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Fast Food Restaurant Pricing Strategies in Michigan Food Deserts

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Abstract

The academic literature primarily focuses on the lack of access to affordable, healthy food in food deserts. However, the behavior of the fast food firms in terms of promotions and pricing within food deserts is not well understood. This study uses food desert – non-food desert match design of census blocks to determine how the pricing strategies of fast food restaurant managers in Michigan food deserts differ by location, ownership, and restaurant characteristics. Results show that while restaurants located in food deserts and non-food deserts offer similar amenities, have similar ownership structures, and have similar business approaches, higher prices are charged for select food items at restaurants located in food deserts.

Keywords: fast food, food desert, pricing strategies, cobranding

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Introduction

From 1980 to 2011, fast food consumption in the United States increased from $6 billion to $219 billion per year (Schlosser 2001; Sales 2012). Accounting for nearly 17.6% of an individual's total food expenditures, fast food has established itself as a main component of the American diet (Food 2012). Concurrently with the increase in fast food consumption, obesity in the United States has increased from 22.9% in 1988 to 35.7% in 2011 (Flegal et al. 2002; Ogden et al. 2012). Several studies have linked the consumption of fast food to obesity (Anderson et al. 2011; Jeffery et al. 2006; Thompson et al. 2004; Maddock 2004). More specifically, Spence et al. (2009) found that an increase in the ratio of fast food restaurants and convenience stores to supermarkets increased the prevalence of obesity.

Particular areas where fast food restaurants and convenience stores out number supermarkets are food deserts [a low-income census tract where a substantial share of residents have low access to supermarkets (Food 2008)]. In the absence of supermarkets, food desert residents must find alternative food suppliers, such as fast food restaurants and convenience stores.

The pricing strategies of fast food restaurants in food deserts are important for two reasons: price exploitation and health impacts. Within food deserts, Ver Ploeg (2010) shows that convenience stores often charge higher than normal prices. This study focuses on managerial pricing decisions to determine if fast food restaurants charge higher prices in the absence of competition from supermarkets. Several studies have focused on the pricing strategies of fast food restaurants (Ater et al. 2010; Stewart and Davis 2005; Kalnins 2003; Thomadsen 2002; Jekanowski 1998; Graddy 1997; and LaFontaine 1995), but not specifically on fast food restaurants in food deserts. In addition to those prior studies, this study will also estimate the effect three independent variables have on fast food price: food desert location, whether or not the restaurant is freestanding, and whether or not the restaurant is cobranded.

This research seeks to inform fast food firms about the impact their pricing strategies have on poor, inner-city consumers with low access to supermarkets. This study will address common concepts about food desert policy and initiatives aimed at improving the diet quality and health of food desert residents.

This study compares food desert – non-food desert census blocks to determine how the pricing strategies of fast food restaurant managers in Michigan food deserts differ by location, ownership, and restaurant characteristics. In the remainder of the paper a review of prior literature is presented, followed by the data, methods, results and conclusions.

Fast Food Pricing in Context

According to the 2008 Farm Bill, a food desert is defined as a low-income census tract where a substantial number or share of residents has low access to a supermarket or large grocery store (Food 2008). The ERS' Food Access Research Atlas further defines low access as a census tract with at least 500 people and/or at least 33% of the population is at least a mile from a supermarket or large grocery store and defines low income as a census tract with a poverty rate

of 20% or higher or a median family income at or below 80% of the area's median family income (ERS 2010).

While the effect the absence of supermarkets has on food deserts has been explored in numerous studies, other factors that affect individual's dining choices are not well understood. To address what food desert residents choose to consume and why, it is essential to characterize the entire built food environment (i.e. buildings, stores, roads and natural elements, (Sallis and Glanz 2006)).

To further characterize the entire built food environment, several recent studies have considered 'food swamps' or 'fast food oases'. The term "food swamp" was first proposed by Rose et al. (2009), who conjectured that while a lack of access to healthy food options is detrimental to food desert residents, an abundance of unhealthy dining options such as fast food and convenience stores may pose an even larger problem. Ver Ploeg (2009) further defined the term 'food swamp' as neighborhoods that have relatively easy access to less healthy foods compared with access to healthy foods.

Irrespective of location, there is extensive literature supporting that fast food restaurants strategically set prices. Carmin et al. (1990), Liang and Kanetkar (2006), and Naipaul and Parsa (2001) found evidence that fast food restaurants practice *odds and cents pricing*. Under this pricing strategy, fast food restaurants prefer prices that end in odd digits, particularly '5' and '9', which is commonly referred to as *just below pricing*. Under this strategy, Stiving (2000) found that fast food restaurants are more likely to set prices just below a round dollar amount (e.g. $1.99) because consumers tend to round down when viewing prices. Fast food restaurants also use prices to signal quality to consumers. Carmin et al. (1990) explains that under the *perceived value* strategy, customers view items that are priced higher as higher quality.

In addition to psychological pricing strategies, studies have found that fast food restaurants' prices are linked with the restaurants' costs, characteristics, location, and competition. Common costs associated with the price of fast food are employee payroll, rent, insurance costs, and real estate costs. As each of these costs increases, fast food prices are expected to increase (Stewart and Davis 2005; Graddy 1997; Jekanowski 1998). Stewart and Davis (2005) and Graddy (1997) found a significant positive relationship between the price of fast food and real estate costs. Evidence of a positive relationship between fast food price and rent was also found by Jekanowski (1998). Graddy tested the relationship between price and both insurance costs and employee payroll, but found no significant relationship.

The characteristics of the restaurants themselves have also been found to affect the prices fast food restaurants charge. A fast food restaurant's status as either corporate or franchisee owned, has been found to impact prices. LaFontaine (1995) reported that there is greater price dispersion among franchises than corporate fast food outlets, while Graddy (1999), Ater et al. (2010), and Kalnins (2003) found that franchised fast food outlets tend to charge higher prices than corporate fast food outlets. Unlike company-owned restaurants whose goal is to maximize sales volume, Kalnins (2003) explains that franchises seek to maximize profits because franchisees are residual claimants (i.e. they receive the restaurant's profits, less royalty fees and operating costs). Thus, franchises tend to charge higher prices than company owned stores in order to maximize their profits.

Demographics of the area in which a fast food restaurant is located has also been identified as a factor that influences pricing. Both Graddy (1997) and Stewart and Davis (2005) found that prices charged by fast food restaurants were higher in low income areas. Graddy (1997) explains that income can either be viewed as a competition variable or a discrimination variable. In lower-income areas, there may be less competition from other restaurants, leading to higher prices. Under the discrimination argument, fast food restaurants may be taking advantage of low-income individuals with few other dining alternatives by charging higher prices. In both cases, income is expected to be inversely related to fast food prices.

Stewart and Davis further found that fast food prices are positively related with population and that there was no significant link between price and age (2005). Population is likely positively correlated with fast food prices because as the population in an area increases, total demand for fast food is also likely to increase. A common response to increased demand for a product is to increase prices. Despite Stewart and Davis' (2005) finding that there is no significant link between age and price, age is expected to have an inverse relationship with price because it also affects demand for fast food. Stewart, Blisard, Jolliffe, and Bhuyan (2005) found that age is inversely related to the demand for fast food. Thus, because of lower demand, fast food price is expected to be lower in areas with an older population.

Several studies have found conflicting results on the effect racial composition of an area has on price. Jekanowski (1998) found that fast food prices tended to be lower in areas with higher proportions of African Americans, while Graddy found that fast food prices were positively related to the proportion of African Americans. Stewart and Davis found no significant relationship between fast food price and the proportion of African Americans (2005). Both Stewart and Davis (2005) and Graddy (1997) found no significant relationship between fast food price and the proportion of Hispanics. Differences in fast food prices based on the proportion of the population that is African-American or Hispanic can be explained by a demand approach or a discrimination approach. Under the demand approach, African-Americans and Hispanics are said to have different taste preferences, which affect their demand for fast food; demand in turn affects fast food price. The discrimination approach posits that fast food restaurants use discriminatory pricing strategies under which they charge higher prices in African-American and Hispanic communities. With mixed results on races' effect on fast food price, this study hopes to further characterize the relationship.

Several studies have examined the effect competition from other fast food restaurants, sit-down restaurants, and supermarkets have on fast food prices. Increased competition from other fast food outlets, sit-down restaurants, and supermarkets is likely inversely related with price; increased competition tends to put downward pressure on prices. Graddy (1997), Jekanowski (1998), and Thomadsen (2002) all conclude that increased fast food outlet density in an area leads to lower prices. Jekanowski further found no significant link between fast food price and the density of sit-down restaurants and supermarkets (1998). Binkley and Connor, however, found that there is price competition between fast food outlets and supermarkets, but were unable to determine the specific nature of the competition (1996).

Data

Eight Michigan cities comprise the focus area of this study: Detroit, Flint, Grand Rapids, Lansing, Livonia, Warren, Sterling Heights, and Dearborn. The first four cities are the four largest cities by population in Michigan with areas characterized as food deserts[1] (Food 2008). The latter four cities are the four largest cities in Michigan with no areas characterized as food deserts.

Within these eight cities, this study analyzes the prices charged by McDonald's, Burger King, and Subway outlets. These three fast food chains were selected because they were the only three chains to appear in the eight-firm concentration ratio (CR-8)[2].

Prices were collected via a phone survey for the three top-selling items at each of the restaurants; three items from each restaurant were chosen because restaurants tend to report their top three selling items in their annual reports. According to the McDonald's 2011 Annual Report, these items are the Big Mac, Chicken Nuggets, and Medium French Fries (McDonald's Annual Report 2011). Information on Burger King's top selling items was not available, so the prices of the Whopper, Chicken Nuggets, and Medium French Fries were collected, analogous to McDonald's top three items. Subway's most popular items, the Italian BMT, Tuna, and Subway Club 6-inch sandwiches were listed on the corporate website (Subway FAQS 2012). 6-inch subs were chosen, as opposed to foot-long subs, because of Subway's national pricing campaign for $5 foot long sandwiches.

In order to conduct the survey, the addresses and phone numbers of all McDonald's, Subway, and Burger King restaurants were collected from their respective corporate websites. Every McDonald's (90 restaurants), Burger King (50 restaurants) and Subway (155 restaurants) was surveyed. All of the restaurants were contacted during March of 2013. Three phone call attempts were made to contact each restaurant. During the phone survey, the restaurant's manager was asked the prices of their three top selling items and whether the prices were promotional. Of the total restaurants in the eight cities, price data was collected from 74% of McDonald's, 80% of Burger Kings, and 54% of Subway restaurants and none of the prices collected were promotional. The responding restaurants were a representative sample of fast food restaurants in food deserts, with 55% of McDonald's, 60% of Burger Kings and 47% of Subways being located in food deserts.

The price data collected from the phone survey was supplemented by data from GIS Business Analyst 2011. Derived from the 2010 US Census, Business Analyst provides data on the sales and characteristics of all businesses within the United States. In addition to the fast food restaurants' sales and characteristics, demographic data on the block group where the restaurant is located was obtained from Business Analyst. Block groups are statistical divisions of census tracts, which generally contain 600 to 3,000 people (Geographic 2010). Raja et al. (2008) explain that often, census tracts are often too large to represent a neighborhood and thus a finer

[1] The ERS' Food Access Research Atlas was used to identify food deserts as defined in the 2008 Farm Bill.
[2] The eight-firm concentration ratio (CR-8) refers to the market share of the eight largest fast food firms.

level of geographic scale is needed to analyze food disparities. Thus, the block group level is used because it is the geographic unit that most accurately represents the neighborhood in which food desert residents shop and dine.

Table 1 lists and provides a description of the variables collected from the price survey and GIS Business Analyst 2011. The dependent variables in this study are the prices of each of McDonald's', Burger King's, and Subway's top-selling items. The independent variables are grouped into six categories: location, restaurant characteristics, prices, costs, demographics, and competition.

The expected sign, name, description and data source for of each of the independent variables is shown in Table 1. The primary variable of interest in this study is the food desert dummy. The food desert dummy variable is expected to have a positive relationship with the price of fast food. A positive relationship is expected due to the fact that other food retailers located in food deserts, such as small, independent grocers and convenience stores, have been found to charge higher prices (Chung et al. 1999; Kaufman et al. 1997; MacDonald et al. 1991). Like these smaller food retailers, fast food restaurants are expected to take advantage of the fact that food desert residents have few alternative food sources by charging higher prices at restaurants in food deserts.

Table 1. Description of Independent Variables

Variable	Expected Sign	Abbrev.	Value Description
Dependent			
Price ($)[a]	---	price	Price per food item
Location			
Food Desert (dummy)[b]	+	fdes	1 if food desert, 0 else
Eight City Dummies [b]	+/-	city	1 if in city, 0 else
Restaurant Characteristics			
Franchise (dummy)[b]	+	fran	1 if franchise, 0 else
Cobranded (dummy)[b]	+	co	1 if cobranded, 0 else
Freestanding (dummy)[b]	-	free	1 if freestanding, 0 else
Playplace (dummy)[a]	+	play	1 if playplace, 0 else
Cost			
Median Home Price ($)[b]	+	home	Mean home price in block group
Sales Volume ($1,000)[b]	-	sales	Restaurant's sales volume
Demographics			
Per Capita Income ($)[b]	-	inc	Mean pci in block group
Population (#)[b]	+	pop	Population of block group
Median Age (#)[b]	-	age	Median age in block group
African-American (%)[b]	+/-	afr	% of the block group that is Afr.-Am
Hispanic (%)[b]	+/-	his	% of the block group that is Hispanic
Competition			
Other Fast Food (#)[b]	-	ffres	#of other fast food within 1 mile
Sit-Down Restaurants (#)[b]	-	sdres	# of sit-down restaurants within 1 mile
Supermarkets (#)[b]	-	smrkt	# of supermarkets within 1 mile

[a] Denotes data collected from the pricing survey
[b] Denotes data collected from GIS Business Analyst 2011

The independent variables unique to the food desert research are whether the fast food restaurant is: cobranded, freestanding, and/or has a playplace. Restaurants that are cobranded, i.e. combined with at least one other brand, are expected to have higher prices. This is because cobranded restaurants often have to pay higher franchise fees and royalty fees than non-cobranded units (Abcede 1994). These higher fees likely translate into higher prices. Non-freestanding restaurants, such as those in malls and airports, are expected to charge higher prices because of their convenient locations. Similarly, fast food restaurants with playplaces are expected to charge higher prices because of the additional entertainment value the playplaces provides.

The expected signs of the remaining independent variables were discussed in the overview of prior studies' findings in the literature review.

Methods

Using the phone survey and GIS data described in Table 1, descriptive statistics are used to compare fast food price, restaurant characteristics, costs, demographics, and competition variables between food deserts and non-food desert block groups. Mean comparison tests are also used to determine whether there is a statistically significant difference in the prices charged for each of the restaurants' top-three best-selling items in food deserts compared to non-food deserts.

The findings from the descriptive statistics and mean comparison tests are used to inform the multivariate regression analysis. OLS regression techniques are used to analyze the pricing strategies of the fast food restaurant managers in food deserts. The general form of the model being estimated is detailed in Equation 1.

(1) $price_{1\text{-}9}$ = (*home, sales, inc, pop, age, afr, his, free, co, fran, play, ffres, sdres,, city, fdes*) [3].

The models dependent variable is the price of the fast food item. A total of nine regressions are estimated, one for each of the prices of the top three selling items at McDonald's, Burger King, and Subway.

Results

Descriptive statistics, mean comparison tests, and regression results are presented for each fast food firm separately in order to determine if they use different pricing strategies in food desert versus non-food desert markets.

McDonald's

Descriptive statistics of the data collected on McDonald's restaurants in both the non-food desert and food desert block groups are shown in Table 2. The McDonald's restaurants are relatively

[3] Independent variable abbreviations are detailed in Table 1.

evenly dispersed among food desert and non-food desert block groups, with 37 restaurants located in food deserts and 30 restaurants located in non-food deserts.

Table 2. McDonalds Descriptive Statistics

	Food Desert (N=37)				Non-Food Desert (N=30)			
Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Restaurant Characteristics								
Franchise (dummy)	0.75	0.43	0.00	1.00	0.77	0.43	0.00	1.00
Cobranded (dummy)	0.05	0.23	0.00	1.00	0.06	0.25	0.00	1.00
Freestanding (dummy)	0.95	0.22	0.00	1.00	0.90	0.31	0.00	1.00
Playplace (dummy)	0.30	0.46	0.00	1.00	0.20	0.41	0.00	1.00
Prices								
Price McNuggets ($)	3.44	0.44	1.99	3.99	3.62	0.19	3.17	3.99
Price Big Mac ($)	3.66	0.27	2.96	4.09	3.66	0.23	3.09	4.15
Price Med. Fry ($)	1.63	0.12	1.39	1.9	1.63	0.15	1.00	1.94
Costs								
Median Home Price ($)	70,528	33,072	0	135,859	110,124	55,983	17,500	250,000
Sales Volume ($1,000)	2,127	454	1,040	3,000	1,948	686	1,000	3,360
Demographics								
Per Capita Income ($)	19,158	6,360	1,667	29,416	24,737	7,445	10,221	36,434
Population (#)	1,183	727	18	3,414	1,575	1,095	178	4,610
Median Age (#)	34.21	6.55	23.60	51.70	39.31	9.99	26.50	68.60
African-American (%)	43.00	41.00	0.00	99.00	24.00	36.00	0.00	98.00
Hispanic (%)	7.00	10.00	0.00	46.00	6.00	13.00	0.00	71.00
Competition								
Other Fast Food (#)	2.62	2.42	0.00	14.00	2.63	1.79	0.00	7.00
Sit-Down Restaurants (#)	3.70	3.04	0.00	17.00	5.53	4.38	1.00	24.00
Supermarkets (#)	0.00	0.00	0.00	0.00	0.53	0.57	1.00	2.00

Source. 2010 US Census and Original Price Survey

The descriptive statistics for the price variables suggests that there is price variation among McDonald's restaurants located in food deserts versus non-food deserts. For McNuggets, the mean price is lower in food desert restaurants than in non-food desert restaurants, with mean prices of $3.44 and $3.62 and a standard deviation of $.44 and $0.19 respectively. The mean prices for a Big Mac and Medium Fries are the same for both food desert and non-food desert locations. However, Big Mac price and Medium Fries price have standard deviations that differ between food desert and non-food desert locations. The price of a Big Mac has a mean of $3.66 with standard deviations of $0.27 in food deserts and $0.23 in non-food deserts. Similarly, Medium Fries has a mean of $1.63 and standard deviations of $0.12 in food deserts and $0.15 in non-food deserts.

Table 3. Mean Comparison of McDonald's Prices by Product in Food Deserts vs Non-Food Deserts

Big Mac Price	**Observations**	**Mean**	**Std. Err.**	**Std. Dev.**
Food Desert	37	3.66	0.04	0.27
Non-Food Desert	30	3.66	0.04	0.23
Combined	67	3.66	0.03	0.25
t-statistic: 0.00			Pr(|T|>|t|): 1.00	
McNuggets Price				
Food Desert	37	3.44	0.07	0.44
Non-Food Desert	30	3.62	0.03	0.19
Combined	67	3.52	0.04	0.36
t-statistic: 2.21			Pr(|T|>|t|): .03	
Medium Fries Price				
Food Desert	37	1.63	0.02	0.12
Non-Food Desert	30	1.63	0.03	0.15
Combined	67	1.63	0.02	0.13
t-statistic: -.12			Pr(|T|>|t|): .91	

Source. 2010 US Census and Original Price Survey

Mean comparison tests of Big Mac, McNuggets, and Medium Fries prices, shown in Table 3 confirm that only the price of McNuggets varies between food deserts and non-food deserts. The mean comparison test for McNuggets price has a t-statistic of 2.21, implying that McNuggets price differs between food deserts and non-food deserts at the 5% significance level.

Although there is price variation for McNuggets, Table 2 shows that all McDonald's restaurants offer similar amenities, have similar ownership structure, and have similar business approaches. Of the 37 McDonald's restaurants located in food deserts (non-food deserts), 75% (77%) are franchised, 5% (6%) are cobranded, 95% (90%) are freestanding, and 30% (20%) have a playplace.

In contrast, as expected the cost and demographic variables show differences between the two types of locations. Considering the cost variables, the median home price is lower in food desert block groups at $70,528 compared to $110,124 in non-food desert block groups. Inversely, the sales volume at McDonald's restaurants in food desert block groups is higher at $2,127,000 compared to those in non-food desert block groups, $1,948,000 in 2010. The demographic variables show that per capita income, population, and median age are lower for McDonald's in food desert block groups versus non-food desert block groups. Conversely, the proportion of the population that is either African-American or Hispanic is higher in food desert block groups compared to non-food desert block groups.

The competition variables reveal major differences in the market environment as well with there being more supermarkets, other fast food restaurants, and sit-down restaurants in non-food desert block groups compared to food desert block groups. This is consistent with the definition of a food desert.

Table 4. McDonald's OLS Regression Results by Product (N=67)

Independent Variables	Big Mac Price	Chicken Nuggets Price	Medium Fry Price
Location			
Food Desert	0.118*	-0.066	-0.017
Restaurant Characteristics			
Franchise	0.028	-0.087	-0.079
Cobranded	-0.097	0.183	0.007
Playplace	-0.078	-0.003	0.057*
Costs			
Sales Volume	-0.001**	-0.000	0.000
Demographics			
Per Capita Income	4.02e-06	8.68e-06	6.06e-06*
Population	-0.000	-0.000	-0.000
Median Age	0.008*	0.011**	-0.001
African-American	.042	0.122	0.167**
Hispanic	.018	0.570	0.358**
Competition			
Other Fast Food	.017	0.026	0.013**
Sit-Down Restaurants	.003	0.006	-0.008**
City Dummies			
Lansing	.181*	0.357**	-0.046
Flint	-0.240***	0.006	-0.071*
Grand Rapids	0.032	0.109	-0.122*
Dearborn	-0.249*	0.014	0.172*
Warren	0.236*	0.100	0.005
Livonia	0..246*	0.282	0.007
R-Squared	0.544	0.309	0.461

Significant at the 90% level, ** Significant at the 95% level, *** Significant at the 99% level

The ordinary least squares estimates for Equation 1 with the prices of McDonald's three most popular food items as dependent variables are shown in Table 4. Variance inflation factors were calculated in order to determine if a multicollinearity problem was present. Three of the independent variables (freestanding, median home price, and supermarkets) had variance inflation factors greater than 10. These variables were removed from the model as they were indicative of a multicollinearity problem (Greene 2003). The Breusch-Pagan test for heteroskedasticity was then used to determine if heteroskedasticity was present in each of the three price models. The test results showed that heteroskedasticity was present in the regression with McNuggets price and Medium Fry price as dependent variables. Robust standard errors were then calculated for all three regressions in order to correct for the presence of heteroskedasticity. The r-squared values of 0.544, 0.309, and 0.461 for the Big Mac price, McNuggets price, and Medium Fries price regressions respectively, show that a significant proportion of the price variation is explained by the independent variables.

Because the primary concern of this paper is to determine if fast food restaurants charge different prices in food deserts, the food desert coefficient is discussed first. Of the three food items, the food desert dummy variable is only significantly related to Big Mac price. The multivariate results suggest that, at the 10% significance level, McDonald's restaurants located in food deserts charge $0.118 more for Big Macs holding all other variables constant. This positive relationship supports the hypothesis that McDonald's restaurants are taking advantage of the fact that food desert residents have few other food alternatives by charging higher prices in food deserts. Why Big Macs cost more in food deserts, but McNuggets and Medium Fries do not, is unclear. Big Mac price differences in food deserts may be attributed to the fact that McDonald's views the Big Mac as its "classic" menu item (McDonald's 2009). Within the 2009 McDonald's Annual Report, McDonald's explains that they are focusing on the sales performance and emphasizing the affordability of their classic menu items such as the Big Mac and the Quarter Pounder with Cheese (McDonald's 2009). The fact that McDonald's specifically focuses on Big Mac sales and affordability may explain why they vary its price in food deserts, but do not vary the price of McNuggets and Medium Fries.

The regression result that Big Macs price is higher in food deserts contrasts with the bivariate mean comparison tests, which showed that there was a significant difference in the price of McNuggets between food desert and non-food desert restaurants, but Big Mac price and Medium Fry price did not differ. These contrasting results arise because the multivariate regression analysis takes into account other location, restaurant characteristics, demographics, costs, and competition variables when determining whether prices differ in food deserts.

Of the three restaurant characteristics variables unique to this study, only the presence of a playplace was found to affect price at the 10% significance level, suggesting that McDonald's restaurants charge $0.057 more for Medium Fries at restaurants that have a playplace. This result supports the hypothesis that restaurants can charge higher prices because of the extra entertainment value that a playplace provides.

Unlike prior studies by Graddy (1999), Ater et al. (2010), and Kalnins (2003), this study finds no significant pricing differences among corporate and franchisee owned McDonald's restaurants.

Looking at the cost variables, the regression results show that there is a negative relationship between sales volume and the price of a Big Mac. At the 5% significance level, a $1,000 increase in sales volume decreases the price of a Big Mac by $0.001. This finding supports the economies of scale view that increased sales can lead to decreased per unit costs, which can then translate into lower prices.

Considering the demographic variables, the regression results show that per capita income, median age, the proportion of the population that is African-American, and the proportion of the population that is Hispanic affect fast food price. Per capita income has a positive relationship with the price of a Medium Fry. Although the per capita income coefficient is significant at the 10% level, its value is close to zero. This implies that, like the Big Mac price and the McNuggets price, the price of Medium Fries is not affected by per capita income. Population is found to have no effect on fast food price. This is contrary to the findings of Stewart and Davis (2005) who found a positive relationship between population and fast food price. This difference in findings

is likely a result of the differing study areas. Median age is positively related to both Big Mac price and McNuggets price. This positive relationship is opposite of what was expected. Prior findings by Stewart, Blisard, Jolliffe, and Bhuyan (2005), showed that fast food demand decreased with age. A typical response to an increase in demand is to increase prices. Thus age was expected to be inversely related to price. The positive relationship between median age and fast food price may result from age groups having different food preferences and dining habits in this paper's study area.

Both the proportion of the population that is African-American and the proportion of the population that is Hispanic are positively related to the price of Medium Fries. At the 5% significance level, a 1% increase in the proportion of the population that is African-American (Hispanic) leads to a $0.167 ($0.358) increase in the price of a Medium Fry. For the Big Mac price and McNuggets price regressions, the coefficients on race variables are nearly significant. This finding is identical to that of Graddy (1997) who found that fast food restaurants charge more for fries in areas with higher proportions of African-Americans. This finding suggests that McDonald's may be using discriminatory pricing strategies under which they charge higher prices in areas with higher proportions of minorities. An alternative explanation is that African-Americans and Hispanics may have different tastes and food preferences which affect their demand for fries. This difference in demand could in turn affect the price of fries in African-American and Hispanic communities.

Of the competition variables, the presence of other fast food restaurants and sit-down restaurants has an effect on the Medium Fry price. At the 5% significance level, an additional fast food restaurant (sit-down restaurant) leads to a $0.013 increase ($0.008 decrease) in the price of a Medium Fry. The positive relationship between the number of other fast food restaurants and Medium Fry price is opposite of what was expected. Additional competition from other fast food restaurants was expected to cause restaurants to lower prices. Muller (1997) offers a possible explanation why the number of food restaurants is positively related to Medium Fry price, but not Big Mac price or McNuggets price. Muller (1997) explains that small changes in the price of a fast food item will lead customers to substitute the item with a competitor's product. Following this argument, McDonald's may not charge higher prices for the Big Mac and McNuggets when faced with competition from other fast food outlets because the Whopper and Burger King Chicken Nuggets act as close substitutes. Because McDonald's french fries are perceived superior in the fast food industry, consumers are likely less sensitive to the Medium Fry price (America's 2012). Thus McDonald's can charge higher prices for Medium Fries despite the added competition from other fast food restaurants.

The inverse relationship between the number of sit-down restaurants and the price of a Medium Fry supports the idea that increased competition leads to lower prices. This finding also supports prior findings that sit-down restaurants have recently been lowering prices in order to compete with fast food restaurants (Senauer et al. 2010). If fast food restaurants charge high prices for additional items such as fries and soda, alternative dining options such as sit-down restaurants may become more appealing.

The regression results show that McDonald's prices vary with the city that the restaurant is located in. The varying prices for the three food items are due to differences in costs of living and consumer preferences amongst the seven cities[4].

Burger King

Descriptive statistics of the data collected on Burger King restaurants in both non-food desert and food desert block groups are shown in Table 5. Similar to McDonald's, the Burger King restaurants are relatively evenly dispersed in food desert and non-food desert block groups, with 24 restaurants located in food deserts and 16 restaurants located in non-food deserts.

Table 5. Burger King Descriptive Statistics

	Food Desert (N=24)				Non-Food Desert (N=16)			
Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Restaurant Characteristics								
Cobranded (dummy)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Freestanding (dummy)	1.00	0.00	1.00	1.00	1.00	0.00	1.00	1.00
Playplace (dummy)	0.17	0.38	0.00	1.00	0.19	0.40	0.00	1.00
Prices								
Price Nuggets ($)	2.83	0.36	2.49	3.69	2.82	0.47	2.02	3.69
Price Whopper ($)	3.59	0.18	3.29	3.95	3.64	0.18	3.29	3.81
Price Med. Fry ($)	2.01	0.19	1.79	2.43	2.00	0.13	1.79	2.29
Costs								
Median Home Price ($)	60,098	33,444	0	112,500	109,220	35,255	47,424	188,996
Sales Volume ($1,000)	1,085	345	600	1,960	1,060	305	640	1,600
Demographics								
Per Capita Income ($)	19,939	7,244	8,579	32,108	24,599	6,030	10,411	33,268
Population (#)	1,143	669	136	2,713	1,533	1,066	411	4,610
Median Age (#)	33.26	6.08	22.80	46.00	37.75	5.07	31.60	51.70
African-American (%)	46.00	39.00	1.00	98.00	10.00	24.00	0.00	98.00
Hispanic (%)	11.00	16.00	0.00	71.00	6.00	13.00	0.00	53.00
Competition								
Other Fast Food (#)	1.50	1.64	0.00	6.00	2.56	1.41	1.00	5.00
Sit-Down Restaurants (#)	3.95	4.17	0.00	15.00	6.25	7.17	2.00	32.00
Supermarkets (#)	0.00	0.00	0.00	0.00	0.44	0.63	0.00	2.00

Source. 2010 US Census and Original Price Survey

The descriptive statistics suggest that there is price variation in all three of Burger King's top-selling items in food desert versus non-food desert locations. The price of Chicken Nuggets has a mean of $2.83 ($2.82) and a standard deviation of $0.36 ($0.47) in food desert (non-food

[4] None of the McDonald's restaurants were located in Sterling Heights

desert) locations. The price of a Whopper has a mean of $3.59 ($3.64) and a standard deviation of $0.18 ($0.18) in food desert (non-food desert) locations. Similarly, the mean price of Medium Fries is $2.01 ($2.00), with a standard deviation of $0.19 ($0.13) in food desert (non-food desert) locations.

Mean comparison tests for the price of each of the three food items in two location types are shown in Table 6. The t-statistics for Whopper price and Chicken Nuggets price are 0.91 and -0.11. This implies that there is no significant price difference for Whoppers and Chicken Nuggets in food deserts compared to non-food deserts. The mean comparison test for Medium Fries, however, has a t-statistic of -1.93. This indicates that medium fry price differs in food deserts compared to non-food deserts at the 10% level.

Table 6. Mean Comparison of Burger King Prices by Product in Food Deserts vs Non-Food Deserts

Whopper Price	**Observations (#)**	**Mean ($)**	**Std. Err. ($)**	**Std. Dev. ($)**
Food Desert	24	3.59	0.04	0.18
Non-Food Desert	16	3.64	0.05	0.18
Combined	40	3.61	0.03	0.18
t-statistic: .91			**Pr(|T|>|t|): .3714**	
Nuggets Price				
Food Desert	24	2.83	0.07	0.36
Non-Food Desert	16	2.82	0.12	0.47
Combined	40	2.83	0.06	0.4
t-statistic: -.11			**Pr(|T|>|t|): .91**	
Medium Fries Price				
Food Desert	24	2.1	0.04	0.19
Non-Food Desert	16	2	0.03	0.13
Combined	40	2.06	0.03	0.17
t-statistic: -1.93			**Pr(|T|>|t|): .06**	

Unlike McDonald's, the descriptive statistics in Table 5 show that there is no variation present in the cobranding and freestanding restaurant dummy variables. All of the Burger King restaurants in this sample are non-cobranded and are freestanding. Information on whether the Burger King restaurant is a franchise was not available and is thus not included in Table 5. There is, however, a small difference in the percentage of Burger King restaurants that have a playplace, 17% (19%) of Burger King restaurants located in food deserts (non-food desert).

The descriptive statistics for the cost variables show that median home price is higher in non-food desert block groups and that the sales at Burger King restaurants in food deserts are higher than the sales of those in non-food deserts. Similar to McDonald's, the demographic variables, per capita income, population, and median age are higher in non-food desert block groups. Also like McDonald's, the proportion of the population that is African-American and the proportion of the population that is Hispanic are higher in food desert block groups.

In the competition variable category, there are more sit-down restaurants, supermarkets, and other fast food restaurants in non-food desert block groups.

The ordinary least squares estimates for Equation 1 with the prices of Burger King's three food items as dependent variables are shown in Table 7. Because of the small number of observations (N=40), bootstrapping, using 200 replications, was used to estimate the standard errors of the regression coefficients. The city dummy variables were not included in the regression in order to increase the degrees of freedom. Variance inflation factors were calculated in order to determine if a multicollinearity problem was present. None of the variables had a variance inflation factor greater than 10, suggesting that multicollinearity was not present in the model. The Breusch-Pagan test for heteroskedasticity was then used to determine if heteroskedasticity was present in each of the three price models. The test results showed that heteroskedasticity was present in the regression with Chicken Nuggets price as the dependent variable. Robust standard errors were then calculated for all three regressions in order to correct for the presence of heteroskedasticity.

Table 7. Burger King's OLS Regression with Bootstrapped SEs Results (N=40)

Independent Variables	Whopper Price	Chicken Nuggets Price	Medium Fry Price
Location			
Food Desert	-0.040	-0.110	0.064
Restaurant Characteristics			
Playplace	-0.003	-0.144	-0.066
Costs			
Sales Volume	-0.000	0.000	0.000
Median Home Value	-2.36 E-07	-7.31 E-07	7.44 E-07
Demographics			
Per Capita Income	3.51 E-06	-3.68 E-06	-4.62 E-06
Population	-0.000	0.000	-0.000
Median Age	-0.018	-0.027	-0.009
African-American	-0.240	-0.287	0.044
Hispanic	-0.331	0.292	-0.810***
Competition			
Other Fast Food	-0.031	0.007	-0.019
Sit-Down Restaurants	0.004	0.013	0.007
Supermarkets	0.061	-0.028	0.046
R-Squared	0.217	0.361	0.401

Significant at the 90% level, ** Significant at the 95% level, *** Significant at the 99% level

The Burger King regression results with bootstrapped standard errors are shown in Table 7. Unlike the mean comparison test results in Table 6, which show that Medium Fry price differs between food deserts and non-food deserts, the regressions results show that being located in a food desert does not significantly affect the price of a Whopper, Chicken Nuggets, or a Medium Fry. This finding suggests that, after accounting for other factors, Burger King does not use different pricing strategies in restaurants located in food deserts versus non-food deserts.

In addition to the food desert variable, only one of the other independent variables significantly affects the food item prices. At the 1% significance level, a 1% increase in the proportion of the population that is Hispanic leads to a $0.81 decrease in the price of a Medium Fry. Within the regressions for each of the three food items, the constant term was significant at the 1% level. This suggests that variables, other than those included in this study and prior literature, likely have an effect on the prices Burger King charges at its restaurants. These finding suggests that the pricing strategies of Burger King differ greatly from those employed by McDonald's and the fast food industry as a whole.

Subway

Descriptive statistics of the data collected on Subway restaurants for both block groups are shown in Table 8. The Subway restaurants are evenly distributed, with 39 restaurants in food deserts and 44 restaurants in non-food deserts.

Table 8. Subway Descriptive Statistics

	Food Desert (N=39)				Non-Food Desert (N=44)			
Variable	**Mean**	**Std. Dev.**	**Min.**	**Max.**	**Mean**	**Std. Dev.**	**Min.**	**Max.**
Restaurant Characteristics								
Cobranded (dummy)	0.36	0.49	0.00	1.00	0.39	0.49	0.00	1.00
Freestanding (dummy)	0.64	0.49	0.00	1.00	0.61	0.49	0.00	1.00
Prices								
Price Italian BMT ($)	4.03	0.09	4	4.25	4.01	0.05	4	4.25
Price Tuna ($)	4.08	0.17	4	4.5	3.89	0.3	3.5	4.5
Price Subway Club ($)	4.55	0.1	4.5	4.75	4.46	0.17	4.00	4.75
Costs								
Median Home Price ($)	81,924	54,166	0	198,077	126,857	71,725	0	265,909
Sales Volume ($1,000)	268	125	40	720	318	160	80	800
Demographics								
Per Capita Income ($)	23,580	10,328	11,370	49,343	26,510	10,479	2,424	53,902
Population (#)	1,239	759	38	3,847	1,441	890	33	4,085
Median Age (#)	37.87	6.51	25.50	50.50	39.59	8.13	23.90	57.70
African-American (%)	45.00	39.00	0.00	99.00	15.50	27.76	0.00	98.25
Hispanic (%)	7.50	13.10	0.00	62.70	2.69	3.10	0.00	17.52
Competition								
Other Fast Food (#)	2.51	1.73	0.00	7.00	2.48	1.55	0.00	6.00
Sit-Down Restaurants (#)	6.77	10.84	0.00	51.00	7.11	5.97	0.00	24.00
Supermarkets (#)	0.00	0.00	0.00	0.00	0.75	0.62	0.00	2.00

Source. 2010 US Census and Original Price Survey

The descriptive statistics suggest that there is price variation in all three Subway sandwiches in food desert versus non-food desert restaurants. The 6-inch Italian BMT price has a mean of

$4.03 ($4.01) and a standard deviation of $0.09($0.05), the 6-inch Tuna price has a mean of $4.08($3.89) and standard deviation of $0.17($0.3), and the 6-inch Subway Club price has a mean of $4.55($4.46) and a standard deviation of $0.10($0.17) in food desert (non-food desert) locations.

Mean comparison tests for sandwich prices in food deserts compared to non-food deserts are shown in Table 9. The t-statistic for the Italian BMT price is -1.32, suggesting that its price does not differ in food deserts versus non-food deserts. The t-statistics for the Tuna and Subway Club however are -3.78 and -2.98 respectively. This implies that at the 1% significance level, the 6-inch Tuna sandwich and the 6-inch Subway Club cost more at restaurants in food deserts.

Like McDonald's, Table 8 shows Subway restaurants located in food deserts and non-food deserts have similar ownership structure and have similar business approaches. Of the 39 (44) Subway restaurants located in food deserts (non-food deserts), 36% (39%) are cobranded and 64% (61%) are freestanding. The franchise variable was not included in Table 8 due to the fact that all Subway restaurants are franchised. Further, the playplace variable was excluded because no Subway restaurant in the sample had a playplace.

Considering the cost variables, median home price is higher in food desert block groups. Unlike McDonald's and Burger King, sales volume is higher at Subway restaurants located in non-food desert block groups. This difference suggests that food desert residents are more likely to dine at burger restaurants and less likely to dine at Subway than non-food desert residents.

Table 9. Mean Comparison of Subway Prices by Product in Food Deserts vs Non-Food Deserts

Italian BMT Price	**Observations (#)**	**Mean ($)**	**Std. Err. ($)**	**Std. Dev. ($)**
Food Desert	39	4.03	0.01	0.09
Non-Food Desert	44	4.01	0.01	0.05
Combined	83	4.02	0.01	0.07
t-statistic: -1.32			**Pr(|T|>|t|): .19**	
Tuna Price				
Food Desert	39	4.08	0.03	0.17
Non-Food Desert	44	3.89	0.05	0.3
Combined	83	3.98	0.03	0.26
t-statistic: -3.78			**Pr(|T|>|t|): .0003**	
Subway Club Price				
Food Desert	44	4.55	0.02	0.1
Non-Food Desert	39	4.46	0.03	0.17
Combined	83	4.5	0.02	0.15
t-statistic: -2.98			**Pr(|T|>|t|): .004**	

Source. GIS Business Analyst and Price Survey

As with McDonald's and Burger King, per capita income, population, and median age are higher in non-food desert block groups, while the proportions of the population that are African American and Hispanic are higher in food desert block groups.

Descriptive statistics for the competition variables show that there are more sit-down restaurants and supermarkets in non-food desert block groups. However, there are more other fast food restaurants in food desert block groups compared to non-food desert block groups.

The OLS regression results for the three Subway sandwiches are presented in Table 10. Variance inflation factors were calculated in order to determine if a multicollinearity problem was present. Three of the independent variables (freestanding, median home price, and supermarkets) had variance inflation factors greater than 10. These variables were removed from the model as they were indicative of a multicollinearity problem (Greene 2003). The Breusch-Pagan test was then used to determine if heteroskedasticity was present in each of the three price models. The test results showed that heteroskedasticity was present in the regression with Italian BMT price and Subway Club price as dependent variables. Robust standard errors were then calculated for all three regressions in order to correct for the presence of heteroskedasticity. The r-squared values of 0.115, 0.455, and 0.216 for the Italian BMT, Tuna, and Subway Club price regressions respectively, show the percent of the price variation explained by the independent variables.

Within the OLS regression for each Subway sandwich, city dummy variables are omitted. Upon analyzing the data collected from the pricing survey, it was found that Subway appears to charge uniform prices for their menu items within each city. For example, in all but 2 Subway restaurants in the sample from Grand Rapids, the 6-inch Subway Club costs the same price, $4.50. In order to determine whether Subway's prices are affected by the food desert dummy, restaurant characteristics, costs, demographics, and competition, it was necessary to exclude the city dummy variables.

The regression results in Table 10 show that Subway restaurants located in food deserts charge higher prices for 6-inch Tuna sandwiches and 6-inch Subway club sandwiches. At the 10% significance level, Subway restaurants charge $0.091 more for 6-inch Tuna sandwiches in food deserts. Similarly, at the 1% significance level, Subway restaurants located in food deserts charge $0.137 more for 6-inch Subway Club sandwiches. These results confirm the bivariate mean comparison test findings that the prices of the 6-inch Tuna and 6-inch Subway Club were higher in food desert versus non-food desert block groups. This positive relationship between price and food deserts supports that Subway restaurants are taking advantage of the fact that food desert residents have few other food alternatives by charging higher prices in food deserts. Why the price of a 6-inch Italian BMT does not vary between Subways located in food deserts versus non-food deserts requires further study outside the scope of this paper.

As with McDonald's, cobranding has no effect on the prices charged for each of the three Subway sandwiches. This suggests that the extra value added from combining two or more brands, does not allow fast food restaurant managers to charge higher prices.

Table 10. Subway's OLS Regression Results (N=83)

Independent Variables	Italian BMT Price	Tuna Price	Subway Club Price
Location			
Food Desert	0.026	0.091*	0.137***
Restaurant Characteristics			
Cobranded	-0.003	-0.001	0.048
Costs			
Sales Volume	0.000	0.001*	-0.000
Demographics			
Per Capita Income	-8.01 E -07	-4.14 E-06	-2.21 E-06
Population	-0.000**	3.78 E -06	8.47 E-06
Median Age	0.001	0.009**	0.001
African-American	-0.017	0.372***	-0.019**
Hispanic	-0.053	0.423*	-0.310**
Competition			
Other Fast Food	0.007	0.034*	-0.019
Sit-Down Restaurants	0.002	-0.003	-0.000

The cost variable, sales volume is found to have a positive relationship with the price of a 6-inch Tuna sandwich. The regression results imply that at the 10% significance level, a $1,000 increase in restaurant sales leads to a $0.001 increase in the price of a 6-inch Tuna sandwich. This finding supports the idea of economies of scale, under which increased sales leads to lower per unit costs, which in turn translate into lower prices.

Four of the demographic variables were found to affect the prices of Subway's sandwiches. The population of the block group in which the Subway is located is inversely related to the price of the 6-inch Italian BMT. However, the coefficient for population in the Italian BMT regression is close to zero. This suggests that like the Tuna price and Subway Club price, the population does not affect the price of the Italian BMT. Median age has a positive relationship with the price of the 6-inch Tuna sandwich. This positive relationship is opposite of what was expected based on the findings by Stewart, Blisard, Jolliffe, and Bhuyan (2005), who showed that fast food demand decreased with age. A typical response to an increase in demand is to increase prices. Thus age was expected to be inversely related to price. The positive relationship between median age and fast food price may result from age groups having different food preferences, which affect their demand for fast food, in this paper's study area.

Both the proportion of the population that is African-American and the proportion of the population that is Hispanic affect the price of Subway sandwiches. A 1% increase in the proportion of the population that is African-American leads to a $0.372 increase in the price of a 6-inch Tuna sandwich at the 1% significance level. Conversely, a 1% increase in the proportion of the population that is African-American leads to a $0.019 decrease in the price of the Subway Club. Similarly, a 1% increase in the proportion of the population that is Hispanic leads to a $0.423 increase ($0.310 decrease) in the price of a 6-inch Tuna (6-inch Subway club) sandwich.

Why Subway charges higher prices for Tuna sandwiches, lower prices for Subway Club sandwiches, and the same prices for Italian BMT sandwiches in communities with a higher proportion of minorities is unclear. It may be the case that African-American's and Hispanic's have higher demand for Tuna sandwiches and lower demand for Subway Club sandwiches compared to population demand as a whole. These differences in demand may translate into different prices for the sandwiches.

The regression results show that per capita income does not affect the price of the three Subway sandwiches. This result differs from both Graddy (1997) and Stewart and Davis (2005) who found that fast food prices were higher in lower-income areas.

Considering the competition variables, only the number of other fast food restaurants affect the price of Subway sandwiches. At the 10% significance level, an additional fast food restaurant causes Subway to charge $0.034 more for a 6-inch Tuna sandwich. Muller's (1997) finding that small changes in the price of a fast food item will lead customers to substitute the item with a competitor's product, can again be used to support this positive relationship. The Italian BMT sandwich and Subway Club sandwich both contain meat and can be viewed as substitutes to the Big Mac and Whopper. The Tuna sandwich however does not have a close substitute at McDonald's and Burger King, whose only seafood offering is a fried fish sandwich. Thus, Subway can likely charge higher prices for the Tuna sandwich despite the added competition from other fast food restaurants.

Conclusions

The results of this study indicate that despite having similar ownership structure, offering similar amenities, and having similar business approaches, some fast food restaurants charge higher prices for select food items at restaurants located in food deserts. Regression results indicate that the McDonald's Big Mac and Subway's 6-inch Tuna and 6-inch Subway Club sandwiches are more expensive in food desert versus non-food desert restaurants. Unlike McDonald's and Subway, Burger King does not appear to charge different prices at food desert versus non-food desert restaurants.

The conclusion that fast food restaurants such as McDonald's and Subway are charging higher prices in food deserts, combined with prior findings that small grocers and convenience stores charge higher prices in food deserts (Chung et al. 1999, Kaufman et al. 1997, MacDonald et al. 1991), suggests the food industry needs to reevaluate their approach to marketing to poor underserved markets. Policymakers may also need to investigate the overall higher food costs in food desert locations.

In addition to evidence of higher fast food prices in food deserts, this study finds that sales at McDonald's and Burger King are higher at restaurants located in food deserts, while sales at Subway are lower at restaurants located in food deserts. This finding suggests that food desert residents are more likely to dine at burger style restaurants than at Subway. With Subway often viewed as a healthier option than burger style restaurants, this finding supports the need for continued food education programs in food deserts. Continued funding of programs such as The Supplemental Nutrition Assistance Program (SNAP-Ed) and The Expanded Food Nutrition

Education Program (EFNEP) is essential in that they are helping individual's with limited means gain the knowledge, skills, and attitudes necessary to have a nutritionally sound diet (Expanded 2013).

This study is the first to analyze fast food restaurant pricing strategies in food deserts. Additional research and data is needed to further understand the role fast food restaurant pricing plays in food deserts. Questions of particular interest include:

- How do fast food restaurants decide which items to charge higher prices for in food deserts?
- Do fast food restaurants charge higher prices for menu items with higher nutritional value at restaurants located in food deserts?
- How are fast food pricing and consumer preferences associated in food desert locations?

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