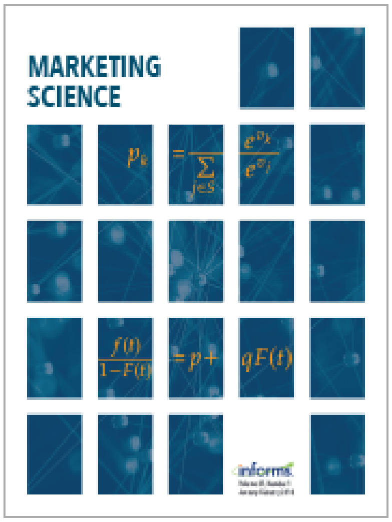

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Product Positioning and Competition: The Role of Location in the Fast Food Industry

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This paper examines optimal product positioning strategies of asymmetric firms in the context of retail outlet locations in the fast food industry. The relationships between profits and product differentiation reveal that both McDonald's and Burger King are better off avoiding close competition if the market area is large enough. However, in small market areas, McDonald's would prefer to be located together with Burger King rather than have the two outlets be only a slight distance apart. In contrast, Burger King's profits always increase with greater differentiation. Offsetting these incentives is the desirability of locating centrally to appeal to the most customers. The equilibrium depends on the market's size. In small markets, McDonald's locates near the center of the market, and Burger King locates to the side of the market. In larger markets, McDonald's and Burger King choose locations on opposite sides of the market, although McDonald's locates closer to the optimal central location than Burger King.

I also show that the role of price competition on product positioning is fundamentally different under asymmetric competition than under symmetric competition. Price competition unambiguously induces symmetric firms toward differentiation. In contrast, with asymmetric firms, price competition shifts Burger King's incentives toward locating closer to McDonald's, even while price competition increases McDonald's desire for differentiation. As a result, equilibrium locations with asymmetric firms are approximately the same, regardless of whether prices adjust with location.

Key words: product positioning; pricing research; geographic competition; fast food
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1. Introduction

When deciding how to position a product, marketing managers need to understand how product differentiation affects competition. Thus, this paper examines the relationship between product differentiation and prices and profits in the fast food industry and uses this information to analyze the optimal product positioning strategies—represented as location choices—of asymmetric competitors. Because McDonald's is a stronger competitor than Burger King, the two firms should follow different product positioning strategies.

The importance of product positioning has generated a vast literature on the topic. Much of the theoretical literature focuses on whether firms should minimally or maximally differentiate their products. For example, d'Aspremont et al. (1979) show that two otherwise identical firms competing on a Hotelling product line will maximally differentiate so as to soften price competition, even though these firms would both locate in the center of the market in the absence of price competition. Hauser (1988) shows that similar results can be obtained for a small number of firms from the defender model of Hauser and Shugan (1983).[1] Moorthy (1988) shows that the tendency to differentiate holds for vertical differentiation as well. Lane (1980) also finds that firms will differentiate to soften price competition, although the differentiation will not be maximal in his model because demand becomes zero if the products are located near the edge of the market. However, not all models find that firms differentiate themselves: Anderson et al. (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[2] and consumers are not too price sensitive.[3]

Neven and Thisse (1990) and Irmen and Thisse (1998) extend the literature through models of competition over multiple product attributes. Both papers

[1] Hauser finds that two or three firms maximize product differentiation under price competition but locate at the center of the market without price competition. The equilibrium is more complex for four or more firms.

[2] Equivalently, when the market size is small enough.

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

conclude that firms will differentiate themselves for one product attribute—horizontal or vertical—and that the firms will choose the optimal product positioning for the other attributes.[4]

These theoretical papers are complemented by computational papers such as Gavish et al. (1983) and Sudharshan et al. (1987), which study optimal product positioning in markets where consumers have ideal points in attribute space. However, these papers do not consider the price response to entry, which theoretical papers have shown to be important.

Empirically, Horsky and Nelson (1992) estimate a choice model and evaluate the optimal product positioning when competitors change their prices after entry. However, consumers in their model do not have any 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. In the economics literature, both Mazzeo (2002) and Seim (2006) show that firms differentiate themselves to soften price competition. Mazzeo classifies motels into two or three vertically differentiated levels and finds that firms generally choose to enter at a different quality level than the other motels in the market. Seim studies horizontal geographic location choice by otherwise undifferentiated firms. She concludes that firms face a tradeoff between locating near large sources of demand and differentiating themselves geographically. Finally, Duan and Mela (2006) estimates latent correlations in demand in the apartment market and uses the estimated demand model to evaluate optimal locations for a new apartment complex.

This paper considers optimal product positioning by firms with asymmetric competitive strengths. At the core of this paper is a model that controls for consumer heterogeneity over willingness to pay 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.

Other theoretical papers examine product positioning among asymmetric firms. Carpenter and Nakamoto (1990) use an ideal-point demand model in which consumers prefer incumbents over entrants to demonstrate that "me-too" strategies are not optimal for entrants. Their conclusion is partially due to an assumption that consumers strongly prefer an incumbent product if the products are similar, while this asymmetry is diminished if the two products are differentiated. This assumption is reasonable in many contexts but does not hold in others. For example, consumers' relative valuations of McDonald's and Burger King's food quality probably do not depend on how close the two outlets are located geographically.[5] Du et al. (2005) use a variant of Desai's (2001) model, which incorporates both a taste for quality and location, to analyze how a retailer should position a store brand competing against stronger national brands. They find that it is not always optimal to position the store brand directly against the strongest national brand. One reason for this result is the benefit that the retailer gains from lower wholesale prices of the national brands if the store brand is properly positioned. However, these incentives differ significantly from those in many industries, including fast food. Tyagi (2000) considers product positioning among firms with symmetric demand but asymmetric costs. He finds that companies will differentiate themselves from firms that have a cost advantage over them. Furthermore, firms with a cost disadvantage might choose to enter at a suboptimal location, anticipating that a stronger firm will later choose to enter at the best location. Finally, Neven and Thisse (1990) provide some analysis of how firms of asymmetric quality should choose locations on a Hotelling line. They find, in contrast with the results of this paper, that both stronger and weaker firms should choose minimum horizontal differentiation if there is enough quality differentiation. However, their result is very sensitive to the precise distribution of consumer preferences across location and quality and does not hold for all parameter values.[6]

The approach used in this paper is computational-theoretic. I derive the theoretical results using a model of consumer and firm behavior that is standard in empirical research. An advantage of using this model is that it is more flexible and realistic than many simpler theoretical models. However, the model is too complex to solve for many of the results analytically; thus, I solve for price-equilibria computationally using a select set of parameters. To make sure the numerical simulations are realistic, I use Thomadsen's (2005) empirical estimates of the model's parameters from a data set of Burger King and McDonald's franchisees. By using estimates from a real industry,

[4] In a horizontal product space, this would be the central location.

[5] Carpenter and Nakamoto do not address the optimal product positioning strategies of the dominant firm.

[6] It is because the theoretical results are sensitive to a model's assumptions and parameter values that I use a relatively flexible model and empirically relevant parameters. I also show in Section 4.5 that many of the strategic results are muted if one places all consumers on a single-dimensional Hotelling line, even if one uses the same model and parameters as used in this paper. Neven and Thisse do not solve for location equilibria among asymmetric firms for all parameter values because analysis of location choice by asymmetric competition was not the focus of their paper.

I obtain not only theoretical results, but also empirically relevant insights into the fast food industry because the magnitudes of the effects are derived from data.

I show that small amounts of differentiation can impact price and profits, and that prices and profits do not always vary monotonically with increased differentiation. In fact, consistent with Hauser and Shugan (1983) and Perloff et al. (1996), I find that it is possible for entry to lead to prices that are above the monopoly level.[7]

The analysis of optimal product positioning reveals that Burger King and McDonald's should pursue different location strategies. Burger King, as the weaker competitor, should try to locate far away from McDonald's to create its own unique niche of customers. In fact, Burger King will generally avoid locating in the optimal market location even if it is entering the market first, to avoid anticipated competition with McDonald's. McDonald's, on the other hand, would like to differentiate itself from Burger King if the market is large enough that the two firms could essentially monopolize two areas. However, in smaller markets, McDonald's would like to match Burger King's actions (denying Burger King a geographic advantage with a subset of customers), which it balances with the benefits of locating near the center of the market.

Put together, equilibrium outcomes will involve McDonald's locating at or near the center of the market and Burger King locating off to one side of the market for small market areas. If the market area is large enough, the two firms will locate on opposite sides of the market, although McDonald's will locate closer to the center of the market than Burger King. In all cases, both firms will choose to locate near large sources of demand, such as a mall or downtown, despite the presence of a competitor. I also show that price competition has less impact on product positioning among asymmetric competitors than it does for symmetric competitors.

Finally, I provide some descriptive support of the theoretical results from the fast food market of Santa Clara County, California. I show that McDonald's does indeed avoid moderate amounts of differentiation while Burger King tries to differentiate itself, and that Burger King is more likely than McDonald's to choose a sub-optimal location.

The rest of the paper proceeds as follows. Section 2 gives a brief synopsis of the fast food industry. Section 3 presents the model of demand and competition that is used, as well as the parameter estimates. Section 4 analyzes the optimal product positioning strategies for each of the firms. Finally, Section 5 concludes.

[7] I also find that geographic competition affects price mostly through the presence of a viable alternative for consumerss and that relatively little of the effect comes from a direct price response.

2. 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. More than 7% of the U.S. population consume a meal from McDonald's each day,[8] and each year more than 80% of Americans eat at a McDonald's.

Both chains 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, and both McDonald's and Burger King's success can be largely attributed to the vigilance with which their founders enforced this homogeneity.[9]

While some outlets are operated directly by McDonald's and Burger King Corporations, most U.S. outlets are operated by franchisees.[10] These franchisees, which pay the franchisor a fixed franchise fee plus a percentage of revenues,[11] operate largely as independent businesses within a framework of a national brand—purchasing their inputs from approved suppliers and setting their own prices.

3. Competition Model

The product positioning analysis is based on the equilibria of a two-stage model. In the first stage, each firm chooses its location.[12] In the second stage, each firm simultaneously chooses its price. Once prices and locations are chosen, consumers nonstrategically purchase from the outlet that provides them with the highest utility.

This section first presents the demand model, which determines each outlet's profits as a function of both firms' location and prices. I then present the supply model, which establishes how firms will set prices given the location decisions. The analysis of the first stage (location choices) is presented in Section 4. While this theory model is generic, I ascribe fast food attributes to it because the parameter values used in the simulations are those estimated from that industry.

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

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

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

[11] Lafontaine (1992) notes that franchisors generally offer the same contract terms to all potential franchisees at a given point in time.

[12] I consider both simultaneous and sequential location choices.

3.1. Demand

Demand for fast food at each outlet is modeled using a discrete-choice framework, where potential consumers (hereafter, consumers) can either purchase one meal from one of J fast food outlets or choose not to eat fast food. The demand model used in this analysis is one of a mixed multinomial logit, adapted to geography in a similar way as Bell and Lattin (1998) and Davis (2006) handle geography in their empirical studies: Consumers are spread across the county and incur a cost of traveling from either their residences or their work locations to the outlets.[13] One advantage of this model is that it incorporates many realistic aspects of competition—enough that the model can be (and has been) estimated using real data.

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

$$V_{i,j} = X_j'\beta - D_{i,j}\delta - P_j\gamma + \eta_{i,j}, \tag{1a}$$

where X_j is a vector of outlet characteristics, $D_{i,j}$ denotes the distance between consumer i and outlet j, and P_j denotes the price of a meal at outlet j. β, δ, and γ are (estimated) parameters, and $\eta_{i,j}$ is the unobserved portion of individual i's utility at outlet j.[14]

Note that because this paper is showing theoretical results, X_j can include both observable and unobservable outlet characteristics. Thus, it is not necessary to add an outlet-specific residual term that is constant for all consumers into Equation (1a), as is done for many empirical papers.[15]

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

$$V_{i,0} = \beta_0 + \eta_{i,0}.^{16} \tag{1b}$$

I normalize $\beta_0 = 0$.

Consumers are located at one of B locations throughout the country. I denote the number of consumers at location b as $h(b)$. Each outlet's demand is then calculated by determining the fraction of consumers at a given location who patronize each outlet as a function of the utility parameters, and then summing these choices across locations.

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

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

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:

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

The heterogeneity provided by the market geography means that the demand for fast food does not suffer the irrelevant alternatives (IIA) property.[17] Rather, the geography of the market plays the same role in determining which products are closer/more distant substitutes as random coefficients play in many papers (McFadden and Train 2000, Sudhir 2001, Chintagunta et al. 2003),[18] or that the variance-covariance terms play in papers using probit demand choice (Chintagunta 2001). In fact, this model of geographic competition belongs to the class of mixed-logit demand functions.[19]

3.2. Supply

Franchisees set prices at their outlets in a way that maximizes profits according to a static Bertrand game.[20] Firm j's profits are then

$$\Pi_j = r_j P_j Q_j(P) - c_j Q_j(P) - FC_j, \tag{4}$$

where FC_j is outlet j's fixed costs, c_j is outlet j's marginal cost, r_j is the fraction of revenue that the franchisee retains after paying their franchise royalties, and P is the vector of prices at all outlets.[21]

Note that maximizing (4) is the same as maximizing

$$\Pi_j = P_j Q_j(P) - \left(\frac{c_j}{r_j}\right) Q_j(P) - \frac{FC_j}{r_j}. \tag{5}$$

I refer to $C_j = c_j/r_j$ as "marginal cost" because the franchisees act as if they are maximizing profits with

[13] I assume that consumers are well informed about prices, locations, and food at all outlets in the market.

[14] 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.

[15] Thomadsen (2005), which provides the parameter estimates, discusses why such a term is not required for empirical work in the fast food industry. However, these arguments are not important for this paper.

[16] The parameter values are based on estimates that controlled for demographic tastes for the outside good. I omit these shifters from the model because they do not affect the conclusions of this paper.

[17] See Anderson et al. (1992, p. 350).

[18] Utility-based, random coefficients models have also been found to extend beyond discrete-choice problems (Dube 2004, Nair et al. 2005).

[19] Note that plugging Equation (2) into Equation (3) yields an expression that looks like Equation (5) in Sudhir (2001).

[20] Bertrand competition is a reasonable assumption in this industry because firms offer to sell as many meals as demanded at posted prices, and because the firms can change their prices quickly and easily.

[21] I do not consider profit maximization across multiple outlets because the product positioning analysis in Section 4 considers only firms with one outlet.

marginal costs of C_j. This profit function in Equation (5) yields the following first-order conditions with respect to price at each outlet:

$$Q_j(P) + (P_j - C_j)\frac{\partial Q_j(P)}{\partial P_j} = 0. \tag{6}$$

3.3. Parameter Values

To ensure that the effects of geographic differentiation are of a reasonable magnitude, I use parameters from Thomadsen (2005), which estimated this model for competition among Burger King and McDonald's outlets in Santa Clara Country, California. Readers interested in the data and estimation details are referred to that paper. Thomadsen (2005) also presents reduced-form regressions that demonstrate that price variation across outlets is indeed related to the degree of competition around the outlet, including the distance to the nearest competitor.[22]

The estimates of the model are reported in Table 1. The differences between the McDonald's and Burger King baseline utilities 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. The marginal cost estimates imply average markups of \$1.23 for Burger King and \$2.01 for McDonalds. These markups are consistent with conventional wisdom on their magnitudes.[23,24]

The estimated model accounts for the possibility that consumer valuation of the outside good is demographic-dependent. I use the value of the outside good for the omitted class (woman 18–29 years in age) for the analysis in Section 4. Changing this assumption does not affect the results in any meaningful way. I also assume that the outlets have no drive-thru or playland, because these variables are not estimated to have a significant impact on consumer utility.

Table 1 Estimates of the Full Model

$$V_{i,j} = X_j\beta - D_{i,j}\delta - P_j\gamma + \eta_{i,j}$$
$$MC_j = C_k + \varepsilon_j$$

Variable name	Variable	Estimate	(SE)
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	

Notes. Standard errors appear in the parentheses.
*, **, *** denote significance at the 90%, 95%, and 99% levels, respectively.

4. Product Positioning

Product positioning is analyzed through a two-stage game, where firms select their locations—simultaneously or sequentially—in the first stage and set their prices in the second stage. Section 4.1 analyzes the second stage of the game, while the rest of Section 4 analyzes the first stage.

I use the fitted model to demonstrate how outlet location affects optimal location choice. Because I cannot solve this model analytically, I calculate the market equilibria computationally under various scenarios. These counterfactual calculations are conducted by placing firms in a hypothetical square market with a uniform distribution of consumers.[25] I vary the market size to demonstrate how it affects the results.

I first demonstrate how product differentiation affects equilibrium prices and profits. I show that the relationships between price and product differentiation are different for McDonald's and Burger King, and I confirm previous results that this relationship can be nonmonotonic. I then discuss how these results affect each firm's location choices: McDonald's wants to either match Burger King's location or serve a different niche, while Burger King always prefers to differentiate itself. Offsetting these effects are benefits from being centrally located. I pull all these effects together and analyze the equilibrium outcomes. I also provide evidence that supports that these findings hold in a real market.

Finally, I consider the importance of using an empirical model by commenting on how the results

[22] Whopper meals vary from \$3.19 to \$3.69, with a mean of \$3.26 and standard deviation of 11¢. Big Mac meals vary from \$2.99 to \$4.09, with a mean of \$3.46 and standard deviation of 27¢.

[23] 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.

[24] Note that McDonald's has both a relative and absolute cost advantage, in the terminology of Jing (2006). Consistent with this, McDonald's outlets generally earn greater profits than Burger King outlets.

[25] This is executed by placing a grid of 1/10- × 1/10-mile square cells over the market and placing an equal number of consumers at each node of the grid.

Figure 1 McDonald's Price and Variable Profit

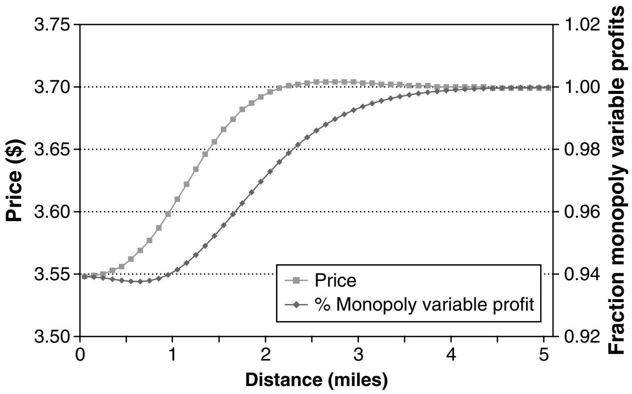
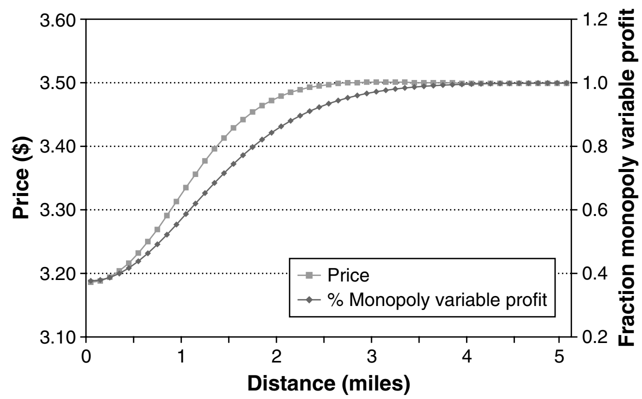


Figure 2 Burger King Price and Variable Profit



would change if the firms were symmetric competitors, or if consumer locations were constrained to a one-dimensional Hotelling line.

4.1. The Effect of Distance on Price and Profits

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 in which one Burger King outlet and one McDonald's outlet are placed at different distances apart in a very large market.[26,27] Figure 1 shows how the price and variable profits of the McDonald's outlet change as the outlets are located farther apart, while Figure 2 shows the same figure for the Burger King outlet.[28] Because all variable profit calculations are valid only 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.

Prices for both McDonald's and Burger King are lowest when the outlets are close to each other and increase as the firms are located farther apart, approximately leveling off once the outlets are about 2–2.5 miles apart. In fact, careful examination of Figure 1 reveals that McDonald's prices are slightly above the monopoly price level when the outlets are 2–4 miles apart, and Figure 2 reveals a similar effect for Burger King.[29] This effect, where entry by a competitor can cause prices to increase, has been found in other papers (e.g., Hauser and Shugan 1983, Perloff et al. 1996, Ward et al. 2002, Goolsbee and Syverson 2004, and Chen and Riordan 2006). Note, however, that the firm is always best off as a monopolist: Variable profits are always below the monopoly level, even at distances (2–4 miles) where prices are at or a bit above monopoly levels.

The nonmonotonic relationship between equilibrium price and product differentiation is matched by a nonmonotonic relationship in price-response. Figure 3 shows the price-response elasticities—the change in one outlet's price in response to a 1% change in the other outlet's price.[30] Burger King's price-response to a change in McDonald's price initially increases with greater differentiation over the first 0.8 miles and decreases only for greater distances. The nonmonotonic relationship for price-responsiveness is consistent with the combined results of Blattberg and Wisniewski (1989) and Bronnenberg and Wathieu (1996). When Burger King and McDonald's are located together, Burger King, as the weaker firm, is unable to attract many consumers from McDonald's by lowering its prices. However, once Burger King is positioned differently enough, it finds that it is attractive to enough consumers that it begins to find that it can use prices to attract customers.

Figure 1 also shows that McDonald's variable profits initially decrease in the distance to a Burger King competitor over the first 0.6 mile of geographic differentiation. This occurs because most consumers would

[26] A 20- × 20-mile market size was used to ensure that there were no "edge of market" effects. I discuss the impact of market size and edge-of-market effects on optimal positioning strategies explicitly below.

[27] This paper focuses on competition between only one McDonald's and one Burger King. This strategy is used because it makes presentation of the analysis simple and because many of the strategic interactions can be demonstrated even in this two-outlet context. However, in reality McDonald's and Burger King enter at multiple locations. Analyses of multiple-outlet locations are more sensitive to assumptions about whether the random components of consumer utility, η, are distributed independently and about whether the chain or individual franchisees choose the outlet locations. Thus, I leave this as an extension for future research.

[28] As a benchmark, a McDonald's monopolist in such a market would charge \$3.70, while a Burger King monopolist would charge \$3.50.

[29] This effect would be larger if there were more firms in the market.

[30] These price-response elasticities are low because McDonald's and Burger King are already relatively differentiated products even without geographic differentiation. The response of variable profits to a rival's price change is generally larger then the price elasticities.

Figure 3 Price-Response Elasticities

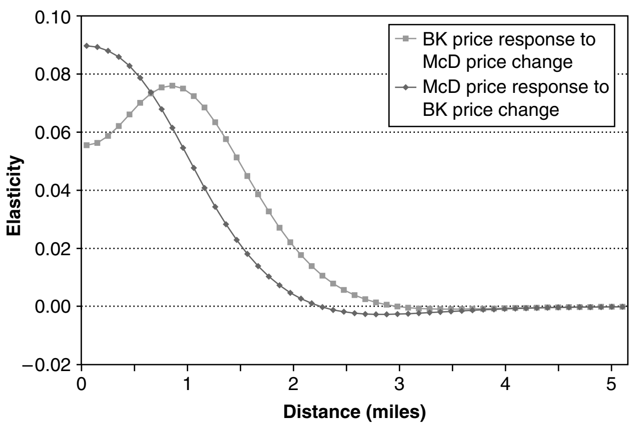
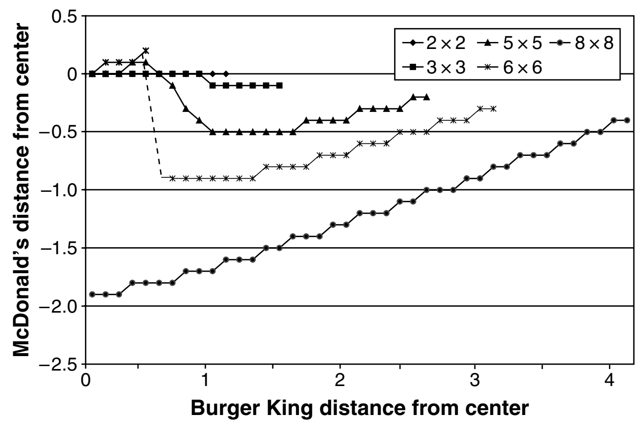


Figure 4 McDonald's Location Best-Response Function



patronize a McDonald's outlet over a Burger King outlet if the outlets were located in the same place. However, when the outlets are located apart, some consumers who prefer McDonald's will instead eat at a Burger King because they are geographically located closer to the Burger King outlet. It is also true that some consumers who prefer Burger King's food will be closer to McDonald's and eat there instead, but because more consumers prefer McDonald's food, the net flow of customers is from McDonald's to Burger King. This dip in variable profits over small levels of geographic differentiation would become more exaggerated—in depth and in distance from an outlet—as there are more firms in the market. Note that this dip in profits is a result of the asymmetry between the two firms. In particular, profits would monotonically increase in the distance between two outlets if both outlets had equal average levels of appeal.

Figure 2 reveals that the impact of competition on both price and profits is larger for Burger King than for McDonald's. Also, Burger King's variable profits monotonically increase with geographic differentiation.

Edge-of-market effects will counterbalance the effects shown on Figures 1 and 2. As the firms are located closer to the edge of the market, they will find that there are fewer consumers located "close" to them. Because it is hard for the firms to attract consumers located far from the outlet, profits will be low at the edge of the market. If the market is large enough, the firms can locate far apart without incurring significant edge-of-market effects. However, the effect of moving away from the center of the market can be large if the market area is small. Ultimately, it is these edge-of-market effects that limit how far apart the fast food outlets will choose to locate from each other and prevent maximum differentiation. Similarly, the edge-of-market effects prevent McDonald's from completely matching Burger King's locations in small markets.

4.2. Response Functions

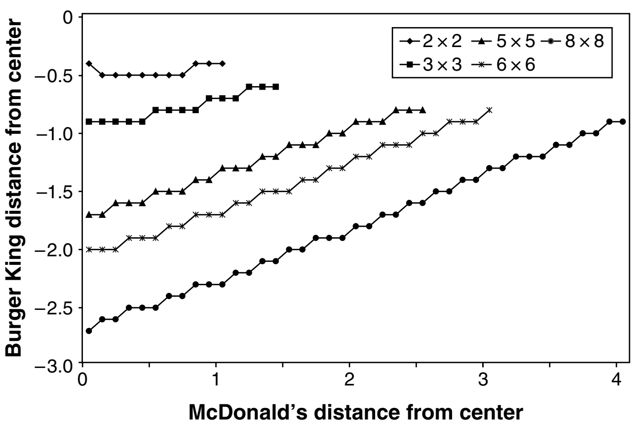
Figures 4 and 5 give the optimal response functions for McDonald's and Burger King, respectively.[31] In each figure, I place a hypothetical firm at different locations along a line through the market, and then see where on that same line the other firm would locate to maximize their profits.[32] Note that as one firm is located away from the center of the market, the other firm can locate either on the same or on the opposite side of the market. Graphically, I denote locating on the same side of the market as the competing outlet as a positive response and locating on the opposite side as a negative response. Figures 4 and 5 show these response functions for a variety of market sizes to see how market size (or dispersion of tastes) affects a firm's optimal positioning strategy.

When McDonald's is in a small (2- × 2-mile) market, it always chooses the central location, regardless of Burger King's location. When the market is a bit larger, e.g., 5 × 5 miles, McDonald's best response function takes a different form: When the Burger King is located near the center, McDonald's wants to locate between the market center and the Burger King outlet, partially matching Burger King's position. McDonald's does not completely match the Burger King's location because it balances the benefit of being located near the center of the market and

[31] I evaluate the optimal locations at 1/10-mile increments. Using a finer increment smoothes the response functions but keeps the same qualitative results.

[32] I place the firms on a line that cuts the square in half across the width of the market. For example, if the market size is 2×2, I move the firms along a line with endpoints $(0, 1)$ and $(2, 1)$. This is a realistic location consideration set because fast food outlets primarily locate on the busiest streets, which are like lines. I discuss the implications of spreading consumers over two dimensions instead of one in Section 4.5.

Figure 5 **Burger King Location Best-Response Function**



being accessible to all consumers, with the benefit of being located close to Burger King and minimizing Burger King's ability to capitalize on the consumers who find the Burger King location to be more convenient. As the Burger King is located farther away, the optimal response gradually swings back towards the center and then to the opposite side of the market. This swing back occurs for two reasons. First, McDonald's can raise its price more when the outlets are located farther apart. Second, once Burger King moves far enough from the center of the market, McDonald's cedes the customers located close to Burger King's edge of the market and instead focuses on being as attractive as possible to the rest of the market.

When the market size is a bit larger, there is a structural change in McDonald's response function. The 6- × 6-mile market response function shows that McDonald's locates between the market center and the Burger King outlet when the Burger King is located near the center. However, McDonald's best response suddenly jumps to a "far" point on the opposite side of the market when the Burger King is located more than 1/2 mile from the market center. This effect is different than that for the smaller market: In this case, the profit function—holding Burger King's location fixed—has two local maxima. One local maximum occurs when the McDonald's is located between the center of the market and the Burger King, while the other occurs when the outlets are located far apart. This is a direct effect of the dip in the McDonald's profit function, as presented in Section 4.1. This discontinuous jump in the response function is a result of a switch in which local maxima is the global maximum. In contrast, the profit function for the 5- × 5-mile market has only one local maximum, and the optimal response function is continuous.

If the market is large enough, both firms always prefer to locate apart and essentially set up a local monopoly. This is pictured graphically by the 8- × 8-mile market, where the McDonald's optimal response is to locate far from the Burger King.

Figure 5 reveals that Burger King, as the weaker competitor, prefers to locate away from McDonald's.[33] The distance that Burger King desires between the two firms increases with the total market area. However, Burger King will not locate too close to the edge of the market because then it will not appeal to enough consumers.

These response functions are consistent with each firm's observed behavior. For example, consistent with the discontinuity in McDonald's response function and the dip in its profit function, McDonald's outlets tend to locate either close to or far away from competing Burger Kings, but not in between. No such trend is observed for Burger Kings. This is can be observed by examining the distances between new outlets and their closest competitor at the time of entry. Because the perceived quality of McDonald's and Burger King might have changed in time, I limit the analysis to entry in the 15 years before the data were collected.[34] Among the 25 McDonald's entering in this period, McDonald's located within 0.5 mile of the Burger King 7 times and more than 1 mile away 16 times. However, McDonald's chose to locate between 0.5 and 1 mile from a Burger King only twice. In contrast, the distribution of distances when Burger King entered is consistent with Burger King wanting to locate away from McDonald's but close to large sources of demand. Out of the 23 entering Burger King outlets, Burger King moved within 1/2 mile of a McDonald's 5 times, between 1/2 and 1 mile 6 times, and more than 1 mile 12 times.

Finally, Figure 6 shows the optimal response functions that would be obtained in a market with two firms of symmetric quality.[35] The key take-away is that all the response functions are negative. Thus, it is the asymmetry between the firms—and the dominance of McDonald's—that leads to the positive response where McDonald's sometimes wants to partially match Burger King's locations.

4.3. Equilibrium

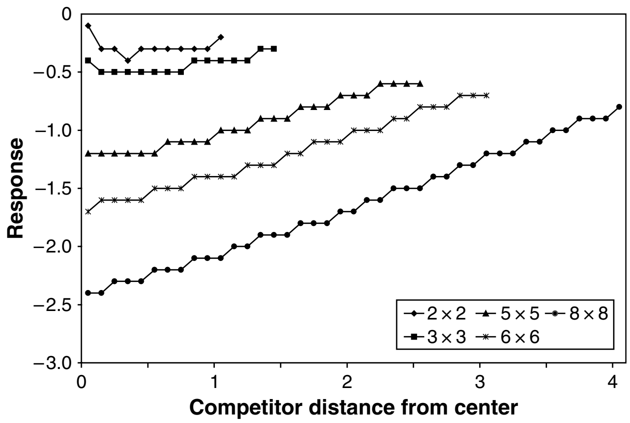
The characteristics of the response functions can be seen in the location-choice equilibria. I consider both

[33] I note in Section 4.3 that if there is a large enough source of demand, such as a mall or a downtown, then Burger King will choose to locate near the demand source even if it means locating next to McDonald's.

[34] As evidence that there has been such a shift, a regression of the distance to the nearest competitor at the time of entry on the year of entry reveals that Burger Kings locate, on average, 0.26 mile farther from competitors in each decade. There is not a similar significant difference for McDonald's entrants.

[35] The picture for two firms of Burger King's quality looks similar.

Figure 6 McDonald's Best-Response Function to McDonald's Quality Outlet



simultaneous and sequential location-choice equilibria. Some readers might be concerned about the possible lack of existence of location equilibria in the simultaneous-move games.[36] This concern is especially appropriate given that McDonald's response function can be discontinuous. However, the parameter estimates ensure that simultaneous-move equilibria exist for the market scenarios analyzed here.[37]

The equilibria involve Burger King locating away from McDonald's, but not maximally (at the edge of the market). Burger King's aversion to direct competition with McDonald's is strong enough that it will not locate at the optimal location (the center of the market) even if it is able to choose its location before McDonald's. Consistent with McDonald's more complicated response function, McDonald's equilibrium locations qualitatively depend on the market size and other market conditions.

Consider a small 2- × 2-mile market—which might be a typical size for a hole in the fast food market. The equilibrium outcome of a simultaneous location-choice game is that McDonald's will choose the central location, while Burger King will choose to locate 0.4 mile away from the center. If, instead, Burger King chose its location before McDonald's, Burger King would still choose to avoid the central location and let McDonald's locate in the center of the market.[38]

When the market is a little larger, all equilibria involve the firms locating apart on the opposite sides of the market, although McDonald's locates closer to the center of the market than Burger King does. For example, in the 6- × 6-mile market, McDonald's locates 0.7 mile from the center on one side and Burger King 1.8 miles away from the center on the other side of the market in the simultaneous-location equilibrium. The sequential-move equilibria are very similar.[39]

This tendency to locate apart in large enough market areas can be offset if there is a large, concentrated source of demand in the market. For example, if there were a large mall located in the center of the market, then each firm would choose to locate at the mall even though the other firm would locate there, too. Similarly, if the center of the market were a "downtown" area with a greater concentration of demand, both firms would choose to locate in the downtown area, although McDonald's will generally take a more central location than Burger King. This can explain why McDonald's and Burger King outlets are often located together in high-demand areas.

I check whether McDonald's gets the most attractive locations by using the estimated model to evaluate whether each Burger King (McDonald's) in Santa Clara Country would be better off swapping locations with the closest McDonald's (Burger King). Overall, 21 out of the 38 Burger King restaurants (55%) would earn higher profits if they swapped locations with the nearest McDonald's. By contrast, only 26 of the 62 McDonald's (42%) would earn higher profits if they swapped locations with the nearest Burger King. These figures are 58% (19/33 Burger Kings) and 38% (17/45 McDonald's), respectively, among those outlets whose profits shift by more than 5%.

Finally, the equilibrium outcomes described in this section differ from what would be obtained from competition between symmetric firms. For example, if two outlets of McDonald's quality were competing against each other in a small 2- × 2-mile market, both outlets would locate apart and away from the center under both simultaneous and ordered entry games. Furthermore, McDonald's will locate closer to, and Burger King will locate farther from, the center of the market than symmetric firms would locate (under both simultaneous and sequential entry).

4.4. Role of Price Competition with Asymmetric Firms

The previous analysis assumes that firms adjust their prices in response to the geographic layout of the

[36] Sequential games always have at least one pure-strategy subgame perfect (therefore, Nash) equilibrium.

[37] The vertical differentiation ensures that the response functions always intersect on the negative portion of McDonald's response function. Also, the equilibria are not sensitive to the level of discretization used in the equilibrium calculations.

[38] When McDonald's moves first, it will choose to locate slightly away from the center of the market because Burger King will respond by locating even farther away from the center: McDonald's will locate 0.1 mile from the center, and Burger King will locate 0.5 mile from the center on the other side (so the firms are located 0.6 mile apart).

[39] If McDonald's moves first, it locates 0.5 mile from the center, and Burger King locates 1.9 miles away from the center on the other side. If Burger King moves first, it locates 1.6 miles from market center, and McDonald's locates 0.7 mile from market center on the other side.

Figure 7 Map for McDonald's Example on El Camino Real (Squares = McDonald's, Circles = Burger King)

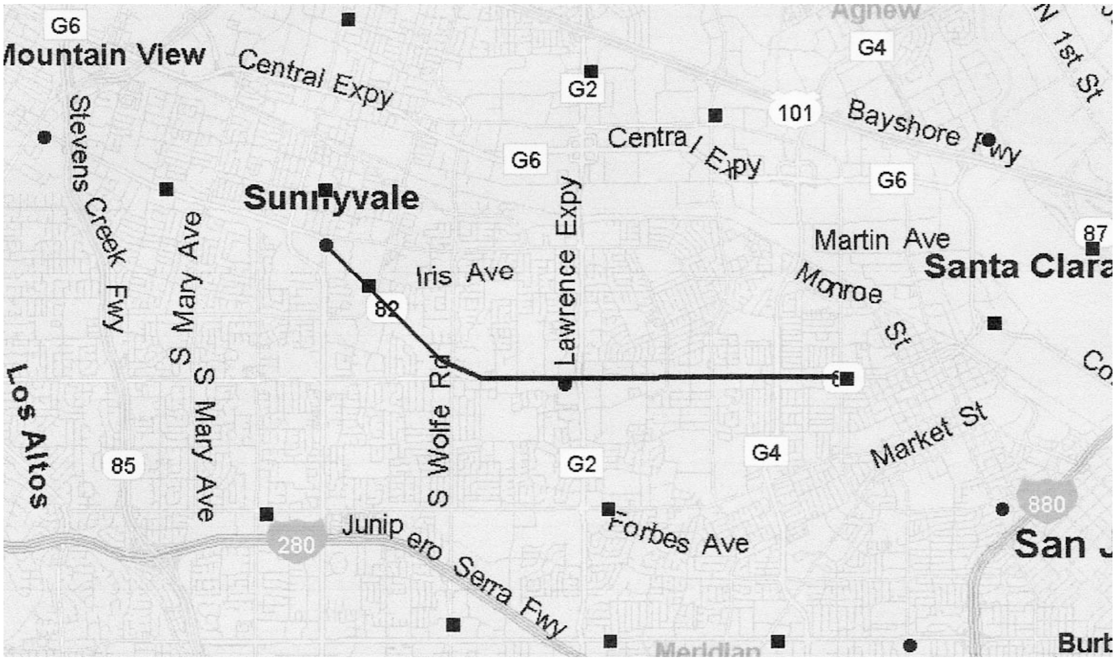
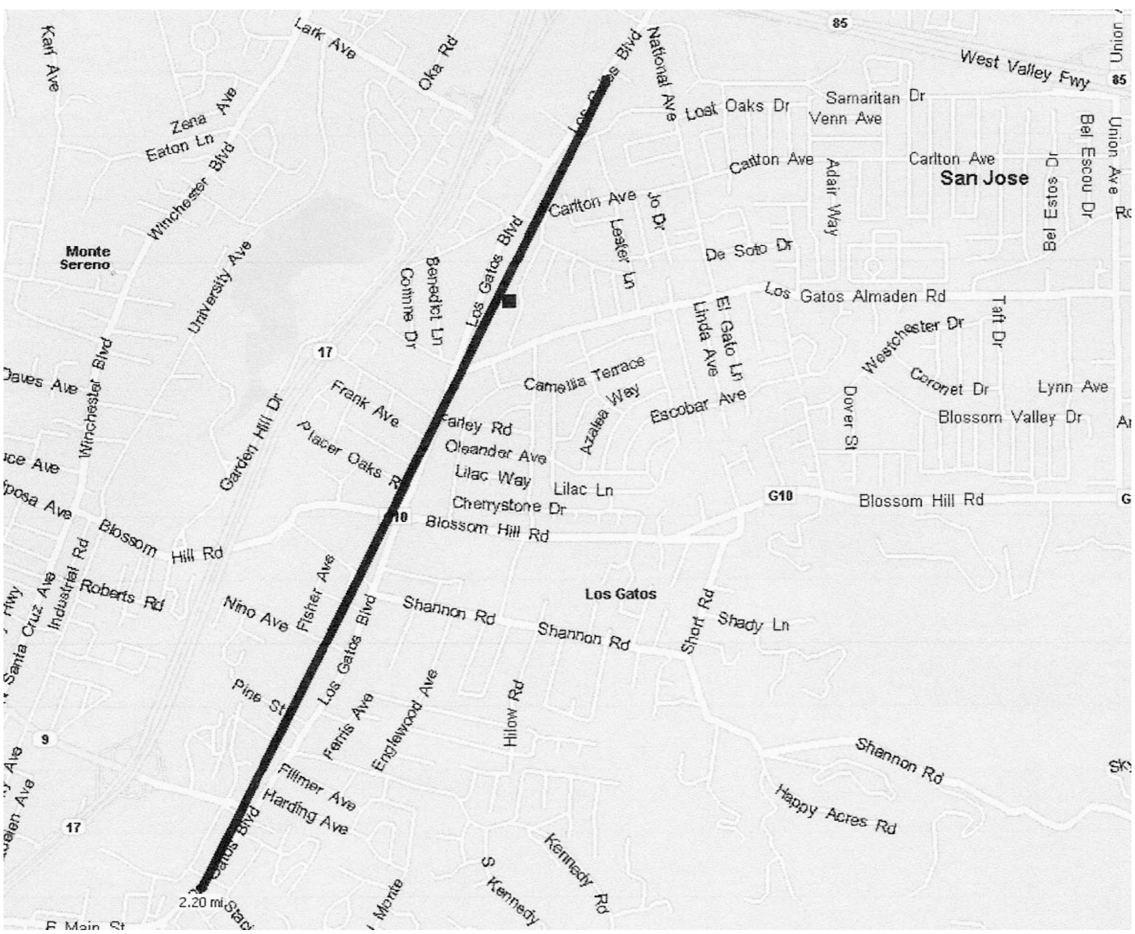


Figure 8 Map for Burger King Example on Los Gatos Blvd



market. While this is a realistic assumption, it turns out that allowing prices to adjust with the location has only a small effect on the equilibrium location choice, in contrast with what happens among symmetric firms.[40]

The reason the impact of price competition on location choice differs between the asymmetric and symmetric cases can be seen by examining how each firm's response function changes depending on whether prices can vary with location. In general, McDonald's and Burger King's location best-response functions when prices are held fixed, regardless of location, are similar to those under price competition, with a few differences. McDonald's generally prefers to locate closer to the Burger King outlet when prices do not vary with location.[41] This is consistent with the result under symmetry, where price competition pushes firms toward product differentiation.[42] However, the effect is the opposite for Burger King, which prefers to locate farther away from McDonald's when prices are fixed because it cannot lower prices to make itself more attractive.

Because the effect of price competition on the strategies of Burger King and McDonald's works in opposing directions, the impact of price competition on location equilibria is very small. Generally, the location equilibria with and without price competition differ by only a few tenths of a mile.[43] This contrasts with the results from previous papers (e.g., Hauser 1988) that analyze competition among symmetric firms. These papers find that firms locate close to the market center in the absence of price competition but differentiate to soften price competition. One obtains a similar result for the model used in this paper, as well. For example, in a 3- × 3-mile market, two McDonald's-quality outlets would locate 1 mile apart when there is price competition in a simultaneous-move game, but they would locate only 0.2 mile apart in a simultaneous entry game without price competition.[44]

[40] That is, the equilibrium of the location game would remain approximately unchanged even if the pricing stage of the game were removed and prices were instead set at a fixed level.

[41] McDonald's also wants to locate on the same side of the market as Burger King for a greater distance of separation when prices do not adjust with location choice.

[42] This is true for the model used in this paper, as well as for Hauser and Shugan (1983) and d'Aspremont et al. (1979).

[43] The opposing impact of price competition on the response functions also means that the absence of price competition can shift the equilibrium locations closer together sometimes and farther apart other times.

[44] Price competition has little impact on location in larger markets in both the symmetric and asymmetric cases because firms choose to differentiate and focus on different consumer segments with or without price competition.

4.5. Comparison to a Hotelling Line

The analysis in this paper is based on markets in which consumers are spread over a two-dimensional geographic space, while firms are placed on a single busy street, as represented by a line. This modeling assumption is chosen because it best approximates consumer and firm locations in the fast food industry. However, given the large literature on product differentiation based on Hotelling-style lines (or other one-dimensional spaces), it is natural to consider how these results would change if the same model was used but consumers were instead located only along the one-dimensional street.

One effect of these assumptions is that prices are less sensitive to differentiation when consumers are spread over a two-dimensional space rather than on a line.[45] This, in turn, contributes to an increase in the propensity for firms to locate together relative to what occurs if consumers are spread along a Hotelling line. Many of the qualitative properties of the model hold even if all consumers are located on a line, but the degree to which McDonald's has an incentive to match Burger King's location is significantly less pronounced. For example, if consumers were spread over a 5-mile line, McDonald's would match Burger King's location if it located within 0.1 mile of the line's center, but McDonald's would locate at least 1.2 miles away from Burger King if the Burger King were located any farther from the center. Thus, moving the theoretical analysis away from reality to a simpler model has the effect of masking some interesting strategic effects.

The effect of the dimensionality of consumer location on both price and firm location is because location has less impact on the marginal consumer[46] when consumers are spread over two dimensions rather than over one. To see why, note that if an outlet changes its location along a line, all consumers on that line experience the same magnitude change in their distance to the outlet. For example, when outlet A moves a distance d to the right, customers to the right of outlet A become a distance d closer to the outlet, while customers to the left of outlet A become a distance d farther from it.[47] Thus, the location of the marginal consumer (who is indifferent between outlet A and its closest competitor) would shift by a distance proportional to d.[48] However, when consumers are

[45] Prices are also higher when consumers are distributed on a line because consumers are, on average, closer to the firm. Thus, the firm does not need to lower prices to attract customers who are far away.

[46] And through this, it has less impact on the intensity of competition.

[47] The distance between the outlet and customers in between the new and old locations changes by less than d, but this represents a negligible fraction of consumers if d is small enough.

[48] For any draw of ε, the distance of the marginal consumer moves by distance $d/2$.

spread over a two-dimensional space, consumers far from the line find that the distance between them and the outlet has changed by less than d. The location of the marginal consumer among those consumers far from the line will shift less than it does among those consumers located on the line.

This effect, where a change in a product attribute causes a large shift in utility for some consumers and a small change in utility for other consumers, is not unique to a geographic product space. For example, it is also true for random coefficients models. Consider the case of cereal in Nevo (2001). If a cereal increases its sugar content, consumers whose tastes depend heavily on sugariness (i.e., those consumers who have large positive or negative coefficients on sugar) will find that the utility they receive from the cereal changes a lot, while those consumers who have small coefficients on sugariness find that their preference for that cereal does not change much.

5. Conclusion

This paper examines the optimal product positioning strategies for firms of asymmetric competitive strength. This is done by first examining the effects of market geography on prices and variable profits. I then examine each firm's location best-response function and show the equilibrium location outcomes. While the results are theoretical, the magnitudes of the effects apply to the fast food industry, and I present some convergent evidence that is consistent with the model's predictions.

I find that McDonald's is more aggressive than Burger King in locating at optimal outlet locations, and that McDonald's will at least partially match Burger King's location choice if Burger King locates close to an ideal location. However, McDonald's will locate away from Burger King and allow each firm to dominate in its own area if the market is large enough. Burger King, on the other hand, always works to avoid direct competition with McDonald's unless there is a large demand source, such as a mall, which would provide Burger King with enough customers to overcome its inability to be a strong competitor against McDonald's.

These results can be illustrated by examining optimal outlet location choice in areas of Santa Clara County, California. First, consider locating a McDonald's outlet along a stretch of El Camino Real in Santa Clara, California. Calculating variable profits a new McDonald's would earn at 1/5-mile increments along the path (shown in Figure 7) reveals that the McDonald's outlet would choose to locate 1/5 of a mile to the west of the Burger King outlet, which is also the location it would choose if Burger King was not present in the market.[49] This is consistent with McDonald's choosing to locate at its optimal location in small market areas, even if it means locating close to a Burger King. I also consider the optimal location for a Burger King outlet along Los Gatos Boulevard—one of two major commercial streets in Los Gatos—as shown in Figure 8. The optimal location for the Burger King outlet is to locate 1 mile south of the McDonald's outlet. However, if the McDonald's outlet had not been present in the market, the Burger King would have instead located 1/5 mile south of McDonald's current location. This is consistent with the result that, in the absence of a large, concentrated source of demand, Burger King will avoid the best location if it means locating away from a McDonald's competitor.

Finally, because geography is just one of many potential product attributes—one that is convenient to use because it is relatively easy to observe—the theoretical results from this paper apply to other types of product positioning. For example, the results of this paper suggest that Apple should make sure its iPod players either match the same set of features as their mp3 player competitors or create a large market niche for itself. On the other hand, other mp3 players should unambiguously try to differentiate themselves from iPod.

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References

Anderson, S. P., A. de Palma, J.-F. Thisse. 1992. *Discrete Choice Theory of Product Differentiation*. MIT Press, Cambridge, MA.

Bell, D. R., J. M. Lattin. 1998. Shopping behavior and consumer preference for store price format: Why "large basket" shoppers prefer EDLP. *Marketing Sci.* **17** 66–88.

Blattberg, R., K. Wisniewski. 1989. Price-induced patterns of competition. *Marketing Sci.* **8** 291–309.

Bronnenberg, B., L. Wathieu. 1996. Asymmetric promotion effects and brand positioning. *Marketing Sci.* **15** 379–394.

Carpenter, G., K. Nakamoto. 1990. Competitive strategies for late entry into a market with a dominant brand. *Management Sci.* **36** 1268–1278.

Chen, Y., M. Riordan. 2006. Price-increasing competition. Mimeo, Columbia University, New York.

Chintagunta, P. 2001. Endogeneity and heterogeneity in a probit demand model: Estimation using aggregate data. *Marketing Sci.* **20** 442–456.

Chintagunta, P., J. P. Dubé, V. Singh. 2003. Balancing profitability and customer welfare in a supermarket chain. *Quant. Marketing Econom.* **1** 111–147.

[49] The coarseness of the consumer data prevents a more precise measurement of optimal location choice.

d'Aspremont, C., J. J. Gabszewicz. J.-F. Thisse. 1979. On Hotelling's "stability in competition." *Econometrica* **47** 1145–1150.

Davis, P. (2006). Spatial competition in retail markets: Movie theaters. *RAND J. Econom.* **37**(4) 964–982.

Desai, P. 2001. Quality segmentation in spatial markets: When does cannibalization affect product line design? *Marketing Sci.* **20**(3) 265–283.

Du, R., E. Lee, R. Staelin. 2005. Bridge, focus, attack or stimulate: Retail category management strategies with a store brand. *Quant. Marketing Econom.* **3** 393–418.

Duan, J., C. F. Mela. 2006. The role of spatial demand on outlet location and pricing. Mimeo, Duke University, Chapel Hill, NC.

Dubé, J.-P. 2004. Multiple discreteness and product differentiation: Demand for carbonated soft drinks. *Marketing Sci.* **23**(1) 66–81.

Emerson, R. 1990. *The New Economics of Fast Food*. Van Nostrand Reinhold, New York.

Gavish, B., D. Horsky, K. Srikanth. 1983. An approach to the optimal positioning of a new product. *Management Sci.* **29** 1277–1297.

Goolsbee, A., C. Syverson. 2004. How do incumbents respond to the threat of entry? Evidence from the major airlines. Mimeo, University of Chicago, Chicago, IL.

Hauser, J. R. 1988. Competitive price and positioning strategies. *Marketing Sci.* **7** 76–91.

Hauser, J. R., S. M. Shugan. 1983. Defensive marketing strategy. *Marketing Sci.* **2** 319–360.

Horsky, D., P. Nelson. 1992. New brand positioning and pricing in an oligopolistic market. *Marketing Sci.* **11** 133–153.

Irmen, A., J.-F. Thisse. 1998. Competition in multi-characteristics spaces: Hotelling was almost right. *J. Econom. Theory* **78** 76–102.

Jing, B. 2006. On the profitability of firms in a differentiated industry. *Marketing Sci.* **25**(3) 248–259.

Lafontaine, F. 1992. Agency theory and franchising: Some empirical results. *RAND J. Econom.* **23** 263–283.

Lane, W. J. 1980. Product differentiation in a market with endogenous sequential entry. *Bell J. Econom.* **11**(1) 237–260.

Love, J. F. 1995. *McDonald's: Behind the Arches*. Bantam Books, New York.

Mazzeo, M. 2002. Product choice and oligopoly market structure. *RAND J. Econom.* **33** 221–242.

McFadden, D., K. Train. 2000. Mixed MNL models for discrete response. *J. Appl. Econometrics* **15** 447–470.

McLamore, J. W. 1997. *The Burger King*. McGraw Hill, New York.

Moorthy, K. S. 1988. Product and price competition in a duopoly. *Marketing Sci.* **7** 141–168.

Nair, H., J. P. Dubé, P. Chintagunta. 2005. Accounting for primary and secondary demand effects with aggregate data. *Marketing Sci.* **24**(3) 444–460.

Neven, D., J.-F. Thisse. 1990. On quality and variety competition. J. J. Gabszewicz, J.-F. Richard, L. Wolsey, eds. *Economic Decision-Making*: *Games, Econometrics and Optimisation*. Elsevier, North Holland, Amsterdam, The Netherlands, 175–199.

Nevo, A. 2001. Measuring market power in the ready-to-eat cereal industry. *Econometrica* **69**(2) 307–342.

Perloff, J. M., V. Y. Suslow, P. J. Seguin. 1996. Higher prices from entry: Pricing of brand-name drugs. Mimeo, University of California, Berkeley, CA.

Seim, K. 2006. An empirical model of firm entry with endogenous product-type choices. *RAND J. Econom.* **37**(3) 619–640.

Shook, C., R. L. Shook. 1993. *Franchising: The Business Strategy that Changed the World*. Prentice Hall, Englewood Cliffs, NJ.

Sudharshan, D., J. H. May, A. D. Shocker. 1987. A simulation comparison of methods for new product location. *Marketing Sci.* **6** 182–201.

Sudhir, K. 2001. Competitive pricing behavior in the auto market: A structural analysis. *Marketing Sci.* **20** 42–60.

Thomadsen, R. 2005. The effect of ownership structure on prices in geographically differentiated industries. *RAND J. Econom.* **36** 908–929.

Tyagi, R. 2000. Sequential product positioning under differential costs. *Management Sci.* **46** 928–940.

Ward, M. B., et al. 2002. Effect of the private-label invasion in food industries. *Amer. J. Agricultural Econom.* **84** 91–73.