The Effects of the Spatial Distribution of Grocery Stores on Food Prices in Low Income Neighborhoods

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Abstract

Introduction

Many studies have shown that food prices in low-income neighborhoods are often higher than in neighborhoods with higher incomes. Explanations have focused on the size of the stores located in low-income neighborhoods. Low-income neighborhoods have a greater concentration of smaller stores and smaller stores tend to have higher prices than large supermarkets. Research on the distribution of food stores in low income neighborhoods also shows that there are fewer stores. This study examines how the distribution of food stores affects prices.

Competing Theories on Retail Pricing.

There are several schools of thought in economics on how competition, consumer information and, hence, retail prices are affected by market structure. Although the arguments are much more varied than what is presented here, we can generalize the arguments into a debate on how market structure and/or consumers' imperfect information affects firm price setting. As has been discussed in other analyses of food prices (see, for example, the discussion of competing theories in Ward et al, 2002), there is no single theory that guides the choice of an empirical specification, though the theories taken together do guide the choice of variables that should be included in any statistical analysis of food prices. In this section, we outline some of the basic economic theories that will help guide our choice of variables for the price equations we wish to estimate.

Pure Competition Theory.

Under theories of competition, as an industry becomes more and more concentrated, prices rise because firms have fewer competitors. Conversely, as the

numbers of retailers increase, the resultant shifting out of the aggregate industry supply curve drives equilibrium prices downward.

Nevertheless, this standard story of firm competition under single-product, commodity markets becomes complicated when looking at food retailers who offer a variety of products, brands, and services and consumers who do not have perfect information about offerings at different stores and must incur search costs to obtain such information.

Connor (1997), for example, discusses many of the particular, complicating marketing aspects of the food retailing industry. Such aspects include product differentiation among the products that each store sells (e.g. stores offer a variety of products and rival brands), differentiation in services that each store provides (e.g. stores may also have delis, gas stations, or pharmacies), and cost differences among the stores, especially with respect to location, and barriers to entry.

An example of how the pure competition theory may not be appropriate appears in a recent study by Ward et al (2002). Ward et al. examined the increase in retailers' use of private-label products (in-store brands) and discovered that the prices of competing brands actually rose on average when stores introduced their own private labels. This study is important because it shows that the standard textbook explanation of an increase in competition leading to lower prices may be complicated by factors particular to food retailers.

Furthermore, the ease with which firms can enter into a market is crucial under competition theory because the threat of competition is a force in and of itself even if the actual competition does not yet exist in a market, yet such a threat is extremely difficult

to measure. Potential entry is important when comparing retail food prices across a metropolitan area, for example, because the ability of a competing firm to enter is based on an area's planning board as much as on the potential for economic profit. Further, as is the case in many urban locations, there simply may not be the space for a competitor to enter a market or for an existing firm to expand in the market even if profits could be made there.

Under pure competition theory, the key to lowering consumer prices is to undertake measures that lead to the opening of more food stores and, thus, the relationship between food prices and the number (as measured by a market's concentration ratio or Herfindahl index) is a direct one that should be measurable. Given the above discussion, other variables of interest would be the number of competing brands/products in particular stores, and the geographic location of retailers.

Economies of Scale Theory.

One critique that concentration and competition are necessarily negatively related (for example, see Demsetz (1973)) is that because of economies of scale in many industries, concentration may very well be the aftermath of an intensely competitive period within an industry rather than the stasis of a non-competitive one. Following a period of intense competition, the firms that are the most efficient remain and would, thus, offer the lowest prices. The rationale here is that for certain industries average costs diminish the greater the sales volume and, as such, it is logical for such industries to be served most efficiently by fewer firms rather than more firms. Further, because of the economies of scale in these industries, even the slightest competitive pressures that remain among the fewer, larger firms would compel them to offer lower prices

consummate with each firm's lower costs of production as each firm services larger and larger market shares.

Under this critique, concentration's cost-savings effect dominates its anti-competitive effect. Small grocery stores giving way to supermarkets that in turn lose market share to so-called hypermarkets (e.g. Wal-Mart Super Stores) may be consistent with this theory if the costs for these establishments decline as the stores grow in size.

The typical case for such a declining cost industry would be one which has very large fixed costs (relative to its variable costs) so that the average costs of a firm in such an industry decline significantly as the volume of its sales increase. For food retailing, the high fixed cost would certainly be related to the actual size of a particular establishment. The high rental rate reflected by the size of the store would lead to lowered average costs as volume increases.

If this theory is true for the food retailing industry, then an increase in concentration would be correlated with lower food prices and, from a policy perspective, the encouragement of larger stores in an area should be undertaken. Thus, there are two variables of importance. The first would be some measure of concentration (see Cotterill, 1986 and Connor, 1999) such as a concentration ratio or Herfindahl index just as in the pure-competition theory above. The difference here is that one would expect a negative relationship between concentration and food prices. The second variable of interest would try to take account of the large fixed costs. We suggest the usage of store square footage available from county tax assessors.

Search Cost Theory.

Under search cost theory (Salop and Stiglitz, 1977; Stiglitz, 1979) an inverse relationship between concentration and prices may, but need not, have anything to do with cost efficiencies from the size of the establishments. Regardless the cost savings from larger, but fewer, supermarkets, search theorists would argue that because consumer time is scarce and there are so many items to compare in a basket of food retail goods, fewer stores may actually be beneficial to consumers. The argument here is that with many stores the facility for any single store to increase its prices is augmented because consumers do not have the ability to keep track of pertinent prices in every store due to the search costs.

However, if there are fewer stores, it is easier to keep track of prices across supermarkets. Thus, if stores offer similar products, consumers will simply choose the store with the lowest overall prices. In this way, theoretically, as few as two retail establishments in a defined market area are all that is needed to have competitive prices because it would then be easy for consumers to change their shopping patterns when they detect relative price changes. On the other hand, if there are many stores to choose from, consumers are not likely to alter their shopping patterns because of the time commitment needed on the part of the consumers to determine which store offers the best deal and prices will be higher as retailers take advantage of consumers' limited information. Under search theory a negative relationship exists between concentration and prices (i.e. as concentration increases, prices go down). If there are many stores to choose from, consumers may find themselves facing overall higher prices because of their reluctance to search across all stores.

Location Theory.

One aspect of product differentiation is establishment differentiation, wherein a store distinguishes itself in some non-trivial way from its rivals. One often overlooked form of establishment differentiation is simply where stores choose to locate relative to their rivals. Location theory as established by Hotelling (1929) and extended in works such as Mussa and Rosen (1978) and Gabszewicz and Thisse (1979) (see also the general and related discussions of product characteristic locations in Rosen, 1974 and Lancaster, 1994) is related to both the competition and search theories above. Under this theory, firms differentiate themselves by locating so as to maximize consumers' search costs so that consumers are essentially "captured" by the closest firm. We are unaware of any study that explicitly looks for the effect of firm location on retail food prices, but examples in food processing markets where this approach has been considered can be found in Alvarez et al. (2002) and Zhang and Sexton (2000).

Consider, for example, two competing food retailers located on either side of a market area and otherwise indistinguishable in terms of products offered for sale. One can imagine that if the per-mile travel cost is the same for all consumers located between the two firms, there would be a point where consumers located "close" to one store would be that store's patrons and consumers located closer to the second store would be its patrons and somewhere in the geographic middle would be a group of consumers indifferent between either store.

Provided the distribution of consumers between the two stores was uniform, if both firms have the same prices, the market should be evenly split. If one store raised its prices, it would lose some consumers, but not all because there still remains a travel cost to switch to a rival store.

In other words, a consumer would only switch stores if the price increase were higher than that consumer's travel cost to go to the other store. As such, the competitive effect of a price increase is attenuated by the loss of only the marginal consumers so that travel costs lead to a softening of price competition.

Location theory explains why a consumer who lives very close to a store with high-prices would continue to patronize it even if the consumer knew that the store across town offered lower prices. It is this knowledge that allows firms located farther and farther from each other to act less and less competitively toward each other. Under location theory, a highly concentrated market could have higher or lower prices as it is the relative location of food retailers and not necessarily their absolute number that influences firms' price setting behavior. As such, the distance between stores and the number of competing stores within a defined market space are important variables in any econometric specification.

For effective policy development, it is also essential to know how the market structure affects prices. As described above, the market structure of food stores in low-income neighborhoods is different than the market structure in higher-income neighborhoods. Previous research has linked higher prices in low-income neighborhoods to the prevalence of smaller stores in those neighborhoods. The conclusion drawn is that small stores have few economies of scale, and need to charge more per unit. In addition, smaller stores carry fewer bulk items that have lower per unit prices. Previous research on concentration has also examined how concentration affects prices for an entire metropolitan area. The studies have been cross-sectional analyses between cities, not between neighborhoods. This research brings together the two disparate research areas.

While there are empirical methods that have arisen in the last decade or so that theoretically would allow an analysis of market conduct between food retailing rivals, for the reasons specified above and because of the competing theories, these techniques are not well suited for supermarket retailing (specifically, see the critiques of the so-called new empirical industrial organization methods in Sexton and Lavoie (2001)). At best the theories presented above offer different reasons for the relationship between prices and concentration and, at worst, offer conflicting conclusions. As such, developing a unified theory of the relationship between concentration, location, firm size, etc. and food prices is not possible. What is possible is to gather, as Schmalansee (1989) opines, as much empirical evidence of the relationship between such things as concentration, location, product choice, costs, consumer income, size of retail store, etc. on prices in order to arrive at some general conclusions. Doing so is the final goal of this project and will allow a researcher to both infer which theory best represents how food prices are affected as well as perform counterfactual simulations on a market model to ascertain how changes in variables of interest might affect food prices, and, hence, consumer demands for particular foods.

What the empirical analysis will tell us

Specifically, we seek to determine how the price levels of particular food retail establishments are related to local and regional measures of market structure such as firm locations, ownership structure, cost and quality factors, and measures of concentration, while taking into account consumer attributes such as population density and demographics including local per-capita income, race, and ethnicity. Our goal is to build a set of hedonic regressions that will relate the variables of interest to a price index

composed of a market basket of standard and of healthier food items. The regressions will be estimated as a market system using the seemingly unrelated regressions technique for all retail food outlets in a particular geographic market. Estimating the regressions in this way will allow us to use any information from correlated, exogenous shocks in the market that would be expected to affect all firms, and, hence, increase the predictive power of the entire system of equations. In particular we seek to find the relationship between prices and the following variables: store/firm concentration, type of firm (supermarket, small grocer, independent, etc.), size of store, distance from store to nearest competitor, and for an appropriate geographic radius of the store, such demographic detail as population, per-capita income, percent ethnicity, and average education.

Testing market structure by estimating a Hedonic Pricing Model

Given the discussion of conflicting theories and complicating factors in the food retailing industry the philosophical framework expounded by Sutton (2000) provides guidance to both policy makers and future model building efforts by establishing a rigorous set of empirical observations. As such a reduced-from or hedonic approach to the determination of prices is arguably the best way to proceed.

Following Rosen (1974), consider a good, z, which consists of a bundle of characteristics that a consumer finds desirable. Denote these n characteristics as z_i, i=1, ..., n. The characteristics encompass the physical attributes of the good (e.g. fat and fiber content, type of fat, sugar content.) as well as the attributes of the store that sells the good (e.g. cleanliness of the store, store size, etc.) and characteristics such as how far away the consumer must travel to obtain the good or how many stores compete within the same market area. Thus, ceteris paribus, from a consumer's perspective the price that is paid

for the good z is actually a function of z's underlying characteristics: $p(z) = p(z_1, z_2, ..., z_n)$.

In Rosen's discussion of hedonic price formulation, the consumer chooses an outside good, x (e.g. a bundle of "all other goods"), and a unit of good, z, by choosing the characteristics that maximize her utility $U(x, z_1, z_2, ..., z_n)$ given her income, y, subject to her budget constraint $y = x + p(z)$. In our analysis, since we will also include attributes such as store location, consumers have a value (positive and negative) for each of the characteristics denoted by an expenditure or willingness to pay function $\pi = \pi(z) = (\pi_1 z_1, \pi_2 z_2, ..., \pi_n z_n)$. π can be thought of as defining a family of indifference surfaces arising from the maximizing of utility $U = \pi(z) + x$ subject to the budget constraint. For a given maximized indirect utility level, π must be tangent to p(z) and, thus, a reduced form equation of the price to the consumer can be found as a function of both z and π: $p=p(z, \pi)$.

A retailer's decision will be to set prices to maximize profits while taking into account aggregate consumer demand based upon the good's attributes, $p(z, \pi)$, and the cost of the item it purchases for resale, the cost of the attributes it adds to this good such as store cleanliness, and the costs of operating the store as determined by a vector of cost variables $c=(c_1, c_2, ..., c_m)$. The retailer also sets prices while taking into account any strategic behavior of the k rival stores in its market area denoted $\theta = (\theta_1, \theta_2, ..., \theta_k)$. In equilibrium, markets must clear so that quantity demanded equals quantity supplied and the resulting equilibrium, reduced-form price of the good will thus be a function of the good's underlying characteristics, consumers' valuations of the characteristics, firms'

costs for providing these characteristics and any strategic behavior by firms: p=p(z,π, c, θ). In other words a hedonic model that relates observed prices with underlying food attributes and market characteristics.

Hedonic models are rampant in the economics literature for determining the statistical relationships among characteristics and a good that is seen to be a bundle of characteristics, as food items sold in retail stores arguably are. For example, Crespi and Sexton (2004) used hedonic models to examine cattle bidding behavior. Ward et al. used such models to look at the pricing of private labeled foods in retail stores. In fact, a simple search of economics articles using the search engine EconLit found over 300 articles in which a hedonic model was used to ascertain the relationship between product characteristics and the price of the good. Arguably, the vast industrial-organization literature using techniques of the Structure-Conduct-Performance paradigm are hedonic models. Cotterill's (1986) examination of market power in retail pricing used such a hedonic model, for example, by regressing retail and market characteristics such as the Herfindahl index, the square footage of a store, the distance from the store to a warehouse, the population of the area of study and per-capita income on a food price index. The results will provide researchers with a useful statistical model of the relationship between consumer and firm demographics and prices, which is the impetus for this study.

The hedonic price model that will be estimated is $Y_{ij} = \beta' X_j + \gamma' W_i + \alpha' Z_i + \varepsilon_{ij}$ where Y_{ij} the cost of the market basket for store type i in neighborhood j, X_j is a vector of neighborhood characteristics such as the distance of food stores from each other, the number of competitors within a specified radius of each

food store, access to stores as measured by the percentage of car ownership and the number of public transportation lines from which a store may be reasonably accessed, and the concentration of firms, W_i is a vector of store characteristics such as store size, Z_i is a vector of nutritional characteristics such as fiber or fat content, β, γ, and α are coefficient vectors, and ε is a random error term.

Data collection

Market basket studies are frequently used to develop a price index of food items commonly consumed a household. The market basket study involved surveyors going into grocery stores in the areas of interest, and collecting prices for a list of food items from each store. The average cost of the standard TFP market basket and the healthier market basket was calculated from these prices and compared using a standard t-test.

Survey development and data collection

The food items in the survey were taken from the two-week grocery store shopping lists in the TFP[15]. The items on the shopping lists were reviewed to determine which could be purchased according to nutritional characteristics including fiber content, fat type and content, and sugar content. Healthier substitutes were identified for dairy, meats, canned fruit, fats, breads, and grain products, and the healthier market basket was developed using those substitutes (Table 1). For instance, the standard TFP market basket has white bread, whereas the healthier alternative has whole wheat bread. By making the described substitutions, the healthier market basket has four times the amount of fiber and one-fifth the grams of total fat than the TFP market basket. The remaining items on the TFP, such as fresh fruits and vegetables, eggs, beans, etc. are included in the

study but remained unchanged between the standard TFP market basket and the healthier basket.

Table 1 about here

Surveyors recorded the lowest price per unit for each food item on the survey. In addition to price, data on fiber content, fat content, whether the food item was a store or name brand, and package size were collected. Three surveys were conducted in each store over a twelve month period to account for seasonal fluctuations in prices (June 2003, September/October 2003, and March/April 2004). Store surveyors were members of the community who participated in a four hour training meeting before collecting data in the stores. The surveys were checked for missing data immediately after the surveys were completed, and were checked again for accuracy of prices within 48 hours by a graduate student in nutrition. There was 77 percent agreement between the original and the checked surveys. Where items did not agree, the price from the checked survey was used in the analysis.

Store Selection

To compare the availability and price of healthier foods for low-income consumers stores were selected from a core area of "very low" income neighborhoods in zip codes where the median household income was between $17,600 and $27,000 a year, and from a five mile radius around these neighborhoods as some consumers may travel up to 3-5 miles to purchase food[17]. The $27,000 a year cap was chosen because it is about 135 percent above the poverty level for a family of four and households become

eligible for food stamps when they fall below 135 percent of the poverty level. Six grocery stores were selected from zip codes within the very low income core area. An additional six stores in six different zip codes were selected outside the core neighborhoods, but within a five mile radius of the core area. The neighborhoods of these stores were varied by median household income and distance from the core area. The neighborhoods were "low" income neighborhoods with a median household income between $30,000 and $34,000, "medium" income neighborhoods between $42,000 and $46,000, and "high" income neighborhoods between $57,000 and $64,000. The final grocery stores were chosen from a database of all food stores in each city, and then surveyed to determine suitability (i.e. did they offer fresh fruits and vegetables, fresh meats and have a dairy section) and type. The chosen grocery stores were either a chain supermarket (over 20,000 square feet); a small (12,000 to 15,000 square feet) independent grocery store; or a supermarket that sold bulk food items, but was not a club warehouse that charged a membership fee. A total of 12 stores in Los Angeles and 13 stores in Sacramento were surveyed during each time period. In two instances, stores had to be substituted when they closed between surveys.

Changes to the composition of the Thrifty Food Plan market basket.

	Market Basket	
Food Item	Thrifty Food Plan	Healthier
Breads	Enriched	100% whole wheat
Canned Peaches	In heavy & in lite syrup	In lite syrup
Canned Pears	In heavy syrup	In lite syrup

Cheese	Whole fat	Low-fat
Chicken	With skin	Skinless
Cold Cereal	Corn flakes	Bran Flakes
Cooking Oil	Vegetable	Canola
Egg Noodles	Whole egg	Yokeless
Evaporated Milk	Whole	Low-fat
Flour	White	Whole wheat
Frozen French Fries	Frozen French Fries	Potatoes
Frozen Fish	Filets & Breaded	Filets
Ground Meat	Lean, lowest price per pound	Lowest fat
Milk	1%, Whole	Non-fat, 1%
Rice	White	Brown
Salad dressing	Regular	Low-fat
Spaghetti	Enriched	100% whole wheat
Spreads	Margarine	"healthy" spread
Tuna Fish	Light	Albacore

Results

The results show that bulk food stores have significantly lower prices than small independent stores and supermarkets. Most bulk food supermarkets are located in the low-income neighborhoods, and lower the average price of a market basket of good for that region.

The fiber content and fat content of the market basket of goods will also significantly raise the price of a market basket. The fiber content affects price not through the extra cost of fiber, but through the lack of availability of high fiber store brands, or larger bulk sizes. People pay more as fat content decreases; however. Based on our results a one percent decrease in fat content will raise the cost of the total market basket by 0.626 percent.

Table 2. Results

	Coefficient
Constant	5.208
Low	-0.001
Bulk	-0.139**
log income	0.079**
log fiber	0.092**
log fat	-0.626**
number of stores in 2.5 radius	-0.001
on commuter bus line	-0.032**
on metro line	0.054*

*significant at the 10% level
** significant at the 5% level

The number of stores near the store surveyed does not have a significant influence on prices charged in the store. Stores on commuter bus lines have significantly lower food prices, while stores on metro line have significantly greater food prices.