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How Did Different Restaurant Segments Perform Differently through the Recession? An ARIMA with Intervention Analysis on US Restaurant Stock Indices

Tianshu Zheng
Iowa State University, tzheng@iastate.edu

John Farrish
University of Louisiana Lafayette, jfarrish@louisiana.edu

Xiaofan Wang
Iowa State University

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Introduction

The restaurant industry in the United States represents an inordinately large part of the national economy, and is one of the nation's largest private employers. In 2012 alone, restaurant sales totaled over $630 billion and the industry employed nearly 13 million people (NRA, 2012). The industry, like all other areas of the American economy, was profoundly affected by the economic recession that began in 2007. As a result of that recession, consumer confidence declined, and consumers therefore cut back on much of their discretionary spending; restaurant spending representing a substantial portion of that cutback (Barbardo and Uchitelle, 2008).

This decline in consumer spending, predictably, had an impact on restaurant stock prices. The Dow Jones U.S. Restaurant Index (DJRI) dropped by 13% in 2008 alone (CBS News, 2009). Still, to speak of the restaurant industry as a whole is to over-simplify the picture. The DJRI, for instance, includes full service restaurants like Olive Garden and Red Lobster, while also including quick service restaurants like McDonald's. Because of the different level of consumer spending each segment represents, it is likely that different segments of the industry were affected differently by the most recent recession. Recent research has shown that recessions have negative impacts on stock prices in general (Collins, 2003), and has also shown that restaurant stocks, in particular, are affected by recessions (Lee and Ha, 2012). Further research has shown that restaurant stocks perform differently based on industry segment (Madanoglu, et. al, 2012). There has not been, however, research performed testing whether the recession of 2008 had distinct impacts on different segments of the restaurant industry. The goal of this research, therefore, was to assess whether that is the case.

This research examines two distinct segments of the restaurant industry, the full service segment and the limited service segment, and is comprised of two different studies, both of which seek to understand whether the recent recession had differing impacts on these two distinct industry segments. The research measures segment performance by examining the stock prices of restaurants within those segments. The first analysis, a time series analysis, examines how stock prices in each industry segment were hurt by the recession and how long it took them to begin to recover from the recession. The second portion of the study consists of a financial ratio analysis of the two segments both before and after the recession to better understand how each segment survived the economic downturn.

This study examined nine hypotheses.

Hypothesis 1: the recent recession did not significantly affect the stock performance of the U.S. restaurant industry;

Hypothesis 2: the stock performance of the U.S. restaurant industry didn't significantly improve after the recession;

Hypothesis 3: the recent recession did not significantly affect the stock performance of the limited service restaurant segment;

Hypothesis 4: the recent recession did not significantly affect the stock performance of the full service restaurant segment;

Hypothesis 5: the stock performance of the limited service restaurant segment didn't significantly improve after the recession;

Hypothesis 6: the stock performance of the full service restaurant segment didn't significantly improve after the recession;

Hypothesis 7: there are no significant differences between the financial ratios of the limited service restaurant segment and the full service restaurant segment before the recession;

Hypothesis 8: there are no significant differences between the financial ratios of the limited service restaurant segment before and after the recession; and

Hypothesis 9: there are no significant differences between the financial ratios of the full service restaurant segment before and after the recession.

Review of Literature

Economic growth is generally cyclical, experiencing alternating periods of growth and contraction, or recession. (Lee, 1955; and Schumpeter, 1954). During recessionary periods economic indicators are largely negative; GDP is reduced, workers' earnings fall, consumer spending declines, and ultimately business profits decrease (Krugman, 2009). Consumer demand and corporate profitability tend to fall at the early stage of a recession and that lack of profitability has a negative impact on a business' stock price (Mankiw, 1989). Recessions generally decrease the velocity of money and squeeze profits, causing stock prices to suffer (Patton, 2012), with some investors forecasting devaluation of stocks by up to 40% (Gorenstein, 2011). According to the National Bureau of Economic Research (NBER), the United States experienced an economic recession – defined as consecutive quarters of negative growth in gross domestic product - from December 2007 through June 2009 (The National Bureau of Economic Research, 2010). It is believed that the recession was the worst one since the Great Depression in terms of its duration and impact (Sum, Khatiwada, McLaughlin, & Palma, 2009). In the first 18 months of the recession, gross domestic product (GDP) shrank about 5.1 percent (Bureau of Economic Analysis, 2011). During this recession stock prices

in general fell 50%, losses much larger, relatively, than those associated with earlier recessions (Dwyer, 2009).

The restaurant industry is particularly vulnerable during times of economic distress (Gu, 1993), and this recession has been no different from previous downturns. Eating and drinking establishments posted five consecutive months of job losses, the first time that had happened sin 1958 (NRA, 2008). The restaurant industry, generally speaking, has lower profit margins than other industries, averaging between 2% and 6% (Skidelsky, 2009); further exacerbating the effect recession has on the industry. As a result, stock prices within the restaurant industry declined significantly. In February of 2009, the stock price of the top 26 restaurant companies had lost an average 49.3% of their value from their highest points over the past 52 weeks (Krantz, 2009).

All other things being equal, different restaurant segments tend to perform differently as they have different styles of operation, target customers, and financial characteristics (Gu, 1996). Full service restaurants generally rely on high profit margins; sales of full service restaurant are mainly derived from customers' discretionary expenditures. When recession comes, customer sentiment and household income are lower, and full service restaurants are first to feel the effects (Youn & Gu, 2010). Fast food restaurants, on the other hand, rely on large sales volume to compensate for their lower profit margins. Their sales are primarily necessity expenditures; therefore they have more steady revenues (Youn & Gu, 2010).

Lee and Ha (2012) examined the effect of the recent recession on restaurant sales, but did not differentiate among different industry segments. Madanoglu, et al. (2008) examined risk-adjusted performance measures, differentiating between casual and fast food restaurants, but did so prior to the recession. Their research found that, during the period 1998 – 2002, casual dining restaurants outperformed fast food restaurants, using the Sharpe Ratio as a determinant. While the period 1998 – 2002 did include a recessionary period from March of 2001, to November of 2001, Madanoglu, et al. examined the stock performance of the two sectors for the five-year period as a whole, and did not examine the recessionary period in particular. This paper fills a gap in the literature by examining the effect of the recession of 2008 on restaurant stock prices by industry segment.

The use of stock indices to measure general performance trends within industries is a widely accepted practice, used to represent the common characteristics of component stocks, such as trading on the same stock market exchange, belonging to the same industry, or having the same market capitalization (U.S. Securities and Exchange Commission, 2007). This study developed stock indices for overall U.S. restaurant industry, the limited service restaurant segment, and the full service restaurant segment and used them as

proxies of stock performance to examine possible impact the recent recession had on the U.S. restaurant industry.

The more usual method for determining stock performance is to use a market capitalization-weighted method (Standard & Poor's, 2011). Market cap represents the value of a corporation determined by multiplying the stock price of a share by the number of total outstanding shares (U.S. Securities and Exchange Commission, 2007). As indicated by Handley (2011) and Standard & Poor's (2011), a weighting based on market cap is thought to be more effective than other measurements of stock performance. This method factors in the size of the company in determining the performance of the industry segment as a whole. In other words, the change of market cap of a company doesn't affect the index. In addition, compared to market cap weighted index, a price-weighted index, such as the Dow Jones Industrial Average, can be heavily affected by a relatively small shift in the price of a large company (Standard & Poor's, 2011). Therefore, this study adopted the S&P 500 approach, or market cap weighted method, to calculate three stock indices.

Methods and Data

The main purpose of this study is to examine whether different types of restaurant firms performed differently through and after the recent recession and to measure the magnitudes of differences, if any. Based on North American Industry Classification System (NAICS), two segments of restaurant firms, limited service restaurants (NAICS code 722211) and full service restaurants (NAICS code722110), a total of sixty-nine publicly traded restaurant firms were identified through Mergent Online database (see Appendix B). A weekly stock index was developed for each of the two restaurant segments for analysis and comparison. To gain a better understanding on the impact of the recession, an overall weekly stock index based on all restaurants chosen was also developed and examined. In addition, a weekly average of the S&P 500 index was included in the analysis to show how the restaurant industry differed from others. To identify and measure the differences of the weekly stock performance time series, the study used a Time Series with Intervention Analysis procedure to identify the structural breaks in each of the four weekly time series data sets.

To further understand how the restaurant industry was affected by the recession, this study used paired samples t-tests to examine the differences for each restaurant segment before and after the recession and used independent samples t-test to test the differences between the two restaurant segments before the recession.

Time Series with Intervention Analysis
    Box-Jenkins Procedure
The Box-Jenkins procedure is a mathematically sophisticated time series analysis method that fits Autoregressive Integrated Moving Average (ARIMA) models to time series data (Box, Jenkins, & Reinsel, 1976). Autoregressive (AR) is a process of calculating a time series value as the weighted average of previous time series values; Integrated (I) represents order of differencing that makes data stationary; and the Moving Average model (MA) states that a time series value is the weighted average of forecasting errors of previous time series values. In other words, ARIMA models time series data and forecasts future time series values based on previous values and forecasting errors. An ARIMA model can be denoted as ARIMA (p,d,q) where:

        p represents the autoregressive *p* order;
        q represents the moving average *q* order;
        d represents the order of differencing for stationary transforming;

        Because of its unique characteristics, the Box-Jenkins Procedure was chosen for time series model fitting. Compared with other time series analysis techniques, the Box-Jenkins procedure takes into consideration estimation error residuals and lagged dependent variables, which makes model fitting more accurate (Box, Jenkins, & Reinsel, 2008). Since it was introduced in the late 1970s, Box-Jenkins Procedure has achieved great popularity in different fields including hospitality and tourism industry-related research. Song, Witt, & Li (2009) found that most post-1990 studies on time series analysis of tourism demand used the Box-Jenkins procedure. It also has been successfully used in hotel and restaurant-related research (Chow, Shyu, & Wang, 1998; Luk, Ferrence, & Gmel, 2008). Furthermore, the Box-Jenkins procedure has been proven to be superior to other time series analysis techniques in some gaming related studies (Cargill & Eadington, 1978; Shonkwiler, 1992; and Eisendrath, Bernhard, Lucas, & Murphy, 2008). This study therefore used the Box-Jenkins procedure to fit an ARIMA model on each of the four time series for analyses.
    ARIMA with Intervention Analysis
Time series are often affected by external events or circumstances such as policy changes, advertising promotions, and changes of economic environment. ARIMA with Intervention Analysis, an advanced Box-Jenkins modeling approach, was designed to identify the impact of those events by detecting structural breaks of a time series (Bowerman, Connell, & Koehler, 2005). More specifically, by detecting possible differences between the mean values before and after an external event, this technique determines whether the event has significant impact on a time series and assesses the magnitude of the impact, if any.

        ARIMA with Intervention analysis has been widely used by event impact studies in different areas. For example, Box and Tiao (1975) measured the impact

of air pollution law. Montgomery and Weatherby (1980) studied the impacts of the Arab oil embargo on sales of electricity in United States. Fox (1996) assessed the impact of natural disaster hurricane Hugo on hospital visits in Charleston, South Carolina; Koski, Siren, Vuori, and Poikolainen (2007) tested the impact of alcohol tax cuts on alcohol-positive sudden deaths in Finland; and Lau, Ip, and Lam (2008) applied this technique in performance measurement. Furthermore, the ARIMA with Intervention Analysis approach has been used in many hospitality-related event impact studies and proven successful. The identification of the sudden acute respiratory syndrome in 2003 and terrorist attacks, like the one of September 11, 2001, were events that significantly affected the hospitality and tourism industry worldwide, the impact of which has been heavily studied and ARIMA with Intervention Analysis approach is a commonly used method (Min, 2008; Lai, 2005; Chen, Kang, & Yang, 2008; Yu, Chan, & Fung, 2006; Fox, 1996; Lee, Oh, & O'Leary, 2005; and Ismail, Yahaya, & Efendi, 2009).

Given the purpose of this study, ARIMA with Intervention Analysis approach was used to determine how the recent recession affected the U.S. restaurant industry. Based on the ARIMA models developed for the four weekly stock index time series data sets, the Intervention analysis approach was used to detect the structural breaks in the time series.

t-tests

Once the impact of the recession on restaurant stock indexes was assessed, ratio analyses and comparisons were performed to reveal how the recession affected restaurant firms with different financial characteristics. Twenty-six financial ratios, thirteen before the recession and thirteen after the recession (ratios shown in Appendix A), were calculated for each of the sixty-nine restaurant firms. Financial ratios were retrieved from the WRDS database and multiple t-tests were performed for comparisons.

Paired Samples t-test

The Paired Samples t-test, also known as repeated measures, is a method of comparing mean values of one group of subjects when data are collected from two different occasions or under two different conditions (Mendenhall, & Sincich, 2003). Using financial ratios immediately before and after the recession, this method was used to test if any financial ratio changed significantly through the recession. One Paired Samples t-test was performed for each ratio. A total of twenty-six t-tests, thirteen for limited-service restaurant segment and thirteen for full-service restaurant segment, were performed.

Independent Samples t-test

To further understand the uniqueness of each restaurant segment and how different financial structures and operation performance might have led to different stock performance through the recession, this study also performed Independent Samples t-tests on each financial ratio to examine the differences

between the two segments prior to the recession. Since ratios from different restaurant firms in two different segments needed to be compared, the Independent Samples t-test was chosen because it is a statistical method of comparing the mean scores of two different groups of subjects (Mendenhall, & Sincich, 2003).

Data Collection and Preparation

This study used secondary data from the WRDS database. Daily S&P 500 index and daily closing price of sixty-nine publicly traded restaurant firms from January 2, 2005 through December 26, 2010 (a total of 313 weeks) were collected for the development of the time series; and annual reports of the sixty-nine publicly traded restaurant firms for the years before and after the recession were retrieved for the calculations of financial ratios.

Weekly time series were used to assess the impact of the recession. Daily S&P 500 index and sixty-nine stock prices were converted to weekly data by averaging the daily values. The daily S&P500 index was converted to a 313-week time series. Using the S&P 500 approach, which is a capitalization-weighted method, three 313-week stock index time series were created for the limited-service restaurant segment (LSR), the full-service restaurant segment (FSR), and the overall restaurant industry (OR). To be comparable, all restaurant stock indexes were calculated using base value of 1,186.19, which was the weekly average of S&P 500 index for the week of January 2, 2005, the first week of the weekly time series.

Data Analysis and Results

To assess whether each of the four weekly time series was significantly affected by the recession and experienced significant recovery after the recession, two ARIMA with Intervention analyses were performed on each data set to identify the impact week and recovery week. In this study, the week a time series started showing significant decrease after the recession started was defined as impact week; and the week a time series started showing significant increase after the recession ended was defined as recovery week. Once the fluctuations of the time series were identified and examined, multiple t-tests were performed to gain better understandings of the differences between the limited-service restaurant firms, full-service restaurant firms, the overall restaurant industry, and the S&P 500. The procedures of the ARIMA with Intervention Analysis and t-tests on all four weekly time series are identical.

ARIMA with Intervention Analysis

Model Fitting

Following the procedures proposed by Bowerman et al. (2005), an ARIMA model was fitted to each of the four time series. Then, two intervention analyses were

performed based on the ARIMA model to test significant changes of mean levels. SAS/ETS Time Series Forecasting System was used for the analyses.

The model fitting was a three-step process: 1) Model Identification: identifying a tentative model; 2) Parameter Estimation: estimating the parameters for the tentative model; and 3) Model Validation: diagnosing the tentative model for adequacy with Ljung-Box test and identifying an improved model, if necessary. The weekly data before the recession, which comprised data from the week of January 2, 2005 through November 25, 2007, a total of 152 weeks, were used for model fitting. After multiple similar models were tested, model ARIMA(4,2,0) without constant was identified to be the model that fit all four weekly time series. Tables 1 & 2 list the summary of parameter estimation and Ljung-Box statistics for all four time series.

Table 1. Summary of Estimates of Model Parameters

Parameter	Coefficient	t-statistic	p-value
Full-service Restaurant Segment			
AR_1	-0.8318	-10.34	< 0.0005
AR_2	-0.6465	-6.53	< 0.0005
AR_3	-0.4576	-4.61	< 0.0005
AR_4	-0.2517	-3.11	0.002
Limited-service Restaurant Segment			
AR_1	-0.9569	-11.99	< 0.0005
AR_2	-0.7795	-7.61	< 0.0005
AR_3	-0.5838	-5.64	< 0.0005
AR_4	-0.2771	-3.42	0.001
Overall Restaurant Industry			
AR_1	-0.8545	-10.60	< 0.0005
AR_2	-0.7192	-7.28	< 0.0005
AR_3	-0.5187	-5.20	< 0.0005
AR_4	-0.2395	-2.94	0.004
S&P 500			
AR_1	-0.9231	-11.31	< 0.0005
AR_2	-0.749	-7.04	< 0.0005
AR_3	-0.4598	-4.29	< 0.0005
AR_4	-0.1916	-2.27	0.025

Table 2. Summary of Ljung-Box Chi-Square Statistic

Lag	Chi-Square	df	p-value
Full-service Restaurant Segment			
12	14.1	8	0.078
24	28.0	20	0.110
36	41.0	32	0.133
48	57.5	44	0.083
Limited-service Restaurant Segment			
12	10.0	8	0.265
24	27.8	20	0.113
36	32.6	32	0.439
48	40.1	44	0.637
Overall Restaurant Industry			
12	9.8	8	0.280
24	27.8	20	0.115
36	34.6	32	0.343
48	42.1	44	0.553
S&P 500			
12	13.0	8	0.111
24	24.4	20	0.225
36	33.1	32	0.415
48	45.0	44	0.431

Intervention Analyses

Time series intervention analysis was designed to test how the mean levels of a time series differ before and after an exogenous event. For each of the four time series, two intervention analyses were performed based on the ARIMA model to identify possible significant impact and recovery during and after the recession. In order to perform an intervention analysis, an event and the time it occurs needed to be identified. Using the definition of recession (The National Bureau of Economic Research, 2010), the two events used in this study were defined as the start of the recession in the week of December 2, 2007 and the end of the recession in the week of June 28, 2009.

However, it is common for events to have a lagged effect on a time series. In other words, failing to identify significant decrease of the mean level in the first week of the recession didn't mean the stock index was immune to the recession. Therefore, for each stock index, if no significant decrease of mean level was detected in the first week of the recession, ARIMA with Intervention analyses were repeatedly performed in the second week, the third week, the fourth week, and so forth until a significant decrease was identified or the end of the data set was reached. Identical analyses were performed for testing the recovery.

The time series used for intervention analyses varied among four indices. For impact identifying, each time series comprised the weekly index from the beginning of the data set, which was January 2, 2005, through the week during the recession that had the lowest value. The rest of the time series were used for recovery identification, with the time of intervention starting from the first week after the recession ended. Tables 3 & 4 provide summary of the time series used for intervention analyses. All Intervention analyses were performed based on ARIMA(4,2,0) using SAS/ETS Time Series Forecasting System. Tables 5 & 6 list the results of the analyses; and Table 7 is a summary of impacts and recoveries identified.

Table 3. Weekly Time Series Used for Impact Identifying

Index	Beginning week / Value	Ending week / Value
Full-service Restaurants	January 2, 2005 / 1186.19	Nov 16, 2008 / 440.11 51st week of the recession
Limited-service Restaurants	January 2, 2005 / 1186.19	March 1, 2009 / 1366.07 66th week of the recession
Overall Restaurant Industry	January 2, 2005 / 1186.19	Nov 16, 2008 / 1127.92 51st week of the recession
S&P 500	January 2, 2005 / 1186.19	March 1, 2009 / 683.38 66th week of the recession

Table 4. Weekly Time Series Used for Recovery Identifying

Index	Beginning week / Value	Ending week / Value
Full-service Restaurants	Nov 23, 2008 / 493.08 52nd week of the recession	Dec 26, 2010 / 1615.48
Limited-service Restaurants	Mar 8, 2009 / 1371.68 67th week of the recession	Dec 26, 2010 / 2110.15
Overall Restaurant Industry	Nov 24, 2008 / 1196.76 52nd week of the recession	Dec 26, 2010 / 1954.67
S&P 500	Mar 8, 2009 / 756.55 67th week of the recession	Dec 26, 2010 / 1257.64

The results suggest that the stock performance of the limited-service restaurant segment was immune to the recession. No significant decrease was identified after the recession started. However, although the weekly LSR index showed a steady increase after the recession ended (shown in Figure 1), no significant increase of mean value was identified after the recession ended. On the other hand, both impact and recovery were identified for the full-service restaurant segment. In the week of December 2, 2007, the first week of the recession, a significant decrease of 57.9 was identified (Table 5); and a significant

increase of 68.45 was identified in the week of December, 27, 2009, which was twenty-seven weeks after the recession ended (Table 6). In other words, compared to that of LSR, stock performance of the FSR was more sensitive to the changes of market conditions and more volatile through and after the recession. As shown in Figure 1, the FSR index has the steepest slope before and after the recession. However, it seems that it took longer for FSR to start to recover from the recession. The plot for FSR index (Figure 1) is flat between weeks 236 and 262, which is between the end of the recession and the week the FSR index started showing a significant increase and represents the lagged period for FSR to recover.

Significant impacts were also identified for the overall restaurant industry index and S&P 500 index for 59.1 and 55.9, respectively. As shown in Table 5, the OR index started showing a significant decrease in the first week of the recession; but the S&P 500 index wasn't significantly affected by the recession until the week of August 31, 2008, the fortieth week of the recession. This difference confirms the theory that the restaurant industry stocks are riskier and more volatile than the overall market.

Due to its larger market cap (shown in Table 8), LSRs might have had some influence on the results of this study even though no significant impact or recovery was identified on LSR index. The decrease in the LSR index wasn't significant enough to be detected by the intervention analysis, but it did decrease largely after the recession started, which might have contributed to the fluctuation of the OR index and led to a slightly larger decrease on OR than on FSR (59.1 vs. 57.9). For the same possible reasons, no recovery was identified in the OR index after the recession ended. Although the FSR index had a significant recovery of 68.5, it had a much smaller market cap than LSRs did and represented only about 22% of the OR market cap.
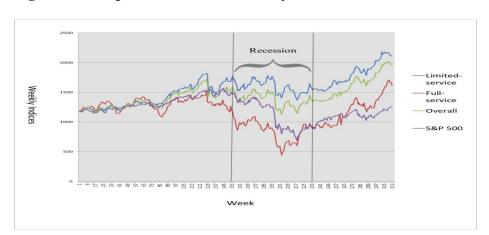
Figure 1. Grouped Plots of Four Weekly Time Series

Table 5. Impact Weeks Identified

Parameters	Estimate	*t*-statistic	*p* value
Full-service Restaurant			
AR(1)	-0.78174	-11.2492	< .0001
AR(2)	-0.60145	-7.1521	< .0001
AR(3)	-0.47249	-5.6248	< .0001
AR(4)	-0.23549	-3.3462	0.0010
week of Dec 2, 2007	**-57.89853**	-2.2619	0.0248
Overall Restaurant Industry			
AR(1)	-0.75963	-11.4309	< .0001
AR(2)	-0.54605	-6.9730	< .0001
AR(3)	-0.46647	-5.9404	< .0001
AR(4)	-0.25657	-3.8484	0.0002
week of Dec 2, 2007	**-59.10428**	-2.3203	0.0213
S&P 500			
AR(1)	-0.90615	-13.8599	< .0001
AR(2)	-0.64130	-7.8289	< .0001
AR(3)	-0.55621	-6.7582	< .0001
AR(4)	-0.31220	-4.7076	< .0001
week of Aug 31, 2008	**-55.89321**	-2.7161	0.0072

Table 6. Recovery Week Identified

Parameters	Estimate	*t*-statistic	*p* value
Full-service Restaurant Segment			
AR(1)	-0.64142	-7.7949	< .0001
AR(2)	-0.50531	-5.4614	< .0001
AR(3)	-0.35685	-3.8705	0.0002
AR(4)	-0.20233	-2.5271	0.0125
week of Dec 27, 2009	**68.44682**	1.9230	0.0563

Table 7. Summary of Impact and Recovery Weeks

Impact	Recovery
Full-service Restaurants	
week of Dec 2, 2007	week of Dec 27, 2009
Limited-service Restaurants	
No significant impact	No Significant Increase until 2010
Overall Restaurant Industry	
week of Dec 2, 2007	Not recovered until 2010
S&P 500	
week of Aug 31,2008	Not recovered until 2010

Table 8. Market Capitalization of Restaurant Segments (in thousands).

Week	Full-service Restaurant Segment (Proportion)	Limited-service Restaurant Segment (Proportion)	Overall Restaurant Industry (Proportion)
January 2, 2005	31,284,699 (32.03%)	66,385,153 (67.97%)	97,669,852 (100%)
December 2, 2007	25,681,870 (19.88%)	103,486,012 (80.12%)	129,167,882 (100%)
June 21, 2009	18,407,540 (17.85%)	84,710,578 (82.15%)	103,118,118 (100%)
December 26, 2010	32,114,305 (22.75%)	109,067,737 (77.25%)	141,182,042 (100%)

t-tests of Ratios

The results of ARIMA with Intervention analyses provided investors with insights on the performance trends of three stock indices through the recession. To understand how different segments behaved differently from a managers' perspective and help managers make informed decisions in coping with possible economic downturns in the future, this study further examined the changes of financial ratios of LSRs and FSRs through the recession. Multiple t-tests were performed to compare the average financial ratios. Paired Samples t-tests were performed on the limited-service restaurant segment and full-service restaurant segment to identify possible significant changes of financial ratios through the recession. Results listed in Table 9 indicate that none of LSR segment's financial ratios significantly changed through the recession, which mirrors the findings of the intervention analysis. Again, the LSR segment appears to be immune to the recession.

However, the average Debt Ratio of FSRs showed significant increase and Debt-to-Equity ratio of FSRs showed modestly significant increase through the recession (shown in Table 10). By the end of the recession, about 56% of the assets in FSR were financed with debt and approximate 80% of operating and financing activities were financed with debt. The significant increases of these two debt ratios imply that FSRs had difficult time raising funds from the stock markets during the recession, which is also reflected by the 28.3% decrease of FSR market cap through the recession.

Table 9. Results of paired samples t-test for limited service restaurants

Ratio	Average before recession	Average after recession	t-value	Sig. two-tailed
Liquidity				
Current Ratio (n=15)	1.2964	1.2169	.389	.703
Quick Ratio (n=15)	.9862	.8312	.847	.411
Leverage				
Debt Ratio (n=14)	.8064	.8573	-.336	.742
Debt-to-Equity (n=11)	3.7193	4.6282	-.357	.728
Times Interest Earned (n=15)	185.6669	-124.3671	1.266	.226
Profitability				
Gross Profit Margin (n=15)	.2865	.2831	.259	.800
Net Profit Margin (n=15)	.0761	.0447	.945	.361
Return on Investment (n=12)	.0853	.0548	.881	.397
Return on Stockholder's Equity (n=11)	.1470	.2060	-.363	.724
Asset Management				
Inventory Turnover (n=15)	74.3498	73.4794	.236	.817
Total Asset Turnover (n=15)	1.7361	1.8559	-.692	.500
Market-based				
P/E (n=15)	33.6460	19.6422	.643	.531
P/BV (n=15)	1.1329	7.0399	-1.684	.114

An Independent Samples t-test was performed to identify possible differences between the financial ratios of LSRs and FSRs at the beginning of the recession. The results listed in Table 11 indicate that Gross Profit Margin Ratios were identified to be significantly different between the two segments and Debt Ratios and P/E ratios were identified to be modestly significantly different between two segments. Although the limited-service segment constantly had higher Debt Ratio through the recession, its higher Gross Profit Margin might have indicated promising earning growth, which consequently led to its higher P/E ratio. This further explains LSR's stronger stock performance through the recession. Although the market cap of LSR shrunk about 18.1% during the eighteen-month recession, versus 28.3% decrease of FSR, the debt ratios of LSR didn't show any significant changes through the recession (Table 9). In other words, LSR might have difficulties raising funds through the recession, but the increase of overall debt is not statistically significant.

Table 10. Results of paired samples t-test for full service restaurants

Ratio	Average before Recession	Average after Recession	t-value	Sig. two-tailed
Liquidity				
Current Ratio (n=31)	1.1018	.9528	.944	.353
Quick Ratio (n=31)	.7938	.6613	.811	.424
Leverage				
Debt Ratio (n=31)	.4167	.5621	-3.757	.001
Debt-to-Equity (n=30)	.8276	4.1277	-1.712	.098
Times Interest Earned (n=25)	81.4394	20.5291	1.324	.198
Profitability				
Gross Profit Margin (n=31)	.2316	.2170	1.685	.102
Net Profit Margin (n=31)	-.0433	.0242	-.834	.411
Return on Investment (n=26)	.0758	.0554	1.515	.142
Return on Stockholder's Equity (n=30)	.0915	-.0172	1.613	.118
Asset Management				
Inventory Turnover (n=30)	81.0008	72.6084	.777	.443
Total Asset Turnover (n=31)	1.4845	1.6203	-1.524	.138
Market - based				
P/E (n=31)	19.2153	-2.8367	.686	.498
P/BV (n=31)	2.9048	3.7762	-.967	.341

Overall, this study found that the limited-service restaurant segment weathered the recession well and no significant impact of the recession on the segment was identified. In fact, four of the twenty limited service restaurant firms had losses in the year before recession; and only two had losses in the year after recession. Two of the four restaurants actually started to have earnings through the recession. On the other hand, once the recession ended, the full-service restaurant segment recovered very rapidly; but no significant increase of stock index was identified for LSRs. In addition, although the restaurant industry seems to be more volatile than overall market, the limited-service restaurant segment appears to have less risk.

Table 11. Pre-recession results of independent samples t-tests.

Ratio	Average for Limited-Service Restaurants	Average for Full-Service Restaurants	t-value	Sig. two-tailed
Liquidity				
Current Ratio (df=63)	1.2584	1.0462	.987	.327
Quick Ratio (df=62)	.9132	.7284	.831	.409
Leverage				
Debt Ratio (df=21.771)	.6976	.4571	1.739	.096
Debt-to-Equity (df=15.171)	2.7825	.9444	1.078	.298
Times Interest Earned (df=56)	147.6913	63.2174	.557	.579
Profitability				
Gross Profit Margin (df=63)	.2722	.2130	2.031	.046
Net Profit Margin (df=63)	.0711	-.0262	1.074	.287
Return on Investment (df=50)	.1006	.1119	-.141	.888
Return on Stockholder's Equity (df=53)	.1401	.0722	1.398	.168
Asset Management				
Inventory Turnover (df=58)	72.6091	79.5977	-.407	.686
Total Asset Turnover (df=59)	1.7009	1.5623	.789	.434
Market-based				
P/E (df=63)	31.1338	.2202	1.705	.093
P/BV(df=19.261)	1.3981	2.5298	-.878	.391

Summary of Results

Using the ARIMA with Intervention Analysis technique and t-tests, this study examined nine hypotheses to explore the behaviors of performance trends of the three restaurant stock indices (hypotheses #1 ~ #6) and changes in financial ratios of different restaurant segments (hypotheses #7 ~ #9) through the recent recession. The results of ARIMA analyses suggest that hypotheses #1, #4, and #6 to be rejected and hypotheses #2, #3, and #5 not to be rejected (shown in Tables 5 & 6). In addition, the t-tests identified significant differences among some of the financial ratios in different restaurant segments through the recession (shown in Tables 9, 10, and 11).

Discussion

The first thing to remark on is the weeks of impact and recovery of the restaurant industry as a whole and the two individual industry segments being analyzed. In

the case of the industry as a whole, the week of December 2, 2007 is the week the recession first had an impact on the stock prices of restaurant companies, and the prices did not recover until the first part of 2010. This impact was mirrored by the performance of full service restaurant stocks as well as the S&P 500 as a whole. Interestingly, though, limited service restaurant stock prices were not significantly affected by the recession at all, and therefore did not need to recover.

When looking at the paired sample t-test examining the financial performance of full service restaurants, it is noted that full service restaurants took on a significantly higher level of debt during the recent recession, both in terms of debt ratio ($p<0.05$) and debt to equity ratio ($p<0.1$). While gross profit margin was not significantly lower ($p=0.102$), the result of the t-test was very close to being statistically significant. When examining these same numbers for the limited service restaurant segment of the industry, there are no significant differences found between pre- and post-recession financial performance.

These results demonstrate quite clearly that limited service restaurants (LSRs), in general, survived the recession with much greater ease than full service restaurants (FSRs). LSRs did not see a decline in stock price during the recession and managed to maintain profitability without having to take on additional debt. FSRs, on the other hand, managed to maintain their profit margins, if only just, but did so at the expense of taking on greater debt.

These results are informative for industry on a number of levels. First is the notion that the limited service restaurant segment was able to weather the most severe recession in the United States since the Great Depression better than the full service restaurant segment. Certainly, if investors can count on LSR stocks not to decline in the face of such a sharp economic downturn, these sorts of restaurants represent a far more secure investment than FSR, for investors and operators alike.

Second, there is mounting evidence that the United States economy, while technically not in recession, is not expected to rebound fully any time in the near future (Barro, 2012). As of July 26, 2012, Treasury Real Yield Curve Rates – the interest rates the United States government pays on bonds that are indexed to inflation – were negative for all bonds of less than twenty years maturity (United States Department of the Treasury, 2012) (see appendix c). In other words, for every maturity of bonds under 20 years, investors are paying the federal government to take their money. This suggests quite strongly that investors are pessimistic about the ability of the U.S. economy to create significant gains in the coming years (Krugman, 2012). Investor pessimism about prospects for the real economy makes the perceived safe haven of U.S. debt attractive even at very low yields (Krugman, 2012). For operators of FSRs, then, this suggests a major realignment of strategic thinking is in order. Since the stock prices of these companies first reacted to the recession in December, 2007, FSRs have purchased

continued profitability at the expense of ever greater debt. If the economy continues as expected this is clearly not a sustainable course of action. Operators of FSRs must quickly come to grips with the reality of the new, less vibrant economy. For investors, this means moving money away from FSRs and into LSRs might be in order.

Adding urgency this problem for FSRs is the notion that the U.S. economy might be headed for a "double-dip" recession, and given that the European economy is experiencing just such a recession, those fears may not be unjustified (UK SME, 2012). Should the U.S. economy experience such a backslide; FSRs will face more severe challenges given that it was significantly affected by the recent recession and its overall debt ratios have worsened through the recession. A change in strategic thinking on the part of FSR managers, therefore, is not only a necessity, but a pressing one.

This study was limited by the fact that only publicly held restaurant companies were surveyed. Privately owned companies and those not large enough to have their stocks listed on large exchanges may have been affected differently than larger concerns. Opportunities for further research include incorporating these other companies into the research, as well as examining LSRs more closely to determine whether they actually are "recession proof."

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APPENDIX A: Financial Ratios

Ratio	Formula
Liquidity	
Current Ratio	$\dfrac{\text{Current assets}}{\text{Current liabilities}}$
Quick Ratio	$\dfrac{\text{Current assets} - \text{ inventories} - \text{ prepaid expenses}}{\text{current liabilities}}$
Leverage	
Debt Ratio	Total debt/ Total assets
Debt-to-Equity Ratio	Total debt/ Total equity
Times Interest Earned Ratio	Earnings before interest and taxes/ Interest Charges
Profitability	
Gross Profit Margin Ratio	Sales- Cost of sales/ sales (revenue)
Net Profit Margin Ratio	Earnings after taxes (EAT)/sales
Return on Investment Ratio	Earnings after taxes (EAT)/ Total assets
Return on Stockholder's Equity Ratio	Earnings after taxes (EAT)/ Stockholders' equity
Asset Management	
Inventory Turnover Ratio	Cost of sales/ Average inventory
Total Asset Turnover	Sales/ Total assets
Market-based	
Price-to-Earnings (P/E) Ratio	Market price per share/ Current earnings per share
Market-to-Book (P/BV) Ratio	Market price per share/ Book value per share

APPENDIX B: Restaurant Firms

(identified through Mergent Online database)

722211 limited service (20)		722110 full service (49)	
AFC Enterprises Inc.	AFCE	Applebee's International, Inc.	APPB
Burger King Holdings Inc.	BKC	Ark Restaurants Corp.	ARKR
Caribou Coffee Inc.	CBOU	Back Yard Burgers, Inc.	BYBI
Carrols Restaurant Group Inc.	TAST	Benihana Inc.	BNHNA
Checkers Drive-In Restaurants	CHKR	Biglari Holdings Inc.	BH
CKE Restaurants, Inc.	CKR	BJ's Restaurants Inc.	BJRI
COSI Inc.	COSI	Bob Evans Farms, Inc.	BOBE
Domino's Pizza Inc.	DPZ	Bravo Brio Restaurant Group Inc.	BBRG
Einstein Noah Restaurant	BAGL	Brinker International, Inc.	EAT

Group			
Good Times Restaurants Inc.	GTIM	BUCA Inc.	BUCA
Jack in the Box, Inc.	JACK	Buffalo Wild Wings Inc.	BWLD
McDonald's Corp	MCD	California Pizza Kitchen Inc.	CPKI
Nathan's Famous, Inc.	NATH	CEC Entertainment, Inc.	CEC
Papa John's International, Inc.	PZZA	Champps Entertainment, Inc.	CMPP
Red Robin Gourmet Burgers Inc.	RRGB	Cheesecake Factory Inc.	CAKE
Ryan's Restaurant Group Inc.	RYAN	Chipotle Mexican Grill Inc.	CMG
Sonic Corp.	SONC	Cracker Barrel Old Country Store, Inc.	CBRL
Wendy's International, Inc.	WEN	Darden Restaurants, Inc.	DRI
Worldwide Restaurant Concepts	SZ	Denny's Corp	DENN
Yum! Brands, Inc.	YUM	DineEquity Inc.	DIN
		Elmer's Restaurants, Inc.	ELMS
		Famous Dave's of America Inc.	DAVE
		Flanigan's Enterprises, Inc.	BDL
		Friendly Ice Cream Corp	FRN
		Frisch's Restaurants, Inc.	FRS
		Granite City Food & Brewery Ltd	GCFB
		J. Alexander's Corp	JAX
		Jamba Inc.	JMBA
		Kona Grill Inc.	KONA
		Landry's Restaurants, Inc.	LNY
		Lone Star Steakhouse & Saloon, Inc.	STAR
		Luby's, Inc.	LUB
		Main Street Restaurant Group Inc.	MAIN
		Max & Erma's Restaurants, Inc.	MAXE
		McCormick & Schmicks Seafood Restaurants Inc.	MSSR
		Morton's Restaurant Group Inc.	MRT

Mexican Restaurants, Inc.	CASA
O'Charley's Inc.	CHUX
OSI Restaurant Partners Inc.	OSI
P.F. Chang's China Bistro, Inc.	PFCB
Panera Bread Co.	PNRA
Quality Dining, Inc.	QDIN
RARE Hospitality International, Inc.	RARE
Rubio's Restaurants, Inc.	RUBO
Ruby Tuesday, Inc.	RT
Ruth's Hospitality Group Inc.	RUTH
Star Buffet, Inc.	STRZ
Texas Roadhouse Inc.	TXRH
Western Sizzlin Corp	WEST

APENDIX C: Daily Treasury Real Yield Curve Rates

Date	5 YR	7 YR	10 YR	20 YR	30 YR
07/02/12	-1.04	-0.81	-0.50	0.10	0.51
07/03/12	-1.08	-0.82	-0.48	0.14	0.53
07/05/12	-1.12	-0.86	-0.51	0.10	0.50
07/06/12	-1.12	-0.87	-0.53	0.08	0.48
07/09/12	-1.14	-0.89	-0.57	0.03	0.43
07/10/12	-1.16	-0.92	-0.59	0.01	0.40
07/11/12	-1.15	-0.90	-0.57	0.03	0.41
07/12/12	-1.13	-0.90	-0.58	0.00	0.39
07/13/12	-1.15	-0.91	-0.59	-0.01	0.38
07/16/12	-1.18	-0.94	-0.61	-0.02	0.37
07/17/12	-1.16	-0.92	-0.59	0.00	0.40
07/18/12	-1.19	-0.94	-0.60	0.00	0.40
07/19/12	-1.20	-0.97	-0.62	-0.01	0.40
07/20/12	-1.18	-0.98	-0.67	-0.08	0.33
07/23/12	-1.18	-0.98	-0.68	-0.09	0.32
07/24/12	-1.13	-0.95	-0.68	-0.11	0.31
07/25/12	-1.12	-0.94	-0.67	-0.10	0.31

Source: United States Department of the Treasury