Product Positioning and Competition:
The Role of Location in the Fast Food Industry

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Abstract

This paper examines how product positioning and competition jointly impact prices and variable profits. Product positioning is analyzed both empirically and theoretically in the context of retail outlet locations in the fast food industry. First, I present an estimated model of demand and supply that accommodates the impact of geography on consumer preferences and competition. I then use this model to calculate how equilibrium prices and variable profits depend on an outlet's proximity to its competitors. The magnitudes of the effects are of direct interest to the fast food industry. However, the simulated theoretical outcomes have broader implications for horizontal product positioning in any product category.

I find that even a small amount of geographic differentiation can lead to large changes in prices and variable profits. Further, prices and profits can vary non-monotonically with increased differentiation. In general, prices level off at approximately monopolistic levels when outlets are located just over 2 miles apart, while profits only level off at monopolistic levels once the competing outlets are about 4 miles apart. The difference in these thresholds occurs because the presence of a competitor can have two effects on price. On one hand, the presence of a competitor means that consumers have another option, which decreases their willingness-to-pay. On the other hand, the competitor generally steals consumers whose willingness-to-pay are lower than average, raising the willingness-to-pay of remaining consumers. These two effects approximately offset when the outlets are about 2 miles apart. However, the latter effect can dominate, leading to the following surprising results: Entry can lead to higher prices and equilibrium prices can be above the monopoly levels. Finally, I find that the dominant chain – McDonald's – has an incentive to locate close to its competitors. In contrast, the weaker chain – Burger King – has an incentive to differentiate itself geographically from McDonald's. However, both firms would choose to locate close to a competitor if it also led to being close to a large source of demand, such as a mall or a business district.

Because geographic location is just a type of product differentiation, the results from the theoretical model – including the findings that prices vary non-monotonically with the level of differentiation, that equilibrium prices can be above the monopoly level when there is a medium level of differentiation, and that the dominant firm wants to match the positioning of the weaker firm while the weaker firm wants to distinguish itself – all apply to horizontal product positioning scenarios in any industry.

INTRODUCTION

Marketing managers need to understand how product differentiation affects competition when deciding how to position a product. The importance of this topic has generated a vast literature on optimal product positioning in the presence of competitors. Much of the theoretical literature on product positioning concludes that firms should differentiate their products in order to soften price competition. For example, Hauser (1988) finds this result using the defender model of Hauser and Shugan (1983), while Moorthy (1988) gets similar results while examining the optimal positioning of vertically-differentiated product lines. More recently, Tyagi (2000) shows that firms may choose to differentiate themselves from firms that have a cost-advantage over them. Neven and Thisse (1990) and Irmen and Thisse (1998) extend the literature by providing models where firms compete over several product attributes. Both papers conclude that firms will differentiate themselves through one product attribute – horizontal or vertical – and that all firms will choose the optimal product for the other attributes. However, not all models find that firms differentiate themselves; Anderson, de Palma and Thisse (1992) show that otherwise identical firms competing for consumers with heterogeneous tastes along both a linear Hotelling dimension and a logit dimension will locate together at the center of the market when travel costs are low enough and that consumers are not too price sensitive.[1]

These theoretical papers have been complemented by computational and empirical papers such as Gavish, Horsky and Srikanth (1983) and Sudharshan, May and Shocker (1987), which study optimal product positioning in markets where consumers have ideal

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[1] These restrictions are not consistent with estimates for the fast food industry in Thomadsen (2005).

points in attribute space. However, these papers do not consider the price response to entry, which theoretical papers have shown to be important. Horsky and Nelson (1992) add competitive response by estimating a choice model and evaluating the optimal product positioning when competitors change their prices after entry. However, their model only accommodates consumers who do not have ideal attribute locations, which in their model means that it is only the cost of providing higher-quality products that prevents all firms from offering as much of all attributes as they can. Thus, their model cannot address issues such as which firms want to make their products similar to their competitors and which do not. Their paper also does not describe how prices and profits vary as the level of competition in the market is changed.

This paper studies how prices and variable profits are affected by the degree of product differentiation present in a market with competitive price-response, as well as some implications of this relationship on optimal product positioning. One important way that this paper contrasts with other papers that have studied these issues is that the model used in this paper controls for consumer heterogeneity in willingness-to-pay in a more realistic manner and includes many of the complexities that exist in real industries: The model has vertical, global-horizontal and local-horizontal product dimensions, and is realistic enough to be estimated using real industry data. While the dimension of product positioning that I focus on is that of geography, the results are theoretical results, so they can guide managers looking to position any product on product dimensions over which consumers have ideal preference points.

I find that the relationship between product differentiation and price is often non-monotonic; Increases in product differentiation can lead to lower prices. Furthermore,

equilibrium prices can be above monopoly levels. The subtleties in the shape of the relationship between prices and product differentiation suggest caveats towards what empirical specifications are appropriate for measuring the effect of product positioning: if a manager or a researcher does not properly control for the theoretical relationship between product differentiation and the intensity of competition then they are likely to under-measure the importance of the product positioning.

These findings also have implications about optimal product positioning. I find that the market leader generally wants to match the product positioning of market followers so few customers have a reason to buy the follower's product. Market followers, on the other hand, want to distinguish themselves from the market leader.

The approach used in this paper is computational-theoretic. While the model of consumer utility and firm costs is standard, it is too complex to solve for many of the results analytically. However, it is possible to solve for price-equilibria computationally given a set of parameters. In order to make sure the numerical simulations are realistic, I use Thomadsen's (2005) empirical estimates of the model's parameters from a dataset of Burger King and McDonald's franchisees.[2] By using estimates from a real industry, I obtain not only theoretical results, but also insights into the fast food industry because the magnitudes of the effects are derived from data.

Thus, the approach I use is to first present a model of demand and supply, from which all of the theoretical results are derived. I then compute how equilibrium prices

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[2] As I discuss later, I focus on the behavior of the franchisees because corporate-owned outlets face more complex incentives – one likely not fully observable in the data. I account for the fact that consumers will be unlikely to distinguish between corporate-owned and franchisee-owned outlets, however.

and variable profits derived from the fitted model vary as the fast food outlets are located closer or further from their competitors.

The simulations demonstrate that small amounts of differentiation (less than 2 miles) can have a significant impact on price (over 10%) and variable profits (over 50%), but that the exact layout of the firms has only a marginal impact. Further, prices and profits do not always vary monotonically with increased differentiation.

Prices level off at approximately monopolistic levels when the firm is located about 2 miles from their nearest competitor, while twice that level of differentiation is required in order for the outlets to earn monopolistic profits. This is due to the fact that the presence of a competitor has two effects on price. On one hand, the presence of a competitor increases the number of goods available to consumers, which decreases the willingness to pay at a particular outlet, leading to lower prices and lower variable profits. On the other hand, the competitor generally steals consumers whose willingness-to-pay is lower than the average among the outlet's customers. Thus, the remaining consumers are those with higher willingness-to-pay. This latter effect is especially likely to be strong if the outlets are at an intermediate distance away, causing a negative correlation in consumers' willingness-to-pay for the goods across each of the outlets. In fact, it is possible for this second effect to be larger than the first effect, meaning that entry can increase prices. This matches the results found in Perloff, Suslow and Seguin (1996); However, the model used in this paper is consistent with industry data, while the model in Perloff *et al* is not – and is not used in the empirical sections of their own paper. While either effect can theoretically dominate, generally the first effect dominates when the competing outlets are located close enough together, while the two effects approximately

offset once the outlets are at about 2 or more miles apart. Note, though, that while entry can lead to increased prices, it always causes a decrease in profits. I also show that most of the effect of geographic competition on price comes from the presence of a viable alternative for consumers and relatively little of it comes from a direct price response.

Finally, I find that the dominant chain, McDonald's, has an incentive to locate close to its competitors while the weaker chain, Burger King, has an incentive to geographically differentiate itself from McDonald's. However, both firms would choose to locate close to a competitor if it also meant being close to a large source of demand, such as a mall or a business district.

The rest of the paper proceeds as follows. Section 1 presents the model of demand and competition that is used. Section 2 discusses the fast food industry, as well as brief synopsis of the data and parameter estimates. The heart of this paper is Section 3, which analyzes the role of geographic differentiation on competition by examining the results of the counterfactual experiments. Finally, Section 4 concludes.

1. THE MODEL

In this section, I present the model from which I derive the main results of this paper. While the model is fairly generic, I use the language of the fast food industry to describe it. The institutional details that justify the model's assumptions are contained in Section 2.

1.1 DEMAND

Demand for fast food meals at each of the outlets is modeled using a discrete-

choice framework. Potential consumers (hereafter, consumers) can either purchase one meal from one of J fast food outlets or they can choose not to eat fast food. Geography is incorporated into the demand through travel costs that consumers incur when patronizing outlets far from either their residence or their work locations. This is comparable to the way that Bell and Lattin (1998) and Davis (nd) handle geography in their empirical studies. Consumers are spread across the county, and also differ in their demographics and in their unobserved tastes for each location-chain combination.[3]

Formally, consumer i''s utility from consuming fast food from outlet j is

(1A) $V_{i,j} = X'_j\beta - D_{i,j}\delta - P_j\gamma + \eta_{i,j}$

where X_j is a vector of dummies indicating (i) the chain to which outlet j belongs, (ii) whether there is a drive-thru or a playland in the outlet, and (iii) whether the outlet is located in a mall. Also, $D_{i,j}$ denotes the distance between consumer i and outlet j,[4] and P_j denotes the price of a meal at outlet j. Finally, β, δ, and γ are parameters to be estimated and $\eta_{i,j}$ is the unobserved portion of utility for individual i at outlet j.

One thing missing from equation (1A) that appears in many empirical papers is an outlet-specific residual term that is constant for all consumers. I do not include such a term because of the high level of homogeneity of the food and experiences within each of

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[3] I assume that consumers are perfectly informed about the prices, locations and nature of the food at all outlets in the market. Consumers can choose to eat at any of the outlets in the county; However, consumers will effectively choose only among the outlets close to them because of the high travel costs that would be incurred from traveling far across the country.

[4] In the estimation of the model, distances are measured as the shortest route along existing streets, except for distances to malls which are calculated using Euclidean distances due to inaccuracies in the official road patterns that exist around malls.

the outlets within each chain. Note, though, that the chain dummies capture not only the utility from observable product attributes of each chain's food, but also the utility obtained from intangible (and unobservable) attributes such as advertising, brand image, and any promotions (Burger King was running a Pokemon promotion at the time).[5,6]

The consumer can also choose not to eat at any of the outlets – commonly called the "no purchase" option. In this case the consumer's utility will be:

(1B) $V_{i,0} = \beta_0 + \pi M + \eta_{i,0},$

where M is a vector of the consumer's demographic characteristics. In the estimated model these include age, gender, race and whether the consumer is at a work location.[7] I normalize $\beta_0 = 0$ because adding a constant to the utility derived from every potential option does not affect consumers' choices.

Consumers are located at one of B locations throughout the country. I denote the number of consumers of demographic M located at location b as $h(b,M)$. Each outlet's demand is then calculated by determining the fraction of consumers of a given location

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[5] The assumption that all unobservable attributes are captured by the chain dummies seems to be especially justified given that even large observable attributes such as a playland or drive-thru do not seem to have a measurable impact on price.

[6] Empirically, these chain fixed-effects will be identified from the fact that the data contain multiple outlets in each chain. Therefore, even if unobservable attributes are correlated with prices, the fixed-effects resolve any potential price endogeneity and eliminate the need for instrumental variables procedures as discussed in Villas-Boas and Winer (1999), Chintagunta (2001), or BLP.

[7] Due to data limitations, I assume that all workers derive the same utility from the no-purchase option regardless of their age, gender or race. Thomadsen (2005) also presents evidence that income is not an important factor in the fast food industry.

and demographic who patronize each outlet as a function of the utility parameters, and then summing these choices across locations and demographics.

I assume that η_i is distributed i.i.d. type I extreme-value. Then the fraction of consumers of demographic M at location b choosing to purchase a meal from outlet j is:

$$(2) \qquad S_{j,b}(P,X,M \mid \beta,\delta,\gamma,\pi) = \frac{e^{\varphi_j}}{e^{\pi M} + \sum_{t=1}^{J} e^{\varphi_t}}$$

where $\varphi_j = X'_j \beta - D_{b,j}\delta - P_j \gamma$. Total demand for each outlet is then the sum of its demand across all locations and demographics:

$$(3) \qquad Q_j(P,X \mid \beta,\delta,\gamma,\pi) = \sum_b \sum_M h(b,M) S_{j,b}(P,X,M \mid \beta,\delta,\gamma,\pi).$$

It is worth noting that there are three different sources of consumer heterogeneity in this model. First, consumers each have different preferences over each of the outlets due to the distribution on η.[8] Second, consumers have a different taste for fast food depending on their demographic characteristics, as modeled through their different preferences for the no-purchase option. Finally, the geographic locations of consumers and firms, along with consumers' distaste for travel, means that consumers generally only find those outlets close to them to be attractive.

The heterogeneity provided by the market geography means that the demand for fast food does not suffer the irrelevant alternatives (IIA) property.[9] Rather, the geography of the market plays the same role in determining which products are closer/more distant

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[8] This can represent, for example, the chance that a consumer happens have a business event or friends located adjacent to a particular outlet throughout the county.

[9] See Anderson, de Palma and Thisse (1992), p. 350.

substitutes as random coefficients play in many papers (McFadden and Train (2000), Sudhir (2001), Chintagunta, Dube and Singh (2003)), or that the variance-covariance terms play in papers using probit demand choice (Chintagunta (2001)). In fact, the model of geographic competition presented above belongs to the class of mixed-logit demand functions.[10]

1.2 SUPPLY

I model the supply of fast food by assuming that franchisees set prices at each of their outlets in a way that maximizes the joint profits of all of their outlets according to a static Bertrand game. Static Bertrand competition is a reasonable assumption because the firms offer to sell as many units of the good as are demanded at the posted prices, and because the firms can change their prices quickly and easily.

Formally, there are F firms (franchisees), each owning a subset F_f of the $j = 1, \ldots,$ J outlets. I assume that the costs for each firm consist of fixed costs plus a constant marginal cost for each unit. The profits to firm f are then

$$(4) \qquad \Pi_f = \sum_{j \in F_f} (r_k P_j Q_j(P) - c_j Q_j(P) - FC_j)$$

where FC_j is the fixed cost of operating outlet j, c_j is the marginal cost of a meal at outlet j, r_k is the fraction of revenue that the franchisees belonging to chain k retain after paying their franchise royalties,[11] and P is the J-dimensional vector of prices for every outlet.

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[10] To see this, note that plugging equation (2) into equation (3) yields an expression that looks like equation (5) in Sudhir (2001).

[11] Burger King and McDonald's franchisees both pay a fixed franchise fee plus a percentage of revenues to the chain, and keep all other revenues.

Note that maximizing (4) is the same as maximizing

$$(5) \qquad \Pi_f = \sum_{j \in F_f} (P_j Q_j(P) - \left(\frac{c_j}{r_k}\right) Q_j(P) - \frac{FC_j}{r_k}).$$

I refer to $C_j = \frac{c_j}{r_k}$ as the marginal cost because the franchisees act as if they are

maximizing profits with marginal costs of C_j.

Different chains will have different marginal costs because they serve different

food. However, it is also possible that the marginal costs differ across outlets belonging

to the same chain. One can accommodate such differences by assuming that each outlet's

marginal cost is equal to a chain-specific marginal cost plus a zero-mean unobservable

component. Thus, outlet j's marginal cost is

$$(6) \qquad C_j = (C_k + \varepsilon_j)$$

where C_k represents the mean marginal cost for all outlets belonging to chain k, and ε_j

represents the zero-mean, outlet-specific, portion of marginal costs.[12]

I assume that the franchisees all know their true marginal cost, including ε_j, when

they set their prices. Then maximizing the profit function in equation (5) yields the

following first-order conditions for the price at each outlet:

$$(7) \qquad Q_j(P) + \sum_{r \in F_f} (P_r - C_k - \varepsilon_r) \frac{\partial Q_r(P)}{\partial P_j} = 0.$$

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[12] For Burger King and McDonald's, all outlets in the county belonging to the same chain will have access

to food and materials at the same cost. However, heterogeneity in marginal costs may come from

differences in the labor efficiency of workers and managers. Reiter (1991), Schlosser (2001) and Emerson

(1990) document that variation in individuals' experience and ability can have a significant effect an

outlet's costs.

For compactness, these J equations can be written in matrix notation. To do this, define a matrix Ω as

$$(8) \qquad \Omega_{j,r} = \begin{cases} \dfrac{\partial Q_r}{\partial P_j}, & \text{if } r \text{ and } j \text{ have the same owner} \\ 0, & \text{otherwise}. \end{cases}$$

This implies that the first-order conditions can be rewritten as

$$(9) \qquad Q(P) + \Omega(P - C - \varepsilon) = 0$$

where $Q(P)$, C and ε are the vectors of quantities, chain-specific marginal costs, and outlet-specific marginal costs, respectively, at each of the outlets.

2. INDUSTRY BACKGROUND AND ESTIMATION SYNOPSIS

2.1 THE FAST FOOD INDUSTRY

McDonald's and Burger King are the two largest fast food chains (in terms of annual revenue) in the United States. Together they had worldwide revenues of over \$57 billion in 2004. Over 7% of the U.S. population consumes a meal from McDonald's each day,[13] and each year over 80% of Americans eat at a McDonald's.

Both McDonald's and Burger King offer products that are very homogeneous within each chain. This product homogeneity – which is observed not just in the food, but also in the menu boards, uniforms, and architectural style – is a large component of the value that comes from being a member of a chain. Both McDonald's and Burger King's success can be largely attributed to the vigilance with which their founders

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[13] McDonald's says that they serve 20 million customers in the US per day. ("McDonald's History … Yesterday and Today," downloaded March 14, 2001.

enforced this homogeneity.[14] While some outlets are operated directly by McDonald's and Burger King Corporations, most US outlets are operated by franchisees.[15] These franchisees, who pay the franchisor a fixed franchise fee plus a percentage of revenues,[16] operate largely as independent businesses within a framework of a national brand – purchasing their inputs from approved suppliers and setting their own prices.

2.2 DATA AND ESTIMATION

In order to ensure that the effects of geographic competition presented in Section 3 are of a reasonable magnitude, I use parameters from Thomadsen (2005), which estimated the model presented in Section 1 for competition among Burger King and McDonald's outlets.[17] I present here a brief summary of the data and estimation procedure; Readers interested in finer points about the estimation and the data are referred to the other paper.

The estimation uses an original dataset, collected over the summer of 1999, of the locations, menu prices, presence of drive-thrus and playlands, and ownership of all 64 McDonald's and 39 Burger Kings in Santa Clara County, California. The estimation

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[14] See Love (1995), McLamore (1997) and Shook and Shook (1993).

[15] About 65% of McDonald's and 92% of Burger Kings in the US are franchised. (2002 McDonald's Annual Report, Burger King Corporate facts at http://www.burgerking.com/ on December 19, 2003.)

[16] Lafontaine (1992) and Lafontaine and Slade (1997) note that a given franchisor tends to offer the same contract terms to each of the potential franchisees at a given point in time.

[17] Kalnins (2003) and Thomadsen (2005) both present evidence that Burger King and McDonald's together form a complete market; that is, the presence of other fast food chains does not seem to have an impact on the prices at McDonald's and Burger King outlets.

utilizes the pricing decisions of the McDonald's and Burger King franchisees, and not those of the 21 outlets owned by McDonald's corporation.[18] This is because corporate-owned outlets face different incentives than franchised outlets.[19] While the estimation does not use the first-order conditions of the corporate-owned outlets, consumers do not know which outlets are franchised or corporate-owned. Thus, consumers can choose to make a purchase at any outlet regardless of ownership, and I control for the presence of all McDonald's and Burger King outlets. However, I assume that the McDonald's and Burger King outlets in the San Jose airport and the McDonald's on the Moffett Air Force Base are competing in separate markets, so these outlets are dropped from the market. The model is thus estimated on the pricing decisions of the 79 franchised outlets (38 Burger Kings and 41 McDonald's) remaining after accounting for these special cases.

The prices used for the estimation are those of the value meals for each chain's signature sandwich: the Whopper for Burger King and the Big Mac for McDonald's. I use these prices because these items have the most purchases, and I have not been able to obtain data about the distribution of sales across all of the menu items.[20] The prices of

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[18] There are no Burger King outlets in this market that are not franchised.

[19] For example, McDonald's corporation profits from sales at all McDonald's outlets, weakening incentives to steal business from franchisees and creating incentives to keep prices low to give an image of value for the McDonald's brand. Consistent with this story, Lafontaine and Slade (1997) find that corporate outlets tend to have lower prices than franchised outlets in their summary of the findings of many academic studies. Similarly, I find that 18 of the 21 McDonald's-owned outlets in my dataset charge $2.99 for the Big Mac meal, the minimum price observed in the market, while only 2 of the 43 franchised outlets charge this price.

[20] Numerous references state that these sandwiches are the chains' best sellers, but I could not find the exact sales figures. Burger King's website (April 5, 2001) states that Burger King sells 4-4.6 million whoppers to

these items were not advertised, and the summary statistics presented in Table 1 demonstrate the degree of within-chain price variation: Prices for Whopper meals range from $3.19 to $3.69, with a mean of $3.26 and a standard deviation of 11¢. Prices of Big Mac vary from $2.99 to $4.09, with a mean of $3.46 and a standard deviation of 27¢.

I also have demographic data that I use to determine the location of consumers. I assume that consumers are either located at their residence or their place of work. I assume that residential consumers live at the centroid of one of 1020 census block-groups. I have data on the population, age distribution, racial distribution, gender distribution in each census block-group. My worker data places workers in one of 479 areas called traffic analysis zones, or TAZs, which are areas defined locally and used by the US Department of Transportation. TAZs are generally, but not always, larger than census block-groups. For TAZs that are smaller than census block-groups, I place the workers at the centroid of that TAZ. For TAZs that are larger then block-groups, I place the workers at the centroids of the internal block-groups, assigning each location a fraction of the workers in the TAZ that is proportionate to the areas of the different block-groups. This yields 1093 different worker locations.[21] Because I do not have data on the

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15 million customers each day, implying that over ¼ of Burger King customers eat a whopper. Love (1995) reports that by 1969 the Big Mac accounted for 19% of all McDonald's sales. McDonald's website http://www.mcdonalds.com/countries/usa/corporate/info/studentkit/index.html says that their best seller is the Big Mac.

[21] Some readers may worry that including both residential consumers and workers would cause double-counting. However, this is not the case because of the no-purchase option. For example, the model allows that someone would only buy fast food while they are at work – then this person would choose the no-purchase option when they are at home.

demographic make-up of workers, I assume that all workers have the same value for the no-purchase option (except for the individual-level idiosyncratic match value).

The estimation approach of Thomadsen (2005) is similar to that of Bresnahan (1987), Berry (1994) and Berry, Levinsohn and Pakes (1995) (hereafter BLP), who estimate utilities and costs in differentiated industries from aggregate data. Similar to Feenstra and Levinsohn (1995), the model is estimated using only price data and not quantity data. Thomadsen (2005) discusses the conditions that are necessary for a model to be identified using only price data, but intuitively the model is identified because the demand side and the supply side of the model both provide relationships between observed prices and implied quantities that jointly identify the parameters of the model.

Formally, the model is estimated without quantity data by substituting equation (3), which solved quantity as a function of the utility parameters, into equation (9):

(10) $Q(P, X \mid \theta) + \Omega(P, X \mid \theta)(P - C - \varepsilon) = 0$

where $\theta' = (\beta', \gamma', \delta', \pi')$. This is rearranged to solve for the vector of residuals for Generalized Method of Moments (hereafter GMM) estimation (Hansen (1982)):

(11) $\varepsilon = P - C + \Omega(P, X \mid \theta)^{-1} Q(P, X \mid \theta)$.

The moments are created by interacting the residuals from equation (11) with the instruments.[22] These traditional "micro" moment conditions are supplemented with

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[22] These are the chain indicator variables as well as the product of the chain indicator variables with each of the following instruments: the distance to the nearest outlet, the number of directions in which there are nearby competitors [= I(1 or more firms within 2 miles NW of the outlet) + I(1 or more firms within 2 miles SW of the outlet) + I(1 or more firms within 2 miles SE of the outlet) + I(1 or more firms within 2 miles NE of the outlet)], the population density of residents in the nearest census block-group, the worker

"macro moments" (Imbens and Lancaster (1994)), which match the ratios of average per-capita consumption implied by the model across different age groups (under 18, 18-29, 30-64, 65 and above), across different genders, and across different races, to the national averages of these ratios as reported in Paeratakul *et al* (2003).[23]

The estimates of the model are reported in Table 2. The estimates of the McDonald's and Burger King baseline utility are statistically significant due to the high covariance of these estimates Travel costs, which are equal to the coefficient of distance divided by the coefficient of price, are estimated to be $3.24/mile − implying that consumers are willing to travel about ⅓ mile to save $1.00. This travel cost estimate implies that consumers have an average opportunity cost of their time of almost $27/hour.[24] The estimates of marginal costs imply that the average markups are $1.23 for Burger King and $2.01 for McDonalds. These markups are consistent with the conventional wisdom of the magnitudes of these marginal costs.[25]

density in the nearest TAZ, and indicator variables for whether the outlet has a drive-thru, whether the outlet has a playland, and/or whether the outlet is located in a mall.

[23] For example, the moment condition matching the implied per capita consumptions for men and women

to the national averages is $G_J(\theta) = \frac{1}{J} \sum_{j=1}^{J} \left[R_{Male} \frac{Q_j(M_{Female}, \theta)}{Pop(M_{Female})} - R_{Female} \frac{Q_j(M_{Male}, \theta)}{Pop(M_{Male})} \right]$, where R_{Male} and

R_{Female} are the national fraction of men and women, respectively, that consumed a fast food meal in the two-day period covered by Paeratakul *et al*.

[24] A trip to an outlet 1 mile away is 2 miles round trip. Traveling 1 mile takes approximately 3 minutes in the study area. Subtracting the 1999 US GSA's 31¢ per mile deduction as true costs yields a cost of $27/hour.

[25] Emerson (1990) provides estimates of the costs of materials and labor as a fraction of revenues. Casual conversations with people involved with the industry confirm that Emerson's numbers are about right.

3. MODEL SIMULATIONS

The estimated model does not directly demonstrate how market geography affects the way that firms compete. I therefore use the estimated model to run counterfactual simulations – computationally calculating the equilibrium for the estimated model – that demonstrate how outlet location affects prices and variable profits. All of the simulations are conducted by placing firms in a hypothetical 20-by-20 mile market with a uniform distribution of consumers.[26] I use such large market to avoid edge-of-market effects, but using more realistic market sizes yields similar results. I discretize the space by placing a grid of square, 1/10 x 1/10-mile cells over the market and treating all consumers located in a particular cell as if they were located at the center of the cell. I then aggregate over the decisions of consumers in each of the cells in the same manner as explained in Section 2.1. The marginal costs used in these experiments are the mean marginal costs for each chain's meal, as reported in Table 3.

3.1 THE EFFECT OF DISTANCE ON COMPETITION

Figures 1 and 2 demonstrate the role of geographic competition on price and variable profits in a simple context. Both figures show results from an experiment where one Burger King outlet and one McDonald's outlet are placed at different distances apart in a market as described above. Figure 1 shows how the price and variable profits of the

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[26] For simplicity – and to emphasize the role of geography – I model the outlets as having no drive-thru or playland, and assume that all consumers are residential women between the ages of 18-29. I also assume that all of the outlets are under separate ownership, although most of the qualitative results still hold when firms compete against co-owned outlets.

McDonald's outlet change as the outlets are located further apart, while Figure 2 shows the same figure for the Burger King outlet. As a benchmark, a McDonald's monopolist in such a market would charge $3.70 while a Burger King monopolist would charge $3.50. Since all variable profit calculations are only valid up to some factor of proportionality, I report the variable profits as a percentage of the variable profits that would be earned by a monopolistic outlet belonging to the chain.

The graphs show that prices are lowest when the outlets are close to each other, but that prices increase as the firms are located further apart, approximately leveling off once the outlets are about 2 miles apart. In fact, a careful look at Figure 1 reveals that McDonald's prices are slightly above the monopoly price level when the outlets are between 2 to 4 miles apart. Other papers have found similar effects – where entry by a competitor can cause prices to increase – in the pharmaceutical, grocery store items and airlines industries (see Perloff *et al* (1996), Ward *et al* (2002) and Goolsbee and Syverson (2004)[27]).[28]

To see why prices can be above the monopoly level, note that a monopolist will set its price in a way that attracts both consumers who are far away and consumers who are close to the outlet. If the firm has a competitor located nearby then the outlet needs to cut its price in order to prevent the competitor from stealing away a large percentage of the customers. However, when a firm is at an intermediate distance apart – 2 to 4 miles apart in this industry – then most consumers near an outlet will choose to patronize the

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[27] Goolsbee and Syverson (2004) find that prices increase for flights into Boston when Southwest Airlines enters into Manchester and Providence but not Boston.

[28] Anderson, dePalma and Thisse (1992) discuss the mathematical properties that lead to this result (p. 187).

closer store unless there is a significant difference in price. Since each outlet will be able to attract consumers located close to them even at a higher price, but will have a difficult time attracting consumers far from them but close to their competitor, the firms shift their strategy of trying to attract all types of customers (those nearby and those far away), and instead focus on attracting the high willingness-to-pay consumers who are located nearby. Put another way, entry has two effects on price. On one hand, entry by a competitor gives many consumers a more attractive alternative to the product than the no-purchase option provides, reducing the average willingness-to-pay of the consumers. On the other hand, if the outlets are far enough apart then the entrant systematically steals those consumers who have lower willingness-to-pay for the original outlet (since they were further away). These two effects go in opposite directions, and while the first effect usually dominates, Figure 1 shows that the second effect can sometimes dominate. For practical purposes, however, these effects usually approximately offset once the outlets are far enough apart.

While the presence of a competitor 2-4 miles away can lead to prices that are above monopoly prices, the firm is still worse off than they would have been if they had been a monopolist: Variable profits are below the monopolistic levels because the outlet is unable to attract consumers that are located close to their competitor. As a result, variable profits are always below the monopoly level, and prices level off at smaller distances than variable profits do. These results are found across all of the experiments.

Figure 1 also shows that McDonald's variable profits decrease as its distance from a Burger King competitor increases if the two firms are located within 0.6 miles of each other. This occurs because most consumers who eat fast food choose to eat at McDonald's when a McDonald's and a Burger King are both located at the same

location.[29]   When the outlets locate a bit further away then some consumers who prefer McDonald's switch to Burger King because it is geographically closer to them. It is also true that some consumers who prefer Burger King's food find that they are closer to McDonald's and eat there instead, but since more consumers prefer McDonald's than Burger King the net flow of customers is from McDonald's to Burger King.

Figure 2 presents the price and variable profits for the Burger King outlet in this same experiment. The effects are very similar to those for McDonald's, although the impact of competition on both price and profits is larger. Also, Burger King's variable profits monotonically increase as geographic differentiation increases. This is because net flow of consumers from McDonald's to Burger King with increased differentiation (as described in the paragraph above) reinforces the increase in profits that occurs because of the softening of price competition.

The changes in prices from the close presence of a competitor are mostly due to consumers having a new option rather than a direct price response. Figure 3 shows that the price-response elasticities – the change in one outlet's price in response to a 1% change in the other outlet's price – of the outlets are low (below 0.1), even when the outlets are very close. This occurs because McDonald's and Burger King are already relatively differentiated products even without geographic differentiation. Note, too, that Burger King's price response to a change in McDonald's price is not monotonically decreasing with the level of differentiation. Instead, greater differentiation causes Burger King's price-responsiveness to increase until McDonald's is located a small distance away from the Burger King (0.8 miles), and only after that does further differentiation

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[29] The demand estimates revealed this with the higher coefficient on McDonald's than on Burger King.

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decrease Burger King's price-responsiveness. This happens because an increase in McDonald's price has two effects on the willingness-to-pay of Burger King's consumers. First, the price increase drives some McDonald's consumers to Burger King. These consumers are approximately indifferent between the two outlets, and thus are relatively likely to switch back to McDonald's if Burger King also raises their prices. Second, McDonald's price increase causes those consumers who had already been consuming from Burger King to prefer Burger King even more strongly over McDonald's. This gives Burger King a greater incentive to increase its price. When the outlets are located close together then the ratio of number of consumers who switch from McDonald's relative to the number of consumers who were previously consuming Burger King food before the price increase is larger than when the outlets are further apart. However, both of these effects dissipate as the firms become more separated: The price responsiveness falls with increased differentiation when the firms are more than 0.8 miles apart. The initial increase in elasticity does not occur for McDonald's because most consumers inherently prefer McDonald's, so the second effect always dominates.

While the price elasticities are small, the response of variable profits to a price change of a rival can be large for Burger King when the two firms are close together. Burger King's variable profits increase about 1.6% for every 1% increase in an adjacent McDonald's price, while McDonald's variable profits increase about 0.15 % for every 1% increase in an adjacent Burger King's price. These figures generally decline as the outlets are further apart.[30] The difference in these magnitudes can be attributed to the fact

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[30] McDonald's profit elasticity increases for the first 0.7 miles of differentiation, then declines. However, the initial increase is fairly small.

that when the outlets are close together most of the consumers choose to consume from McDonald's, so any further increase in Burger King's price brings only a few new customers to McDonald's relative to McDonald's initial consumer base, but an increase in McDonald's price will bring many new consumers to Burger King, an effect which in percentage terms is even larger because Burger King has fewer initial consumers.

3.2 THE EFFECT OF INCREASED COMPETITION

The simulations in Figures 4 and 5 demonstrate how the impact of geographic differentiation changes when additional competitors are present. In these experiments, a McDonald's is placed in the center of the market. I then place 1, 2 or 3 Burger Kings into this market at some distance from the McDonald's and observe how prices and variable profits vary as this distance is changed.

Figure 4 shows the prices for the McDonald's in these experiments. McDonald's prices generally decrease as the number of competitors increases when the competitors are less than 2 miles away, although each additional firm has a diminishing impact on price: If the firms are clustered together then the first competitor causes McDonald's to decrease their price by about 15¢, but the marginal impact of the second competitor is only 10¢ and the marginal impact of the third competitor is only about 8¢. Also, the marginal impact of an additional competitor is relatively constant (actually slightly increasing) for the first ½ mile and then decreases as the outlets are located further away from the McDonald's.

The S-shaped response of price evident in Figure 4 means that a minimum amount of differentiation, ½ mile, is necessary before further differentiation has a significant

impact on price. Also, the presence of competitors has a very small effect on price when the competing firms are 2 or more miles away – at these distances the McDonald's will charge slightly more than its monopoly price. In fact, the McDonald's prices increase slightly as there are more Burger Kings in the market when the competing outlets are 2 or more miles away. This is due to the same logic that led to the super-monopolistic pricing of the McDonald's outlet in Figure 1: As more competitors locate at such a distance away from the outlet, the McDonald's in the center of the market will have the opportunity to attract fewer of the consumers located far from the outlet. This shifts McDonald's incentives towards focusing instead on extracting more revenues from consumers located closer to the outlet. These consumers' willingness-to-pay for McDonald's is, on average, higher than that of consumers who are located further away (and find the McDonald's location to be less convenient).

Figure 5 shows the impact of the number of competitors on McDonald's variable profits. Variable profits are impacted more by competition than prices are (in terms of percentage from monopoly levels). Variable profits decrease as more competitors are present, and while they generally remain low as long as the competitors are located close to the outlet (within 1 mile), profits gradually increase to the monopoly level with further increases in differentiation. The dip in variable profits that occurs when the competing Burger Kings are a slight distance away from the central McDonald's becomes more exaggerated as there are more firms in the market. This is partially a result of the fact that as there are more competing Burger Kings in the simulations, I place the Burger Kings on more sides of the initial McDonald's. Thus, when there are many Burger Kings, the McDonald's suffers the most when consumers in a large number of directions find that

the Burger Kings are more convenient to them than the McDonald's.

3.3 THE EFFECT OF MARKET LAYOUT

The results presented in Figures 6 and 7 demonstrate how the configuration of the competitors' locations affect prices and variable profits. In these simulations, two Burger King outlets are placed at some distance away from the central McDonald's. One line in Figure 6 shows the price of the McDonald's outlet when the Burger Kings are located on opposite sides of the McDonald's, and the other line shows the price of the McDonald's when the Burger Kings are placed together on the same side of the outlet. Figure 7 presents the McDonald's variable profits in these two cases.

Figure 6 shows that the firm layout has a negligible impact on prices when the firms are located very close together or very far apart, but that the market configuration can have a marginal impact of up to 4¢ when the firms are 0.8 miles apart.[31] If all three of the outlets had instead been McDonald's, a similar set of pricing patterns would have emerged, but the price impact would have been larger – up to 12¢. Also, for some range of distances prices are slightly higher if the outlets are located on opposite sides of the outlet rather than on the same side. The cause of this effect is the same as the cause for the above-monopoly prices discussed earlier: When the Burger Kings are on the opposite sides of the McDonald's, McDonald's focuses only on attracting customers that are nearby. However, when both Burger Kings are on the same side of the outlet, the McDonald's decreases prices a bit to try to lure in some consumers on the vacant side who are further away but not served by any competitors.

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[31] This difference would be somewhat larger if there were more firms located in the market.

Figure 7 demonstrates that the different layouts have only a marginal impact on variable profits. Also, consistent with the logic that was presented in the discussion of Figure 5 above, having both firms on the opposite side of the outlet causes small levels of differentiation to lead to a larger decline in variable profits than if both competitors were located on the same side. Finally, unlike in Figure 6, the lines in Figure 7 never cross: profits are always higher for the firm if their competitors are located together than if the competing outlets are more dispersed.

3.4 STRATEGIC IMPLICATIONS ON OPTIMAL ENTRY

The results in the previous sections have implications on the product positioning strategies for firms. Figure 1 shows that McDonald's variable profits are higher when the outlet is located next to a Burger King than they are when the Burger King is located further away (but within the first mile of the outlet). In contrast, Figure 2 shows that Burger King's variable profits monotonically increase with increased geographic differentiation. Given that it is often not possible to get more than a mile of geographic differentiation (64% of the McDonald's and Burger King outlets in the study area were located within 1 mile of at least one other McDonald's or Burger King), McDonald's outlets prefer to locate adjacent to Burger King outlets while Burger Kings are better off geographically differentiating themselves from McDonald's outlets.

This result may seem striking given that clusters of fast food restaurants are commonly observed even in locations where the McDonald's outlet entered first. However, Figures 8 and 9 demonstrate that even Burger Kings may prefer to locate next to a McDonald's if doing so also means locating near a large demand source, such as a

mall or downtown business district.

Figure 8 presents each chain's variable profits when there is a competitor located adjacent to a mall.[32] The x-axis denotes how far the restaurant is from this mall. McDonald's variable profits at the mall are about twice the monopolistic profit level from Figure 1, and profits steadily decrease the further the outlet is from the mall. However, the McDonald's profits level off at approximately the monopoly level once it is located about 2 miles away from the mall. Burger King's variable profits are also greatest near the mall, but decrease to below the monopoly level as the outlet is located further from the mall within the first mile of differentiation. However, if the Burger King is located far enough away from the mall then the McDonald's and the Burger King are effectively competing in separate markets and the Burger King earns monopoly profits.

Figure 9 shows the variable profits for a McDonald's and a Burger King competing in a downtown business district. In this case, the market looks the same as before except that there is now a 1.5 x 1.5-mile downtown district with a density that is 6 times as large as the rest of the market. Each curve represents the variable profits of a McDonald's (Burger King) outlet located at various distances away from a Burger King (McDonald's) located in the center of this downtown area, which extends for the first 0.7 miles of the distance on the x-axis. The McDonald's curve looks very similar to the McDonald's curve in the mall example above, indicating that the McDonald's would like to locate close to the Burger King. The Burger King variable profit curve differs from the mall example, however: Burger King variable profits increase slightly as it is located a

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[32] The mall is modeled as having a location with density of 750 potential consumers, while the density of the other area is 100 individuals per square mile.

small distance away from the McDonald's and peak at 0.4 miles – well within the downtown area. The Burger King's optimal location will be closer to the McDonald's outlet as the downtown density of consumers is larger.

Thus, McDonald's outlets generally prefer to locate near Burger Kings, while Burger King outlets prefer to locate away from McDonald's. However, both firms will choose to locate together if it also means locating where there is especially high demand, such as a mall or a business district.

4. CONCLUSION

This paper presents a utility-based discrete-choice model of fast food supply and demand. The fitted model is used to calculate the effects of market geography on the prices and variable profits. While the results are theoretical, the magnitudes of the effects apply to the fast food industry.

There are several key results of the theory: (1) Prices do not always monotonically increase with product differentiation. (2) Equilibrium prices can be above monopoly prices when there is a moderate level of differentiation. (3) Profits for the market leader (McDonald's) are higher when the two products are similar then when they are a little bit differentiated (although they are effectively competing in separate markets if they are differentiated enough). Profits for the market follower (Burger King) increase with differentiation. Thus, the market leader wants to minimize differences between its products and those of its competitors, while market followers want to distinguish themselves in some way. However, both firms are better off locating near consumers even if it means locating near a competitor.

Also, the S-shaped relationship between price/profit and the level of differentiation, along with the non-linear effect of a greater number of competitors, provides a caveat to managers and marketing researchers seeking to measure the impact of product positioning. Failing to account for the shape of the relationship dictated by theory can lead to mismeasurement of the impact of competition. For example, if one posited a linear relationship between prices and the level of differentiation in the market, and one observed markets where products were close substitutes and markets where products were distant substitutes, then one would most likely under-measure the importance of product differentiation.

Finally, because geography is just one of many potential product attributes – one that is convenient to use due to the fact that it is relatively easy to observe – the theoretical results from this paper apply to product positioning in any industry with at least some horizontal differentiation. For example, the results of this paper suggest that Apple wants to make sure that iPods have at least the same set of features as their mp3 player competitors, while other mp3 players should try to differentiate themselves from iPod. Similarly, applied to the yogurt industry, this would imply that Dannon wants to make sure that other yogurts appealing to the same demographics do not offer flavors they do not offer, while the smaller yogurt companies have an incentive to find innovated new flavors – as long as they are attractive to a large enough demographic.

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TABLE 1: Summary Statistics

Variable	N	Mean	Std Dev	Minimum	Maximum
Burger King price	38	3.26	0.11	3.19	3.69
McDonald's price	41	3.46	0.27	2.99	4.09
Playland dummy	79	0.279	0.451	0	1
Drive-thru dummy	79	0.684	0.468	0	1
Mall dummy	79	0.089	0.286	0	1

TABLE 2: Estimates of the Full Model

$V_{i,j} = X\beta - D_{i,j}\delta - P_j\gamma + \eta_{i,j}$

$MC_j = C_k + \varepsilon_j$

Variable Name	Variable	
BK Base utility	β_1	**4.07***
		(2.42)
McD Base utility	β_2	**6.53****
		(2.69)
Price sensitivity	γ	**0.91***
		(0.47)
Distance disutility	δ	**2.58*****
		(0.56)
Playland utility	β_{play}	-0.47
		(0.30)
Drive-thru utility	β_{drive}	0.09
		(0.32)
Mall utility	β_{mall}	-0.91
		(1.05)
Outside utility ages < 18		0.34
		(0.27)
Outside utility ages 30-49		0.13
		(0.16)
Outside utility ages 50-64		0.38
		(0.25)
Outside utility over age 64		**2.11*****
		(0.57)
Outside utility for males		**-0.34*****
		(0.13)
Outside utility for blacks		0.10
		(0.26)
Outside utility for workers		**2.46****
		(1.12)
Marginal Cost BK	$C_{Burger\ King}$	**2.03*****
		(0.58)
Marginal Cost McD	$C_{McDonald's}$	**1.45***
		(0.84)
Implied travel costs	δ/γ	**2.82****
		(1.23)
Objective function		3.24
χ^2 p-value		0.34

Standard errors appear in the parentheses.

*, **, *** denote significance at the 90, 95 and 99% levels respectively.

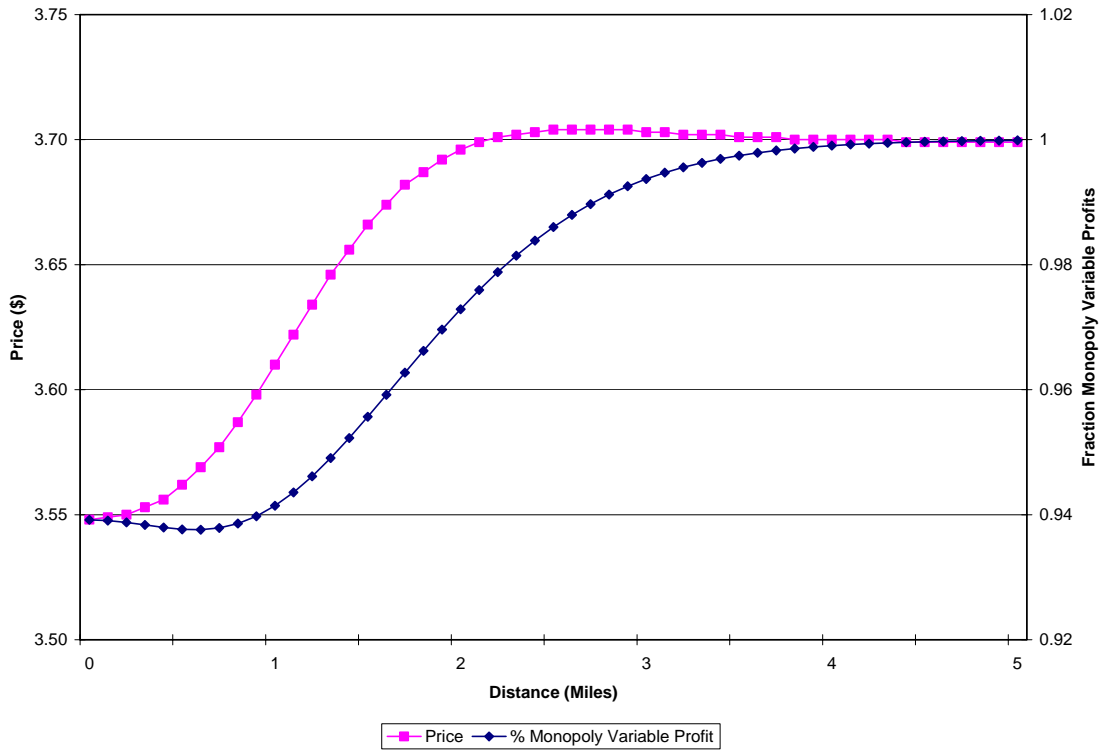**FIGURE 1: McDonald's Price and Variable Profit (one BK competitor)**

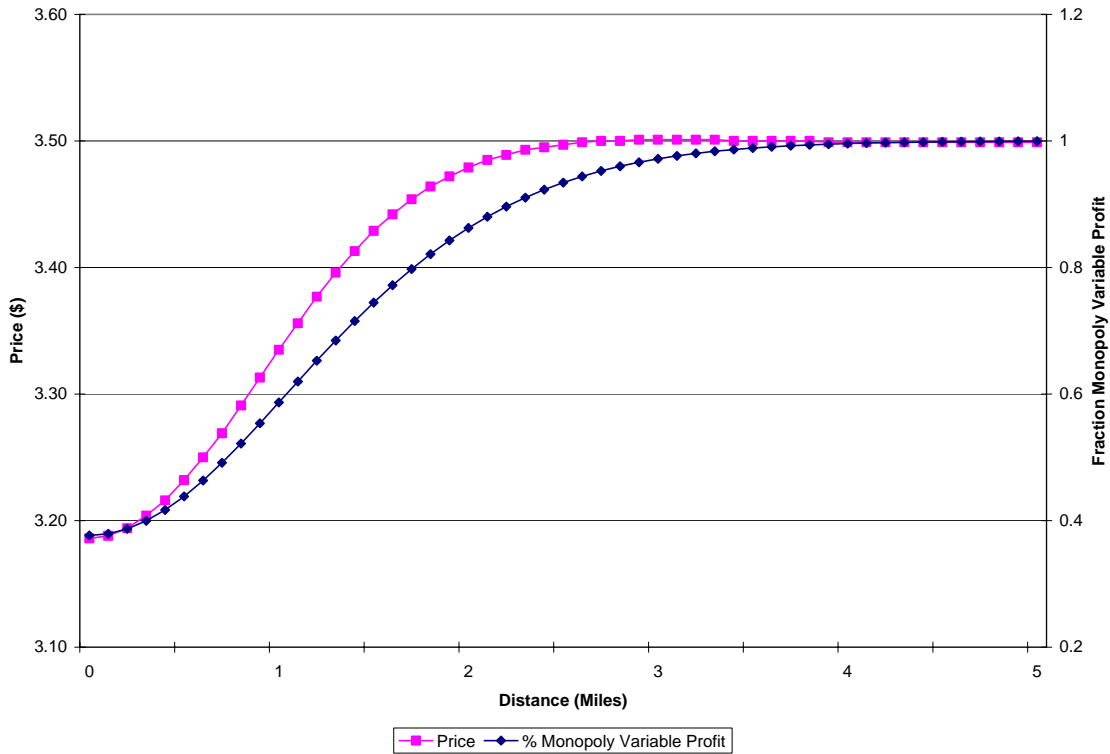**FIGURE 2: Burger King Price and Variable Profit (one McDonald's competitor)**

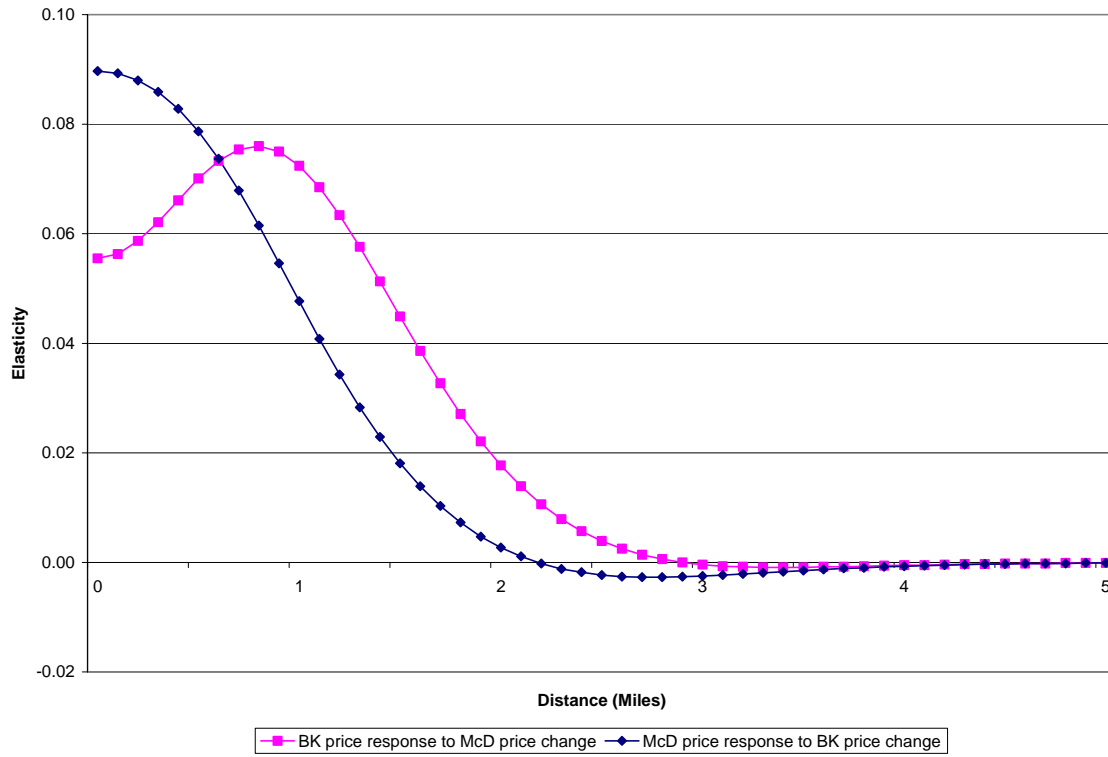**FIGURE 3: Price-Response Elasticities**

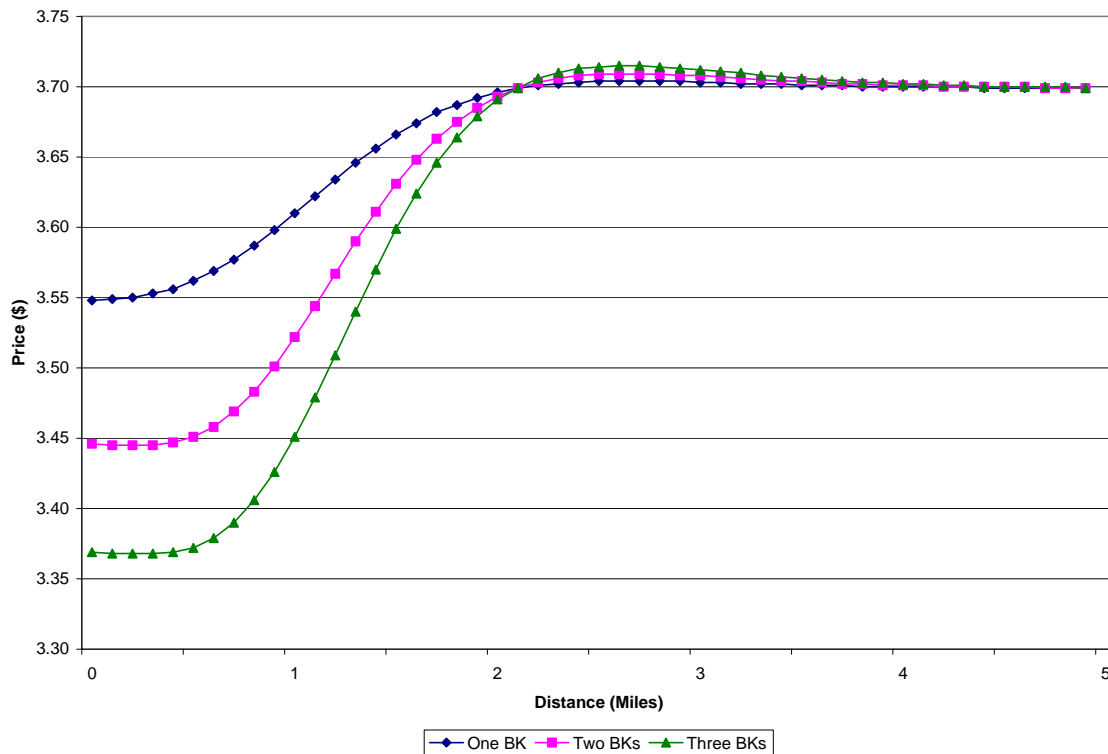**FIGURE 4: McDonald's Price with Different Numbers of BK Competitors**

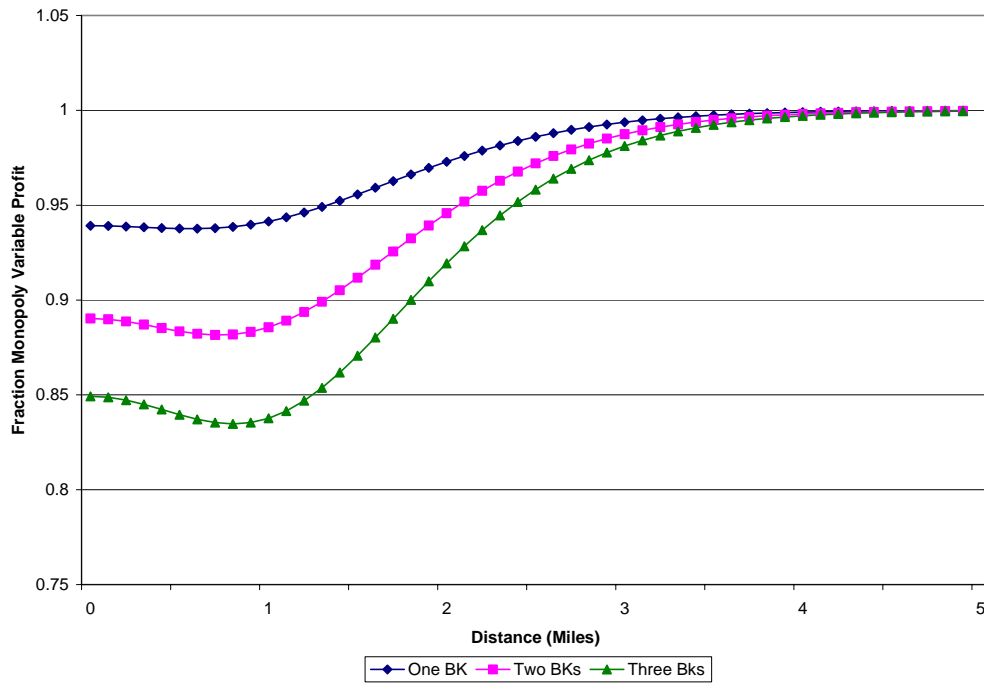**FIGURE 5: McDonald's Profit with Different Numbers of BK Competitors**

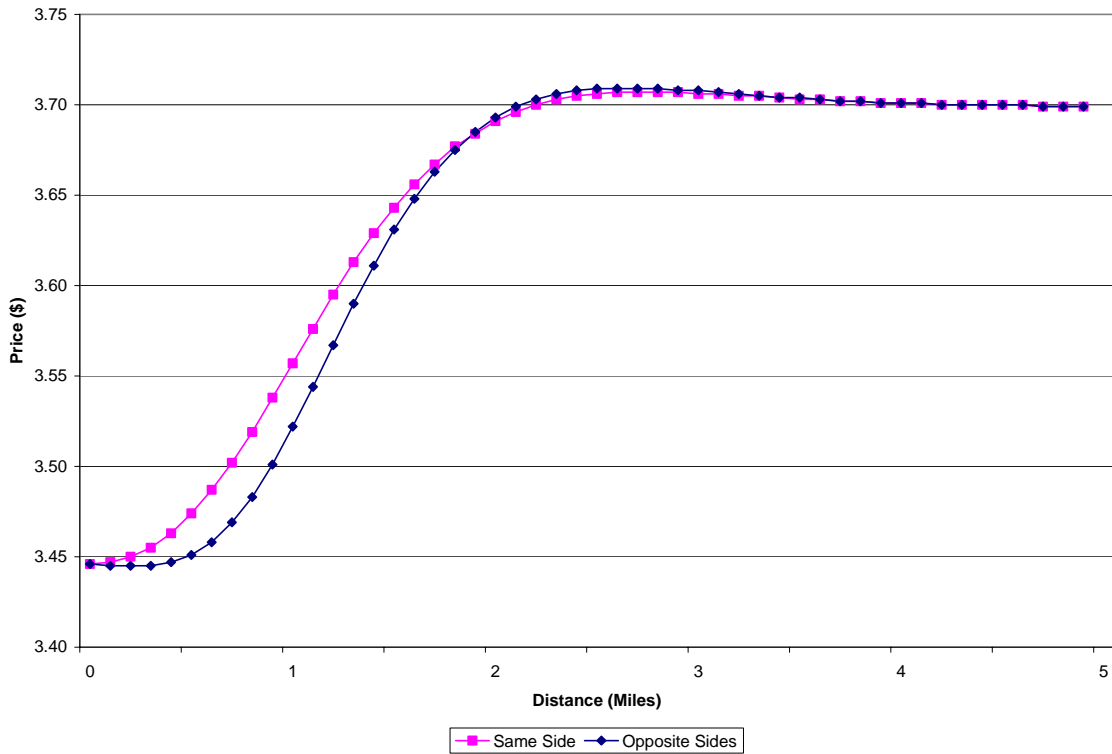**FIGURE 6: McDonald's Price by Layout (2 BK Competitors)**

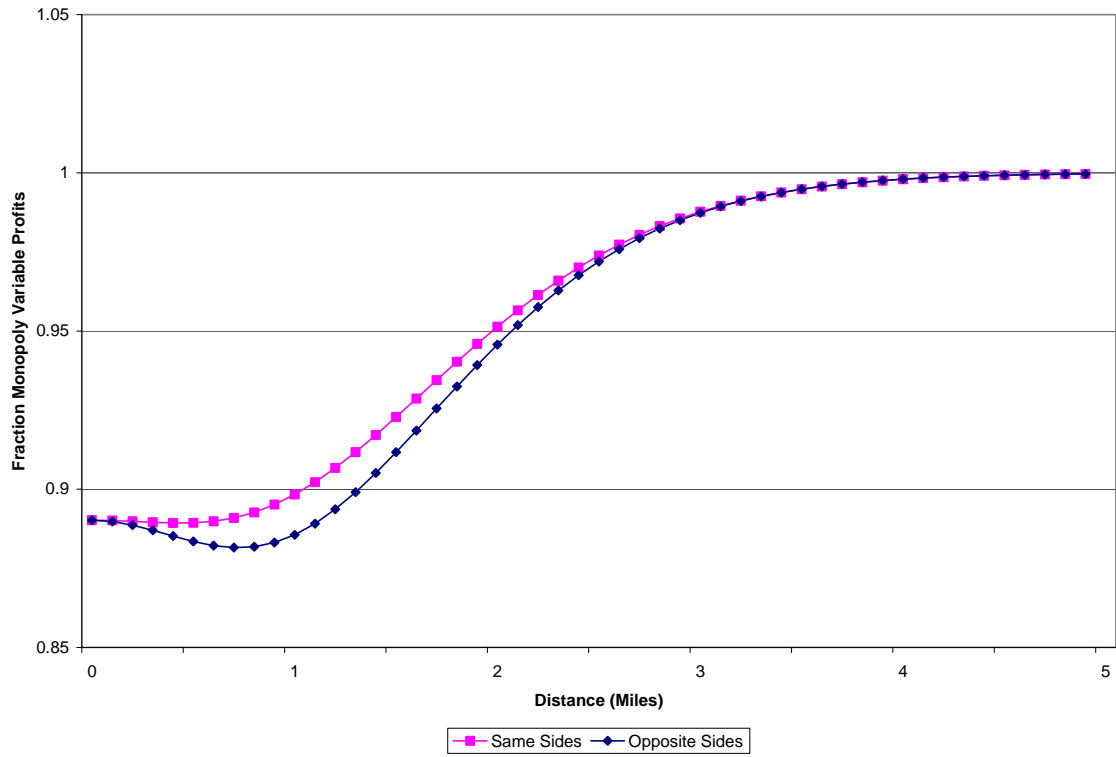**FIGURE 7: McDonald's Profit by Layout (2 BK Competitors)**

Legend: Same Sides — Opposite Sides

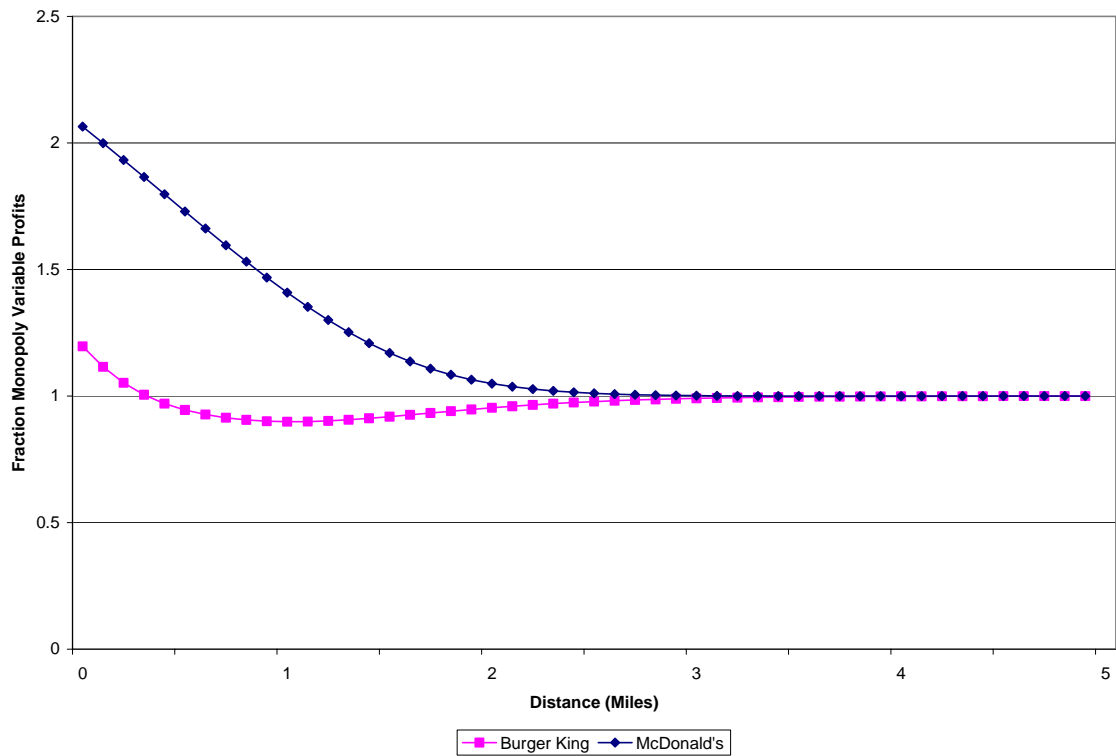**FIGURE 8: Variable Profit near a Mall**

Legend: Burger King — McDonald's

FIGURE 9: Variable Profit near a Commercial District