Quality Competition in Restaurants Industry:

How Restaurants Respond to Fluctuating of Consumers' Review Ratings of Rivals

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Abstract:

The goal of businesses is to maximize profit which in turn is affected by quality competition. According to the quality competition theory, an increase in competitors' quality, all else equal, create a more competitive market which will cause a business to raise its quality. The objective of this paper is to examine the theory through an assessment of the longitudinal dataset of a restaurant's quality. Customer review ratings of a restaurant are utilized as a proxy of a restaurant's quality. To achieve the objective mentioned above, this research uses the average customer review ratings from 7,610 restaurants in the Phoenix Metropolitan Area. Ratings were collected from Yelp.com from the end of each month, from 2014 to the end of 2017, to investigate the effect of competition on restaurant quality. A fixed effect panel regression model with a spatial distance band weight matrix is used to evaluate the effect that changes in competing restaurants' quality have on a restaurant. The results indicate that restaurants predominantly compete, and therefore are influenced, by their competitors and rivals with the same category and price range. The findings show that the rivals' quality competition has a much more significant impact on high-price restaurants than on lower-price restaurants. This paper also is the first to note that high-quality entrants have a positive effect on the review ratings of other restaurants.

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1. Introduction

How does a firm respond to competition? In many businesses, quality and price are the two major components of spatial competition among the services they offer. In price and quality competition, high quality is associated with high prices and low quality with low prices (Chioveanu 2012). Since low-quality businesses can eventually shift into a different quality, a higher price business with a higher quality needs to continue to raise the quality as well to ensure the expected profit. At equilibrium, businesses with different prices can compete with each other through quality. The symmetric equilibrium of different consumer tastes causes a positive expected profit for businesses. When a new firm enters the market, nearby incumbent firms may increase their quality up to a higher level to retain their customers. This quality competition procedure is an intriguing research area for industrial organization economists as well as urban economics researchers.

In the case of restaurants, an owner can attract more customers by either lowering prices or increasing quality. As the demand for restaurants increases, quality has become one of the most critical factors in evaluating customer satisfaction. Quality, therefore, is endogenously chosen by restaurants (Berry and Waldfogel 2010). If two restaurants have the same price, higher quality can make one restaurant successful if their business is in the same location as a rival. In this way, being aware of the quality expected by the customers gives the restaurant an advantage in the highly competitive market. The most likely scenario is that competition shifts the quality of restaurants simultaneously, and, as a result, they adjust the quality based on the quality of competing restaurants.

Needless to say, it is difficult to measure the quality of restaurants. I argue, however, that customer reviews can serve as a proxy for the quality of restaurants. In recent years, reviews have become a vital key to the success of restaurants. That is why restaurant owners need to be aware

of the influence of review websites such as Yelp, and the role that they play in popularity and profitability of their restaurants.

The ambiguous evidence of competition based on quality among restaurants leads me to investigate this relationship further. In light of recent evidence, the present research outlines the impact of competition on the quality of firms in the restaurant market by utilizing the customers' review ratings of Yelp as a proxy for restaurant quality. In this study, I intend to present empirical evidence regarding the dynamic spatial effect of competition on quality among restaurants. This paper improves present empirical research of quality competition by focusing on the dynamic quality competition between restaurants. Using a panel dataset of 7,610 restaurants in the Phoenix Metropolitan Area, this paper looks to answer the following questions: "Does a shift in the quality of rivals influence a restaurant's quality," " Do restaurants with the same category and price have a higher effect on each other," and "Do high-quality entrants have effects on the incumbents' decision to increase their quality?"

In this research, I use longitudinal data of all restaurants listed on Yelp in the Phoenix Metropolitan Area. Yelp had 141 million unique visitors[1] and 148 million reviews[2] by the end of 2017. As a result, Yelp has become the primary source for consumer review ratings in the United States for the restaurant industry. I use a panel dataset that covers nearly all restaurants' reviews in the Phoenix Metropolitan Area from 2014 to 2017. This dataset includes the geographic location, cuisine category and average review rating of restaurants in each month. Furthermore, this dataset includes the price range of each restaurant in three categories: economy, midrange, and luxury. Since restaurants offer different qualities and prices for various services, researchers are able to examine product heterogeneity more accurately compared to other industries. The panel

[1] "Yelp, Form 8-K Current Report, Filling Date Feb 7,2018". secdatabase.com. Retrieved May 1,2018.
[2] "Yelp, Form 10-K Current Report, Filling Date Feb 28,2018". secdatabase.com. Retrieved May 1,2018.

nature of the dataset allows me to deal with the seasonality problem that affects the restaurant industry.

The results indicate that restaurants at similar price levels have a strong effect on each other. An increase in a competing restaurant's quality also increases the quality of restaurant that serves the same cuisine in a one-mile radius by 0.0522 at next month. The theoretical model suggests that high-price restaurants, which tend to have more inelastic consumers, should care more about the changes in rival restaurant quality. Additional results illustrate that high-price restaurants are more responsive when competitors make a change in quality. A one star change in a competitors rating can increase the review rating of luxury restaurants in a one-mile radius by 0.2826 after one month.

I find that the location features increase the quality of restaurants. A one standard deviation increase in diversity can increase the quality of competing restaurants by 0.0373 rating points. Similarly, this paper finds that high-quality entrants have an impact on competing restaurant quality. The restaurant's customer review rating increases by 0.002, if the proportion of high-quality restaurants increases by 10 %.

In section 2 of this paper, I review some previous literature. I discuss the data in section 3. I suggest an empirical econometric model section 4. Section 5 outlines the empirical results which complement the theoretical predictions. Finally, section 6 concludes with a discussion of policy implications based on the findings of this paper.

2. Literature Review

Quality competition is one of the most valuable topics to investigate in the industrial organization area. Many researchers have studied the subject and developed quality competition such as Cellini,

Siciliani, and Straume (2105). This paper inspired me to work on quality competition in restaurants. They suggested a new theory with using quality competition with an endogenous price in Hotelling line model (Hotelling 1929) with implying dynamic interaction of firms over time. They found that further quality and price competitions motivate industry to increase their quality or reduce the price. Cellini, Siciliani, and Straume mentioned that profit-oriented businesses compete on quality as a way to attract customers when they do not intend to change the price. Their theory proposed that in a hoteling model, where the price of firms does not change, more competition increases the quality of the firm. It can be concluded that with more competition, consumers are reacting positively to quality. This response cause firms to improve their quality in order to raise their profit.

Biscegliay, Cellini, and Grillix (2018) added to the previous research on the spatial quality competition by looking at government regulated markets. They find that firms increase their quality to attract customers. Chioveanu (2012) proposed a simultaneous price and quality competition in an oligopolistic market. He emphasized the tradeoff between quality and price, and how profits change when some consumers consume the high-quality product and others spend less money to consume a lower quality product.

Existing studies have analyzed the influence of reviews on firm profits. Luca (2016) investigated the causal impact of online consumer reviews on restaurant revenues by using Yelp. He has found that one-star improvement in the Yelp ratings increases restaurant revenues by 5 to 9 percent. He indicated that consumers only use some of the information that is visible to them. Additionally, he noted that reviews do not impact restaurants with chain affiliation. Cabral and Hortacsu (2010) found that negative reviews drop the weekly sales rate of a seller from positive

5% to negative 8%. Also, they show that the seller's probability of exit after low review rating is very high, and they receive more negative reviews than their lifetime average just before exiting.

It has become clear that the problem of low quality is a crucial indicator that often results in exclusion from the market. Berry and Waldfogel (2010) investigate the relationship between market size and quality in the restaurant industry. They find that quality is associated with a variable cost, and a markets' size enhances the quality that the restaurants offer because the broader market size has, the smaller the market share.

3. Data

Yelp is a platform where reviewers write reviews about local businesses. In the fourth quarter of 2017 alone, Yelp had over 140 million visitors (based on unique IP addresses)[3]. On the Yelp website, customers can write or read about restaurants after registering for a free account. The rating system includes discrete numbers between 1 to 5 with increments of 0.5. Reviews are accessible to everyone for free, and customers discern the quality of restaurants at ease based on these ratings.

A unique panel dataset on the average review rating for each month for all restaurants in the Phoenix metropolitan area was collected from the Yelp website. Data is collected for each restaurant from January 2014 to December 2017. Table 1 presents summary statistics for the restaurants.

The data covers more than 96% of existing restaurants in the Phoenix area based on the Bureau of Labor Statistics data in the food service section[4]. Specifically, the dataset has 9,611 unique restaurants properties. All information is available for only 7,610 of the restaurants. During

[3] https://www.yelp.com/factsheet
[4] https://www.bls.gov/iag/tgs/iag722.htm

the period from 2014 to 2017, 2,905 new restaurants entered the market, and 3181 restaurants exited the market. Figure 1 shows the numbers of entry and exit for each month. The latitude and longitude coordinates, price range, number of reviews in each month, an average rating of reviews, and food category are collected for each restaurant. Graph 2 shows the time trend of the average review rating between the different price ranges. Each restaurant is classified in three price range categories: economy, mid-price, and luxury. On table 2 and 3 they contain the number of observation for the price range and different cuisine categories.

Based on Zhang, Li, and Hong (2016) and Karamshuk, et al. (2013) research, I can control location characteristics by setting three dynamic geographic features: Location Density, Competitiveness, and Heterogeneity. Summary statistics of characteristics for restaurants in 48 months is presented in table 4.

Location Density is defined as the popularity of location by utilizing number (*N*) of nearby restaurants *j* in the distance d_{ij} with *l* mile radius around restaurant *i* at time *t*. Location Density is simply a number of restaurants in *l* mile radius. The Location Density is defined as:

$$Loc\_Den_{it} = \sum j \in (d_{ij} < l) \quad (1)$$

Competitiveness is defined as the ratio of nearby restaurants with similar category type with the total number of restaurants within the same area for the restaurant *i* at time t with category type *c*. For example, Indian restaurants could be situated close to each other which results to competition becoming higher for this type of cuisine. The value of this feature is between 0 to 1.

$$Competitiveness_{it} = \frac{N_{cjt}(i,l)}{N_{jt}(i,l)} \quad (2)$$

Heterogeneity is defined as the HHI index of different category in the market. To calculate Heterogeneity, I have used HHI index with finding market share of each category in the area. For example, if most restaurants around restaurant *i* are Indian type restaurants, the heterogeneity value

is very low. However, a neighborhood that includes all types of restaurants has a higher heterogeneity value. Each restaurant has its category type, c. N_c, signifies the number of nearby restaurants for category c with mile radius l where $c \in C$ and C is a set of all category types.

$$Heterogeneity_{it} = \sum_{c \in C} \left(\frac{N_{ct}(i,l)}{N_t(i,l)}\right)^2 \quad (3)$$

The distance resulting from the longitudinal data is a good estimate of the geographic interaction of restaurants. I use the Haversine function on latitude and longitude points of restaurants to estimate the distance between them. The haversine function finds the circle distance between two points on a sphere with their longitudes and latitudes. In my dataset, the distance between two restaurants ranges from less than a foot to more than 90 miles. Graphs 3, 4 and 5 are the comparisons between average review ratings and various components of competing restaurants in a one-mile radius. Graph 3 shows that when the number of competitors increases around a given restaurant, the rating of that restaurant increases. In other words, competition can increase the quality of restaurants. Graph 4 and Graph 5 showcase the relationship between competitiveness and heterogeneity with customer review rating, respectively. Even though they have a positive correlation with the review rating of restaurants, the two graphs are very noisy. I believe the noise is because restaurants do not just compete among their category type and price range, they also compete with other restaurants based on distance.

4. Empirical Model

Hypotheses of this paper suggest that a shift in an average of quality of rivals affect a restaurant's quality. This effect is higher for restaurants with the same category and price. Economics theory also suggests that high-quality entrants have effects on the incumbents' decision to increase their quality. In order to test the hypothesis in this study, I have taken advantage of the

panel fixed effect regression model to test the hypothesis of this paper related to quality competition theory.

I have applied a panel regression approach to analyze if the shifting the average rating of competitors has a causal impact on the change of the rating of restaurants. In this research, I have decided to remove all restaurants with less than ten reviews overall from my data analysis. These restaurants are removed because the quality of these restaurants does not change over a monthly period if they have a low number of reviews. The regression equation can be written as follows:

$$R_{it} = \alpha_i + \beta_k \sum_{i \neq j,} W_{(ij)} R_{j(t-k)} + \gamma_n x_{itn} + \vartheta_m + \mu_y + \in_{it}, \quad (4)$$

where, R_{it}, is the rating of review between time *t* and time *t-1* for restaurant *i*. $R_{j(t-k)}$, are competitor review ratings with lags. Subscript, *k*, determines the lags for the ratings of the competitors. *W*, is designed with distance band weighting matrix between restaurant, *I*, and its competitor, *j*. In this weight matrix, the value of competitors that are located within a certain geographic distance is set equal to one, and the rest are set equal to zero. Next, the matrix is normalized to show the average value of review rating of competitors. *X*, is location futures for restaurants, namely: number of reviews, location density, competitiveness, and heterogeneity. This regression is included with ϑ_m, month, and μ_y, year, dummy variables. β_k, are coefficients of interest that inform us of the effect that the change in restaurants' quality may have on one another.

I exclude all fast food to observe the effect of competition on independent restaurants in model one. I analyze an alternative specification to observe the change in reviews of restaurants by including interaction terms between competition components and the average review of restaurants. The coefficient on interaction would capture the value of the change in both competition and average review rating component of rival restaurants. In the next step, I analyze the effect of shifting the quality of restaurants in the same category on each other by splitting

restaurants into two categories. One category groups if the same cuisine is served at both restaurants in a one-mile radius, and the second category groups restaurants that serve different cuisines and compete with the given restaurant. Since all restaurants are in three prices range, I categorize restaurants in their price range for separate identification of the first model. The coefficient estimates the change in the restaurant's quality if a similarly priced competitor's average quality changes.

Finally, I estimate the effect of new high-quality entrants on the customer review rating of the incumbent restaurants in the market within a certain radius. I consider the day in which the first review has been posted as the entrance day of a restaurant into a given market. This model can be specified as:

$$R_{it} = \alpha_i + \beta \sum_{i \neq j,} W_{(ij)} en - hq_{j(t-1)} + \gamma_n x_{itn} + \vartheta_m + \mu_y + \in_{it,} \quad (5)$$

Where, $W_{(ij)}$, is the distance band weight matrix from equation 4. Variable, $en - hq_{j(t-1),}$ is the number of high-quality entrants divided by the diversity of the market in a one-mile radius around the restaurant. The coefficient of interest is, β, which identifies the effect of entry on the customer review rating of the incumbent. I consider restaurants that have an average of 4 or more of reviews of at least four-star rating in the first month as a high-quality entrant. I also analyze the model with the entry of all new restaurants, without considering the quality of them.

5. Results

In all tables, panel A utilizes the model with all restaurants in the market and panel B shows the results when fast-food restaurants are excluded from the model. Table 5 shows the effect of competition on review rating of restaurants. The main dependent variables and the coefficient of interests are, $R_{j(t-1)}, R_{j(t-2)}$, which are the changes in rating reviews of rivals with one lag and

two lags, respectively**.** The other dependent variables of the regression are *Number of Reviews, Location Density, Competitiveness,* and *Heterogeneity*.

I find on table 5 that none of the coefficients of interest are significant except, the average change in the review rating of competitors at a two-mile radius which is significant at a 10 percent level in panel A and 5 percent level in panel B. An estimate of 0.1934 in panel A indicates that a restaurant's review rating changes by 0.1934 if the average customer review rating of competitors in two miles changes by one star. The result indicates the evidence of the effect of the average review rating of competitors on the changing of the review rating of a given restaurant. One reason why more significant effects are estimated for a two miles radius is because more restaurants are included in this distance, and a change in average quality would impact more restaurants.

By combining the results of table 5, it is clear that there is that the location component impacts the customer review rating of restaurants. In other words, restaurant quality increases when the competition in the location becomes more intense. Regarding location density, restaurant rating increases by 0.0373 if the number of restaurants in a one-mile distance increases by one standard deviation. One standard deviation in competitiveness (which is equal to 0.111) is estimated to increase the review rating of restaurants by 0.0077. A one value increase in standard deviation of heterogeneity of location (which is equal to 0.192) also improves the quality of restaurants by 0.0066 in a one-mile distance.

It is helpful to capture the effect of competition on the customer review rating of restaurants where both the location characteristic and the average review rating of competitors become more competitive. Table 6, shows the result of Model 1 with the interaction terms between average review rating of rivals and all location components. The coefficients for this interaction term are always significant, between 0.2140 for restaurants within one half-mile to 0.4859 for restaurants

within 2 miles of their competitors. The coefficients for the interaction between review rating and competitiveness are also found to be significant between 0.1052 to 0.2183 for different distances between competitors.

I expect to find that the average changing of the quality of competitors affects the quality of restaurants with the same category. Table 7 shows the results of a change in the quality of restaurants compared to other restaurants in the same category and different category with varying distances. The results of column 5 and 6, for non-fast-food restaurants in the Phoenix Metropolitan area, are statistically significant. This means that restaurants respond to other restaurants of the same category. Review rating changes between 0.0522 and 0.0787 after one month within a one-mile distance and a two-mile distance, respectively, if the average review rating of same category restaurants increases by one value of customer review rating. Average review rating of restaurants with differing categories does not have any effect on competitors.

The most important finding is that an increase in the rating of competitors with the same price is associated with an increase in competing restaurants review rating in the following two months. Table 8 presents the results of changes in quality with differentiating restaurants with their price range. The spillover effect on luxury restaurants is considerably higher than for low-price restaurants. I believe the reason for this difference is that high-price restaurants compete in quality more so than low-price restaurants. For low-price restaurants, competition to a large extent revolves around price. A one-star increase in average quality of competing luxury restaurants can increase the rating of other luxury restaurants within a one-mile radius by 0.2826 after one month. However, economy restaurants and medium-price restaurants are affected by similar, competing restaurants by 0.1665 and 0.0792, respectively. Higher coefficient values for larger market radius

in table 9 is likely due to the larger number of restaurants that are affected, which means that absolute quality improvement is occurring.

Coefficients for location characteristics are more significant for lower priced restaurants compared to higher priced restaurants in table 8. Increasing one value of location density can improve the review rating of economy restaurants by 0.0529 and mid-range restaurants by 0.0153. However, location density does not have a statistically significant effect on luxury restaurants. This means, lower price restaurants shift the quality if the number of their competitors or variety of restaurants in their market change. It can be concluded that luxury restaurants, whose customers are quality sensitive, respond to changes in the quality of their high price rivals more than other types of restaurants. For the economy restaurants with price-sensitive customers, on the other hand, the coefficients for average review rating of customers are getting smaller. As a result, lower priced restaurants are affected more by the location that they compete than the reviews of their rivals.

To investigate the effect of new high-quality entrants on responding to incumbents, I run the fixed effect panel model in the second model. In Table 10, panel A reports coefficients of all the restaurants in the market. Panel B estimates the regression when fast foods are excluded from the model. The results clearly indicate that restaurants respond to their incumbents in panel B. Although the new high-quality entrants do not have a significant effect in Panel A for the improvement of the quality of restaurants in the market, new high-quality entrants in a one-mile radius cause incumbent restaurants to increase quality by 0.02 if fast food restaurants are excluded from the model. This means that a one percent increase in the number of high-quality restaurants around a given restaurant results in an increase in quality by a value of 0.0002. The results illustrate that low-quality entrants would not influence the customer review rating of the incumbents in the market.

6 Conclusion

Understanding the competition pattern of business behavior in the market, especially how businesses respond to each other's quality from the economics perspective, helps business owners proactively recover their loss and improve their benefits. Theoretical analyses conclude that owners' operative profits are affected by quality shifting of other firms.

Using panel data on customer review ratings from Yelp in the Phoenix Metropolitan Area, my research highlights the quality competition in a two-stage format, where profit-oriented business providers set price in the first stage and then shift quality in the next stage based on their rivals quality. Results indicate that elements of competition increase the customer review rating of restaurants. The value of the customer review rating is estimated to rise by 0.0373 for a one standard deviation increase in location density. The level of competitiveness was found to increase the review rating by 0.0077 within a one-mile distance. Heterogeneity is estimated to increase the review rating of restaurants by 0.0066. Review ratings are found to be more critical for luxury restaurants, whose customers are less price sensitive. On average, a one-star review rating increase by a restaurant can increase a competing restaurant's review rating by 0.2826 after one month, if the two are restaurants are within a one-mile radius and have similar prices. Also, as theory predicts, the restaurants with same cuisine type, without considering fast foods in the market, have an effect on the quality rating of each other. A one value change in the quality of restaurants with same cuisine types can shift the quality of competing restaurants by 0.0522 and 0.0787 in one mile and two-mile distances, respectively. Finally, an increase in the proportion of high-quality restaurants increases the customer review ratings of all restaurants by 0.0002.

Overall, the findings of this research show that restaurant competition affects quality. This paper also presents evidence that online customer reviews of restaurants influence each other. An

increase in a competing restaurant's quality makes the market more competitive, which in turn causes restaurants to increase their own quality. The impact of competition is more substantial in luxury and high-price restaurants. The model presented in this paper provides a guide for analyzing quality competition in other markets. The evidence of this paper also has the potential for future research on urban agglomeration and regional economics.

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Table 1: Restaurants Summary Statistic

Variable	mean	Std. Err	Min	Max
Economy Restaurants	0.505	0.499	0	1
Midrange Restaurants	0.47	0.497	0	1
Luxury Restaurants	0.025	0.157	0	1
Average stars	3.413	0.807	1	5
Number of reviews	86.624	143.224	3	2035
Number of Observation	9611			

Notes: Averaged across all restaurants in all periods

Table 2: Number of price level restaurants after omitting variable

Price level	Numbers	%of using	% compare to other
Economy Restaurants	3751	74.321	49.290
Midrange Restaurants	3639	84.944	47.819
Luxury Restaurants	220	78.853	2.891

Table3: *Counts of each restaurants type*

Fast Food	1530	*Mexican*	825	*Sandwiches*	574
Burgers	402	*American (New)*	345	*Breakfast/Brunch*	344
Chinese	344	*Italian*	264	*Chicken Wings*	182
Seafood	150	*Cafes*	150	*Salad*	134
Delis	127	*Sushi Bars*	123	*Japanese*	120
Barbeque	109	*Coffee & Tea*	98	*Event Planning*	97
Thai	96	*Buffets*	89	*Asian Fusion*	78
Greek	76	*Steakhouses*	76	*Diners*	75
Vegetarian/Vegan	73	*Bakeries*	71	*Vietnamese*	68
Hot Dogs	66	*Indian*	65	*Juice Bar & Smoothies*	60
Middle Eastern	50	*Ice Cream*	48	*Specialty Food*	44
Gluten-Free	41	*Korean*	36	*Food Trucks*	33
Latin American	33	*Beer*	32	*Arts & Entertainment*	30
French	29	*Cheesesteaks*	27	*Food Delivery Services*	27
Hawaiian	24	*Comfort Food*	23	*Grocery*	22
Southern	20	*Rest*	2274		

Table 4: Dynamic Summary Statistic of Restaurants

Variable	Mean	Std. Err	Min	Max
Economy Restaurants	0.497	0.499	0	1
Midrange Restaurants	0.473	0.497	0	1
Luxury Restaurants	0.029	0.151	0	1
Review Change	-0.004	0.148	-3	3.5
Average Rivals Review Change	-0.004	0.04	-1.187	1.268
Average Number of Cuisine Type	7.836	18.016	0	38
Number of Reviews	3.091	3.877	0	62
Location Density	53.604	53.257	0	298
Competitiveness	0.103	0.111	0	1
Heterogeneity	1.02	0.192	0	1.337
Time Competing in the Market	39.719	9.13	4	48
Number of Observation	302262			

Notes: Excluded restaurants with missing price and adress and with less than 10 reviews. Distance for competition characteristic is one mile.

Table 5: *Effect of competition on review rating of restaurants*

	Panel A			Panel B		
Dependent Variables	0.5 mile	1 mile	2 mile	0.5 mile	1 mile	2 mile
$R_{j(t-1)}$	0.0386	0.0666	0.1934 *	0.0080	0.0454	0.1995 **
	(0.0522)	(0.0817)	(0.0583)	(0.0352)	(0.0753)	(0.0476)
$R_{j(t-2)}$	-0.0109	0.0252	0.1068	-0.0073	0.0438	0.1245
	(0.0522)	(0.0885)	(0.1349)	(0.0491)	(0.0631)	(0.1234)
Number of Reviews	0.0161 ***	0.0156 ***	0.0156 ***	0.0196 ***	0.0194 ***	0.0194 ***
	(0.0012)	(0.0014)	(0.0014)	(0.0012)	(0.0014)	(0.0014)
Location Density	0.0369 ***	0.0373 ***	0.0375 ***	0.0446 ***	0.0446 ***	0.0448 ***
	(0.0064)	(0.0042)	(0.0043)	(0.0088)	(0.0082)	(0.0082)
Competitiveness	0.0075 **	0.0077 *	0.0131 *	0.0081 **	0.0094 **	0.0153 *
	(0.0034)	(0.0047)	(0.0086)	(0.0023)	(0.0029)	(0.0056)
Heterogeneity	0.0074 ***	0.0066 ***	0.0025	0.0089 ***	0.0080 ***	0.0071 ***
	(0.0026)	(0.0024)	(0.0020)	(0.0026)	(0.0025)	(0.0023)

*Notes: *** p<0.01, ** p<0.05, * p<0.1, standard errors reported in parenthesis are robust at the group level*

Table 6: *Effect of competition on review rating of restaurants with interaction terms*

	Panel A			Panel B		
Dependent Variables	0.5 mile	1 mile	2 mile	0.5 mile	1 mile	2 mile
$R_{j(t-1)}$	0.1279 **	0.0343	0.0632	0.0946	0.0458	0.0867
	(0.0471)	(0.1086)	(0.1805)	(0.0675)	(0.0975)	(0.2273)
$R_{j(t-1)}$ *	0.2140 ***	0.2822 ***	0.4735 ***	0.2245 ***	0.3087 ***	0.4859 ***
Location Density	(0.0450)	(0.0469)	(0.0573)	(0.0411)	(0.0410)	(0.0518)
$R_{j(t-1)}$ *	0.1052 ***	0.1587 **	0.2101 *	0.1379 ***	0.1716 **	0.2183 **
Competitiveness	(0.0315)	(0.0644)	(0.1293)	(0.0311)	(0.0623)	(0.1167)
$R_{j(t-1)}$ *	0.0056	-0.0003	-0.0128	-0.0003	-0.0006	-0.0069
Heterogeneity	(0.0227)	(0.0264)	(0.0230)	(0.0285)	(0.0292)	(0.0314)
Numbers of review	0.0137 ***	0.0137 ***	0.0113 ***	0.0186 ***	0.0185 ***	0.0184 ***
	(0.0011)	(0.0013)	(0.0012)	(0.0012)	(0.0014)	(0.0014)
Location Density	0.0684 **	0.0807 ***	0.0927 ***	0.9574 ***	0.1006 ***	0.1504 ***
	(0.0275)	(0.0108)	(0.0142)	(0.0198)	(0.0134)	(0.0163)
Competitiveness	0.0287 ***	0.0480 **	0.0506	0.0303 ***	0.0496 ***	0.0522
	(0.0079)	(0.0170)	(0.0340)	(0.0076)	(0.0117)	(0.0302)
Heterogeneity	0.0018	0.0056	0.0059	0.0036	0.0108	0.0112 *
	(0.0045)	(0.0061)	(0.0043)	(0.0044)	(0.0067)	(0.0049)

*Notes: *** p<0.01, ** p<0.05, * p<0.1, standard errors reported in parenthesis are robust at the group level*

Table 7: *Effect of competition on review rating of restaurants with cuisine category differentiation*

	Panel A			Panel B		
Dependent Variables	0.5 mile	1 mile	2 miles	0.5 mile	1 mile	2 miles
Same $R_{j(t-1)}$	0.0475	0.0285	0.0554	0.0511	0.0522 **	0.0787 **
	(0.0468)	(0.0683)	(0.1165)	(0.0373)	(0.0175)	(0.0187)
Same $R_{j(t-2)}$	0.0283	0.0266	0.100	0.0194	0.0168	0.02954
	(0.0448)	(0.0708)	(0.124)	(0.0189)	(0.0185)	(0.0298)
Different $R_{j(t-1)}$	-0.0104	0.0069	-0.015	0.0053	0.0037	-0.0059
	(0.0306)	(0.0320)	(0.035)	(0.0280)	(0.0808)	(0.0473)
different $R_{j(t-2)}$	-0.0287	-0.0044	0.017	-0.0094	0.0049	0.0059
	(0.0324)	(0.0308)	(0.034)	(0.0495)	(0.0428)	(0.0280)
Number of Reviews	0.0161 ***	0.0156 ***	0.0156 ***	0.0195 ***	0.0195 ***	0.0195 ***
	(0.0012)	(0.0014)	(0.0014)	(0.0014)	(0.0014)	(0.0014)
Location Density	0.0095 ***	0.0373 ***	0.0374 ***	0.0446 ***	0.0446 ***	0.0448 ***
	(0.0165)	(0.0042)	(0.0043)	(0.0088)	(0.0082)	(0.0082)
Competitiveness	0.0074 **	0.0079	0.0131 *	0.0081 **	0.0095 **	0.0157 **
	(0.0034)	(0.0052)	(0.0086)	(0.0024)	(0.0029)	(0.0042)
Heterogeneity	0.0032	0.0066 ***	0.0024	0.0089 ***	0.0080 ***	0.0071 ***
	(0.0026)	(0.0024)	(0.0020)	(0.0028)	(0.0026)	(0.0024)

*Notes: *** p<0.01, ** p<0.05, * p<0.1, standard errors reported in parenthesis are robust at the group level*

Table 8: *Effect of competition on review rating of restaurants with price differentiation in a one-mile distance*

	Panel A			Panel B		
Dependent Variables	Economy Restaurants	Midrange Restaurants	Luxury Restaurants	Economy Restaurants	Midrange Restaurants	Luxury Restaurants
$R_{j(t-1)l}$	0.1665 *	0.0145	0.0890	0.2793 ***	0.0773	0.1167
	(0.0917)	(0.0827)	(0.1801)	(0.0478)	(0.0487)	(0.9323)
$R_{j(t-2)l}$	0.0333	0.0873	-0.0273	0.0635	0.1191 *	-0.0057
	(0.0929)	(0.0767)	(0.0975)	(0.0589)	(0.0443)	(0.0847)
$R_{j(t-1)m}$	0.0605	0.0253	0.1179	0.1184	0.0459	0.2085 *
	(0.0710)	(0.0772)	(0.1562)	(0.0635)	(0.0571)	(0.0838)
$R_{j(t-2)m}$	0.1293	0.0792 *	0.1383 *	0.1749 *	0.1247 *	0.2268 ***
	(0.0694)	(0.0397)	(0.0797)	(0.0639)	(0.0487)	(0.0586)
$R_{j(t-1)h}$	-0.0218	-0.0292	0.2826 **	0.0191	0.0387	0.3067 ***
	(0.0365)	(0.0311)	(0.0723)	(0.0269)	(0.0295)	(0.0680)
$R_{j(t-2)h}$	0.0295	0.0367	0.1074	0.0312	0.0056	0.1198 *
	(0.0342)	(0.0290)	(0.0612)	(0.0368)	(0.0471)	(0.0558)
Number of Reviews	0.0232 ***	0.0077 ***	0.0059 ***	0.0378 ***	0.0093 ***	0.0060 ***
	(0.0028)	(0.0015)	(0.0005)	(0.0028)	(0.0013)	(0.0005)
Location Density	0.0529 ***	0.0153 ***	0.0059	0.0858 ***	0.0212 ***	0.0094
	(0.0085)	(0.0049)	(0.0146)	(0.0062)	(0.0034)	(0.0097)
Competitiveness	0.0095	0.0095	0.0032 *	0.0086	0.0082	0.0024 *
	(0.0084)	(0.0066)	(0.0012)	(0.0076)	(0.0062)	(0.0010)
Heterogeneity	0.0063 *	0.0064 *	0.0043 *	0.0061 **	0.0061 **	0.0043 *
	(0.0036)	(0.0033)	(0.0025)	(0.0028	(0.0026)	(0.0021)

*Notes: *** p<0.01, ** p<0.05, * p<0.1, standard errors reported in parenthesis are robust at the group level*

Table 9: *Effect of competition on review rating of restaurants with price differentiation in for different radius*

	0.5 mile			2 mile		
Dependent Variables	Economy Restaurants	Midrange Restaurants	Luxury Restaurants	Economy Restaurants	Midrange Restaurants	Luxury Restaurants
$R_{j(t-1)l}$	0.0152	0.0633	0.0700	0.3044 **	0.0723	0.1614
	(0.0612)	(0.0584)	(0.1353)	(0.1255)	(0.1327)	(0.3198)
$R_{j(t-2)l}$	0.0013	0.0024	-0.2672	0.0305	0.0634	0.3706
	(0.0707)	(0.0574)	(0.1945)	(0.0818)	(0.0774)	(0.3184)
$R_{j(t-1)m}$	0.0703	0.0046	-0.0637	-0.0186	0.0645	0.4552
	(0.0507)	(0.0496)	(0.1786)	(0.1332)	(0.1281)	(0.3768)
$R_{j(t-2)m}$	0.0208	0.0723 *	0.0565 *	-0.0425	0.1007 *	0.1493
	(0.0503)	(0.0374)	(0.0206)	(0.0663)	(0.0504)	(0.1623)
$R_{j(t-1)h}$	-0.0293	0.0297	0.0784 *	0.0046	-0.0070	0.2838 **
	(0.0562)	(0.0416)	(0.0363)	(0.0329)	(0.0286)	(0.1474)
$R_{j(t-2)h}$	0.0230	0.0149	0.0105	0.0090	0.0384	0.1079 *
	(0.0496)	(0.0374)	(0.1136)	(0.0175)	(0.0193)	(0.0602)
Number of Reviews	0.0217 ***	0.0072 ***	0.0109 ***	0.0233 ***	0.0078 ***	0.0050 ***
	(0.0021)	(0.0015)	(0.0034)	(0.0028)	(0.0015)	(0.0005)
Location Density	0.0317	0.0113	0.0213	0.0532 ***	0.0156 ***	0.0039
	(0.0279)	(0.0214)	(0.0412)	(0.0085)	(0.0049)	(0.0147)
Competitiveness	0.0171 **	0.0023	0.0044	0.0201	0.0042	0.0107
	(0.0062)	(0.0042)	(0.0091)	(0.0143)	(0.0096)	(0.0255)
Heterogeneity	0.0018 *	0.0047 *	0.0096 *	0.0024	0.0049 *	0.0098 **
	(0.0044)	(0.0019)	(0.0042)	(0.0027)	(0.0032)	(0.0047)

*Notes: *** p<0.01, ** p<0.05, * p<0.1, standard errors reported in parenthesis are robust at the group level*

Table 10: *Effect of new entrants on review rating of restaurants in a one-mile radius*

	Panel A			Panel B		
Dependent Variables	Model 1	Model 2	Model 3	Model 1	Model 2	Model 3
$en - hq_{j(t-1)}$	0.0200	0.0200 *	0.0201 *	0.0240	0.0244 *	0.0245 **
	(0.0149)	(0.0112)	(0.0104)	(0.0148)	(0.0113)	(0.0106)
$en_{j(t-1)}$	0.0368	-	0.0306	0.370	-	0.0331
	(0.0352)		(0.0292)	(0.0358)		(0.0338)
Number of Reviews	-	0.0159 ***	0.0158 ***	-	0.0198 ***	0.0198 ***
		(0.0013)	(0.0013)		(0.0014)	(0.0014)
Location Density	-	0.0373 ***	0.0293 **	-	0.0328 *	0.0287 *
		(0.0022)	(0.0098)		(0.0109)	(0.0124)
Competitiveness	-	0.0077	0.0077	-	0.0094 *	0.0094 *
		(0.0047)	(0.0046)		(0.0044)	(0.0044)
Heterogeneity	-	0.0062 **	0.0062 **	-	0.0083 ***	0.0083 ***
		(0.0022)	(0.0022)		(0.0023)	(0.0023)

*Notes: *** p<0.01, ** p<0.05, * p<0.1, standard errors reported in parenthesis are robust at the group level*

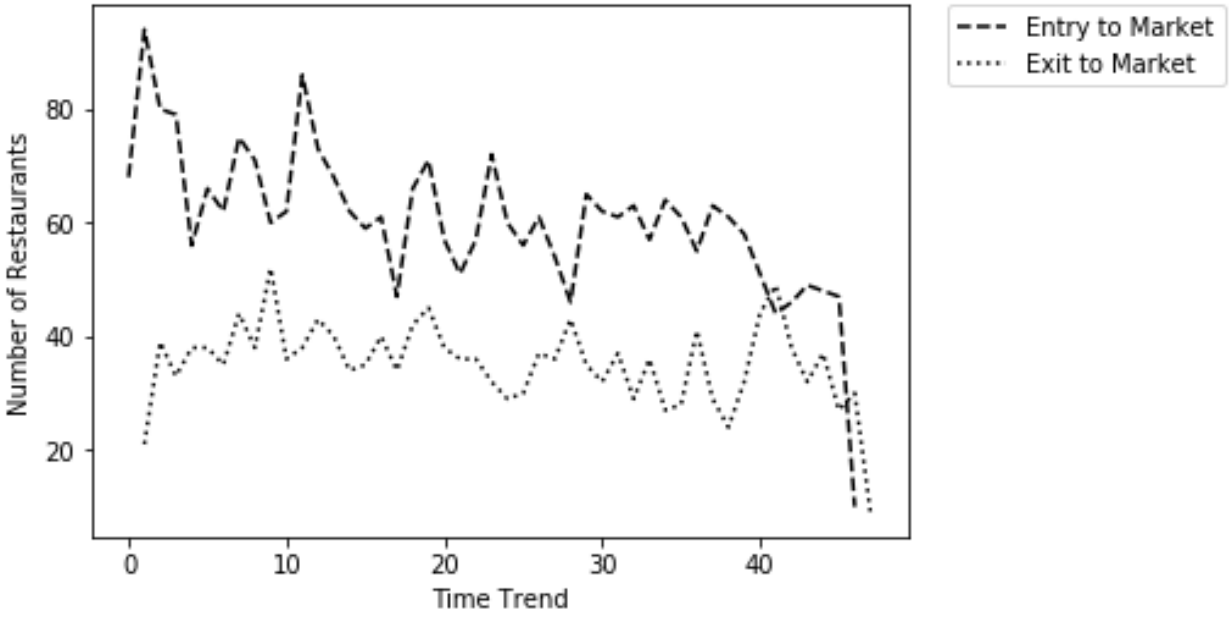

Figure1: Number of entry and exit in each month

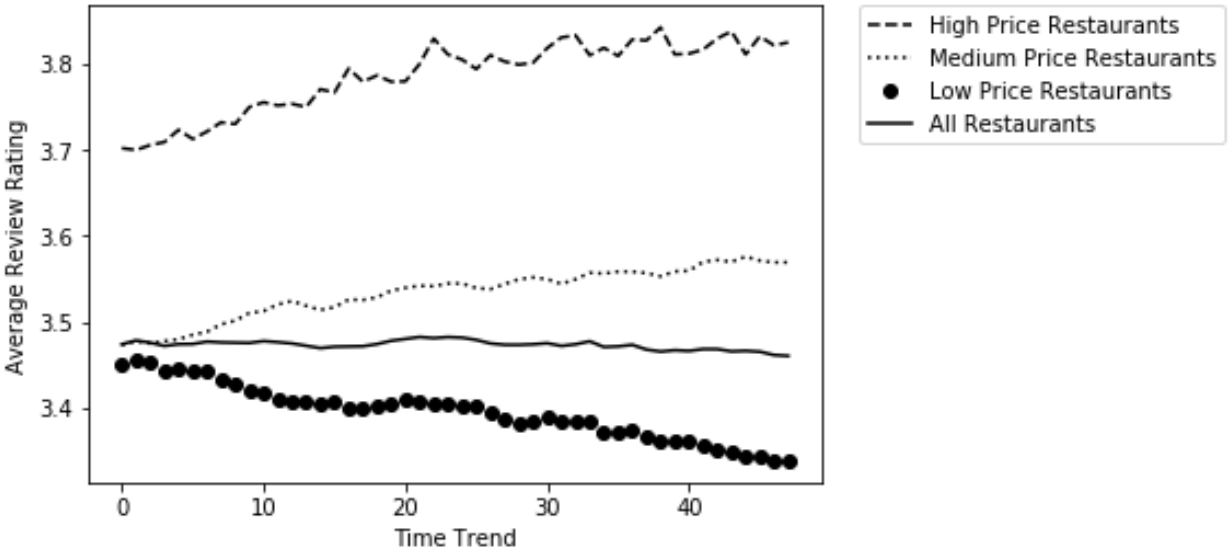

Figure 2: average review rating for the different price range for every month

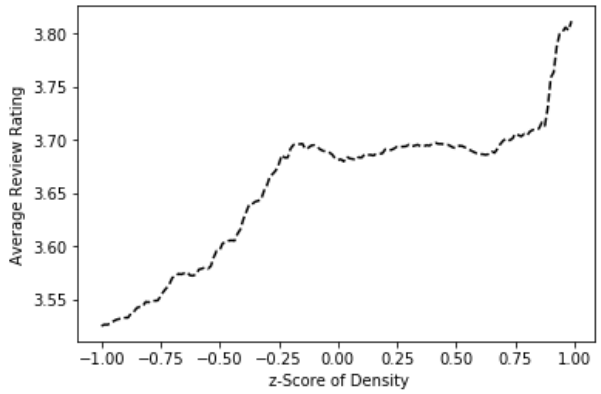

Figure 3: z score of density in one mile compare to review

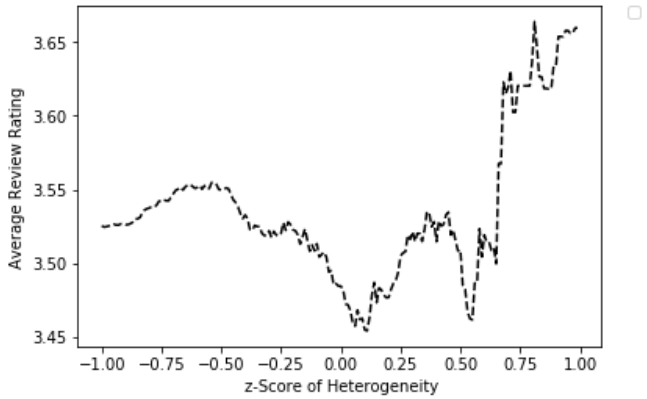

Figure 4: z score of heterogeneity in one mile compare to review

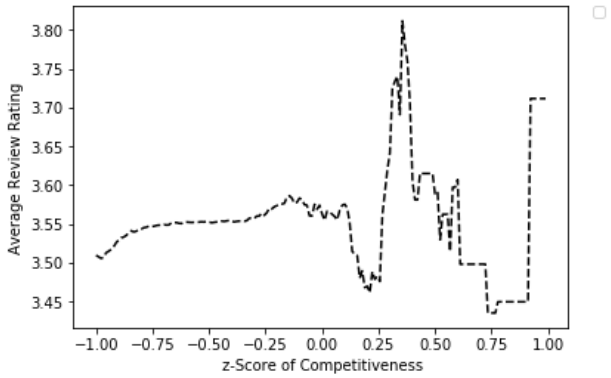

Figure 5: z score competitiveness in one mile compare to review