Local, Organic, Inexpensive and Safe: Can Large Retailers Do It All?

Henry An (University of Alberta)

Sébastien Pouliot (Iowa State University)

Richard Volpe (Economic Research Service-USDA)

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Introduction

One of the most important changes in the food industry in recent decades has been the increase in retailer concentration at the national level. The trade publication *Progressive Grocer* releases the Super 50 annually, a ranking of the 50 largest food retailers in the U.S., by receipts. In 1997 the top 5 retailers controlled 24 percent of the national market. By 2004 this figure was 46 percent and by 2010, 61 percent.[1] Much of this change has been driven by waves of mergers and acquisitions (Franklin, 2001), but it is impossible to overlook the role that big box, low-cost supercenter stores, particularly Wal-Mart, have played.[2] Wal-Mart entered food retail with its first supercenter in 1988 and has since grown to become the largest food retailer in the U.S. by a wide margin.

While the structure of food retail has evolved, so have consumers' demands and preferences. Consumers increasingly demand food that is certified organic (Greene et al., 2009), grown locally (Martinez et al., 2010), or both. And regardless of the source of their food, consumers demand safety and traceability in their food (Loureiro and Umberger, 2007), while their willingness-to-pay for these latter attributes is less clear, which poses further complications for retailers. We argue that the increased costs associated with acquiring foods that meet these criteria, particularly in conjunction with one another, present challenges to supercenter stores that seek to maintain reputations for having prices lower than their competitors. We develop a model that examines the multiple objectives facing supercenters in food retailing. Specifically, we take

[1] *Progressive Grocer* does not include club stores (e.g. Costco) in their rankings. For a ranking of the industry that does include these stores, see Supermarket News: http://supermarketnews.com/top-75-retailers-wholesalers-2012. This ranking also has Wal-Mart positioned in the number one spot.

[2] Supercenters, also referred to as hypermarkets or superstores in the literature, are combinations of department stores and full supermarkets.

a look at the challenges facing such firms in today's retail food environment to offer food that is local or organic, safe, and lowest-cost.

We are motivated in particular to undertake this research due to the example of Wal-Mart and while our model is applicable to all supercenter chains (including Target, KMart, and Fred Meyers and others), much of our framework was drawn up with Wal-Mart in mind. In recent years Wal-Mart has been in the press for its efforts to expand its offerings of both organic (Bustillo and Kesmodel, 2011) and local (Clifford, 2010) foods. In the case of local foods, Wal-Mart has pledged to double its share of produce that is grown locally by the end of 2015. While organic production has been expanding rapidly in the U.S. and demand has grown between five and 16 percent each year since 2004 (*National Business Journal*, 2010), the story for local foods is somewhat different. Martinez et al. (2010) note that even defining local as being grown in the same state as the stores in which food is sold leads to differences in the economic viability of local food systems within the U.S. The less established is a local food system, or the less suited it is to producing produce during certain seasons, the higher are the costs of acquiring these foods. Wal-Mart's forays into organic and local foods may be contributing to the trend researchers have uncovered that the price difference between Wal-Mart Supercenters and those of competitors has been shrinking in recent years (Leibtag et al., 2010).

Through modeling supercenters and their multiple objectives, we are also able to draw implications for the development and viability of local food systems and the determinants of food safety in the US. We note that the costs to retailers incurred due to food safety incidents are highly important in determining the quantity of local food offered by supercenters and may induce large retail firms to purchase farmland in order to vertically integrate local food production. This corroborates Clifford (2010) who notes that Wal-Mart is investing more than $1 billion through 2015 in directly supporting local agriculture. The cost of ensuring that local food is also safe may well prove to be a factor in keeping smaller and independent retailers active in the food supply chain despite the ongoing wave of consolidation and concentration.

The model

We present a model of a food supply chain with producers, retailers and consumers. The model focuses on the decisions by a large chain store to offer local food while competing with small retail stores. The discussion of the model focuses on local production but extends to organic products and the model applies to other quality attributes. We describe below the preference of consumers for local food, the production of local food, and competition at retail between small retail stores and a large chain stores.

Consumers

The model considers that the origin of food (i.e. local vs. outside) is a vertically differentiated quality attribute. As such, at equal price, all consumers strictly prefer a local food product over food not locally produced. In addition, we assume that consumers strictly prefer, at an equal price, buying local food at a small retail store than in a chain store. These assumptions capture ethnocentric preferences for local food and local outlets (Lusk and Briggeman 2009). That is, consumers prefer purchasing local products in small stores because they believe it supports the local economy or that local products are of better quality. The model assumes that the large chain offers products that originate from outside of the local area in addition to local foods. For our discussion, we will label non-local food as the generic food product.[3] One interpretation of our demand specification is that it represents the residual demand for a food product, net of all purchase of generic food elsewhere.

We assume that consumers do not observe the safety of food. For most pathogens, consumers are unable to detect contamination by sensory inspection. Consumers however value food safety and may perceive that origin transparency, or traceability, is a signal of quality. Thus, one of the motives for consumers being willing to pay more for local food is that they believe that it is safer than generic, although this may not be true in practice.

We model consumer preferences for three quality attributes regarding origin following Gabszewicz and Thisse (1979). The quality attributes are local food at a small retail store (subscript r), local food at a chain store (subscript c) and generic food at a chain store (subscript g). The utility of a consumer $i \in [1,...,N]$ for one unit of food is $u_i = \delta_j \theta_i - p_j$, where $j = \{r,c,g\}$, θ_i is a taste parameter, δ_j differentiates food products by their attributes and p_j is the price. We assume that the taste parameter θ_i is uniformly distributed between zero and one. A consumer with a large θ_i has more ethnocentric preference than a consumer with a small θ_i. The parameter δ_j accounts for the quality of food products with $\delta_r \geq \delta_c \geq \delta_g$. For simplicity, and without loss of generalization, we set $\delta_r = 1$. We denote by υ the reservation utility when a consumer abstains from by the food product. To avoid notation clutter, we set $\upsilon = 0$, again without loss of generality.

[3] We do not use the term generic in the branding sense or marketing sense, where it denotes a product absent any manufacturer branding.

Farms

The supply of local food is constrained by growing conditions around the purchase center and by the definition of local production. By restricting production to a radius around the purchasing area, or limiting production within the state of purchase, the definition of local effectively limits the supply for the local product. We implement the limit on local production in our model by considering a fixed number M of local identical farms. If, for example, the definition of local expands by considering farms within a greater radius, then M increases.

Our model explicitly considers the cost to farms of producing safe food and the decision by the retail chain to impose food safety standard to farms. We simplify by assuming that the production of the generic product is exogenous to the model. We will thus focus in this section on local production and its safety.

A local farm $k \in [1,...,M]$ produces one unit of food that is safe with probability $s_k \in (0,1)$. Producing safe food is of course costly (e.g. Antle, 2000). We assume that the cost of producing safe food is convex and that it is impossible for a farm to ensure that its one unit of food is perfectly safe. The cost of a farm is

$$c\frac{s_k}{1-s_k},$$

where c is a cost parameter common to all farms. The functional form for the cost function assures that perfectly safe food can be produced only at an infinite cost. The profit of a farm is

$$\pi_k = w_k - c\frac{s_k}{1-s_k}, \tag{1}$$

where w_k is the price paid to a farm k.

We assume that the food that a local farm sells to small retailers is safe with probability s_r. The safety of food sold to small retailers is determined by forces outside of this model and therefore exogenous. Small retailers pay a price w_r to the farms. The chain store offers farms a contract that pays w_c per unit of food and requires farms to produce food that is safe with probability s_c. The contract must be incentive compatible such that it yields a profit to farms at least as large as selling to a small retailer. We will find below solutions for the contract offered to local farms.

Retailers

The model assumes that small stores sell only local food. We denote by b the unit cost of a small store. As small stores are competitive and earn zero profit, it means that at equilibrium that $p_r = w_r + b$. We assume that the unit cost b includes all costs related to the retail of local food, including potential costs from the sale of unsafe food.

The chain store sells generic food and may sell local food. We assume that the only costs of the chain store are the prices of food, w_c for local food and w_g for generic food, and the costs associated to the sale of unsafe food. From selling a quantity q_g of generic food and a quantity q_c of local food, the chain store incurs costs

$$w_g q_g + w_c q_c + \left(1 - s_g\right) A_g q_g + \left(1 - s_c\right) A_c q_c ,$$

where s_g is the safety of generic food, A_g is the cost per unit of unsafe food to the chain store and A_c is the cost per unit of unsafe local food to the chain store. We assume that the safety of generic food and the costs per unit of unsafe food are exogenous to our model.

Selling food is not the only activity of the chain store. To implicitly account for this in our model, let us assume that the store has a limited shelf space for food products such that the total quantity it sells is no larger than Q. We can think of the limit on shelf space as a profit maximizing decision by the chain store in the long run.

Model solutions

The quantity of local food that maximizes the profit of the chain store may equal zero. Because food products are vertically differentiated by origin, we must consider separately solutions for the case where the quantity of local food for the chain store equals zero and the case where that quantity is greater than zero. The next subsection describes solutions where the chain store chooses not to sell local food. We then describe solutions for the case where the chain store sells local food and finally we look at comparative statics on variables that affect the decision of the chain store to offer local food.

Chain store does not sell local food

Let us begin by deriving expressions for demand when there is no local product at the chain store. First, as there are two types of food products, we must find the consumer that is just indifferent between consuming local food from a small stores and generic food by equating his utility for the two products: $\theta_i - p_r = \delta_g \theta_i - p_g$. The consumer that is just indifferent between local food at a small store and generic food has a taste parameter $\theta^{rg} = \lambda\left(p_r - p_g\right)$, where $\lambda = 1/\left(1-\delta_g\right)$. As θ_i is uniformly distributed between zero and one and there are N consumers, the demand for the local food at small store is

(2) $$q_r^d\left(p_r, p_g\right) = N\left(1 - \lambda p_r + \lambda p_g\right).$$

We find the demand for the generic food product by equating the utility of a consumer that is indifferent between the generic food product and not consuming the food product: $\delta_g \theta_i - p_g = 0$. The taste parameter of that consumer is $\theta^g = \beta p_g$, where $\beta = 1/\delta_g$. The demand for the generic product is the consumption by all consumers between θ^{rg} and θ^g such that

(3) $$q_g^d\left(p_r, p_g\right) = N\left(\lambda p_r - \left(\lambda + \beta\right)p_g\right).$$

Recall that that the production of local food is fixed and equals the number of farms M as each farm sells one unit of food. Recall also that the price of generic food is determined exogenously. Thus, we can find the price of local food by equating the demand for local food in (2) to the supply of food, which equals M, such that we find

(4) $$p_r^* = \frac{1}{\lambda}\left(1 - \frac{M}{N}\right) + p_g.$$

Let us assume that $N > M$ such that the solution in (4) is consistent with some consumers buying the generic food product at the chain store.

Substituting for the solution for p_r in (3), we find the solution for the sales of generic products by the chain store

(5) $$q_g^* = N\left(1 - \frac{M}{N} - \beta p_g\right).$$

Thus, we can write the solution for the profit of the chain store from selling generic food only as

(6) $$\pi_c^* = \left(p_g - w_g - \left(1 - s_g\right)A_g\right)q_g^*,$$

assuming that $q_g^* \le Q$, where Q is the maximum quantity of the food product that the chain store can sell, given constraint of the available shelf space.

Chain store sells local food

The expressions for the demand functions are different when the chain store offers local food. Recall that consumers prefer local food at small store over local food at chain store, which they prefer to generic food. Thus, first, we must find the consumer that is indifferent between local food in the two types of retail stores: $\theta_i - p_r = \delta_c \theta_i - p_c$. The taste parameter of that consumer is $\theta^{rc} = \gamma p_r - \gamma p_c$, where $\gamma = 1/(1-\delta_c)$, and the demand for local food at a small retail is

(7) $$q_r^d\left(p_r, p_c\right) = N\left(1 - \gamma p_r + \gamma p_c\right).$$

The utility of a consumer that is indifferent between local food at the chain store and generic food is such that $\delta_c \theta_i - p_c = \delta_g \theta_i - p_g$. The taste parameter of the indifferent consumer is $\theta^{cg} = \alpha p_c - \alpha p_g$, where $\alpha = 1/\left(\delta_c - \delta_g\right)$, and the demand for local food at the chain store is given by all the consumer between θ^{rc} and θ^{cg}

(8) $$q_c^d\left(p_r, p_c, p_g\right) = N\left(\gamma p_r - (\alpha + \gamma) p_c + \alpha p_g\right).$$

Finally, there is a consumer that is indifferent between buying the generic food product or not buying food such that $\delta_g \theta_i - p_g = 0$. The taste parameter of the consumer indifferent between that generic food product and not buying the food product is $\theta^g = \beta p_g$, where $\beta = 1/\delta_g$. The demand for the generic product is given by the consumers between θ^{cg} and θ^g such that

(9) $$q_g^d\left(p_c, p_g\right) = N\left(\alpha p_c - (\alpha + \beta) p_g\right).$$

We solve for the profit of the chain store in two steps. First, we find the contract that the chain store offers to local farms. This will determine the per-unit cost of selling local food. Second, we maximize profit by finding the price of local food that maximizes the profit of the chain store. For small retailers, the maximization of profit follows from the market clearing condition as we assume competitive retailers with a constant marginal cost.

The chain store buys generic food on the national market and we assume that it does not have sufficient market power to impose a contract to farms that supply the generic product. Thus, the marginal cost of selling one unit of generic food, which includes the price of the food product and the expected cost of food safety, is constant per unit. In contrast, the chain store is sufficiently large to impose its own standard to local farms and offer farms an incentive compatible price. In choosing a food safety standard, the chain store considers the production cost of farms and its own food safety cost. Thus, the chain store selects a food safety standard that minimizes the total per unit food safety cost as given by

(10) $$\left(1-s_c\right)A+c\frac{s_c}{1-s_c}.$$

Minimizing food safety cost, the first order condition is

(11) $$-A_c+c\frac{1}{1-s_c}+c\frac{s_c}{\left(1-s_c\right)^2}=0.$$

Solving for the solution between zero and one, we find the food safety standard that the chain store imposes to farms

(12) $$s_c^{**}=1-\sqrt{\frac{c}{A_c}}.$$

Observe that the solution for the safety of food for the chain store does not relate to the level of food safety for the small retailers. What matters to the chain stores is only its own incentive to deliver food that is safe as consumers do not observe food safety. Therefore, the local food sold by the chain store can be either safer or less safe than that sold by small retailers. Our model does not allow us to determine the rank of the safety of food.

A farm sells to the retailer that offers the highest return. Thus, when imposing a minimum food safety standard s_c, the chain store must offer farms a contract that pays w_c per unit of food that is incentive compatible given the return to farms from selling to small retailers. The contract is incentive compatible if

(13) $$w_c - c\frac{s_s}{1-s_s} \geq w_r - c\frac{s_r}{1-s_r}.$$

Unless the chain store captures the whole market for local food, expression (13) holds with equality. Inserting (12) in (13), we find the solution for the price paid to farms by the retail store is

(14) $$w_c = w_r + c\left(\frac{s_c^{**}}{1-s_c^{**}} - \frac{s_r}{1-s_r}\right).$$

From (12) and (14), we find the expression for the unit cost of the retailer for local food is

(15) $$w_c + \left(1-s_c^{**}\right)A_c = w_r + 2\sqrt{c}\sqrt{A_c} - c\frac{1}{1-s_r}$$

The second step is the maximization of profit by the chain store. The expression for the profit of the chain store when it sells both local and generic food is

(16) $$\pi_c = \left(p_g - w_g - I_g\right)\left(Q - q_c^d\left(p_r, p_c, p_g\right)\right) + \left(p_c - w_c - I_c\right)q_c^d\left(p_r, p_c, p_g\right),$$

where we simplify the expression by writing $I_g = \left(1-s_g\right)A_g$ and $I_c = \left(1-s_c^{**}\right)A_c$. The expression for the profit accounts for the shelf space constraint that we assume to be binding when the chain store sells both local and generic food. The chain store maximizes profit by setting a price for the local food that it sells. The first order condition for profit maximization is

(17) $$\frac{\partial \pi_c}{\partial p_c} = N\left(\gamma p_r - (\alpha+\gamma)p_c + \alpha p_g\right) - N\left(p_c - p_g + w_g - w_c + I_g - I_c\right)(\alpha+\gamma).$$

When it holds with equality, equation (17) defines the price of local food at the chain store as a function of the price of food a local stores.

Recall that the purchase price of generic food is exogenous to the chain store. Thus, along with the price of local food at the chain store, the only other variable that we must solve for is the price of local food at small retailers. To find that price, we must look at the market clearing condition for the supply and sales for local food as given by

(18) $$q_r^d\left(p_r, p_c\right)+q_c^d\left(p_r, p_c, p_g\right)=M .$$

Substituting in (18) using (7) and (8) we can write that $N\left(1-\alpha p_c+\alpha p_g\right)=M$, an expression that does not depend on p_r . We can however solve expression (18) and find that the equilibrium price of local food at the chain store is

(19) $$p_c^{**}=p_g+\frac{N-M}{N\alpha} .$$

Observe that the price of local food at the chain stores is not a function of the cost of producing local food. That is because of the ranking of preferences and the constant per unit cost for farms and the retail chain. As food is differentiated by origin, it is the relative price of local food at the chain store and the price of generic food that determines the total consumption of local food. On the supply side, the marginal cost is constant but the total supply of local food is constrained by number of local farms. Thus, this means that the supply of local food is perfectly inelastic at equilibrium and therefore the marginal cost does not matter in the price of local food at the chain store.

Small stores are competitive and have a marginal cost b such that we can write $w_r=p_r-b$. Solving (17) for p_r to find the equilibrium price of local food at small store, substitute expression (14) into expression (17). After these substitutions, and letting (17) hold with equality and solving for p_r using (19), we find

$$p_r^{**} = \frac{p_g\gamma}{\alpha+2\gamma} + \frac{2(\alpha+\gamma)(N-M) + N\alpha\left((\alpha+\gamma)\left(b+c_r-c_c+I_g-I_c+w_g\right)\right)}{N\alpha(\alpha+2\gamma)}. \tag{20}$$

where $c_c = c\,s_c^{**}/\left(1-s_c^{**}\right)$ and $c_r = c\,s_r/(1-s_r)$. Unlike the solution for the price of local food at the chain store, the cost of producing safe local food enters the solution for the price of local food at small stores. The supply of local food to small stores is constrained by the supply to the chain store and therefore is not directly limited by local supply constraint. In consequence, the supply of local food to small stores is perfectly elastic and a function of the food safety standard set by the chain store. As the demand for local food at chain stores slopes down, the equilibrium price for local food at small store is determined by the intersection between the demand and the marginal cost of local food at small stores.

The solutions for the prices paid to local farms follow from prices at retail. The price paid to farms that sell to small stores is

$$w_r^{**} = p_r^{**} - b, \tag{21}$$

and the price paid to farms that sell to the chain store is

$$w_c^{**} = w_r^{**} + c_c - c_r. \tag{22}$$

The solution for the quantity of local food at the local store is

$$q_r^{**} = \frac{M\gamma + N(\alpha+\gamma)\left(1+\gamma\left(c_c-c_r+I_c-I_g+p_g-w_g-b\right)\right)}{\alpha+2\gamma}. \tag{23}$$

Observe in (23) that the shelf space at the chain does not appear on the right-hand-side. Thus, in this model, the chain store cannot affect the quantity of local food at local stores by expanding its total offering of the food product. Shelf space does not appear in (23) because it is the marginal cost of local food that determines the quantity offered by the chain store and that generic food fills up the remaining shelf space.

The quantity of local food at the chain store is

(24) $$q_c^{**} = \frac{\alpha+\gamma}{\alpha+2\gamma}\left(M - N\left(1+\gamma\left(c_c - c_r + I_c - I_g + p_g - w_g - b\right)\right)\right).$$

The quantity of generic food is not determined by the demand curve for generic food in (9) but rather by the available shelf space at the chain store. Recall that in writing the profit of the chain store in (16) that we assumed that the quantity was binding. Consistently, the quantity of generic food at equilibrium is

(25) $$q_g^{**} = Q - q_c^{**}.$$

Finally, we can write the profit of the retail store as

(26) $$\pi_c^{**} = \left(p_g - w_g - I_g\right)\left(Q - q_c^{**}\right) + \left(p_c^{**} - w_c^{**} - I_c\right)q_c^{**}.$$

Profit maximization by chain store

The chain store offers local food if it maximizes its profit. To evaluate the decision by the chain store, let us write the difference in profit as

(27) $$d\pi = \pi_c^{**} - \pi_c^{*}.$$

We will not expand the expression in (27) to save space and sustain readability. The chain offers local food if the difference in profit in (27) is positive. Our objective is not to derive conditions for the chain stores to offer local food but rather find how parameters of the model affect the chain store's decision.

We first look at how the cost of a food safety incident from local food, the parameter A_c, affects the decision of the chain store to sell local food. Recall that A_c affects the food safety standard required by the chain store and also enters the cost of the chain store and appears only in the expression for π_c^{**}. The effect of A_c on the difference in profit, simplifying using expression (15), is

$$\frac{\partial d\pi}{\partial A_c}=\frac{\partial \pi_c^{**}}{\partial A_c}=\frac{2\sqrt{c}\gamma\left(\alpha+\gamma\right)\left(N\left(1+\gamma\left(w_c+\left(1-s_c\right)A_c-p_r+p_g-w_g-I_g\right)\right)-M\right)}{\sqrt{A_c}\left(\alpha+2\gamma\right)^2}. \tag{28}$$

The sign of (28) is algebraically undetermined as two forces are at play. First, an increase in the food safety cost per unit of local food causes the chain to require more stringent food safety standard from local farm as $\partial s_c^{**}/\partial A_c=\sqrt{c}/2A_c^{0.75}>0$ and higher compensation to local farms. Thus, an increase in the food safety cost per incident from local food has a negative effect on the entry of the chain store as it increases its cost per unit of local food. Second, the corresponding decrease in the supply of local food by the chain store causes the price of local food at the chain store to increase. It is this effect on demand that leads us to be unable to algebraically sign the effect of A_c on the difference in profit.

Although the effect of A_c on the decision to enter appears algebraically undetermined, the effect of A_c on the decision to enter is always negative. The chain store maximizes profit by setting the price of local food that maximizes its profit. In doing so, the chain store, acting as a monopolist, splits markets such that it maximizes total profit in selling local and generic food. An increase in A_c causes an increase in the cost of food and indirectly an increase in the price of local food at the chain store. In the context of the chain store acting as a monopolist in the sale of local food at a chain store and sale of generic food, an increase in cost cannot increase profit as the monopolist decides of the quantity of local and generic food. This is unlike for example Chalfant and Sexton (2002) who show that grading errors can increase profit of competitive farms participating in a marketing order. A monopolist however always does better with lower cost as it has control over quantities of the qualities it offers. Thus, the higher the cost of food safety incidents, the less likely it becomes for a chain store to enter into the market for local food such that (28) is negative.

A low food safety cost for an incident involving local food favors the entry of the chain store into the local market. However, that low food safety cost also implies that the chain store requires less stringent food safety standard from the local farm. This suggests that a chain store will offer local food products that present a small financial risk but at the same time these products are those that represent the most risk to consumers as the chain store will not require stringent standards to local farms. By extension, it also means that the chain store is more likely to offer local food that is not as safe as local food in small stores.

Let us now explore the decision of the chain store to enter the local food market based on the definition of local food. In our model, we can interpret an increase in the number of farms as an increase in the radius that defines local production. Another interpretation of a change in the number of local farms is in considering two markets, with the same definition of what constitutes local farms, but with different growing conditions such that the density of farms is different. For example, we can interpret the results of the comparative statics in the context of a chain store in Iowa and a chain store in California.

Taking the partial derivative of (27) with respect to M yields

(29) $$\frac{\partial d\pi}{\partial M}=\frac{2(\alpha+\gamma)\Big(M-N\Big(1+\gamma\Big(w_c+\big(1-s_c^{**}\big)A_c-p_r+p_g-w_g-I_g\Big)\Big)\Big)}{N(\alpha+2\gamma)^2}>0\ .$$

The sign of (29) is the opposite of the sign of (28) and is therefore positive. Expression (29) says that an expansion of the definition of what constitute local food makes the chain store more likely to enter the local food market. Expression (29) also says that a chain store located in a region with many farms in the vicinity is more likely to offer local food. Note from (23) that quantities at the local retail stores increase in function of the number of local farms. Thus, even though expanding the definition of local increases offering by the chain store, it also favors sales at small stores, thus bringing more diversity in the local food market.

Recall from (12) that only the cost of producing safe food and the liability cost to the chain store affect the safety of food. Thus, in this model with identical farms, a broader definition of local production does not affect the safety of food sold by the chain store.

In this static model, the chain store cannot take strategic action to prevent entry by the small stores. In a dynamic model with a sunk entry cost for small stores, the chain store could deter entry by expanding its shelf space (building capacity) and setting a price that prevents entry by small stores. In doing so, the chain store may sacrifice profit now to capture a larger share of the market later. In our model, the chain store may still prevent entry by the small store but it is not because of strategic considerations. Rather, it is because market conditions are favorable enough for the chain store to capture the whole market for local food. The sourcing cost for local food for the chain store depends directly on its cost from unsafe local food. Thus, let us find the value for food safety cost such that the quantity at small store in (23) is smaller or equal to zero

(30) $$A_c \leq \frac{\left(M\gamma + N\left(\alpha+\gamma\right)\left(1+\gamma\left(-c-p_r+p_g-w_g-I_g\right)\right)\right)^2}{4cN^2\gamma^2\left(\alpha+\gamma\right)^2}.$$

Expression (30) says that there is a positive food safety cost for which the chain is willing to undercut the small store to capture the whole market for local. This is because of the background safety of food sold by local stores. The value of A_c may be low when it is difficult to trace the origin of contaminated food. Thus, in a region that does not invest in detecting foodborne illnesses, chain stores are more likely to displace small stores in the market for local food.[4] In the United States, as the capacity to detect foodborne illnesses detection varies by states, it is therefore possible that chain store capture a larger share of the local market because it is profit maximizing for them to require slack standards to local food suppliers.

Conclusion

Our model explores the supply of local, organic, and safe foods by large retail chains, such as Wal-Mart. Specifically, we model the tradeoff between offering local food products and maintaining low prices by a retail chain with market power on the demand side. We show the profit-maximizing sourcing option – local versus outside – and the profit-maximizing food safety for the retail chain under different conditions. Our model yields several interesting results. First, in contrast with small food stores, the price of local food at the retail chain is not a function of the cost of producing local food. Second, the level of food safety offered by the chain store is independent of the level of food safety offered by the small retailer. Third, an increase in the per unit cost of providing unsafe local food has a negative effect on the entry of chain stores into the local food market, while a more inclusive definition of what constitutes local food has a positive effect on the probability of entry by a chain store. Lastly, we find that in regions where there is no investment in the detection of foodborne illnesses, chain stores are more likely to displace small stores in the market for local food.

Our results have several policy implications. In particular, the definition of local determines the likelihood of entry by the chain store, and possibly the size of market captured by

[4] This statement implicitly assumes that detection efforts in discovering and tracing of unsafe from small stores and chain stores are independent. In practice, authorities do not differentiate between sources of food in allocating their effort to detect and trace unsafe food.

the chain store. That is, for example, if the definition of local changes from "within the State where sales occur" to "within the State and the neighboring States where sales occur" then the possibility of a chain store providing local foods increases. However, the definition of local does not have direct implications on the safety of food offered by the chain store, under our assumption of identical farms. The second important policy implication is based on the relationship between foodborne illness detection capabilities and the displacement of small stores in the local food market. In states where the budgets for food safety-related issues are small, our model predicts larger shares of the local food market by chain stores, which could lead to lower overall safety levels of local foods as the incentives to provide safer foods are smaller.

Our model's simplicity allows us generate analytically tractable solutions, but it also leads to several weaknesses. One of our main weaknesses is the assumption that the food safety level of local foods provided by farmers, s_k, is exogenous instead of endogenously determined. It is reasonable to believe that farmers would choose the profit-maximizing level of food safety to provide but treating this variable as endogenous instead of exogenous leads to an analytically intractable model. Another solution around this would be to treat s_k as exogenous but to allow heterogeneity among farms. Another limitation of our model is its static nature. The inclusion of dynamics would allow chain stores to act strategically in order to deter entry by small stores.

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