Non-Price Competition and the California WIC Program

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Introduction

The food retail sector of the United States saw significant consolidation and concentration in the past two decades (McCorriston 2002; Reardon et al. 2003; Sexton 2013). Over this time, the concentration of sales in the top four leading grocery retail chains more than doubled, accounting for more than 80% of all sales in some geographic regions (Sexton 2013; Richards and Pofahl 2010). Scale economies in buying power and innovations in procurement logistics and inventory management technology drove much of this change (Reardon et al. 2003). In addition to the expansion of sales in national supermarket chains, supercenters like Walmart increased their presence in this market. Walmart's superior supply chain management and purchasing power enables the supercenters to charge, on average, 10% less for all food products compared to nearby supermarkets (Basker and Noel 2007). Further, the authors observe that supermarkets' and other grocers' price responses to Walmart range from small to nearly nothing. When "traditional" food retailers lose the ability to compete in price, how will they remain profitable in a highly concentrated industry?

An additional and likely related shift in the food retail industry is the considerable increase in the number of products carried. From 1980 to 2010, the median number of stock-keeping units (SKUs) carried by supermarkets increased from roughly 14,000 to up to 60,000 for some supermarkets (Richards and Hamilton 2006; Progressive Grocer 2010). Because of the costs associated with managing a large and diverse inventory in a store location with fixed shelf space, it very likely that food retailers use the brands of products they carry strategically to compete with other retailers to attract consumers.

Further, consumer surveys reveal that many customers base their patronage decisions strongly on the assortment of products a store offers (Progressive Grocer 2010).

Economists have long asked how firms optimally differentiate themselves from one another with approaches highly applicable to food retail. A long history of theoretical literature exists characterizing how firms locate in geographic (or product) space (Hotelling 1929; Benson and Faminow 1985), how firms choose multiple qualities of a good (Mussa and Rosen 1978) and how many varieties firms produce (Dixit and Stiglitz 1977; Spence 1976). These studies inspired empirical investigations of how food retailers strategically use price promotions (Kalnins 2003), food and non-food services (Bonnano and Lopez 2009) and the quantity and quality of brands stocked (Richards and Hamilton 2006).

A grocery retailer differentiating its store based on product offerings will impact the firm's market share and prices charged. Yet, it is difficult to empirically observe effects of such brand competition. Shelf price changes and price promotions (temporary decreases in price) are both confounding factors in previous work. To resolve this issue, we propose a case study involving the Women, Infants and Children (WIC) program, a federal food assistance program providing vouchers for food products redeemable at authorized food retailers. Participants redeem the vouchers at no cost and hence have perfectly inelastic demand. A subset of authorized vendors, A-50 vendors, who derive 50% or more of food sales from WIC, cater almost exclusively to WIC participants. The unique institutional features of WIC and the authorized A-50 vendor population facilitate the study of a market where price is not a strategic variable and hence only non-price variables (e.g., brands carried, geographic location) drive market share.

Background

The Special Supplemental Nutrition Program for Woman, Infant and Children (WIC Program) provides food assistance and health interventions to low-income women, infants, and children under 5 years of age in the United States. Specifically, eligible women and children have a household income of at most 185 percent of the federal poverty line and are often eligible for or receiving Supplemental Nutrition Assistance Program (SNAP; formerly known as Food Stamps), Temporary Assistance for Needy Families (TANF) and/or Medicaid benefits. Nationwide, nearly 9 million women, infants and children participate in WIC (USDA FNS 2012), a group which historically includes roughly one-half of all infants born in the United States (Davis 2007), making WIC an integral part of the nation's public safety net.

The federal government funds the program and charges the individual states to administer the provision of supplemental food, nutritional counseling, and access to health-care services. The food assistance component explicitly promotes the consumption of foods that are beneficial to the wellbeing of prenatal and postpartum mothers and the healthy development of their newborns and young children (USDA FNS 2013). WIC provides the supplemental food at no cost to the participant, which includes an array of nutritionally focused product categories such as infant formula and infant foods, milk, eggs, cheese, dry beans and lentils, peanut butter, breakfast cereal, fruit juice, and whole grain products. While these product categories are federally mandated, it is the responsibility of the individual state to approve specific food brands, package sizes, and types for WIC food packages (USDA FNS 2013). For example, California WIC's criteria

for authorizing a food item includes that a given food brand or type (a) promotes (or at a minimum, does not detract from) WIC health and nutrition goals while demanded by participants, and (b) helps maintain the cost-effectiveness of the Program while being consistently available on the wholesale market (California DPH 2012a). Product categories require either brand specific or non-brand specific approval. For example, in breakfast cereal category, WIC participants can only purchase approved brands of ready-to-eat cereal (e.g., General Mills Cheerios), yet if a participant chooses to use her voucher to procure oatmeal, all brands meeting general product characteristic requirements can be purchased.

The latter criterion of cost-effectiveness ensures that candidate food brands and types are not so costly that they could undermine the ability of WIC to adequately provide benefits. Because WIC is not an entitlement program it must maximize Program benefits under a fixed annual budget constraint, necessitating the requirement for cost control. In California, the Program administration minimizes costs in the non-brand specific approval process by excluding product types that are premium, luxury or otherwise highly priced compared to related goods. For example, the state agency approves many types of cheese such as cheddar, Colby, jack, etc. where consumers can purchase any brand; however, more expensive artisan or organic cheeses are excluded (California DPH 2012). For brand-specific product categories, such as breakfast cereal, certain brands may not receive approval if they are prohibitively costly even if they meet nutritional requirements, (e.g., organic cold breakfast cereals) (California DPH 2012).

The approval process for infant formula, on the other hand, is unique compared to all other product categories. The California WIC Program approves a single brand of

infant formula by way of a bidding process that selects the producer who is willing to accept the lowest final price (USDA FNS 2013, California DPH 2012a). Essentially, the winning formula producer is the one who offers the highest per unit rebate to the state agency following reimbursement of the WIC vendors. Manufacturers have a strong incentive to provide a high rebate to gain market share, as roughly 50% of all infant formula is sold through WIC (Oliveira, Frazao and Smallwood 2010; Reed and Levedahl 2012; Davis 2012).

Program participants "purchase" the supplementary food by means of redeemable food vouchers, or food instruments (FIs), for specified bundles of WIC-approved products. Consumers receive FIs monthly for bundles that vary in breadth from a month's supply of infant formula to a basket of low-fat milk, eggs, cheese, and peanut butter or dry beans. For a given FI, consumers can typically choose among multiple brands within a product category without a limit on the price, provided the item is authorized by the FI and WIC Program guidelines. Participants can only redeem FIs at authorized WIC vendors, which consist of private food retailers that vary in size, store format, and brand availability. For example, supercenters (e.g., Walmart), large grocery chains (e.g., Safeway), and many small grocery and convenience stores in low-income neighborhoods operate as WIC vendors. The WIC vendor approval process ensures that a candidate retailer can meet mandated minimum stocking requirements of WIC products and is equipped to handle FI redemptions (USDA FNS 2013).

Over 5,000 vendors are authorized currently in California. The USDA Food and Nutrition Service halted authorization of new vendors as of 2011 to ensure the state WIC

Agency was able to manage the existing authorized vendor population (California DPH 2012b).

When a participant redeems a FI, the vendor records the retail value of the bundle purchased and submits the dollar amount to the state agency for reimbursement. WIC reimburses the vendor up to a pre-determined price ceiling–or maximum allowable department reimbursement (MADR)–that varies by store size (measured by the number of registers in a store) and geographical region. A pair of store-size grouping by register and geographical region constitutes a peer group, the unit for which a MADR rate is computed. The MADR rate is information provided to all vendors within a peer group. A peer group's MADR rate for a FI is a function of a twelve-week rolling average value of all redemptions within the peer group for that FI. In particular, WIC calculates the MADR rate for FI i and peer group j at time t as follows

$$MADR_t^{ij} = X_{t\sim 12}^{ij} + c_{t\sim 12}^{i,10}\sigma_{t\sim 12}^{ij}$$

where $X_{t\sim 12}^{ij}$ is the rolling twelve-week average value of redemptions in the FI-peer group combination, $\sigma_{t\sim 12}^{ij}$ is the standard deviation and $c_{t\sim 12}^{i,10}$ is a scaling constant. The agency specifies the scaling constant such that peer groups with high variance in 10+ register store redemption values have a higher MADR rate. This specification gives vendors in geographic peer groups with highly variable prices a greater level of tolerance in the maximum they can charge for a FI.

Recently, WIC shifted policy so that the aforementioned MADR rate formula only applies to larger stores, those with five or more registers. Instead, WIC allows 1-2 register (3-4 register) stores a 15% (11%) markup over the average redemption value of a FI for stores with five or more registers. This change in how MADR rates were calculated

was intended to reduce costs by restraining the amount smaller stores charge to the state, while allowing them to charge slightly more on average due to potential cost disadvantages.

For many grocery chains and supercenter retailers, the share of WIC sales relative to total sales is small. And, because these retailers must compete with each other for market share of paying customers, the MADR rate is often not a binding constraint. However, in the past decade, so-called A-50 stores (stores for which more than 50 percent of their food revenue is derived from WIC sales) that cater largely or exclusively to WIC consumers entered the market and captured a significant share of WIC business. A-50 stores include small food markets that accommodate large numbers of WIC participants and so-called “WIC-only Stores”, food retailers that carry only WIC products and serve WIC participants exclusively.

Compared to traditional food retailers, many A-50 vendors claim to offer a shopping environment amenable to the comfort and needs of WIC consumers. These stores are large in number, amounting to just over 900, more than 15% of WIC authorized vendors in California. A-50 vendors’ redemptions account for over one-third of the value of all WIC redemptions in the state. To control costs stemming from these stores, the A-50 MADR rate is set equal to the statewide average redemption value for the FI, which is often much lower than the MADR rate of non-A50 vendors of similar size. The low MADR rate is typically a binding constraint for A-50 vendors, resulting in these vendors charging approximately the MADR rate consistently for a given FI.

A-50 stores tend to concentrate in geographic areas with relatively high densities of low-income households with typically more than one A-50 vendor in a given locale.

The proximity of A-50 stores to one another as well as other authorized WIC vendors prompts the question: do these stores compete with all WIC vendors and, if so, how? Because WIC customers are not sensitive to the price of WIC authorized foods, it must be that A-50 stores do not compete using price as a strategic variable and instead use non-price dimensions to attract WIC participants.

One such avenue for non-price competition is the quality and quantity of the brands of a given product offered by an A- 50 store. WIC minimum stocking requirements only require that a vendor carry a certain number of items of at least one brand of every WIC product category. However, we observe that A-50 stores tend to carry multiple brands for many product categories, likely because variety will appeal to the customers. On the other hand, the comparatively low MADR rates in place for A-50 stores may induce these vendors to cut costs by carrying brands that are relatively low cost. To this end, this paper investigates the relationship between the institutional details of California WIC and its impact on the brand choice of A-50 vendors.

Previous Work

Attention paid to WIC in the economics literature is small relative to its larger food assistance counterpart SNAP. To date, the studies that address the WIC Program have fallen into one of two veins. One includes market impact studies of sole-source infant formula contracts. For example, Oliveira et al. (2004) examine the role that manufacturers played in rising infant formula prices following the implementation of sole-source contracting.

The other strand of literature includes analysis health impact on WIC participants. Arcia, Crouch, and Kulka (1990) examine the changes in reported consumption from two

survey datasets, one survey conducted before WIC enrollment and one during enrollment. The authors observe a reduction in the number of away-from-home meals consumed, an increase in healthy food intake, and no change in total household food expenditure. Subsequent work, using similar data, corroborates the second conclusion, finding that WIC participants, on average, consume food with less added sugar intake (Wilde, McNamara, and Ranney 1999) than non-participants. Carlson and Senauer (2003) show that young children enrolled in WIC have better health on average than non-enrolled.

Studies on Nonprice Competition in Food Retailing

Bonanno and Lopez (2009) model milk demand as a function of price and the food and non-food services offered by supermarket chains. The authors frame services as demand shifters that linearly increase marginal operating costs. Using scanner data on milk from several major U.S. metropolitan regions, combined with knowledge of services offered, they find in-store services tend to increase market share and retain a relatively price-inelastic clientele.

Richards and Hamilton (2006) investigate how supermarket chains strategically use product category heterogeneity, measured by the number of varieties of a product that the store carries. A supermarket chain's demand curve follows from a nested logit approach in the vein of McFadden (1978), where consumers' utility comes from the chain patronized and products purchased, consecutively. Both components of utility are subsumed into a nested CES function, incorporating preference for variety as the sole determinant of the utility of chain patronization (Dixit and Stiglitz 1977). Like Bonanno

and Lopez (2009), the authors employ scanner data and analyze the fresh fruit offerings of Los Angeles area supermarket chains.

Richards and Hamilton (2006) find that price and variety choices are strategic complements, allowing supermarkets to increase the number of products they carry in order to maintain market share while raising price. Additionally, supermarkets tend to match variety offerings meaning one chain increases the type of fresh fruit that it carries in response a competitor increasing its product offerings in the fresh fruit category. However, the response is not homogenous across firms.

Heterogeneity among any food retailers could exist for a number of reasons. For example, Benson and Faminow (1985) applied the Hotelling (1929) framework coupled with cost variation to show that spatial differentiation can account for price dispersion. In principle, the geographic space of Benson and Faminow (1985) can be extended generally to all modes of address product differentiation.

Addressing geographic space and the effect of price promotions on fast-food demand, Kalnins (2003) takes a spatial econometric approach in the vein of Anselin (2006). The author's reduced form approach models the strategic variable of one firm as a direct function of those of all neighboring competing firms. One advantage of this approach is the ability to employ various measures of distance of firms from one another. Additionally, when price is not a strategic variable as with WIC A-50 stores, the methodology can be readily applied to non-price strategic variables.

In contrast to the extant literature on the WIC program, our primary objective in this study is to utilize the unique features of the Program to address a broader set questions related to food retailing and grocer non-price competition rather than

exclusively evaluating program impacts. We explore to what extent both types of spatial differentiation (product and geographic) drive observed heterogeneity among A-50 WIC vendors. Whereas price competition is a confounding factor in the existing non-price competition literature, our approach takes advantage of the institutional details of WIC where price is organically non-strategic. In this setting, we explore how A-50 vendors engage in non-price competition to achieve spatial oligopoly when only non-price strategic choice variables are available.

Conceptual Framework

Economists have long been interested in various modes of product differentiation relevant to competition in food retail. Two types of product differentiation paradigms comprise the broader address model approach to modeling product differentiation: i) horizontal differentiation, where consumers differ across product attribute space in their preferences (Hotelling 1929; d'Aspremont et al. 1979; Benson and Faminow 1985), and ii) vertical differentiation where consumers all prefer high quality goods but vary in intensity of preference (Mussa and Rosen 1978). Alternatively, the non-address approach models study the number of products supplied by multiproduct firms in the face of consumer preference for variety (Dixit and Stiglitz 1977; Spence 1976). Both approaches potentially provide at least a partial explanation for WIC vendors' brand stocking choices and hence we synthesize the address and non-address conceptual frameworks to account for them all.

Consider a vendor's choice to stock, for example, one particular brand of ready-to-eat breakfast cereal. A highly differentiated product, consumers vary in the location of their preference (or address) over the horizontal product characteristics of ready-to-eat

breakfast cereal brands (e.g.,flavor, sugar content, and type of grain). The domain of a particular characteristic can be thought of as Hotelling's linear city where consumers are distributed along the line in accordance to their preference. Choosing to stock (or locate) a ready-to-eat breakfast cereal, say, high in whole grains attracts consumers located near this product. However, consumers who prefer cereal made of refined grains are less enticed as they would endure a significant "transport cost," in utility terms, to consume this good.

Additionally, this candidate ready-to-eat breakfast cereal brand can have a distinct vertical quality component such that all consumers could agree that it was preferred to other brand offerings. For example, consumers may prefer a nationally recognizable brand to a generic brand of cereal although differ in their intensity of this preference. A vendor who stocks a higher quality product entices consumers to endure the transport costs to purchase the good. We can think of consumers having an "address" here also such that consumers are located along a continuum according to their intensity of preference.

However, most food retailers stock more than one brand of most products. And, likewise, consumers may purchase multiple brands with different horizontal and vertical characteristics. In this case, consumers may have a preference for variety of brands that may or may not be independent of a preference over the qualities of a single good. On one hand, between shopping trips, a consumer may desire to alternate between two or more cereal brands. On the other hand, the consumer may be shopping for multiple individuals, each with their own unique addresses in product attribute space. Both

scenarios can account for consumers preferring vendors who carry more brands then others.

In studying the optimal provision of product variety by multiproduct firms, studies in the vein of Dixit and Stiglitz (1977) and Spence (1976) use a CES utility function where utility is increasing in the number of products offered. An address approach, often assumes a utility function that is increasing in a product's proximity to the consumer in space (either geographic or product characteristic) (Hotelling 1929, d'Aspremont 1979) or increasing the quality of a product consumed (Mussa and Rosen 1978). Because both address and non-address differentiation plays a role in the brands vendors chose to stock, we do not assume an explicit form of the utility function to motivate the approach.

Instead, let $u_j(x_i)$ be the indirect utility of WIC participant j associated with purchasing a particular FI bundle from vendor i where x_i is a k-dimensional vector of the k non-price brand-related characteristics of vendor i. We take any element of x_i to be either the quantity or quality measure of brands for a given product category. Utility $u_j(x_i)$ is not a function of prices because WIC participants redeem their FI at no cost.

For simplicity, consider the case where x_i is one-dimensional. We assume $u_j(x_i)$ to have the property that $u_j'(x_i) \geq 0$ consistent with the utility specifications utilized in both address and non-address specifications. For example, if x_i is the number of breakfast cereals offered $u_j'(x_i) \geq 0$ could arise from either a consumer's preference for variety or a brand being proximate to consumer i's location in product space. Alternatively, if x_i measures the quality of brands then we expect $u_j'(x_i) \geq 0$ as well.

Participants choose to redeem their FI at the vendor for which their utility is maximized. Then vendor i's demand for a given product category is the number of participants for which $u_j(x_i) > u_j(x_{-i})$ where $-i$ denotes all other vendors who are not i. It follows then that vendor i's demand is function of both x_i and x_{-i} and is defined as $f_i(x_i, x_i)$. It follows from the utility function, $u_j(x_i)$, that vendor i's demand function has the properties $\partial f_i / \partial x_i > 0$ and $\partial f_i / \partial x_l < 0$ for $l \in -i$.

We assume the objective of the A-50 vendor is to maximize profits by selling FIs rather than specific goods themselves. Let the redemption value of the FI for vendor i be denoted as $p_i \in [0, \overline{p}]$ where $\overline{p}$ is the FI MADR rate. The profit maximization problem of vendor i is

$$\underset{\substack{0 \le p_i \le \overline{p} \\ x_i \ge 0}}{MAX}\ \Pi_i = \left(p_i - c_i(x_i)\right) f(x_i, x_{-i})$$

where $c_i(x_i)$ is vendor i's marginal cost of the FI at brand-characteristic level x_i with the properties $c_i'(x_i) > 0$ and $c''_i(x_i) > 0$.

Maintaining $k = 1$, the first-order conditions of the problem are

$$\frac{\partial \Pi_i}{\partial p_i} = f(x_i, x_{-i}) \ge 0 \tag{1.1}$$

$$\frac{\partial \Pi_i}{\partial x_i} = -c_i'(x_i) f(x_i, x_{-i}) + \left(p_i - c_i(x_i)\right)\left[\frac{\partial f_i}{\partial x_i} + \sum_{\forall l \in -i} \frac{\partial f_i}{\partial x_l}\frac{\partial x_l}{\partial x_i}\right] \le 0 \tag{1.2}$$

Equation (1.1) then holds with strict inequality meaning vendor i sets $p_i = \overline{p}$. In other words, because WIC participants are price inelastic, A-50 vendors will price goods such that the redemption value is equal to the MADR rate.

Equation (1.2) holds in equality since $c_i''(x_i) > 0$ and we rewrite it as

$$\left(p_i - c_i(x_i)\right)\left[\frac{\partial f_i}{\partial x_i} + \sum_{\forall l \in -i} \frac{\partial f_i}{\partial x_l}\frac{\partial x_l}{\partial x_i}\right] = c_i'(x_i)\, f(x_i, x_{-i}) \qquad (1.3).$$

Intuitively, vendor i increases the non-price brand variable x_i until the gain in revenue from increasing demand, taking into account competitors' responses, equals the change in marginal cost of increasing x_i. In other words, equation (1.3) summarizes an A-50 vendor's relevant strategic behavior as engaging in non-price brand competition to balance the tradeoff between shifting demand and increasing costs.

In general, however, it is reasonable to think that $k > 1$ since all food vendors in practice face brand choices over many product categories. With respect to the model of A-50 vendor behavior, equation (1.3) would evolve into a system of k equations with conduct parameters allowing for vendor l to respond to any element of x_i in any of the k dimensions.

The theoretical literature of multidimensional product differentiation in price competition predicts that firms differentiate in only one characteristic, the one with the largest marginal utility (Tabuchi 1994; Irmen and Thisse 1998). This result is driven by the tradeoff to maximize market share (minimally differentiating) while also distancing oneself from a competitor (maximizing differentiation) to minimize price competition. Offsetting economic forces would appear to be at work. On one hand, an A-50 store can increase the number and quality of brands it carries, relative to competing WIC vendors, to attract customers. On the other hand, given that prices received by the A-50 vendors are fixed at the price ceiling, cost minimization through carrying cheaper brands presents itself as the only option to increase profit margins. Because A-50 vendors do not engage in price competition and product differentiation is costly, the degree to

which vendors differentiate themselves will be driven by the cost-to-market-share tradeoff. Thus, vendors must balance the profit-margin effect of carrying cheap brands with the market-share effect of carrying more brands and more expensive brands.

Data

We use four data sets to estimate the impact of spatial competition on brand choice: (i) individual vendor FI redemption data for California, (ii) an in-store product survey for California WIC vendors, (iii) store-wide wholesale and price information on all food products sold for several leading grocery chains in Northern and Southern California, and (iv) information on the precise geographic locations of all WIC vendors in California.

The first dataset consists of all FI redemptions made under the California WIC Program for the 29-month period from October 2009 to February 2012. Each month of redemption data contains approximately five million observations or about 150 million observations in total. The variables contained in the redemption data can be divided into three categories: i) FI identification and information, ii) vendor identification and information, and iii) redemption information.

Each observation in the data identifies the specific FI for which the vendor requested redemption. Further, the data provide information on the participant category (e.g., breastfeeding mother, pregnant woman, etc.) under which the FI is provided, as well as a brief description of the types of items allowed by the FI. However, we do not observe the specific products purchased.

With respect to vendor information, each observation provides vendor identification number, contract identification number, zip code, county of the vendor location, and the vendor peer group. From the vendor identification number, vendor name

and address information were merged onto the data to allow for the identification of specific retailers or chains of retailers. Based upon location and peer-group information, the number of registers operated at each vendor location was inferred. Redemption information includes the MADR rate and the amount redeemed.

This first dataset is important because we can observe the market share of A-50 vendors in the California WIC program for the above time-period. Table 1 summarizes the number and value of WIC redemptions by A-50 vendors and non A50-vendors by number of registers which proxies for store size. A-50 vendors themselves redeem 37% of the value of total WIC transactions despite comprising less than 17% of all WIC vendors. The value of A-50 vendors' redemptions is even higher than those of large (10+ registers) vendors, which include large supermarkets and supercenters. This provides evidence that A-50 vendors play a big role in the WIC program.

The second dataset was derived from three in-store surveys (two of non A-50 vendors and one of A-50 vendors) that we designed and which were implemented with the cooperation of the California WIC Program: a small-store survey was designed for non A-50 vendors with from 1 – 4 registers; a large-store survey was designed for vendors with 5 or more registers; and an A-50 vendor survey. Both surveys were conducted by the Program's local vendor liaisons during two distinct time periods. The A-50 survey was completed by the A-50 vendors themselves, with the results transmitted to the California WIC Program, which required participation by the A-50 vendors.

Table 2 provides a list of the product categories that were included in each of the surveys. For a particular product category, we observe the specific brands that a vendor carried on shelves at the time of the survey. This allows us to construct measures of

brand competition for vendors, for example, the number of brands of breakfast cereal carried, which is computed and summarized in Table 3 for surveyed A-50 vendors.

There is a significant amount of variation in the number of breakfast cereal brands observed. Sixteen possible brands can be observed, and looking at Table 3, we see then on average all A-50 vendors carry about 75% of them. However, some vendors carry all of them while others carry as little as four brands. There is a small difference across differently sized stores, for example, the small stores tend to carry on average one brand less. Further, the standard deviation for largest A-50 vendors (5 registers) is the smallest of all.

The third dataset was provided by the California WIC Program and contains weekly wholesale cost and retail price data for three large supermarket chains in Northern California and four large supermarket chains in Southern California for the time period August 2011 through May 2012. Wholesale costs and retail prices in this dataset are averaged for each supermarket chain and location in each week. The data also contain product description, package quantity, product size, and UPC code.

For surveyed products from the second data set, we can match wholesale prices to the brands carried by vendors. It is a common modeling framework to assume higher quality products are more costly to produce (Mussa and Rosen 1978) and hence we use wholesale costs to proxy quality of brand. We take the average wholesale cost for a given brand across the time period in terms of cents per ounce. For breakfast cereal brands, for example, nationally recognized brands' wholesale price mean is 24.9 cents per ounce with a standard deviation of 5.7, with some brands falling as low as 14.5 cents per ounce. One surveyed "off" brand (Mill Select) was not included in the wholesale data

and the highest average wholesale cost of a comparable non-surveyed WIC-certified off-brand (Western Family, roughly 11.3 cents per ounce). This allows us to present variation in vendor's wholesale costs in a conservative manner. Table 4 summarizes the average of combined nationally recognized and proxied off-brands wholesale costs for all the brands a vendor carries by number of registers. With lower-cost off-brands included, the average wholesale cost per brand carried ranges from roughly 19.32 to 27.30 cents per ounce with no significant differences across store size.

The fourth data set, the exact geographic location of all vendors, allows us to relate, for instance, the number of and average supermarket wholesale costs of breakfast cereals spatially. Figures 1 and 2 respectively map these two variables for all A-50 vendors in Los Angeles County, a geographic region with a significant number of A-50 vendors. Thiessen polygons centered on a vendor incorporate contiguous vendors as competing neighbors. A pattern emerges that many vendors tend to have similar values of the two measures. However, this pattern is not uniform, noting that the largest deviations occur in more dense parts of the county. For example, towards the bottom-center of Figure 1 are two vendors with very high and very low numbers of breakfast cereal brands on shelves who are neighbors. Interestingly, the two vendors switch roles when it comes to supermarket wholesale costs: the vendor with the low number carries brands with higher wholesale costs and vice versa as seen in Figure 2. These two figures alone a rich picture of competition in brands that is heterogeneous across space.

Conclusion

The California WIC program's unique institutional features present a valuable opportunity to study non-price competition among food retailers. In particular, WIC

participants' inherent perfect price inelasticity of demand allows us to organically abstract from price as a confounding factor when studying the strategic behavior of A-50 vendors who cater nearly exclusively to WIC consumers. The usefulness of results from such an experiment stem from the observed phenomena of (a) many retailers losing the ability to compete effectively in price against discount supercenters such as Walmart, and (b) a simultaneous proliferation in the number and types of highly differentiated products offered—upwards of 60,000 SKUs in some supermarkets. Our study gives a first look at the nature of non-price competition among vendors in the WIC program, and the results should also provide insights more generally into nonprice competition among food retailers.

We hypothesize that the intensity of non-price competition varies with the spatial proximity of A-50 vendors to one another. From initial results, we observe that neighboring firms tend to carry similar quantities and quality of breakfast cereal brands, a highly differentiated product category in various respects. However, the picture is not uniform as we also observe at least one pair of A-50 vendor neighbors in high-density areas take on opposite values of their strategic non-price variables. This latter observation departs from the prediction of the theoretical literature that differentiation occurs in one dimension only (Tabuchi 1994, Irmen and Thisse 1998).

Moving forward to obtain a deeper empirical picture of observed A-50 vendor heterogeneity, we plan to employ a spatial econometrics approach similar to that of Kalnins (2003). This approach takes the value of a vendor's strategic non-price variable as being a function of those of neighboring vendors weighted by their relative degree of proximity. Numerous concepts can characterize proximity and we plan to treat the spatial

dimension using various measures. We will compare our results to existing empirical studies of non-price competition and the predictions of the theoretical literature as well.

Tables

Table 1 Number and Value of FI/CVV* Redeemed by Register Group (Oct. 2009-Feb. 2012)

Register Group	Number of FI/CVV Redeemed	Value ($) of FI/CVV Redeemed	% of Value of FI/CVV Redeemed
A-50 Vendors	51,638,123	956,792,684.88	37
1-2 Registers	9,677,149	277,222,603.58	10.7
3-4 Registers	5,744,937	121,740,696.55	4.7
5-6 Registers	7,432,990	128,569,514.80	5
7-9 Registers	17,951,286	295,549,773.86	11.4
10+ Registers	50,731,895	808,884,544.80	31.2

*Cash Value Vouchers (CVVs) are also given to WIC participants for things such as fresh fruits and vegetables. Our surveys do not account for product categories eligible for purchase by CVV, only FIs.

Table 2 Surveyed Product Categories by Vendor Type

Product Category	A-50 Vendor (5+ Vendors)	Small Vendor (1-4 Vendors)	Large Vendor (5+ Vendors)
Milk		X	X
Cheese		X	X
Eggs		X	X
Soy Beverage		X	
Tofu		X	
Whole Grains	X	X	X
Breakfast Cereal	X	X	
Peanut Butter	X	X	
Dry Beans, Lentils & Peas		X	
100% Fruit Juice	X	X	
Canned and Frozen Fruits & Vegetables		X	
Infant Cereal	X	X	X
Infant Formula		X	X
Infant Fruits & Vegetables	X	X	
Infant Meats		X	
Canned Fish		X	

Table 3 Number of Surveyed Brands of Breakfast Cereals by Number of Registers for A-50 Vendors Only

Registers	n	Mean	Std. Dev.	Min	Max
1	109	12.13	0.28	4	16
2	91	11.38	0.32	4	16
3	46	13.22	0.24	7	16
4	28	13.68	0.27	9	16
5	24	13.58	0.12	12	14
All	298	12.33	2.70	4	16

Table 4 Average Supermarket Wholesale Cost of A-50 Vendors' Observed Surveyed Brands

Registers	n	Mean	Std. Dev.	Min	Max
1	109	22.34	1.69	19.32	27.30
2	91	22.29	1.70	17.02	26.60
3	46	22.25	1.45	19.75	24.27
4	28	22.98	1.56	19.75	24.27
5	24	23.23	1.37	21.35	24.27
All	298	22.45	1.64	17.02	27.30

Figure 1 Number of Observed Breakfast Cereal Brands for LA County A-50 Vendors (white is lowest and black is highest)

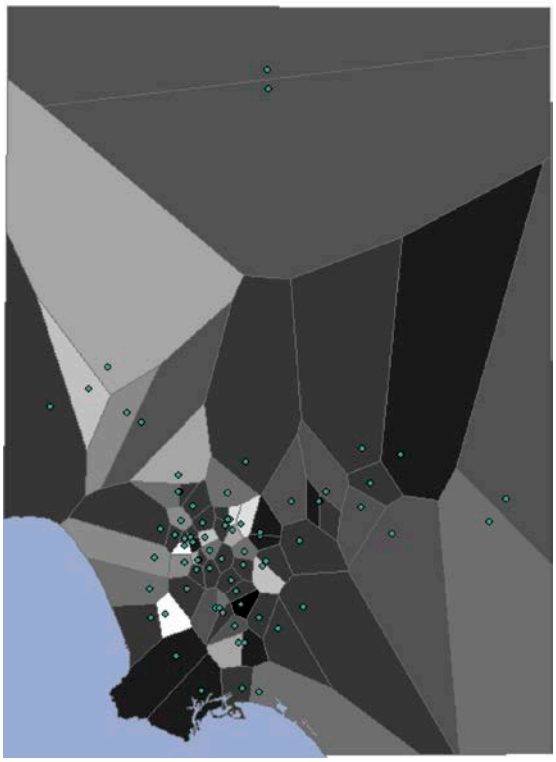
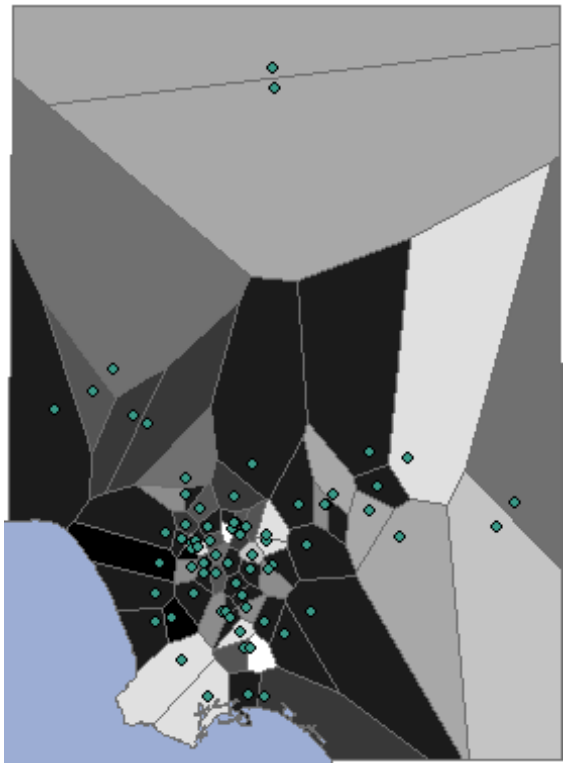


Figure 2 Average Supermarket Wholesale Costs of Breakfast Cereal Brands Carried for LA County A-50 Vendors (white is lowest and black is highest)



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