.189)	0.032 (0.529)	-0.001 (-0.385)	256	0.364
CONTROLADORA VUELA	0.031 (0.985)	-0.163*** (-4.859)	-0.019 (-0.609)	-0.066** (-2.118)	0.077** (2.466)	0.001 (0.640)	256	0.608
Joint Hypothesis for all the firms H2	3213.67***	605.27***	3001.95***	15741.76***	3559.42***			
H3	1696.94***	425.42***	1641.70***	3846.18***	1032.74***			

Appendix A.3

Stock price reactions to the COVID 19 crisis in various event dates: Hotel and Restaurant Industries

This table presents the market reaction of COVID-19 events on the share price of the Hotel & Motel and Restaurant industries. There are 14 events in our study during the COVID-19 crisis period. The events are reported in Appendix A.1. Market returns are S&P 500 index returns. T-values are reported in parenthesis. Standard errors are heteroscedasticity and autocorrelation adjusted robust. *, **, *** represent the coefficients are significant at 10%, 5%, and 1% level.

Company Name	Mkt Ret	γ_1	γ_2	γ_3	γ_4	γ_5	γ_6	γ_7	γ_8	γ_9
HILTON WORLDWIDE	1.735*** (10.005)	-0.073* (-1.809)	-0.107*** (-2.645)	-0.040 (-0.939)	-0.163*** (-3.846)	-0.187*** (-4.189)	-0.291*** (-7.146)	-0.025 (-0.606)	0.440*** (11.172)	-0.081** (-2.015)
BLUEGREEN VACATNS	1.125*** (10.398)	-0.009 (-0.348)	-0.068*** (-2.706)	-0.038 (-1.427)	-0.041 (-1.557)	-0.087*** (-3.141)	-0.174*** (-6.856)	-0.127*** (-5.028)	0.233*** (9.475)	-0.010 (-0.407)
EXTENDED STAY AMERICA	0.943*** (10.860)	-0.005 (-0.256)	-0.047** (-2.340)	-0.047** (-2.201)	-0.012 (-0.583)	-0.157*** (-7.057)	-0.210*** (-10.328)	-0.246*** (-12.148)	0.428*** (21.710)	0.066*** (3.290)
INTERCONTINENTAL HOT	0.388*** (3.454)	-0.020 (-0.788)	-0.043* (-1.659)	-0.043 (-1.551)	-0.136*** (-4.960)	-0.132*** (-4.563)	-0.006 (-0.242)	-0.115*** (-4.403)	-0.046* (-1.799)	-0.150*** (-5.792)
LINDBLAD EXPEDITIONS	1.172*** (16.973)	-0.062*** (-3.883)	-0.047*** (-2.919)	0.056*** (3.316)	-0.084*** (-4.964)	0.023 (1.281)	-0.139*** (-8.611)	-0.067*** (-4.180)	0.018 (1.171)	0.113*** (7.077)
HILTON GRAND	0.845*** (17.281)	0.005 (0.469)	-0.018 (-1.558)	-0.018 (-1.454)	-0.036*** (-3.035)	-0.060*** (-4.799)	-0.060*** (-5.231)	-0.027** (-2.392)	0.087*** (7.824)	0.030*** (2.651)
ROYAL CARIBBEAN	0.880*** (8.464)	0.017 (0.707)	-0.002 (-0.087)	0.028 (1.095)	0.059** (2.328)	-0.025 (-0.935)	-0.056** (-2.297)	-0.092*** (-3.818)	-0.056** (-2.362)	0.083*** (3.457)
PLAYA HOTELS & RESORTS	1.062*** (6.327)	-0.021 (-0.545)	-0.091** (-2.345)	-0.255*** (-6.170)	-0.105** (-2.567)	-0.003 (-0.065)	0.076* (1.922)	-0.150*** (-3.836)	0.002 (0.054)	0.173*** (4.470)
MARRIOTT INTL INC	1.182*** (8.067)	-0.035 (-1.021)	0.033 (0.970)	0.036 (1.009)	-0.239*** (-6.664)	-0.091** (-2.424)	-0.279*** (-8.124)	0.037 (1.076)	-0.010 (-0.310)	0.153*** (4.506)
GREENTREE HPTY GP -ADS	1.532*** (8.302)	-0.084* (-1.957)	-0.023 (-0.533)	0.021 (0.459)	-0.034 (-0.752)	-0.039 (-0.832)	-0.250*** (-5.788)	-0.038 (-0.886)	0.114*** (2.723)	0.156*** (3.662)
WYNDHAM HOTELS & RS	1.294*** (10.147)	-0.019 (-0.650)	-0.106*** (-3.575)	-0.037 (-1.185)	-0.021 (-0.666)	-0.171*** (-5.222)	-0.292*** (-9.778)	-0.136*** (-4.571)	0.267*** (9.213)	0.054* (1.836)
CHOICE HOTELS INTL INC	1.330*** (7.599)	-0.091** (-2.246)	-0.056 (-1.373)	0.024 (0.565)	0.046 (1.068)	0.083* (1.852)	-0.160*** (-3.904)	-0.097** (-2.391)	-0.054 (-1.354)	0.063 (1.552)
NORWEGIAN CRUISE LINE	1.295*** (6.076)	-0.062 (-1.251)	0.022 (0.442)	-0.041 (-0.786)	-0.159*** (-3.049)	0.034 (0.627)	-0.173*** (-3.465)	-0.157*** (-3.153)	0.211*** (4.368)	-0.015 (-0.311)
RED LION HOTELS CORP	1.006*** (11.230)	-0.022 (-1.081)	-0.074*** (-3.546)	-0.099*** (-4.493)	-0.013 (-0.612)	0.062*** (2.715)	-0.042** (-1.996)	-0.044** (-2.126)	0.055*** (2.693)	0.136*** (6.562)
WYNDHAM DESTINATIONS	1.301*** (9.521)	-0.044 (-1.400)	-0.074** (-2.329)	-0.043 (-1.267)	-0.098*** (-2.943)	-0.080** (-2.279)	-0.173*** (-5.415)	-0.260*** (-8.168)	0.193*** (6.238)	-0.032 (-1.024)
HYATT HOTELS CORP	1.503*** (15.797)	-0.062*** (-2.797)	-0.013 (-0.568)	0.033 (1.397)	-0.084*** (-3.594)	-0.044* (-1.815)	-0.084*** (-3.770)	-0.073*** (-3.313)	-0.092*** (-4.248)	0.154*** (7.014)
HUAZHU GROUP LIMITED	0.843*** (5.495)	-0.028 (-0.778)	-0.021 (-0.577)	0.010 (0.253)	-0.059 (-1.560)	-0.012 (-0.313)	-0.146*** (-4.050)	-0.068* (-1.891)	0.217*** (6.244)	-0.013 (-0.354)
MARRIOTT VACATIONS	1.278*** (9.206)	-0.096*** (-3.003)	-0.081** (-2.525)	-0.006 (-0.170)	-0.050 (-1.465)	-0.007 (-0.187)	0.059* (1.828)	-0.033 (-1.013)	0.115*** (3.641)	-0.012 (-0.359)
BRINKER INTL INC	0.694*** (7.551)	-0.029 (-1.370)	-0.028 (-1.329)	0.018 (0.786)	-0.068*** (-3.045)	-0.075*** (2.581)	0.056** (2.581)	-0.181*** (-8.432)	0.149*** (7.161)	0.015 (0.686)
CRACKER BARREL OLD	2.381*** (12.967)	-0.074* (-1.733)	-0.033 (-0.774)	-0.098** (-2.161)	0.001 (0.022)	0.060 (1.281)	-0.229*** (-5.324)	-0.327*** (-7.637)	0.033 (0.802)	0.082* (1.941)
WENDY'S CO	1.679*** (8.513)	-0.003 (-0.064)	-0.039 (-0.855)	-0.094* (-1.969)	-0.275*** (-5.785)	-0.156*** (-3.115)	0.042 (0.925)	-0.058 (-1.291)	-0.006 (-0.146)	-0.046 (-1.020)
FLANIGANS ENTERPRISES	1.010*** (18.236)	0.005 (0.378)	-0.039*** (-3.031)	0.005 (0.341)	0.034** (2.506)	-0.042*** (-2.981)	-0.053*** (-4.115)	0.007 (0.567)	0.087*** (6.912)	-0.011 (-0.896)
MCDONALD'S CORP	1.429***	-0.053*	-0.054*	-0.013	-0.036	-0.112***	0.023	0.191***	-0.022	-0.167***

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Appendix A.3 (continued)

Company Name	Mkt Ret	γ_1	γ_2	γ_3	γ_4	γ_5	γ_6	γ_7	γ_8	γ_9
	(10.414)	(-1.677)	(-1.687)	(-0.379)	(-1.077)	(-3.169)	(0.713)	(5.966)	(-0.716)	(-5.278)
NATHAN'S FAMOUS INC	1.394***	-0.067***	-0.078***	-0.006	0.073***	-0.083***	-0.117***	-0.164***	0.091***	0.221***
	(13.342)	(-2.785)	(-3.231)	(-0.248)	(2.846)	(-3.106)	(-4.764)	(-6.753)	(3.846)	(9.162)
J. ALEXANDER'S HOLDINGS	2.217***	-0.099**	-0.034	-0.111**	-0.135***	0.192***	-0.209***	-0.079*	-0.005	0.161***
	(11.959)	(-2.305)	(-0.785)	(-2.421)	(-2.985)	(4.028)	(-4.809)	(-1.840)	(-0.130)	(3.755)
ARK RESTAURANTS CORP	1.695***	-0.092**	-0.029	0.030	-0.102**	0.138***	-0.092**	-0.321***	0.117***	0.189***
	(8.772)	(-2.069)	(-0.644)	(0.630)	(-2.157)	(2.769)	(-2.024)	(-7.137)	(2.670)	(4.240)
JACK IN THE BOX INC	0.506***	-0.029	-0.001	-0.101***	-0.010	-0.161***	-0.037	-0.059**	0.387***	0.054**
	(4.793)	(-1.206)	(-0.042)	(-3.865)	(-0.402)	(-5.933)	(-1.486)	(-2.391)	(16.158)	(2.207)
NOODLES & CO	0.712***	-0.022	-0.009	0.006	-0.003	0.076***	0.020	-0.037*	-0.023	0.048**
	(7.882)	(-1.045)	(-0.444)	(0.255)	(-0.116)	(3.264)	(0.934)	(-1.751)	(-1.100)	(2.285)
POTBELLY CORP	1.389***	-0.072***	-0.023	0.068***	-0.108***	0.069***	-0.214***	-0.082***	0.041*	0.178***
	(14.259)	(-3.205)	(-1.009)	(2.815)	(-4.539)	(2.768)	(-9.379)	(-3.601)	(1.864)	(7.927)
DENNYS CORP	1.451***	-0.052**	-0.081***	-0.021	-0.028	-0.076***	-0.237***	-0.113***	0.240***	-0.018
	(14.503)	(-2.269)	(-3.489)	(-0.866)	(-1.151)	(-2.974)	(-10.102)	(-4.837)	(10.578)	(-0.797)
EL POLLO LOCO HLDG	0.837***	-0.058	0.003	-0.002	-0.087*	-0.056	-0.134***	0.049	-0.082*	-0.107**
	(4.347)	(-1.303)	(0.068)	(-0.047)	(-1.842)	(-1.122)	(-2.960)	(1.101)	(-1.881)	(-2.409)
SHAKE SHACK INC	0.575***	-0.034	0.041	0.007	-0.062*	0.043	-0.028	-0.044	0.059*	0.026
	(4.032)	(-1.025)	(1.243)	(0.202)	(-1.764)	(1.179)	(-0.826)	(-1.334)	(1.834)	(0.802)
WINGSTOP INC	1.443***	-0.027	-0.053**	0.037*	-0.049**	-0.044*	-0.210***	-0.116***	-0.020	0.247***
	(16.555)	(-1.333)	(-2.595)	(1.706)	(-2.298)	(-1.948)	(-10.259)	(-5.724)	(-1.036)	(12.267)
DINE BRANDS GLOBAL INC	2.000***	-0.089	0.008	0.095	-0.201***	0.067	-0.290***	-0.278***	0.210***	0.335***
	(6.697)	(-1.406)	(0.127)	(1.393)	(-2.970)	(0.936)	(-4.501)	(-4.361)	(3.399)	(5.287)
STARBUCKS CORP	1.755***	-0.119**	-0.125***	0.006	-0.277***	-0.249***	-0.197***	-0.163***	0.768***	-0.020
	(8.587)	(-2.511)	(-2.640)	(0.115)	(-5.537)	(-4.744)	(-4.106)	(-3.430)	(16.562)	(-0.424)
CHEESECAKE FACTORY	1.853***	-0.060	-0.065*	0.033	-0.065*	-0.147***	-0.291***	-0.290***	0.248***	0.080**
	(11.568)	(-1.612)	(-1.759)	(0.831)	(-1.662)	(-3.564)	(-7.761)	(-7.762)	(6.820)	(2.174)
PAPA JOHNS INTL	0.234	-0.038	-0.038	-0.016	0.008	-0.223***	-0.170***	0.463***	-0.197***	-0.238***
	(1.187)	(-0.831)	(-0.841)	(-0.320)	(0.161)	(-4.412)	(-3.686)	(10.101)	(-4.408)	(-5.241)
YUM CHINA HOLDINGS	0.988***	-0.008	-0.019	0.063***	-0.091***	0.007	-0.122***	-0.023	0.028**	-0.030**
	(15.910)	(-0.525)	(-1.347)	(4.103)	(-5.995)	(0.429)	(-8.386)	(-1.587)	(1.982)	(-2.105)
DARDEN RESTAURANTS	1.155***	-0.020	-0.004	0.045**	-0.076***	0.018	-0.069***	-0.114***	0.023	0.081***
	(13.666)	(-1.007)	(-0.221)	(2.176)	(-3.660)	(0.849)	(-3.469)	(-5.781)	(1.201)	(4.137)
FAT BRANDS INC	2.009***	-0.136***	-0.167***	-0.165***	-0.035	0.228***	-0.202***	-0.120**	0.051	0.148***
	(9.560)	(-2.796)	(-3.426)	(-3.196)	(-0.678)	(4.217)	(-4.105)	(-2.447)	(1.074)	(3.049)
KURA SUSHI USA INC	1.027***	-0.084	0.044	0.055	-0.028	-0.002	-0.115*	-0.046	0.027	0.000
	(4.078)	(-1.442)	(0.743)	(0.887)	(-0.446)	(0.887)	(-0.037)	(-0.786)	(0.474)	(0.009)
DAVE & BUSTER'S ENTMT	1.495***	-0.072	-0.149***	-0.162***	0.020	-0.165***	-0.130**	-0.027	0.255***	0.066
	(6.665)	(-1.383)	(-2.861)	(-2.940)	(0.366)	(-2.857)	(-2.470)	(-0.511)	(5.014)	(1.273)
BJ'S RESTAURANTS INC	0.374***	0.006	-0.016	-0.013	-0.037	-0.054*	0.021	-0.012	0.114***	-0.058**
	(3.399)	(0.230)	(-0.644)	(-0.493)	(-1.391)	(-1.916)	(0.804)	(-0.456)	(4.560)	(-2.292)
BBQ HOLDINGS INC	1.292***	-0.005	-0.090***	0.091***	-0.034	0.000	-0.139***	-0.069**	0.137***	0.090***
	(10.364)	(-0.174)	(-3.125)	(2.967)	(-1.105)	(0.007)	(-4.771)	(-2.359)	(4.844)	(3.118)
YUM BRANDS INC	1.792***	-0.049	0.022	0.036	-0.120***	-0.120***	-0.461***	-0.143***	0.064*	-0.002
	(10.499)	(-1.239)	(0.545)	(0.847)	(-2.869)	(-2.745)	(-11.517)	(-3.593)	(1.661)	(-0.052)
RED ROBIN GOURMET	1.159***	-0.061***	-0.023	0.041*	-0.064**	0.044*	-0.154***	-0.055**	0.145***	0.104***
	(10.786)	(-2.688)	(-1.016)	(1.687)	(-2.627)	(1.701)	(-6.635)	(-2.374)	(6.525)	(4.577)
DOMINO'S PIZZA INC	1.847***	-0.059	-0.061*	0.009	-0.071*	-0.088**	-0.280***	-0.018	-0.057	-0.103***
	(11.796)	(-1.640)	(-1.686)	(0.223)	(-1.847)	(-2.186)	(-7.619)	(-0.490)	(1.598)	(-2.857)
TEXAS ROADHOUSE INC	0.946***	0.019	-0.020	-0.064***	0.051***	-0.059***	-0.124***	-0.029*	-0.019	-0.050***

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Appendix A.3 (continued)

Company Name	Mkt Ret	γ_1	γ_2	γ_3	γ_4	γ_5	γ_6	γ_7	γ_8	γ_9
	(13.489)	(1.192)	(-1.241)	(-3.713)	(2.994)	(-3.250)	(-7.565)	(-1.772)	(-1.224)	(-3.104)
RUTHS HOSPITALITY	1.577***	-0.049*	-0.127***	0.075***	0.059**	-0.022	-0.082***	-0.234***	-0.039	0.216***
	(14.368)	(-1.921)	(-4.972)	(2.790)	(2.191)	(-0.763)	(-3.187)	(-9.145)	(-1.548)	(8.507)
CHIPOTLE MEXICAN GRILL	2.062***	-0.186***	-0.001	0.042	-0.126**	-0.010	-0.203***	-0.147***	0.310***	-0.028
	(10.061)	(-3.916)	(-0.022)	(0.831)	(-2.517)	(-0.180)	(-4.234)	(-3.087)	(6.675)	(-0.591)
BLOOMIN' BRANDS INC	1.257***	-0.052***	-0.027	-0.025	-0.063***	0.051**	-0.167***	-0.127***	0.083***	0.231***
	(15.477)	(-2.767)	(-1.423)	(-1.259)	(-3.156)	(2.440)	(-8.745)	(-6.688)	(4.526)	(12.277)
DUNKIN' BRANDS GROUP	0.829***	-0.014	-0.011	0.002	-0.006	0.010	-0.033	-0.004	0.027	0.085***
	(6.662)	(-0.491)	(-0.396)	(0.081)	(-0.182)	(0.319)	(-1.141)	(-0.146)	(0.973)	(2.959)
CARROLS RESTAURANT	1.161***	-0.027	-0.137***	0.042	0.073**	-0.035	-0.104***	-0.152***	0.019	0.133***
	(9.664)	(-0.973)	(-4.902)	(1.426)	(2.480)	(-1.119)	(-3.678)	(-5.421)	(0.714)	(4.790)
ARCOS DORADOS	1.413***	-0.075***	-0.069***	0.068***	-0.136***	-0.119***	-0.220***	-0.066***	0.409***	0.125***
	(13.712)	(-3.146)	(-2.865)	(2.683)	(-5.409)	(-4.503)	(-9.116)	(-2.756)	(17.490)	(5.239)
ARAMARK	1.039***	-0.054	-0.047	-0.025	-0.082**	-0.083**	-0.038	-0.258***	0.219***	-0.123***
	(6.884)	(-1.533)	(-1.328)	(-0.663)	(-2.216)	(-2.133)	(-1.074)	(-7.336)	(6.403)	(-3.529)
CHUY'S HOLDINGS INC	1.431***	-0.125***	-0.004	-0.156***	-0.005	-0.139***	-0.047	-0.151***	0.177***	0.533***
	(7.871)	(-2.971)	(-0.089)	(-3.480)	(-0.112)	(-2.974)	(-1.094)	(-3.556)	(4.300)	(12.684)
FIESTA RESTAURANT	1.656***	-0.042	-0.048*	0.085***	0.031	-0.050*	-0.188***	-0.317***	0.114***	0.254***
	(14.526)	(-1.586)	(-1.805)	(3.022)	(1.106)	(-1.723)	(-7.053)	(-11.925)	(4.409)	(9.645)
<i>Joint tests for all firms</i>										
H2	1767.82***	2141.42***	597.81***	1372.31***	889.02***	9756.26***	10886.54***	440000.00***	13972.02***	1767.82***
H3	1057.26***	1127.74***	597.26***	1023.99***	665.95***	5063.26***	7008.14***	300000.00***	11600.98***	1057.26***
Company Name	γ_{10}	γ_{11}	γ_{12}	γ_{13}	γ_{14}	Constant	Observations	Adj R-sq.		
HILTON WORLDWIDE	0.193***	0.145***	-0.163***	-0.017	0.090**	0.001	256	0.668		
	(4.854)	(3.407)	(-4.131)	(-0.421)	(2.256)	(0.365)				
BLUEGREEN VACATNS	0.256***	0.081***	-0.067***	-0.018	0.052**	-0.001	256	0.694		
	(10.354)	(3.061)	(-2.713)	(-0.749)	(2.084)	(-0.439)				
EXTENDED STAY AMERICA	0.071***	0.145***	-0.068***	0.026	-0.045**	0.002	256	0.837		
	(3.555)	(6.801)	(-3.443)	(1.307)	(-2.282)	(1.204)				
INTERCONTINENTAL HOT	0.046*	0.166***	0.002	0.018	0.095***	0.000	256	0.481		
	(1.774)	(6.052)	(0.073)	(0.692)	(3.710)	(0.263)				
LINDBLAD EXPEDITIONS	0.062***	-0.013	-0.110***	-0.003	0.030*	0.000	256	0.696		
	(3.956)	(-0.776)	(-7.023)	(-0.196)	(1.889)	(0.327)				
HILTON GRAND	-0.053***	0.106***	0.002	0.005	0.009	-0.000	256	0.810		
	(-4.755)	(8.817)	(0.214)	(0.434)	(0.795)	(-0.303)				
ROYAL CARIBBEAN	0.043*	0.041	0.015	0.020	0.056**	-0.001	256	0.469		
	(1.789)	(1.604)	(0.625)	(0.841)	(2.374)	(-0.763)				
PLAYA HOTELS & RESORTS	0.178***	0.100**	-0.010	-0.060	0.013	-0.001	256	0.485		
	(4.638)	(2.436)	(-0.255)	(-1.588)	(0.345)	(-0.270)				
MARRIOTT INTL INC	-0.088***	0.296***	-0.054	0.028	0.088***	-0.000	256	0.579		
	(-2.615)	(8.243)	(-1.609)	(0.842)	(2.626)	(-0.025)				
GREENTREE HPTY GP -ADS	0.055	-0.045	-0.054	-0.024	0.010	-0.000	256	0.366		
	(1.293)	(-1.001)	(-1.281)	(-0.574)	(0.240)	(-0.015)				
WYNDHAM HOTELS & RS	0.146***	0.120***	-0.032	0.210***	-0.080***	0.000	256	0.712		
	(5.007)	(3.838)	(-1.091)	(7.258)	(-2.742)	(0.143)				
CHOICE HOTELS INTL INC	0.065	0.119***	-0.096**	0.008	0.041	0.000	256	0.371		
	(1.620)	(2.767)	(-2.408)	(0.204)	(1.036)	(0.048)				
NORWEGIAN CRUISE LINE	0.004	0.048	-0.039	-0.025	0.052	0.000	256	0.293		
	(0.087)	(0.911)	(-0.813)	(-0.520)	(1.062)	(0.017)				

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Appendix A.3 (continued)

Company Name	γ_{10}	γ_{11}	γ_{12}	γ_{13}	γ_{14}	Constant	Observations	Adj R-sq.
RED LION HOTELS CORP	0.005 (0.266)	0.028 (1.270)	-0.030 (-1.472)	0.079*** (3.865)	0.003 (0.128)	-0.002 (-1.353)	256	0.596
WYNDHAM DESTINATIONS	0.118*** (3.776)	0.179*** (5.333)	-0.113*** (-3.614)	-0.020 (-0.644)	0.061* (1.953)	0.000 (0.217)	256	0.650
HYATT HOTELS CORP	0.032 (1.463)	0.058** (2.497)	-0.056** (-2.562)	-0.027 (-1.268)	0.059*** (2.726)	-0.000 (-0.314)	256	0.697
HUAZHU GROUP LIMITED	0.033 (0.937)	0.066* (1.752)	-0.005 (-0.149)	-0.008 (-0.225)	-0.026 (-0.746)	0.002 (0.873)	256	0.305
MARRIOTT VACATIONS	0.069** (2.187)	0.110*** (3.220)	-0.018 (-0.568)	-0.006 (-0.202)	0.016 (0.496)	-0.000 (-0.064)	256	0.490
BRINKER INTL INC	0.132*** (6.254)	0.087*** (3.867)	-0.020 (-0.955)	0.010 (0.465)	-0.067*** (-3.185)	0.001 (1.023)	256	0.602
CRACKER BARREL OLD	0.155*** (3.683)	0.112** (2.497)	-0.118*** (-2.828)	-0.070* (-1.673)	0.068 (1.621)	0.001 (0.313)	256	0.660
WENDY'S CO	0.015 (0.332)	0.076 (1.587)	-0.072 (-1.630)	-0.076* (-1.725)	0.135*** (3.032)	0.001 (0.389)	213	0.545
FLANIGANS ENTERPRISES	0.004 (0.331)	0.055*** (4.023)	0.016 (1.251)	0.008 (0.630)	-0.003 (-0.251)	-0.000 (-0.499)	256	0.790
MCDONALD'S CORP	0.034 (1.098)	0.093*** (2.761)	-0.072** (-2.289)	0.009 (0.285)	0.024 (0.779)	-0.001 (-0.466)	256	0.590
NATHAN'S FAMOUS INC	-0.008 (-0.354)	0.067*** (2.603)	-0.083*** (-3.493)	-0.005 (-0.225)	0.100*** (4.185)	0.000 (0.073)	256	0.734
J. ALEXANDER'S HOLDINGS	0.253*** (5.965)	0.020 (0.431)	-0.087** (-2.053)	-0.093** (-2.214)	0.101** (2.380)	-0.001 (-0.491)	256	0.542
ARK RESTAURANTS CORP	-0.024 (-0.543)	-0.216*** (-4.569)	-0.006 (-0.140)	0.004 (0.100)	0.049 (1.098)	-0.001 (-0.245)	256	0.434
JACK IN THE BOX INC	0.072*** (2.979)	-0.089*** (-3.449)	-0.047* (-1.939)	0.041* (1.732)	-0.065*** (-2.689)	0.002 (1.486)	256	0.630
NOODLES & CO	0.034* (1.653)	-0.027 (-1.229)	0.008 (0.392)	-0.030 (-1.445)	-0.036* (-1.725)	0.001 (0.445)	256	0.287
POTBELLY CORP	-0.020 (-0.876)	0.000 (0.004)	-0.122*** (-5.477)	-0.012 (-0.548)	0.133*** (5.946)	-0.000 (-0.170)	256	0.651
DENNYS CORP	0.096*** (4.203)	0.184*** (7.492)	-0.070*** (-3.080)	-0.022 (-0.957)	0.040* (1.766)	-0.001 (-0.506)	256	0.780
EL POLLO LOCO HLDG	-0.057 (-1.303)	0.051 (1.081)	-0.041 (-0.928)	-0.010 (-0.234)	-0.101** (-2.303)	0.002 (0.880)	256	0.175
SHAKE SHACK INC	-0.012 (-0.375)	-0.026 (-0.731)	-0.030 (-0.931)	0.023 (0.707)	-0.069** (-2.107)	0.001 (0.579)	256	0.067
WINGSTOP INC	0.022 (1.092)	0.018 (0.829)	-0.068*** (-3.448)	0.003 (0.146)	0.034* (1.718)	0.000 (0.236)	256	0.751
DINE BRANDS GLOBAL INC	0.248*** (3.964)	-0.048 (-0.705)	-0.085 (-1.365)	-0.170*** (-2.750)	-0.013 (-0.203)	0.002 (0.285)	108	0.566
STARBUCKS CORP	0.340*** (7.276)	0.415*** (8.284)	-0.099** (-2.124)	-0.073 (-1.577)	0.136*** (2.903)	-0.003 (-0.847)	256	0.742
CHEESECAKE FACTORY	0.224*** (6.122)	0.183*** (4.654)	-0.073** (-2.008)	-0.026 (-0.703)	0.056 (1.528)	-0.000 (-0.059)	256	0.696
PAPA JOHNS INTL	-0.128*** (-2.841)	0.161*** (3.335)	-0.030 (-0.677)	-0.086* (-1.921)	0.053 (1.167)	0.003 (1.139)	256	0.460
YUM CHINA HOLDINGS	0.002 (0.147)	0.145*** (9.506)	-0.046*** (-3.261)	0.027* (1.929)	-0.008 (-0.583)	-0.001 (-0.562)	256	0.738

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Appendix A.3 (continued)

Company Name	γ_{10}	γ_{11}	γ_{12}	γ_{13}	γ_{14}	Constant	Observations	Adj R-sq.
DARDEN RESTAURANTS	-0.039** (-2.027)	-0.021 (-1.013)	-0.079*** (-4.092)	-0.001 (-0.064)	0.055*** (2.842)	0.001 (0.582)	256	0.606
FAT BRANDS INC	0.169*** (3.519)	0.235*** (4.561)	-0.165*** (-3.442)	-0.071 (-1.482)	0.118** (2.446)	-0.001 (-0.473)	256	0.549
KURA SUSHI USA INC	-0.046 (-0.806)	-0.009 (-0.141)	-0.021 (-0.370)	-0.004 (-0.066)	0.041 (0.715)	-0.002 (-0.596)	256	0.071
DAVE & BUSTER'S ENTMT	0.372*** (7.241)	0.039 (0.704)	-0.115** (-2.254)	-0.019 (-0.365)	0.025 (0.483)	0.000 (0.107)	256	0.475
BJ'S RESTAURANTS INC	0.091*** (3.624)	0.026 (0.959)	-0.011 (-0.427)	0.013 (0.541)	-0.044* (-1.760)	0.001 (0.736)	256	0.221
BBQ HOLDINGS INC	0.137*** (4.800)	0.047 (1.522)	-0.078*** (-2.750)	0.008 (0.270)	0.028 (0.994)	-0.000 (-0.151)	256	0.522
YUM BRANDS INC	0.129*** (3.292)	0.267*** (6.380)	-0.078** (-2.004)	-0.085** (-2.205)	0.037 (0.954)	0.000 (0.118)	256	0.642
RED ROBIN GOURMET	0.072*** (3.216)	0.017 (0.717)	-0.011 (-0.480)	0.013 (0.591)	-0.011 (-0.472)	0.002 (0.756)	108	0.722
DOMINO'S PIZZA INC	0.194*** (5.416)	0.126*** (3.284)	-0.062* (-1.742)	0.023 (0.645)	0.008 (0.234)	0.000 (0.091)	256	0.614
TEXAS ROADHOUSE INC	0.047*** (2.954)	0.189*** (10.980)	-0.075*** (-4.683)	0.050*** (3.142)	-0.023 (-1.444)	-0.000 (-0.059)	256	0.779
RUTHS HOSPITALITY	-0.105*** (-4.194)	0.031 (1.160)	-0.086*** (-3.420)	-0.062** (-2.484)	0.141*** (5.621)	0.001 (0.583)	256	0.750
CHIPOTLE MEXICAN GRILL	0.195*** (4.154)	-0.126** (-2.509)	0.056 (1.200)	0.041 (0.890)	-0.046 (-0.975)	-0.001 (-0.295)	256	0.488
BLOOMIN' BRANDS INC	0.054*** (2.881)	-0.093*** (-4.671)	-0.109*** (-5.909)	-0.010 (-0.544)	0.101*** (5.444)	-0.000 (-0.075)	256	0.727
DUNKIN' BRANDS GROUP	-0.013 (-0.470)	-0.034 (-1.122)	0.018 (0.632)	0.001 (0.048)	0.019 (0.666)	0.001 (0.276)	256	0.223
CARROLS RESTAURANT	-0.037 (-1.354)	-0.066** (-2.257)	-0.020 (-0.734)	-0.044 (-1.602)	0.046* (1.666)	0.000 (0.150)	256	0.552
ARCOS DORADOS	-0.086*** (-3.630)	-0.035 (-1.367)	-0.061** (-2.589)	-0.012 (-0.502)	0.023 (0.979)	0.001 (0.416)	256	0.763
ARAMARK	0.020 (0.589)	0.174*** (4.699)	0.034 (0.976)	-0.012 (-0.345)	0.059* (1.703)	0.001 (0.252)	256	0.553
CHUY'S HOLDINGS INC	0.094** (2.250)	-0.120*** (-2.699)	-0.000 (-0.009)	0.041 (0.994)	-0.036 (-0.869)	-0.001 (-0.386)	256	0.582
FIESTA RESTAURANT	-0.056** (-2.145)	0.031 (1.096)	-0.041 (-1.560)	-0.061** (-2.346)	0.081*** (3.087)	0.002 (0.909)	256	0.759
<i>Joint tests for all firms</i>								
H2	16814.71***	2441.72***	9017.87***	22146.62***	5067.56***			
H3	14294.70***	1673.66***	5336.46***	22007.04***	4806.75***			

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