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The effect of ownership structure on prices in geographically differentiated industries

Raphael Thomadsen*

I analyze how ownership structure and market geography jointly influence fast food prices. I estimate a model of demand and supply that accounts for the market geography and run counterfactual experiments that demonstrate how mergers affect prices. I find that the impact of mergers can be large, that this impact decreases as the merging outlets are farther apart, that mergers among market leaders generally increase prices more than mergers among weaker firms, and that mergers can increase prices even if the outlets are so far apart that neither outlet's presence affects prices at the other before the merger.

1. Introduction

■ This article examines how the price impact of mergers among franchisees in the Santa Clara County, California fast food industry varies according to the outlets' proximity to each other and to competitors. The price impacts from these mergers are similar to the ones that the Federal Trade Commission (FTC) examines when it decides whether to require merging retail companies, such as grocery stores or movie theaters, to divest themselves of key outlets. I first present regression estimates that demonstrate links between ownership structure, market geography, and prices. I then measure the impact that joint ownership has on price under different market conditions by estimating a model of demand and supply that is consistent with economic theory and accounts for the geographic locations of all firms in the market, and then using the fitted model to conduct counterfactual experiments that demonstrate how geographic differentiation affects the pricing incentives of firms under different ownership structures.

The data I use consist of the prices, locations, and outlet attributes of every Burger King and McDonald's outlet in Santa Clara County, California. As is common in many industries, it is difficult to obtain quantity data because the firms keep this information as proprietary, while price data are easy to obtain because the econometrician can pose as a consumer.[1] Building on the work

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[1] While many companies keep the data as proprietary information, more and more individual-choice data, including the outlet from which goods are purchased, are available from sources such as AC Nielsen. However, these data can be

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of Feenstra and Levinsohn (1995), I accommodate the fact that quantity data were not available by using the assumption of utility maximization by consumers to get a relationship between price and quantity, and then substituting this relationship into the firms' first-order conditions from static Bertrand competition to jointly estimate the parameters of the indirect utility functions of consumers and the marginal costs of firms.

The results show that mergers between McDonald's franchisees can significantly increase prices. For example, a McDonald's in my sample set is shown to have a price that is 70¢ higher than it would have been if the outlet had been independently operated. While mergers have a greater effect on prices when the co-owned outlets are closer together rather than far apart, I also find that prices increase from mergers among outlets that are far enough apart that each outlet's presence would have no impact on the other's prices under separate ownership. This suggests that examining whether existing outlets affect the prices in other nearby outlets is an insufficient test of a merger's impact. I also find that mergers between Burger King outlets have smaller effects on prices than do mergers between McDonald's outlets, suggesting that antitrust authorities should focus mainly on mergers among dominant firms.

The rest of the article proceeds as follows. In Section 2 I describe the industry, data, and results of descriptive regressions. Section 3 presents the model and the estimation procedure. In Section 4 I report the estimation results and analysis through counterfactual experiments. Finally, Section 5 concludes.

2. Data and descriptive analysis

■ **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 sell $30 billion of food in the United States and $50 billion worldwide each year. Almost 6% of the people in my study area consume a meal from McDonald's each day,[2] and each year over 80% of Americans eat at a McDonald's.

While both McDonald's and Burger King corporately own and operate many of their own outlets, most of the outlets in the United States are operated by franchisees.[3] These franchisees operate largely as independent businesses within a framework of a national brand, for which they pay a fixed franchise fee plus a percentage of revenues to the franchisor. 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. In general, franchisees for these chains are initially allowed to own only a single outlet. However, the fast food chains award additional outlets to franchisees who perform well and maintain the standards that the chain specifies (see, e.g., Love, 1995). Kalnins and Lafontaine (2005) find that co-owned outlets tend to be close to each other, as they usually are in my data, too.

An important key to success in the fast food industry, to which both McDonald's and Burger King ascribe, is consistency in the product offered across outlets. Early industry leaders that did not impose strong standards of uniformity, such as A&W and Dairy Queen, lost their lead, while those that insisted on uniformity, like Burger King and McDonald's, prospered. Ray Kroc, the founder of McDonald's, was known to be especially focused on detail and unaccepting of deviations from the corporate norms that he established (Love, 1995; Shook and Shook, 1993). Burger King, too, performed poorly until Edgerton and McLamore were able to buy the rights to the name and impose uniformity on all Burger King outlets (McLamore, 1997).

While some chains tried to extract profits and impose product uniformity by selling inputs to

very expensive, tend to be oriented toward home-consumable products, and do not exist for many industries, especially service industries such as hair salons, ice cream parlors, ATMs, legal or medical services, and recreational activities (such as golf courses), for example.

[2] This figure is the national daily average number of customers who eat in each McDonald's (1,540 per day, according to McDonald's Corporation), times the number of McDonald's in Santa Clara County, divided by the population of the county. Another 3.5% go to a Burger King on any given day.

[3] 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.

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franchisees, Ray Kroc did not use this model with McDonald's, preferring to have the franchisees supplied by independent approved suppliers with which Kroc negotiated discounts.[4] In 1971 the courts ruled in *Siegel* v. *Chicken Delight* that franchisors could not force franchisees to purchase supplies from the company (or authorized suppliers) if products of equal quality were available on the open market (Dicke, 1992; Love, 1995). One result of this ruling is that the amount of inputs currently sold by franchisors to franchisees in the fast food industry is small; Lafontaine (1992) finds that the value of inputs that came from the franchisors in the restaurant industry is about 4.5% of a franchisee's total sales. All of the outlets belonging to a given chain in Santa Clara County should have access to the same set of suppliers.

One attribute that Kroc tried to keep uniform across outlets was price; an early hallmark of McDonald's was the 15¢ hamburger (Love, 1995). However, the U.S. courts began to limit the types of pricing restrictions franchisors could place on franchisees as franchising became more common, culminating in a Supreme Court ruling in *Albrecht* v. *Herald Co.* (1968), which prohibited franchisors from setting maximum resale prices that franchisees could charge. (Although minimum resale price restrictions are also illegal, these constraints have generally not been the focus of the industry. See Blair and Esquibel (1996) and Lafontaine (1999).) The Supreme Court relaxed the Albrecht decision in its 1997 *State Oil Company* v. *Khan* decision, ruling that maximal resale price maintenance agreements should be tested by the rule of reason rather than be illegal per se. While this decision occurred before I collected prices in 1999, it appears that Burger King and McDonald's did not try to reimpose setting prices, probably because this would have entailed renegotiating all of the franchise agreements.[5] This is consistent with Lafontaine and Shaw's (1999) finding that franchise contract terms are rarely renegotiated within the contract period (typically 20 years).

□ **The data.** This study uses an original dataset, collected over the summer of 1999,[6] of the locations, menu prices, presence of drive-thrus and playlands, and ownership of all fast food restaurants belonging to chains in Santa Clara County, California, including all 64 McDonald's and 39 Burger Kings in the county.[7] I focus on competition between Burger King and McDonald's, but use the full dataset to confirm the validity of limiting the market to these two chains.

I focus on the pricing decisions of the franchised McDonald's and Burger Kings, and not those of the 21 outlets owned by McDonald's corporation,[8] because corporate outlets face different incentives than do franchised outlets, largely because the parent chain profits from sales at every McDonald's outlet, giving them weaker incentives to steal business from franchisees and stronger incentives to keep prices low to add an image of value to the McDonald's brand as a whole. The hypothesis that McDonald's corporate incentives are different from those of its franchisees is consistent with the results found in Lafontaine and Slade (1997), which finds that corporate outlets tend to have lower prices than franchisee-owned outlets in their summary of the findings of many academic studies on the topic. This result is also found in my data: 18 of the 21 McDonald's-

[4] See Shook and Shook (1993) and Schlosser (2002). The only exception was that Kroc had franchisees buy Multimixers from him. It was Kroc's job as a Multimixer salesman that led him to the McDonald brothers' store and got him involved in fast food. Multimixers are no longer used at McDonald's outlets.

[5] The evidence of this includes the price variation I find at these outlets, the lack of academic or rumored trade discussion that price maintenance was reimposed in the fast food industry, a conversation I had with a Burger King franchisee in 2000 who stated that Burger King did not try to set prices at the franchised outlets, and a statement on the McDonald's website stating that the franchisees could set their own prices (www.mcdonalds.com/corporate/info/faq/index.html, September 6, 1999).

[6] With only four exceptions, all Burger King and McDonald's prices were collected between June 22 and July 29, 1999. There were no observed price changes during the period I collected prices except for specials, and these were not on items I use for the prices.

[7] I obtained the locations of the outlets from the Santa Clara Department of Environmental Health, online yellow pages, and each chain's website. I confirmed the accuracy of the locations and collected data indicating whether a drive-thru or playland was present and the full menu of prices by physically visiting the restaurants. The menu was collected through photography where possible; complete menus were written down by hand where photographs could not be taken.

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

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TABLE 1 **Summary Statistics**

Variable	N	Mean	Standard Deviation	Minimum	Maximum
Burger King price	38	3.26	.11	3.19	3.69
McDonald's price	41	3.46	.27	2.99	4.09
Burger King dummy	79	.481	.503	0	1
Number BK/McD within 2 miles	79	3.835	1.918	1	8
Number co-owned within 2 miles	79	.532	.765	0	2
Number other hamburger within 2 miles	79	4.443	1.831	0	9
Distance to BK/McDonald's	79	.691	.488	.006	1.933
Multiple-owner dummy	79	.633	.485	0	1
Distance to co-owned	79	1.426	1.550	0	5
Distance to other hamburger	79	.630	.548	.005	2.739
Number directions	79	2.671	.930	1	4
Playland dummy	79	.279	.451	0	1
Drive-thru dummy	79	.684	.468	0	1
Mall dummy	79	.089	.286	0	1
Population density	79	6,454.6	4,251.4	11.4	20,964.6
Worker density	79	934.6	5,879.8	0	49,260.1
Fraction nearby kids	79	.241	.057	.109	.334
Fraction nearby 30–64	79	.447	.041	.334	.530
Fraction nearby >64	79	.084	.027	.038	.134
Fraction male	79	.506	.012	.484	.541
Fraction black	79	.038	.019	.008	.084
Fraction Asian	79	.169	.098	.034	.401
Fraction Hispanic	79	.223	.140	.050	.558
Median income ($)	79	46,250	7,811	28,750	67,500

Note: Population density and worker density are measured as (number of people)/(mile^2).

owned outlets in my dataset charge $2.99 for their Big Mac meal, the minimum price observed in the market, while only 2 of the 43 franchised outlets charge this price.

I also completely omit from the market the outlets located in the San Jose airport[9] and the McDonald's located on the Moffett Air Force Base, because I believe that these outlets do not compete with other fast food firms in the same manner as the other firms in my market. The estimates in this article are based on the pricing conditions of the 79 outlets (38 Burger Kings and 41 McDonald's) remaining after accounting for these special cases.

The prices used for this study are the prices of the value meals with the signature sandwich for each chain: the Whopper for Burger King and the Big Mac for McDonald's. I use these prices because these items are the most-purchased items, and I was not able to obtain data about the distribution of sales across all of the menu items.[10,11] Table 1 presents summary statistics of the price variation within these two chains (and of the other variables used in this article). Prices for Whopper meals range from $3.19 to $3.69, with a mean of $3.26 and a standard deviation of 11¢. Big Mac meals vary in price from $2.99 to $4.09, with a mean of $3.46 and a standard deviation of 27¢.

I supplement the firm data with demographic data, including the population density, age

[9] One McDonald's and one Burger King—each in different terminals.

[10] 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 a day to 15 million customers, implying that over a quarter 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 says that its best seller is the Big Mac at the website www.mcdonalds.com/countries/usa/corporate/info/studentkit/index.html.

[11] The unweighted average correlation between the Whopper meal price and the other value meals is .54; the average correlation between the Big Mac meal and the other extra value meals is .74. The unweighted average correlation across all menu items is .51 and .55, respectively.

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distribution, racial distribution, gender distribution, and median income of each census block-group. I also have the locations where people work by traffic analysis zones (TAZs), which are areas defined locally and used by the U.S. Department of Transportation. On average, the TAZs are about three times the size of a block-group, although some TAZs are smaller than block-groups. Finally, I have the locations of the eight major malls in Santa Clara County.

□ **Descriptive analysis.** The descriptive regressions reported in Table 2 show that geography and ownership structure affect prices. The regressions demonstrate that prices decrease as the number of competing McDonald's or Burger King outlets in the area increases, and that outlets held by franchisees who own other nearby franchises charge higher prices than outlets held by franchisees who own one outlet only. The regressions also show that outlets belonging to hamburger chains other than McDonald's or Burger King do not affect the prices charged by McDonald's or Burger King.

Column 1 in Table 2 gives the result from the regression of log-price on the number of competing outlets (McDonald's and Burger Kings owned by different parties) and number of co-owned outlets located within 2 miles of the outlet,[12] along with variables describing whether the outlet is in a mall or has a drive-thru or playland. I also control for local demographics, including the density of residents and workers within 2 miles of the outlet, the fraction of the residential population within 2 miles that is made up of children, the fraction aged 30–64, the fraction older than 64 years old, the fraction that is black, and the fraction that is male. The signs of most of the coefficients on the variables are as expected: the presence of competitors within 2 miles of the outlet reduces prices, while the presence of an outlet under the same ownership leads to higher prices. The coefficient on the mall dummy variable is not significant, reflecting the fact that about half of the outlets in malls have prices that are above the average price for the chain while the other half have prices below the average for the chain. The coefficients on the drive-thru and playland variables are insignificant and slightly negative, demonstrating that the average prices in outlets with a drive-thru or a playland are the same as or somewhat below, respectively, the average prices of the chain. However, since the coefficients on the drive-thru and playland variables are always insignificant, and the signs of these variables change across different models,[13] I interpret these results as suggesting that these variables do not have a significant impact on price.

While the signs on the competition variables match economic intuition, the t-statistic on the coefficient for competing McDonald's and Burger Kings within 2 miles of the outlet is only 1.3. However, counting the number of outlets within a given distance of an outlet is not the only way to measure an outlet's competitive environment. Column 2 gives the regression results from a similar model, except the level of competition is now measured by including the distance to the nearest competing outlet, a dummy variable indicating whether the owner of the outlet owns any other outlets, the distance to the closest such outlet if one exists, and the number of directions in which other outlets within 2 miles are located.[14] As in column 1, the signs of these coefficients generally match expectations: prices increase as competitors are further away and decrease as outlets are located in more directions; co-ownership increases prices, but less and less as the co-owned outlets are further apart.

The regressions reported in columns 3 and 4 are the same as the regressions in columns 1 and 2, respectively, except they include some additional demographic variables about the population located within 2 miles of the outlet: their median income, the fraction that are Asian, and the fraction that are Hispanic. All of these coefficients are insignificant (with t-statistics at or below .82). This justifies omitting income or race variables other than black in the structural model I present and estimate later in this article.

[12] Using a cutoff of 1.5 miles gives similar results, with larger standard errors on the competitive variables.

[13] The coefficient on playland is positive in other regressions in Table 2; the coefficient on drive-thru is positive when I estimate the model in Section 3.

[14] = I(1 or more firms within 2 miles northwest of the outlet) + I(1 or more firms within 2 miles southwest of the outlet) + I(1 or more firms within 2 miles southeast of the outlet) + I(1 or more firms within 2 miles northeast of the outlet).

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TABLE 2 **Descriptive Regressions**
Dependent Variable: Log(Price)

Variable	(1)	(2)	(3)	(4)	(5)	(6)
Constant	4.632***	4.503***	4.736***	4.812***	4.651***	4.670***
	(.516)	(.513)	(.652)	(.634)	(.520)	(.556)
Burger King dummy	−.051***	−.049***	−.050***	−.049***	−.051***	−.048***
	(.013)	(.013)	(.013)	(.013)	(.013)	(.013)
Number BK/McD within 2 miles	−.005		−.004		−.004	
	(.004)		(.004)		(.004)	
Number co-owned within 2 miles	.024***		.027**		.025***	
	(.009)		(.010)		(.009)	
Number other hamburger within 2 miles					−.002	
					(.004)	
Multiple-owner dummy		.031		.028		.027
		(.018)		(.024)		(.019)
Distance to BK/McD		.026*		.026*		.028**
		(.013)		(.014)		(.014)
Distance to co-owned		−.013**		−.012*		−.012*
		(.006)		(.007)		(.006)
Distance to other hamburger						−.011
						(.013)
Number directions		−.017**		−.018**		−.017**
		(.007)		(.008)		(.007)
Playland dummy	−.005	.004	−.003	.006	−.005	.004
	(.014)	(.014)	(.015)	(.015)	(.014)	(.014)
Drive-thru dummy	−.013	−.012	−.016	−.014	−.012	−.014
	(.015)	(.015)	(.017)	(.017)	(.015)	(.016)
Mall dummy	.019	.038	.019	.038	.020	.038
	(.028)	(.030)	(.029)	(.030)	(.029)	(.030)
Population density	.332**	.414***	.329**	.396**	.334**	.386**
(100,000/mile^2)	(.149)	(.148)	(.155)	(.152)	(.150)	(.153)
Worker density	−.335**	−.408***	−.340**	−.385***	−.346**	−.400***
(100,000/mile^2)	(.139)	(.136)	(.147)	(.143)	(.142)	(.137)
Fraction nearby kids	.084	.188	.090	−.225	.067	.128
	(.266)	(.264)	(.560)	(.548)	(.270)	(.275)
Fraction 30–64	.153	.197	.127	.440	.156	.156
	(.219)	(.221)	(.351)	(.355)	(.220)	(.228)
Fraction > 64	.467	.726	.528	.217	.486	.558
	(.547)	(.548)	(.751)	(.721)	(.552)	(.588)
Fraction male	2.216***	2.376***	2.031*	1.766	2.187***	2.155**
	(.782)	(.784)	(1.101)	(1.067)	(.789)	(.834)
Fraction black	−1.233***	−1.411***	−1.466**	−1.306**	−1.200***	−1.391***
	(.421)	(.424)	(.597)	(.629)	(.429)	(.426)
Fraction Asian			.086	−.016		
			(.143)	(.157)		
Fraction Hispanic			−.001	.168		
			(.206)	(.204)		
Median income			−.024	.000		
($100,000s)			(.242)	(.248)		
R^2	.510	.545	.513	.555	.511	.550

Standard errors in parentheses. *, **, and *** denote 90%, 95%, and 99% significance, respectively.

The regressions in columns 5 and 6 support designating McDonald's and Burger King as the relevant market. These regressions include the number of outlets belonging to other hamburger chains within 2 miles of the outlet in column 5, and the distance to the closest outlet belonging to other hamburger chains in column 6. In column 5, the coefficient on the number of other

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hamburger outlets variable is small—about half the size of the coefficient on other McDonald's or other Burger Kings—and insignificant, with a t-statistic just below .5. A similar result is obtained in regression in column 6; the coefficient on the other hamburger variable is again statistically insignificant, and the sign of the coefficient is the opposite of what would be expected from a competitor.[15] These results are consistent with Kalnins (2003), who finds that the relevant sets of competitors in the hamburger segment are smaller subsets of competitors, and that other franchisees belonging to the same chain are often an outlet's strongest competitor.

3. The model

■ Although the descriptive regressions reported above demonstrate a correlation between the ownership structure of firms and prices, they have two flaws. First, the measures of competitors used above are ad hoc, and it is impossible to account for the full richness of the layout of firms in the market in such a regression. For example, an outlet's equilibrium prices will be different if there are two competitors located a half mile away from the outlet but adjacent to each other than they will if the two competitors are located a half mile away but on opposite sides of the outlet. One could add a dummy variable to the regression to differentiate these two cases, but there are numerous potential market layouts and generally it will be impossible to account for every layout using a real dataset. Also, in a large market such as Santa Clara County it is not clear which outlets are close enough to be relevant competitors. Rather than imposing an *ex ante* restriction on the set of competitors, it would be preferable to use economic foundations to allow the data to identify the relevant set of competitors.

The second flaw is that while regression results can establish that prices are higher at outlets owned by franchisees who own other proximate franchises and at those outlets that are further away from competing outlets, they cannot be used to calculate what prices would be for these outlets under different ownership structures, because they do not establish a causal relationship between prices and market structure. It is possible that this conditional correlation is instead a result of common factors that affect both variables. Thus, the econometrician cannot know whether the conditional correlations will remain after the economic environment is changed. This problem is larger for cross-sectional analysis than for panel analysis because a panel allows the econometrician to control for persistent common factors. However, counterfactual prediction with panel regressions is still problematic if there are common factors that vary over time or omitted common factors that affect the choice of which outlets have changes in ownership. (See Ashenfelter et al. (2004) and Reiss and Wolak (2006) for more discussion of these issues.)

I address both of these concerns by estimating a model of supply and demand that is consistent with economic theory, accounts for the true locations and ownership structure of firms, and allows the data to reveal which firms are *de facto* competitors. I then conduct counterfactual experiments with the fitted model to demonstrate how geography and ownership patterns jointly affect prices. This approach of measuring merger impact by examining the differences in pricing incentives of merged versus independent firms has become common practice. (See, for example, Nevo's (2000) analysis of cereal mergers, or Dubé's (2005) study of soft drink mergers.)

This section outlines the model and estimation procedure, and Section 4 presents the estimates and analysis. The approach used in this article follows work by Bresnahan (1987), Berry (1994), and Berry, Levinsohn, and Pakes (1995) that demonstrates how to estimate utilities and costs in differentiated industries from aggregate data. Demand is modelled as being derived from consumers making a discrete choice of where to purchase their meal.[16] Consumers each choose to consume a representative meal at the outlet that delivers the maximum utility. Geography is incorporated into the demand side of the model following Davis (forthcoming), who added geography to the Berry, Levinsohn, and Pakes framework in his study on the welfare effects of movie theater locations. The supply of fast food meals is modelled by assuming that each

[15] If other hamburger outlets were competitors, then prices should increase as these competitors are further away. Instead, the coefficient is negative.

[16] I assume that consumers are perfectly informed about the prices, locations, and food quality at all outlets.

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franchisee faces a constant marginal cost of producing meals and maximizes his profits by setting prices at each of his outlets, which compete through static Bertrand competition. As in Bresnahan (1987) and Berry, Levinsohn, and Pakes, firm marginal costs are estimated as parameters rather than derived from cost data.

Similar to Feenstra and Levinsohn (1995), I estimate the model using only price data and not quantity data. This is possible because both the parameterized utility functions from the demand side of the model and the first-order conditions for each franchisee on the supply side provide relationships between observed prices and implied quantities that jointly identify the parameters of the model. This approach gives estimates that are less efficient than one could obtain if accurate quantity data were available.[17] However, quantity data are often not available because the firm keeps the information a secret, which is the case for my dataset. On the other hand, price data can be easier to collect because the econometrician can often pose as a customer.[18]

□ **Demand.** Demand for fast food meals at each of the outlets is modelled using a discrete-choice framework. (For similar frameworks, see Davis (forthcoming) and Manuszak (2000).) Consumers choose either to purchase their meal from one of the J fast food outlets or to consume an outside good. Consumers are spread across the county but have the same utility function except for differences from different demographic attributes and from different unobserved tastes for each location/chain combination. Note that although consumers can choose to eat at any outlet in the county, they *de facto* choose between those close to their location because of their disutility for travel. Thus, proximate restaurants are closer substitutes than outlets that are further away.

Formally, the conditional indirect utility of consumer i from fast food 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 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; $D_{i,j}$ is the distance between consumer i and outlet j;[19] P_j is the price of a meal at outlet j; β, δ, γ are parameters to be estimated; and $\eta_{i,j}$ is the unobserved portion of utility for individual i at outlet j.

If the consumer instead consumes only the outside good, his indirect utility is then

$$V_{i,0} = \beta_0 + M_i\pi + \eta_{i,0}, \tag{1b}$$

where M_i is a vector of the consumer's age, gender, and race. β_0 is normalized to be zero.

I account for the different physical product characteristics of the food at the different chains through the chain dummies that appear in the indirect-utility function. Product-differentiation articles have traditionally accommodated physical differences by defining utilities over each of the product attributes. However, these articles also note that equilibrium prices depend both on the observable product attributes and on the product attributes that are unobserved by the econometrician but observed by the firms and consumers.

I can circumvent this problem because a chain's food is nearly identical at each of its restaurants, allowing me to get multiple observations of the same item in a variety of competitive environments. Note that not only is the food identical, but the chains also try to make the experiences at each of their outlets identical. For example, their outlets have a uniform appearance, their menu boards look very similar, and their workers wear similar uniforms.[20] Also, both the

[17] Quantity data can come in a micro format or an aggregate format, where Berry, Levinsohn, and Pakes (1995)-style methods are used.

[18] An exception is the automobile industry, the focus of Berry, Levinsohn, and Pakes (1995), where obtaining transaction prices is difficult.

[19] 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.

[20] While there could theoretically be some unobserved heterogeneity in the quality of different outlets—for example, some restaurants could be cleaner than others—I did not observe many differences in my personal visits to these outlets in my study area. In contrast with many other urban markets, I found that all but one of the McDonald's and Burger King restaurants that I visited in the county appeared to be very clean.

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descriptive analysis and my estimated demand model show that even significant product attributes such as the presence of a playland or drive-thru, or whether an outlet is located in a mall, have minimal impacts on prices, reinforcing the idea that small unobservable differences are probably not driving differences in prices.

I exploit this homogeneity by estimating a fixed effect for each chain's food in a manner similar to Nevo (2001), who also observes identical products in a variety of competitive environments. This fixed effect captures the total utility for the food at each chain, including utility from unobservable attributes, including advertising, brand image, and Pokemon toys.

The consumer will purchase one meal from the restaurant that delivers the highest utility unless the outside good provides an even greater utility. Given this utility function and $f(\eta_i)$, the probability density of the $(J+1)$-dimensional vector η_i, the share of consumers located in a particular location, b, and demographic type, M, who consume from outlet j is

$$S_{j,b}(P, X, M \mid \beta, \delta, \gamma, \pi) = \int_{A_j} f(\eta_i) d\eta_i, \tag{2}$$

where P is the J-dimensional vector of prices for every outlet in the market, and

$$A_j = \{\eta_i \mid (V_{i,j} > V_{i,t} \; \forall \, t \neq j) \cap (V_{i,j} > V_{i,0})\} \tag{3}$$

is the set of match values, η_i, between consumers and outlets such that the consumer derives a higher utility by consuming from outlet j than from any other outlet t or from the outside good. I assume that η_i has an i.i.d. type-I extreme-value distribution. Thus, the fraction of consumers of demographic type M located in location b who choose to purchase a meal from outlet j is

$$S_{j,b}(P, X, M \mid \beta, \delta, \gamma, \pi) = \frac{e^{X_j'\beta - D_{b,j}\delta - P_j\gamma}}{e^{\pi M} + \sum_{t=1}^{J} e^{X_t'\beta - D_{b,t}\delta - P_t\gamma}}. \tag{4}$$

I discretize the consumers' locations and sum over the decisions of consumers at each location.[21] I consider two types of consumers: residential consumers and workers at their work locations. Residential consumers live in one of 1,020 census block-groups. These block-groups are relatively small areas, and I place all of the residents at the block-group's centroid. My worker data places workers in one of 479 areas called traffic analysis zones, or TAZs. As noted in Section 2, these 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 than 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 1,093 different worker locations.

Total demand for each outlet is then calculated by summing the product of the fraction of consumers of demographic M and location b who patronize the outlet and the mass of consumers of that demographic at that location, $h(b, M)$, across all demographic-location pairs:

$$Q_j(P, X \mid \beta, \delta, \gamma, \pi) = \sum_b \sum_M h(b, M) S_{j,b}(P, X, M \mid \beta, \delta, \gamma, \pi). \tag{5}$$

The derivative of demand with respect to price is computed in a similar manner:

$$\frac{\partial Q_j(P, X \mid \beta, \delta, \gamma, \pi)}{\partial P_k} = \sum_b \sum_M h(b, M) \frac{\partial S_{j,b}(P, X, M \mid \beta, \delta, \gamma, \pi)}{\partial P_k}. \tag{6}$$

[21] Because the county is largely surrounded by mountains or a bay, only two of the outlets whose price-setting behavior I use are located within one mile of the county border. I ignore the demand and competition effects from neighboring counties. However, the market conditions are similar on both sides of the border.

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□ **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. This assumption is reasonable because the firms offer to sell as many units as are demanded at the posted prices, and because the firms can change their prices quickly and easily.

The major costs for these firms include rent, equipment and other capital, labor, food, paper (and other materials for food containers), and payments to the franchisor. Payments to the franchisor consist of a combination of a fixed component and a percentage of revenues. The equipment and capital are fixed costs, while labor, food, and paper costs vary according to the number of meals sold. Labor is adjusted not just for the expected demand, such as having more workers during lunch hours than in the late afternoon; firms also attempt to adjust labor according to the realized demand by calling in more workers on unexpectedly busy days and sending workers home early on unexpectedly low-volume days (Reiter, 1992; Schlosser, 2002).

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

$$\Pi_f = \sum_{j \in F_f} (r_k P_j Q_j(P) - c_j Q_j(P) - FC_j), \tag{7}$$

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, and P is the J-dimensional vector of prices for every outlet.[22] Note that maximizing (7) is the same as maximizing

$$\Pi_f = \sum_{j \in F_f} \left(P_j Q_j(P) - \left(\frac{c_j}{r_k}\right) Q_j(P) - \frac{FC_j}{r_k} \right). \tag{8}$$

I refer to $C_j = c_j / r_k$ as the marginal cost, since the firms will be acting as if they are maximizing profits with marginal costs of C_j.

I assume 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

$$C_j = (C_k + \varepsilon_j), \tag{9}$$

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.[23] The different chains will have different marginal costs because they serve different food. I attribute the outlet-specific component of marginal cost to the labor efficiency of the workers and the management of the outlet because the other sources of variable costs, food and materials, are very standard across all of the outlets.[24] The efficiency of the workers, on the other hand, varies with the experience and ability of different individuals (Reiter, 1992; Schlosser, 2002; Emerson, 1990). I assume that the franchisee knows his true marginal cost, including ε_j, when he sets prices, but that this marginal cost is unobservable to the econometrician.

Each firm maximizes the profit function in (8), yielding the following first-order conditions

[22] Including fixed costs for the total joint operation of several outlets would not affect my estimation.

[23] I assume that these unobserved costs are uncorrelated across outlets among owners. To support this, I calculated the correlation between the fitted residual for each outlet and the mean of these fitted residuals across all of the other outlets owned by the same owner. The correlation is $-.15$. All but two owners have at least one outlet with negative and one outlet with positive unobservable components of marginal costs, and the two exceptions own only two and three outlets, respectively.

[24] Part of the residual may also come from different franchise rates that the different franchisees have to pay. This will not prove to be problematic, since, as described in Section 2, the franchise rate varies only with the date that the contract was signed, and not with the location of the outlet.

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for the price at each outlet:

$$Q_j(P) + \sum_{r \in F_f} (P_r - C_k - \varepsilon_r) \frac{\partial Q_r(P)}{\partial P_j} = 0. \tag{10}$$

These J equations can be solved for each ε_j. To do this, define a matrix Ω as

$$\Omega_{j,r} = \begin{cases} \dfrac{\partial Q_r}{\partial P_j} & \text{if } r \text{ and } j \text{ have the same owner} \\ 0 & \text{otherwise.} \end{cases} \tag{11}$$

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

$$Q(P) + \Omega(P - C - \varepsilon) = 0, \tag{12}$$

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

While I do not have data on quantity and the derivative of quantity with respect to price, these variables were solved as a function of the utility parameters in the above subsection. Substituting these quantities and derivatives into (12) yields

$$Q(P, X \mid \theta) + \Omega(P, X \mid \theta)(P - C - \varepsilon) = 0, \tag{13}$$

where $\theta' = (\beta', \gamma', \delta', \pi')$. This can be rearranged to solve for the vector of residuals for generalized method of moments (hereafter GMM) estimation:

$$\varepsilon = P - C + \Omega(P, X \mid \theta)^{-1} Q(P, X \mid \theta). \tag{14}$$

□ **Estimation.** Appropriate instruments, Z, will be uncorrelated with ε_j, but correlated with the cost or demand terms. A sufficient condition for the latter requirement is that

$$E[\varepsilon_j(\theta^*) \mid Z_j] = 0, \tag{15}$$

where θ^* is the true value of θ.

The first instruments I use are chain dummies, which shift the costs of the outlet.[25] The unobserved components of costs are, by assumption, independent of the chain affiliation of the outlet, but the chain dummies will be correlated with the marginal costs of the outlet.

The remaining instruments are demand shifters. The first demand shifters are the distance to the nearest outlet and the number of directions from the outlet in which there are other outlets within 2 miles.[26] I assume that these instruments are uncorrelated with the unobserved components of cost.[27] Berry, Levinsohn, and Pakes (1995) suggest one way that this can be justified: assume that the ε's evolve as a first-order Markov process, where the innovation in that process is independent of the outlet's proximity to competitors. This assumption is reasonable in the fast food industry due to the high rate of employee and managerial turnover, which is often over 100% (Emerson, 1990; Reiter, 1992; Schlosser, 2002). In this case, the level of ε observed at the time that the data

[25] These shift demand, too, but the other instruments I use are demand shifters.

[26] A firm that is further from its nearest competitor has higher demand, all else equal, and is able to charge a higher price. A similar argument applies to the number of directions of competing outlets, which is described in Section 2. Changing the 2-mile cutoff to 1.5 miles does not change the estimates much.

[27] Note that this is similar to the assumption in Berry, Levinsohn, and Pakes (1995) that the nonprice attributes of outlets and those of their competitors are uncorrelated with the outlet's unobserved component of marginal cost. This assumption is consistent with the findings of Toivanen and Waterson (2005), who use panel data to conclude that unobservable location attributes do not play an important role in fast food decisions. See, too, Sault, Toivanen, and Waterson (2002) for more on entry in the fast food industry.

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TABLE 3 **Correlation of Instruments with Log(Price)**

Instrument	Correlation with Log(Price)
McDonald's dummy	.449
Number directions	−.164
Distance to closest outlet	.229
Drive-thru dummy	.006
Playland dummy	−.016
Mall dummy	−.045
Population density (100,000/mile^2)	.149
Worker density (100,000/mile^2)	−.221

was collected should be approximately independent of the level of ε that existed when the firm entered the market.

The next set of instruments are dummy variables indicating the presence of observable traits of the outlets—whether the outlet is located in a mall or has a drive-thru or a playland—which are included in consumers' utility functions in case they have an impact on the outlets' demand. The final set of instruments consists of demographic data for each of the outlets. These are the population density in the nearest census block-group and the density of workers in the closest TAZ. These factors shift demand because, all else equal, sales increase when firms are located near a cluster of potential customers.[28]

Table 3 shows the correlation between the log of prices and the instruments. Each of the instruments is correlated with log-price except for the observable attributes of the outlets themselves. In general, the signs of the correlation of each of the other instruments are the same as would be expected, except for that of worker density. However, my findings in Section 4 that workers are generally less likely to consume fast food than are residents, along with the fact that areas with high worker density generally have low population density,[29] mean that this result is, perhaps, not as surprising as it may at first seem. Indeed, when I run reduced-form regressions using data from my estimated model of demand and supply, I find that local worker density has a small and sometimes negative impact on price. These results are presented in Table 5.

Finally, all of these instruments except the mall indicator dummy are interacted with the chain dummies to account for the asymmetries in the way that market conditions affect the two chains. I did not interact the mall dummy with the chain dummy because there are only seven noncorporate outlets located in a mall—two Burger Kings and five McDonald's.

I supplement these moments with a set of demographic moments, termed "macro-moments." Imbens and Lancaster (1994) suggest supplementing micro-moments with macro-moments to increase the efficiency of the estimates, and this approach has been used in industrial organization applications by Petrin (2002) and Davis (forthcoming).

I match macro-moments based on three different demographics—age, gender, and race. I assume that the ratios of average per capita demand among members in each age group that I observe (children, adults age 18–29, adults age 30–49, adults age 50–64, and senior citizens age 65 and above) match the national averages of these ratios, as reported in Paeratakul et al. (2003). I also assume that the ratio of average per capita fast food demanded by males to that demanded by females, and the same ratio for blacks to nonblacks, matches these averages as reported in the same article.

Formally, I define a set of instruments $Z = (z_1, z_2, \ldots, z_N)$ to use in the estimation. The

[28] While absolute population densities of consumers are unimportant, relative densities are important. Higher absolute densities of the nearest block-group are correlated with higher probabilities that the density of consumers near the firm is higher than the density a little further away.

[29] The correlation between worker density and population density is −.14.

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sample analogs of the moments, which are zero in expectation, are then

$$G_J(\theta) = \frac{1}{J}\sum_{j=1}^{J} Z_j \varepsilon_j(\theta) \tag{16a}$$

$$G_J(\theta) = \frac{1}{J}\sum_{j=1}^{J}\left[R_{18-29}\frac{Q_j(M_{\text{Age}},\theta)}{Pop(M_{\text{Age}})} - R_{\text{Age}}\frac{Q_j(M_{18-29},\theta)}{Pop(M_{18-29})}\right] \tag{16b}$$

$$G_J(\theta) = \frac{1}{J}\sum_{j=1}^{J}\left[R_{\text{Male}}\frac{Q_j(M_{\text{Female}},\theta)}{Pop(M_{\text{Female}})} - R_{\text{Female}}\frac{Q_j(M_{\text{Male}},\theta)}{Pop(M_{\text{Male}})}\right] \tag{16c}$$

$$G_J(\theta) = \frac{1}{J}\sum_{j=1}^{J}\left[R_{\text{Black}}\frac{Q_j(M_{\text{White}},\theta)}{Pop(M_{\text{White}})} - R_{\text{White}}\frac{Q_j(M_{\text{Black}},\theta)}{Pop(M_{\text{Black}})}\right], \tag{16d}$$

where R_M is the fraction of people of demographic M who consumed a fast food meal in the two-day period covered by Paeratakul et al. (2003), and $Pop(M)$ is the number of people in the county who belong to the demographic group M. Both the R_M and $Pop(M)$ terms are data, while the $Q_j(M, \theta)$ terms are functions of the demand parameters to be estimated. The GMM estimator is then the value of $\hat{\theta}$ that solves

$$\arg\min_{\hat{\theta}} G_J(\theta)' A G_J(\theta), \tag{17}$$

where A is a weighting matrix for the moments. The optimal weighting matrix is an estimate of the inverse of the asymptotic variance of the moment conditions $(E[G_j(\theta^*)G_j(\theta^*)'])^{-1}$. Therefore, I use a common two-step procedure, where I use GMM to get a consistent estimate, θ_1, and then run GMM a second time using the weighting matrix $A = [(1/J)\sum_{j=1}^{J} Z_j Z_j' \varepsilon_j^2(\theta_1)]^{-1}$.

As discussed in Section 2, I do not use the first-order conditions of the corporate outlets to estimate the model because these outlets are likely to face different incentives than do the franchised outlets. Including the pricing decisions of firms whose objective functions are incorrectly specified would introduce error that would destroy the consistency of the estimates. However, I account for the effects that their prices and presence have on the demand for every other outlet in the market, because consumers typically do not distinguish between outlets that are corporate-owned and those that are franchised (or even know which outlets are which).

Note that using only the first-order conditions of outlets owned by franchisees, and not those of the parent corporation, does not introduce any sample selection bias into the estimates because I am conditioning on firms that have similar incentives, rather than on the endogenous variable, price (or ε). The only potential loss from omitting pricing decisions of the corporate-owned outlets is efficiency, because the ε_j's still retain their properties of being mean zero and orthogonal to the instruments,[30] while the instruments are still correlated with each outlet's demand and chain-specific marginal cost. However, since I am using only the pricing decisions of franchised outlets, I can only claim to have estimated the marginal costs and behavior of franchised outlets, and am unable to say anything about the costs or behavior of corporate outlets or to run counterfactuals predicting how pricing would change if an outlet went from being franchisee-operated to being corporate-operated.

□ **Identification.** The intuition behind the identification of the utility and cost functions comes from the idea that while there may be more than one combination of parameter values that are consistent with the observed equilibrium prices under some market structures, different sets of parameters will lead to different equilibrium prices in other market conditions. For example, increasing both the parameter for consumers' base utility for a good and the parameter for price

[30] That is, $E[Z_j\varepsilon_j(\theta^*)] = 0$ still holds.

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sensitivity could keep the profit-maximizing price of the good in a monopoly market unchanged. However, the changed price sensitivity would lead to an equilibrium where the firms would charge different prices in a duopoly market than they would have charged if both of these parameters had been smaller. The market structures used in this article, where firms are closer to and further away from different sets of competitors, have a much richer set of substitution patterns than can be achieved under the traditional market structures of monopoly, duopoly, etc.

To see how both supply and demand effects are identified through the observed prices, note that (13) can be solved for price:

$$P = C - \Omega(P, X \mid \theta)^{-1} Q(P, X \mid \theta) + \varepsilon. \tag{18}$$

Thus, price can be divided into two components. The first component, the cost component, will not vary in different competitive environments, while the second term, the markup, which comes from the demand for the product, will. Of course, it is also necessary that the *rate of change* in the markup term as a function of market structure (in this case, geography) be unique in the demand parameters in order for all of the parameters to be identified. The demand model introduced earlier in this section has this property.[31,32]

4. Analysis

■ **The estimates.** The estimates of the model are reported in Table 4. Column 1 reports the estimates for the model described in Section 3, where consumers are located either at home or at work and get different utilities for consumption at outlets in malls than from consumption at stand-alone outlets. Column 2 reports the results for a similar model; the only difference is that consumers are indifferent between whether an outlet is located inside or outside of a mall, holding all other attributes of the outlet constant. The model estimated in column 3 is the same as the one in column 2, except that some consumers are located at each mall.[33] Note that while the estimates vary somewhat across these specifications, the important characteristics of the estimates remain the same, adding confidence that the results are not dependent upon the exact specification of the model. Also, the p-values for χ^2 tests of overidentifying restrictions are .34 or less in each specification, so I conclude that overidentification is not a problem.

Since all of the specifications give similar estimates, I focus on the estimates in column 1. I assume that the model and assumptions presented in Section 3 are correct for the rest of the analysis, and I use this fitted model in the counterfactual experiments.

Due to the covariance between the McDonald's and Burger King baseline utility estimates, the standard error of the difference between these variables is .96, implying that McDonald's gives a statistically significantly higher utility to consumers than does Burger King. Travel costs, which are equal to the coefficient of distance divided by the coefficient of price, are estimated to be close to \$3.00/mile. This travel cost estimate implies that consumers have an average opportunity cost of their time of almost \$27/hour.[34]

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[31] See Thomadsen (2001) for more on this.

[32] Note that there is a parallel between (i) the requirement that the rate of change in the markup term as a function of market geography be unique in the demand parameters and (ii) the result in Bresnahan (1982) that it is important that the markup term be unique in the level of market power variable in order to identify the oligopoly solution concept.

[33] The number of consumers located at each mall is determined by regressing the number of daily shoppers at the three malls in the county that report the number of people who come to the mall on a constant and the number of square feet in the mall, and then using these estimates and the size of each mall to get the fitted number of customers. For daily customers, I take the number of weekly shoppers (as reported by the *Directory of Major Malls* (2000)) and divide by seven. The regression yields that the number of customers is −20,461 + .0458 times the area of mall. The standard errors of the point estimates are 5,238 and .0048, respectively.

[34] Note that a person going to an outlet one mile away travels two miles round trip. It takes approximately three minutes to travel one mile in my study area. Subtracting the 1999 U.S. GSA's 31¢ per mile deduction as true costs (www.gsa.gov/Portal/gsa/ep/contentView.do?contentId=9646&contentType=GSA_BASIC) yields an hourly cost of the time of \$27/hour. Median income in Silicon Valley was \$59,639 (quickfacts.census.gov/qfd/states/06/06085.html). Two opposing

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TABLE 4 **Estimates of the Full Model:**
$V_{i,j} = X_i\beta - D_{i,j}\delta - P_j\gamma + \eta_{i,j}$
$MC_j = C_k + \varepsilon_j$

Variable Name	Variable	(1)	(2)	(3)
BK base utility	β_{BK}	4.07*	3.95	4.66**
		(2.42)	(2.60)	(2.24)
McD base utility	β_{McD}	6.53**	5.26*	8.23***
		(2.69)	(2.88)	(2.91)
Price sensitivity	γ	.91*	.86*	1.15**
		(.47)	(.47)	(.48)
Distance disutility	δ	2.58***	2.10***	3.53***
		(.56)	(.39)	(1.01)
Playland utility	β_{play}	−.47	−.36	−.65
		(.30)	(.32)	(.35)
Drive-thru utility	β_{drive}	.09	−.22	.26
		(.32)	(.29)	(.38)
Mall utility	β_{mall}	−.91		
		(1.05)		
Outside utility kids		.34	.42	.33
		(.27)	(.27)	(.27)
Outside utility age 30–49		.13	.21	.10
		(.16)	(.13)	(.18)
Outside utility age 50–64		.38	.40	.33
		(.25)	(.40)	(.25)
Outside utility >age 64		2.11***	1.85***	2.29***
		(.57)	(.68)	(.59)
Outside utility for males		−.34***	−.27*	−.38***
		(.13)	(.15)	(.13)
Outside utility for blacks		.10	.11	.24
		(.26)	(.19)	(.27)
Outside utility for workers		2.46**	3.51	3.08**
		(1.12)	(2.46)	(1.22)
Outside utility for people shopping in a mall				4.05***
				(1.07)
Marginal cost BK	$C_{\text{Burger King}}$	2.03***	1.91***	2.29***
		(.58)	(.67)	(.38)
Marginal cost McD	$C_{\text{McDonald's}}$	1.45*	1.72**	1.55***
		(.84)	(.78)	(.60)
Implied travel costs	δ/γ	2.82**	2.43*	3.06***
		(1.23)	(1.29)	(1.05)
Objective function		3.24	2.79	3.76
χ^2 p-value		.34	.27	.19

Standard errors in parentheses. *, **, and *** denote 90%, 95%, and 99% significance, respectively.
Note: The model in column 2 does not use the dummy variable indicating whether the outlet is located in a mall as an instrument. The model in column 3 uses two moment conditions (where the residuals are interacted with the distance to the nearest mall) not used in the model estimated in column 1. Using these moments in column 1 would not have changed the estimates much.

The estimated marginal costs indicate that the firms hold significant market power.[35] The estimates of marginal costs in column 1 imply that the average markups are \$1.23 for Burger King and \$2.01 for McDonalds. These markups are even larger after accounting for the rate at

effects make it difficult to compare travel costs to annual income. On one hand, money spent on fast food comes from post-tax income, implying that travel costs should be lower than the median salary. However, the opportunity cost of time away from work is higher than that of time at work, since the marginal opportunity cost of leisure grows as there are fewer and fewer leisure hours left. This intuition is codified in the requirement that U.S. employers pay employees time and a half for overtime hours.

[35] Defined as price above marginal cost. See Tirole (1995) for different definitions of market power.

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which the firms keep their revenues.[36] The marginal cost estimates in Table 4 imply that the real economic marginal costs for the outlets are $1.27 for McDonald's and $1.86 for Burger King.

The estimated marginal costs seem to be consistent with other information I have on what marginal costs should be: Emerson (1990) estimates that, on average, food and paper costs are about 34% and 32% of sales for McDonald's and Burger King, respectively, with this number falling at about 15% over 10 years, and that labor costs are approximately 22% and 28% of sales for these two firms. Discussions with other people familiar with the costs of running a fast food outlet have given me similar numbers. Paper and food clearly belong as part of marginal costs. It is more difficult to determine the fraction of labor costs that should be classified as marginal costs because some labor costs are fixed costs. If the national averages apply to the market I study, then the real marginal costs would be in the range of $1.00–$1.76 for McDonald's and $.89–$1.80 for Burger King, depending on the amount of labor costs that are allocated to marginal costs. My estimate of $1.27 for McDonald's falls within this range, while my estimate of $1.86 for Burger King is just above it. However, the fact that retail prices and wages were higher in Silicon Valley than in the rest of the country[37] suggests that Emerson's cost guide will not hold exactly in this market.

To add confidence in the estimated model, Table 5 reports regression results where the log of the predicted prices implied by the fitted model[38] are regressed on the same regressors as in columns 1 and 2 of Table 2. The estimates of the key competitive variables—the number of competing and co-owned outlets within 2 miles, the distance to the closest competing and co-owned outlets, and the number of directions in which nearby outlets are located—are of the same order of magnitude as the estimates from the actual data. Also, the R^2's of these regressions are similar to the R^2's in the regressions using the actual data.

Table 6 reports the own and cross-price elasticities for outlets surrounding the Burger King located at 5154 Moorpark. A map of this area is presented in Figure 1. The cross-price elasticities are larger for outlets located close together than for those located further apart. Also, changes in prices at McDonald's have much larger effects on the percentage changes in quantities at either McDonald's or Burger King than do changes in prices at Burger Kings.[39]

□ **Experiments.** I use the estimates from the model reported in column 1 of Table 4 to run counterfactual experiments that demonstrate how ownership structure and location jointly affect prices. These experiments demonstrate both that co-ownership can increase prices significantly, especially if the co-owned outlets are close together, and that mergers can lead to increased prices even when the merging outlets are far enough apart that the presence of the other outlet would have no impact on price under separate ownership. The experiments also demonstrate that mergers among McDonald's outlets increase prices more than mergers among Burger Kings.

To see how the magnitude of a merger's impact on prices is affected by the proximity of the merging outlets, I contrast how two different mergers would change prices. The first merger I consider is a merger between the McDonald's located at 1935 Tully and the McDonald's located in the Eastridge Mall. These outlets are about a third of a mile apart, and both are independently owned. A merger between these outlets would increase prices at 1935 Tully by 29¢ (with a 95% confidence interval of 5¢ to $1.04), from $3.19 to $3.48. This is larger than the price impact that would result from a merger between the McDonald's located at 5925 Almanden and the McDonald's located in the Oakridge Mall, which is located 1.25 miles away. The additional

[36] The estimates reported in Table 4 are for the true marginal cost divided by the fraction of the revenue that the franchisee keeps, as shown in equation (7). I use the current effective franchise rates as reported on each chain's website on July 21, 2004. Burger King franchisees keep 91.5% of their revenues according to www.burgerking.com/CompanyInfo/FranchiseOpps/us/franchisee_facts.aspx. McDonald's franchisees keep 87.5% of their revenues (www. mcdonalds.com/corp/franchise/mrktspecific/usa/fact_sheet.html).

[37] Fast food firms often posted ads/signs with starting wages above $8/hour—well above the California minimum wage of $5.75.

[38] Equals actual prices minus the residual from each outlet's idiosyncratic cost variation.

[39] Compare columns B and C for an illustration of this.

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TABLE 5 Descriptive Regressions. Dependent Variable: Log(Price)

Variable	(1)	(2)
Constant	4.8894***	4.8976***
	(.6836)	(.7817)
Burger King dummy	−.0298*	−.0512***
	(.0168)	(.0196)
Number BK/McD within 2 miles	−.0067	
	(.0047)	
Number co-owned within 2 miles	.0786***	
	(.0116)	
Multiple-owner dummy		.1236***
		(.0280)
Distance to BK/McD		.0556***
		(.0204)
Distance to co-owned		−.0164*
		(.0090)
Number directions		−.0152
		(.0107)
Playland dummy	−.0224	−.0120
	(.0181)	(.0208)
Drive-thru dummy	−.0318	−.0159
	(.0202)	(.0234)
Mall dummy	−.0781***	−.0151
	(.0377)	(.0451)
Population density (100,000/mile^2)	.0788	.2144
	(.1981)	(.2256)
Worker density (100,000/mile^2)	−.0035	−.1826
	(.1849)	(.2074)
Fraction nearby kids	.3010	.2424
	(.3533)	(.4023)
Fraction nearby 30–64	.3003	−.0285
	(.2903)	(.3367)
Fraction nearby > 64	1.1655	1.3064
	(.7251)	(.8340)
Fraction male	1.1914	1.3494
	(1.0374)	(1.1948)
Fraction black	1.1005*	.6568
	(.5582)	(.6465)
R^2	.6017	.5129

Standard errors in parentheses. *, **, and *** denote 90%, 95%, and 99% significance, respectively.

distance between the outlets implies that the merger would increase prices at 5925 Almaden by 12¢ (2¢ to 35¢), from \$3.39 to \$3.51.[40] While this price effect is smaller than the effect of the merger between the outlets at 1935 Tully and Eastridge Mall, it is worth noting that the merger between these owners would lead to the 12¢ increase in prices even though these outlets are far enough apart that, given the presence of other competitors in the area, the presence of the outlet in the Oakridge Mall[41] has only a minimal effect on the price charged at 5925 Almaden under the

[40] The owner of 5925 Almaden owns two other outlets, both of which are so far away that their existence does not affect the price at 5925 Almaden. The owner of the Oakridge Mall outlet owns two other outlets.

[41] As well as all of the other outlets owned by this outlet's owner.

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TABLE 6 **Own and Cross-Price Elasticities for Outlets Near 5154 Moorpark**

	A	B	C	D	E	F	G	H	I
A	−2.514	.039	.234	.081	.007	.119	.426	.027	.720
B	.026	−2.548	.801	.054	.002	.011	.030	.005	.478
C	.044	.227	−2.703	.120	.006	.024	.056	.004	.313
D	.010	.010	.081	−1.379	.114	.110	.024	.000	.012
E	.009	.004	.035	1.073	−2.717	.206	.037	.000	.010
F	.029	.004	.031	.205	.042	−2.158	.306	.004	.033
G	.057	.006	.040	.025	.004	.170	−2.152	.056	.141
H	.029	.008	.020	.003	.000	.019	.450	−2.676	.472
I	.065	.065	.151	.009	.001	.013	.098	.040	−1.816

Cell entries, i, j, where i indexes the row and j indexes the column, give the percentage change in quantity for outlet i with a 1% change in the price of j.

separate ownership structure that actually exists. That is, if the McDonald's outlet located in the Oakridge Mall (and all of the other outlets owned by the same owner) exited from the market, the price of the Big Mac meal at 5925 Almaden would increase by only 1¢, from \$3.39 to \$3.40.

To understand how this can occur, consider the effects that a merger and an exit by a competitor each have on an outlet's pricing incentives. A merger creates an incentive to increase prices as long as some of the outlet's consumers will instead choose to patronize the other store, allowing the owner to recapture some of the profits from these marginal consumers. On the other hand, the exit of a competitor has two effects on an outlet's pricing incentives. First, consumers have one less alternative in their choice set, decreasing their price sensitivity. However, some of the exiting outlet's customers will switch to the remaining outlet. These customers tend to find patronizing the remaining outlet to be less attractive relative to consuming the outside good than the outlet's original customers rate this relative attractiveness. If the outlets are far enough apart, this last effect can offset the effect on price sensitivity from the decrease in choices. Thus, the exit of a competitor has an ambiguous effect on an outlet's demand elasticity,[42] while a merger can only cause prices to increase.

While the above experiments demonstrate the link between outlet proximity and the magnitude of the price impact of a merger, it is worth noting that mergers between outlets can have even larger effects depending on the exact combination of market geography and ownership structure involved. For example, the price at the outlet located at 952 El Monte, whose owner owns several outlets in the vicinity, is 70¢ (31¢ to \$1.46) higher than the price would be if the outlet were instead operated under independent ownership.

I further demonstrate these findings—that mergers can have a large effect on price, that the effect of mergers is larger among outlets that are closer together, and that a merger can lead to increases in prices even when outlets are located far enough apart that the presence of the other outlet would not decrease the outlet's price under separate ownership—by running an experiment in an artificial market. In this experiment, I place two McDonald's into a 10×10 mile market with a uniform distribution of consumers. I place one McDonald's outlet at the center of the market. I then place the other McDonald's outlet at different distances away from the McDonald's at the center of the market and calculate the equilibrium prices for the McDonald's located at the center of the market under joint and independent ownership structures. As a benchmark, if there were only one McDonald's in the market, and if it were located at the center of this market, then this outlet would charge a monopoly price of \$3.71.

Figure 2 graphs the equilibrium prices for the McDonald's located at the center of such a market as a function of the distance between it and the other outlet. Under separate ownership,

[42] Perloff et al. (1996) demonstrate that entry can cause prices to increase in differentiated industries. Thomadsen (2005) demonstrates that this can happen with this estimated model, although the price increases are minimal in the few cases where entry actually increases prices.

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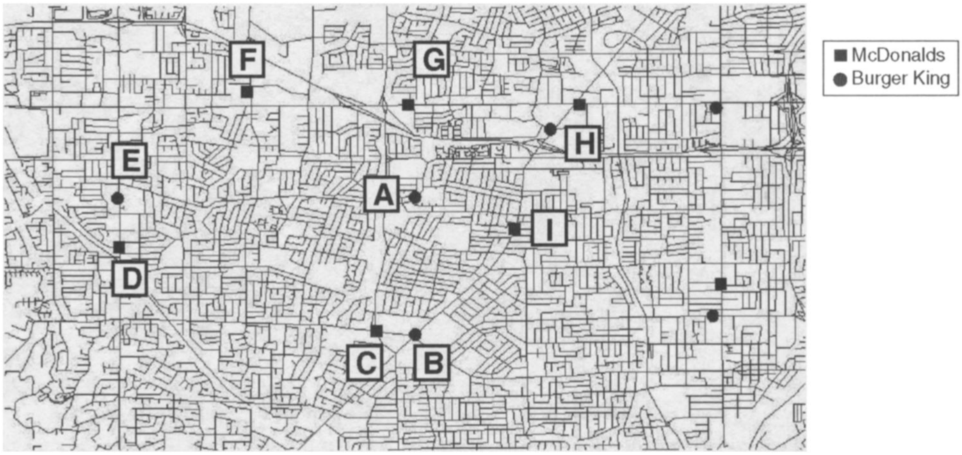
FIGURE 1

MARKET AREA AROUND 5154 MOORPARK

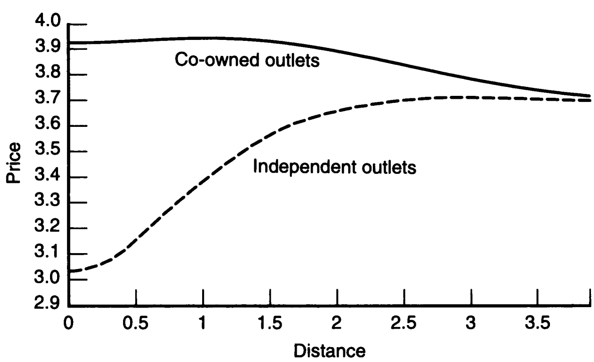


this outlet would charge a price of \$3.04 if the outlets were located near each other, but prices would be higher if the outlets were located further apart. If the outlets were 2.5 miles or more apart, then the presence of the competing outlet would have no impact on price under separate ownership—these outlets would charge the monopoly price. Under joint ownership, prices would at first slightly increase, then decrease, as the outlets were located further and further apart. This initial increase in prices would occur because when the outlets are located very close to each other, the joint company would want to attract both the consumers located close to the outlets and those further away (who value the good less relative to the outside good than the nearby consumers who do not suffer a large disutility of travel). As the outlets are located further apart, attracting the consumers who are further from a particular outlet becomes less important because many of these consumers instead patronize the other outlet; this leads to higher prices than would be observed if the outlets were closer together. However, eventually the outlets become far enough apart that very few of the marginal customers who are far away from one outlet are located close to the other outlet. In this case, the firms are far enough apart that they are almost operating in separate markets, in which case the outlets will charge the monopoly price.

Note that the distance at which prices reach the monopoly level is much larger for firms under joint ownership than it is for firms under separate ownership. Thus, there is a range of distances where a merger would increase prices even when the firms are far enough apart that they would charge the monopoly price under separate ownership. For example, when the two McDonald's

FIGURE 2

PRICE AS A FUNCTION OF DISTANCE AND OWNERSHIP



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outlets are 2.5 miles apart, the price at the centrally located McDonald's will be 14¢ higher under joint ownership than the price of \$3.71 (which is also the monopoly price) it would be under independent ownership.

Finally, the counterfactual experiments show that while mergers among McDonald's outlets can increase prices significantly, mergers between Burger Kings have much smaller effects on prices. I demonstrate this by comparing the price differentials from the different ownership structures for the outlets above to those that would have emerged at these outlets if every McDonald's outlet had been a Burger King and every Burger King outlet had been a McDonald's. Note that in this case the featured outlets would now be Burger Kings.[43] As noted above, a merger between the McDonald's outlets located at 1935 Tully and in the Eastridge Mall would lead to a 29¢ price increase at 1935 Tully; however, such a merger would have increased this price by only 2¢ (0¢ to 6¢) if these outlets had instead been Burger Kings. A merger between the McDonald's outlet located at 5925 Almaden and the outlets owned by the owner of the Oakridge Mall McDonald's would have increased prices at 5925 Almaden by 12¢, but such a merger would increase price by only 1¢ (0¢ to 4¢) if these outlets had instead been Burger Kings. Finally, the outlet at 952 El Monte was 70¢ higher than it would have been if it were not owned by the same owner as many of the nearby outlets. But if these outlets were Burger Kings, then the effect of co-ownership would have been only 10¢ (3¢ to 26¢).

The reason mergers among Burger Kings do not increase prices as much as mergers among McDonald's is that when an outlet increases its price, its consumers can choose to (1) continue patronizing that outlet, (2) consume the outside good, or (3) switch to a different outlet. Equal-sized increases in prices at McDonald's or Burger Kings will cause the same decrease in the utility of eating at the outlet that increased prices, and there will be no change in the appeal of the outside good. However, because most consumers prefer McDonald's to Burger King, customers who switch outlets are more likely to switch to a McDonald's outlet than they are to switch to a Burger King outlet. If the owner of the outlet considering a price increase also owns another McDonald's, then he will recover a greater proportion of the consumers he would lose from the price increase than he would recover if his other outlet were a Burger King, increasing the incentives to increase prices. These results suggest that policy makers ought to be more concerned about mergers between market leaders[44] than those among weaker firms.

5. Conclusion

■ In this article I demonstrate how ownership structure and market geography jointly affect prices that firms charge by examining pricing patterns in the fast food market of Santa Clara County, California. First, descriptive regressions on the data demonstrate that there is a link between ownership, location, and prices. Then, I estimate a model of supply and demand that accounts for the actual layout of the firms. This fitted model is used to conduct counterfactual experiments that illustrate how price effects of mergers depend on the proximity and identity of the outlets.

I find four general results. First, mergers can lead to significant price increases; for example, I demonstrate that co-ownership at one outlet leads to prices that are 23% higher than they would have been if the outlet were instead owned by a separate franchisee. Second, I find that mergers increase prices more for outlets that are located close to each other than for outlets that are located further apart. Third, I find that mergers can increase prices at outlets that are located far enough apart that the presence of each outlet has no effect on the other's prices under separate ownership. Finally, I find that mergers between outlets belonging to the market leader, here McDonald's, lead to greater price increases than do mergers between weaker firms.

[43] Practically, this involves swapping both the base utility of the chain and the mean marginal cost of the chain, so now McDonald's base utility is 4.07 and Burger King's base utility is 6.53. Similarly, McDonald's mean marginal cost is now \$2.03 and Burger King's mean marginal cost is now \$1.45.

[44] For the purposes of this statement, the firm that is the market leader is the firm with the highest value of $X_j\beta - C_j\gamma$, where C_j is the marginal cost of the product.

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These results suggest that policy makers should keep a careful watch over mergers but focus mostly on mergers among the dominant firms in a market. The results also demonstrate that finding that one firm's presence does not affect another firm's prices is not sufficient to rule out that a merger between the two firms will increase prices. Thus, policy makers should determine the impact of a merger between two grocery stores by estimating a flexible model of demand and supply and simulating how prices would change if the merger were allowed rather than testing whether the outlets are far enough apart that the presence of one of the stores keeps the prices at the other lower than their monopoly level.

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