

Follow the Leader: Adoption Behavior in Food Retailers' Decision to Offer Fresh Irradiated Ground Beef

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Abstract: During the 14-month period from May 2002 to June 2003, approximately 10 percent of U.S. supermarkets began to offer fresh irradiated ground beef under the stores' own labels. Using a survey of supermarket store managers from this time period, this paper investigates the factors that influenced new product offerings and adoptions. Results from the adoption model show that factors associated with competition and structure in the food retailing industry play a strong role in the decision. Among other results, we find that variables relating to a competitor's adoption status and proximity significantly affect a store's decision to offer fresh irradiated ground beef.

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In February 2000, USDA and FDA authorizations became effective that permitted the use of ionizing radiation to reduce pathogens and extend the shelf-life of fresh and frozen red meat products. Because radiation was considered an effective treatment against *E. coli* (O157:H7) and other pathogens found in raw meat, this new authorization carried important implications not just for the meat processing or food retailing industries, but also for public health. Earlier, using a cost-of-illness approach, Buzby *et al.* estimated the cost of premature deaths from *E. coli* in the U.S. to be between \$160 million and \$700 million annually. With its high sales and its history with meat recalls and pathogen contamination, fresh ground beef was anticipated to be among the first irradiated red meat product introduced. In the two years that followed authorization, however, introduction of irradiated ground beef by meat processors and food retailers, however, could be characterized as cautious or sporadic. For example, early introductions often featured frozen, branded products, and were marked by regional emphases, in states such as Wisconsin and Minnesota, or by test market offerings by supermarket chains.

The industry changed in May 2002 when Wegmans Food Markets, a regional supermarket based in Rochester, NY, announced that it would become the first supermarket chain to launch a company-wide introduction of fresh irradiated ground beef packaged under its own name. Over the next few months, the 62-store Wegmans prominently featured irradiated ground beef in its ads and promotions, focusing on the food safety aspects of the new product. In September 2002, a second supermarket, Virginia-based Lowes Foods, followed Wegmans lead and announced it would offer a similar fresh irradiated ground beef product in 48 of its 110 stores. Over the ten months from September 2002 to June 2003, 31 more supermarket chains with over 3,800 stores collectively made similar announcements. By June 2003, a bit more than

10 percent of all U.S. supermarket stores were offering fresh irradiated ground beef under their own label.

In Figure 1, which illustrates this burst in irradiated ground beef adoption, one can see the beginnings of a widely observed S-curve of cumulative new product introductions or technology adoptions. Mahajan, Muller, and Bass describe how the cumulative adoption curve can stem from models of individual adoption decisions: a potential adopter's utility is based on perceptions of the innovation or product's benefits. Perceptions change, however, as the potential adopter learns more about the innovation. When the perceived net economic benefits exceed the status quo, one adopts. The S-curve results, therefore, from aggregation across various potential adopters.

The burst of adoption announcements depicted in Figure 1 does not, however, capture the whole story. When spatial as well as chronological information is considered, the adoption activity may suggest that other competitive forces are at work. Figure 2 depicts the spatial nature of the adoptions from May 2002 through June 2003. In this figure, circles are approximately positioned over the corporate headquarters of food retailers that announced the adoption of irradiated ground beef. Moreover, size of the circles corresponds to the relative number of supermarket stores to which the adoption announcement applies. Thus the circle centered on Landover, MD, which represents Giant Food, Inc.'s introduction of fresh irradiated ground beef to 188 stores has roughly three times the area of the circle centered on Rochester, NY, which represents Wegmans' introduction at 62 stores. While the circles in Figure 2 only approximate the scope of each store's market, one can see that many circles either overlap or nearly overlap. When this spatial information is coupled with chronological information, we observe that the adoption of fresh irradiated ground beef is not randomly distributed over the U.S., but rather is related to market demographics and geographic rivalries. In other words, while we may witness

the beginnings of a standard S-curve adoption pattern along a temporal dimension, we see a richer story when we consider both temporal and spatial factors.

Past research suggests that a more complete story of new product adoption may draw upon factors from three broad categories: product-related attributes, structural supply-channel attributes, and characteristics of industry competition. The first two categories are the focus of Rao and McLaughlin; McGlaughlin and Rao; McGlaughlin and Fredericks; Desai; and Park. This research emphasizes the merchandizing procedures and needs of “gate keeper” buyers in addition to how product attributes affect profitability perceptions. For example, from a survey of supermarket managers, Park finds that the three attributes that receive the most consideration are the new product’s potential to increase overall store sales, the potential to increase overall store profit, and the potential to increase product movement. Park also finds that the top preferences for supplier’s promotional campaigns were in-store demonstrations and sampling, slotting allowances, television or radio advertising, and some form of coupon programs.

A related line of research focuses on broadly defined competition among food retailers and the role that new product introductions plays as part of broader non-price competitive strategies.¹ Forms of non-price competition among retailers extend to include shelf-space allocations (Chen et al.); quality-of-service versus low-price philosophies (Popkowski Leszczyc, Sinha, and Timmermans); retail format choices (Bhatnagar and Ratchford); product variety decisions (Swann; Ratchford; Krishnan, Koelemeijer, and Rao); and geographic or spatial forces (Allaway, Berkowitz, and D’Souza; Sinha; Walden; Benson and Faminow). Allaway, Berkowitz, and D’Souza’s analysis of spatial diffusion of new loyalty card programs contains a number of similarities to the diffusion of irradiated ground beef. A number of factors that Allaway, Berkowitz, and D’Souza find particularly important, including the effects of spatial

¹ Alternatively, Connor provides a summary of research on price competition in grocery retailing.

distance and the role of previous adopters, may be equally important in explaining the cumulative adoption of irradiated ground beef.

In this paper, we analyze supermarket adoption of irradiated ground beef depicted graphically in Figures 1 and 2 by investigating the factors that lead to the adoption of fresh irradiated ground beef by food retailers. To accomplish this objective, we arranged for the University of Minnesota's Food Industry Center to add questions about irradiated ground beef to its 2003 panel survey of supermarkets. The Food Industry Center has surveyed store managers of supermarket for seven years, from 1998 to 2004, and in that time it has developed a continuing panel of survey participants. As the 2003 survey was being designed and implemented, we also interviewed upper level managers – e.g., corporate directors of meat products – at a small handful of supermarket firms to help us decide what issues might be important in the adoption decision. In this paper, we first discuss these potential factors and then apply a logit model to the 2003 Supermarket data to formally analyze the adoption question. Results from the adoption model show that factors associated with the competition and structure in the food retailing industry play a very strong role in the adoption. Among other results, we find that variables related to a competitor's adoption status and proximity significantly affect a store's decision to offer irradiated ground beef.

Before we provide the necessary background information and develop the model, we must acknowledge one other very important industry development. In January 2004, the irradiation technology provider SureBeam, Inc., declared bankruptcy for, among other reasons, accounting irregularities associated with the sale/purchase of irradiation facilities. SureBeam began to dismantle itself almost immediately, jumping straight to Chapter 7 liquidation rather than Chapter 11 reorganization. As a result, the industry lost its main technology provider. Currently, neither Wegmans nor any other supermarket is offering a fresh irradiated ground beef

product under the store's own label.² Adoption, therefore, was curtailed at approximately 10 percent of supermarket stores, well before one could know for sure whether or not adoption of fresh irradiated ground beef would follow the typical S curve. Despite this development, the adoption story has important implications for other products that carry some public health attributes, especially those where the attribute in question is part of an ongoing controversy.

Preliminary Thinking on Adoption of Irradiated Ground Beef

At the time federal approval was given to fresh or frozen irradiated meat products, the conventional wisdom about industry adoption of the new technology focused on how familiar supermarket managers were about the product's expected profitability, consumer opinions, and managers' own opinions about the new product (Jensen and Jaenicke). For example, two politically and socially controversial issues were those dealing with the unique attributes associated with the irradiation technology and whether consumers would accept the product. First were potential environmental concerns. The words radiation, and irradiated, might bring up images of nuclear reactors (Demetrakakes). In reality, there are three separate technologies used to irradiate food. Two use high voltage electricity to create electron beams, either in the form of beta rays or X-rays. Only the third technology uses radioactive isotopes, e.g., Cobalt-60, as a source of gamma rays. Wegmans' irradiated ground beef product used patented electron beam technology developed by SureBeam, Inc. After Wegmans' product launch, nearly every other supermarket that likewise adopted fresh irradiated ground beef used SureBeam's "e-beam" technology. This technology choice may have diffused many of the environmental concerns.

² A Wegman's press release dated Oct. 1, 2004, announced that Wegmans would offer frozen irradiated beef patties marketed by Huisken.

A second related issue thought to affect adoption was whether or not the product would be perceived as “unnatural” by consumers. This issue, therefore, also dealt with irradiation technology, but now as a product attribute rather than a production technology. Many consumer acceptance studies of irradiated food were conducted before and during the time when approval was granted (Bailey; Fox et al., Hashim, Resurreccion, and McWatters; Henson 1995; Resurreccion et al.; Sapp, Harrod, and Zhou). Frenzen et al. found that 49.5 percent of consumers would accept irradiated ground beef or poultry products and 31.8 percent would not, with the remainder not sure. A deeper look at the Frenzen et al.’s results, however, found that of those consumers that found the irradiated product acceptable, only 22.7 percent would purchase if the product were more costly than regular ground beef. More recently, using consumer intercept interviews, Nayga, Poghosyan, and Nichols found that 58 percent of interviewed consumers would be willing to buy irradiated ground beef. In many of these studies, consumer information is thought to play a strong role in consumer acceptance: For example, Nayga, Aiew, and Nichols find that the percentage of consumers self-identifying as “strong buyers” increased after information was provided, while the percentage self-identifying as “doubters” decreased.

The Frenzen et al. findings also provide insight regarding the product’s underlying economics, which is the third important issue thought to affect adoption. Not counting the public health benefits from potentially removing pathogens from ground beef, in-store economic decisions centered on the potential extra cost of the product balanced against in-store benefits associated with the product’s longer shelf life. Cost estimates of the technology ranged from \$0.05 to \$0.06 per pound (Bogart and Tolstum; Engeljohn; Kaye and Turman). The benefits from longer shelf life are less well known. The wild card, of course, is related to consumer demand: irradiated ground beef’s demand is not well understood, nor is it known how it would affect demand for regular ground beef.

Wegmans' introduction provided a number of insights into these issues. First, the environmental issue was diffused by the specific e-beam technology choice. (Wegmans' reported only a handful of protesters at its highly publicized launch.) Second, Wegmans' dealt with the "unnatural" issue by emphasizing choice in its promotional materials. For example, Wegmans' ads stressed that shoppers now had a choice of buying regular or irradiated ground beef. And third, while the in-store economic issues were not well publicized, Wegmans' did publicize both the price and relative sales of its irradiated ground beef, which sold for about \$0.10 to \$0.30 above regular ground beef. However, the irradiated product was often on sale for the same price as the regular product (Groom). Wegmans has indicated that, across all its stores, irradiated ground beef sales represented as much as 15 percent of total fresh ground beef sales (Hartnett).

Adoption as Part of Competitive Strategy

Two industry observations suggest that "post-Wegmans" adoption decisions for irradiated ground beef may center less on the potentially controversial aspects of product attributes and more on the broader aspects of industry competition. First, Wegmans' product introduction strategy, which was highly publicized, appears to have successfully addressed and diffused the three issues discussed above – environmental concerns, consumer acceptance, and in-store economics. Second, supermarket adoptions picked up speed as more companies launched the product. These observations coupled with a number of personal interviews with corporate-level meat managers point to several factors that might affect adoption decisions. More specifically, we have identified three broad factors that may influence stores' adoption of irradiated ground beef: (i) intensity of direct competition; (ii) store size and corporate structure; and (iii) store philosophy.

Intensity of direct competition: Despite trends in consolidation among food retailers and their increasing power with respect to suppliers, competition between retailers is generally considered intense. Food retailers compete in many different dimensions, including pricing policies (e.g., Everyday Low Prices), variety of offerings, and service offerings. Other studies of competition among food retailers or new product introductions emphasize geographic proximity as part of a broader model of firm behavior (e.g., Sinha; and Walden). Stores facing intense competition may be more concerned with mimicking their competition. In this way, stores compete for the median shopper. Regarding irradiated ground beef, stores may feel less pressure to adopt if their direct competitor is not offering it.

Merchandising philosophy: Some stores are known to be variety or service leaders – i.e., stores attempt to attract shoppers by offering the newest and largest variety of products, technologies, or services. An irradiated ground beef product could complement these philosophies in a number of ways: it adds to product variety, it represents the latest technology, and it arguably provides a higher degree of food safety, which could be loosely considered to be one of the store’s service functions. Therefore, it may be the case that stores that identify with variety or service philosophies may be more likely to adopt and offer irradiated ground beef.

Store size and structure: Interviews with corporate meat managers suggested that store size, and the connected issue of corporate structure, may have a mixed impact on the adoption decision. In essence, the question focuses on how easy it would be to add a new product to store shelves. Store size, in terms of available selling space, seems likely to have a generally positive impact on the adoption of any new product. However, companies with extremely large selling areas may also have a different selling format – i.e., extremely large stores may place a higher emphasis on general merchandize. For these “mega” stores, large size may not be an indicator of

how easily a new product is added to shelves. One might expect, therefore, that store size may positively impact the adoption of irradiated ground beef up to some size threshold.

Corporate structure, as measured by the number of stores in a chain, is another factor that affects how easily it is to add a new product. Kinsey et al. report that 58 percent of surveyed stores rely on an independent wholesaler or distributor for product supply. They further report that more than 90 percent of supermarkets with 50 or fewer stores rely on outside wholesalers. These independent or small supermarket chains that rely on outside distributors, therefore, may find that accessibility to an irradiated ground beef product is not completely under the store's control.

Data

The data used in this analysis are from the Food Industry Center's 2003 Supermarket Panel. Kinsey et al. detail the survey instrument and 2003 Panel results. This survey, conducted annually since 1998, is based on a random sample of U.S. supermarkets. More specifically, the sample is drawn from the 32,695 establishments classified as supermarkets by the USDA that accept food stamps. Approximately 2,000 supermarkets were invited to take part in the 2003 Panel survey and 391 supermarkets responded. The overall response rate was 19.6 percent, with 47 percent (182) of these responses collected via the Internet. About 69 percent of respondents had participated in at least one prior Panel survey. Kinsey et al. (p. 4-5) report that median store characteristics are similar to those reported by the Food Marketing Institute and Progressive Grocer in similar studies, and that 2003 Panel represents a cross-section of the U.S. supermarket industry "rather well."

The 2003 Panel saw several changes and additions from previous years. The most significant change in sampling was that the survey was offered over the Internet for the first time. A second change to the 2003 Panel was the construction of composite variables based on a

collection of responses to individual questions. For example, the Food Industry Center created variety and service offering indexes based on answers to a number of specific questions.

Finally, the one change that actually makes the current analysis possible was the addition of questions dealing with the offering of fresh irradiated ground beef. The Food Industry Center asked store managers about the adoption status of fresh irradiated ground beef and 361 responded with valid answers. A total of 25 said their store have offered fresh irradiated ground beef for more than six months; 29 said they offered within the last six months; 15 said they would start offering the product within the next three months; 46 said adoption plans were under discussion; 143 said they had no plans to adopt; and the remainder (103) said they did not know. These data, excluding the “don’t know” responses, are presented in Figure 4. Also found in Figure 4 are the store managers’ responses to similar questions about the store’s self-identified top three competitors.

The Logit Model and Results

The Food Industry Center’s survey instrument contained 46 multipart questions, which are described in detail by Kinsey et al. Based on previous research and interviews with corporate-level meat managers, our analysis focuses on six variables that either come directly or indirectly from one of the instrument’s questions. These variables reflect the adoption status of fresh irradiated ground beef and store characteristics that may affect the adoption decision in the context of industry competition. More specifically, we expect a store’s adoption status to be affected by (i) that adoption status of its primary competitor, (ii) the intensity of competition as reflected by the distance from its primary competitor, (iii) the degree to which the store is a service leader, (iv) store size, (v) a corporate structure stratum variable that reflects the number of stores in the operating company, and (vi) regional dummies for three of four broad regions in the U.S., i.e., East, Midwest, and South.

Some of these variables are directly available from the 2003 Panel response data, some require minor manipulation, and still others require a proxy variable based on other information drawn from the Panel. For example, as seen in Figure 4, the Panel response data have very detailed information on adoption status. However, because we are interested only in a yes/no adoption status, we convert this response into a binary variable by assigning a 1 to all responses where a store is already offering fresh irradiated ground beef, or where an offering is imminent. The same conversion is made for the status of the store's self-identified primary competitor. Distance to the primary competitor comes directly from the Panel, as does store size. The variable reflecting the degree to which the store follows a service philosophy is a composite variable calculated directly by the Food Industry Center: they construct a service index based on responses to 17 service-related questions.³ Regional identifiers came directly from the Panel: States were grouped by the Food Industry Center into four regions: West includes AK, AZ, CA, CO, HI, ID, MT, NM, NV, OR, UT, WA, and WY; Midwest includes IA, IL, IN, KS, KY, MI, MN, MO, ND, NE, OH, SD, WI, and WV; South includes AL, AR, FL, GA, LA, MS, NC, OK, SC, TN, and TX; and Northeast includes CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, and VT.⁴ Of the 391 overall responses in the Panel, 342 had complete information on these nine variables discussed above. Table 1 provides summary information on the variables used for analysis.

Table 2 shows the results of the Logit model, where a store's adoption status is the dependent variable. All estimated coefficients are significant at the 90 percent confidence level or above. The estimates, for the most part, support the hypothesis that a store's decision to adopt

³ Examples of the 17 variables that compose the service index include the following: customer self scanning, bagging service, carryout service, and custom meat cutting. See Kinsey et al, p.15-16, for more information. While the Food Industry Center constructs a similar index for variety, because the index includes the adoption status of irradiated ground beef, its inclusion could bias the model estimation.

⁴ In the Logit estimation that follows, the West region was used as the baseline.

irradiated ground beef is part of the overall competitive landscape. For instance, the coefficient on competitor's status is positive, indicating that a store is more likely to adopt the irradiated ground beef product if its primary competitor has also adopted, all else equal. Moreover, the coefficient on distance to primary competitor is negative. To the extent that store proximity proxies the intensity of rivalry, then a more intense rivalry (i.e., closer proximity) increases the odds of adoption.

A store's service index has a positive and significant impact on a store's likelihood of offering fresh irradiated ground beef. As Kinsey et al. state (p. 39-49), service offerings can be a way for stores to differentiate themselves from local competitors. In the specific case of irradiated ground beef, it may be that stores who are already committed to being service leaders see the new product offering as providing a new service to their customers. For its new product launch, for example, Wegmans' promotional materials stressed that its new offering provided added food safety benefits.

Store size has two effects on the likelihood of adoption. The positive sign on store size implies that larger stores are more likely, and may find it easier, to adopt. But this relationship changes as stores get larger, as evidenced by the negative sign on squared store size. Combined, the two results imply that store size may have a positive effect on adoption until the size becomes too large, at which time the relationship reverses. In other words, the ease of adopting a new product may increase with store size up to the point where a store's large size may indicate an alternative format.

The positive coefficient on corporate structure stratum suggests that as firms increase the number of stores from one category to another, the odds of adoption increase. Finally, the positive coefficients on the regional dummy variables for East, Midwest, and South all suggest that the odds of adoption increase compared to the West region.

Table 2 also presents the marginal probabilities (change in probability) of the Logit coefficients. Among other findings, these results show that a store is 7.1 percent more likely to adopt irradiated ground beef if one of its competitors has also adopted. Also, a store in the East region is 55.7 percent more likely to adopt than a store in the West region; a store in the Midwest is 15.3 percent more likely to adopt; and a store in the South is 24.4% more likely to adopt.

In an attempt to gain further insights regarding the relationship between a competitor's status and a store's own adoption decision, we identified two groups of stores that decided to adopt irradiated ground beef. Based on the survey responses associated with Figure 4, we split the adopters into two groups: "leaders" and "followers." Leaders were those stores that adopted in advance of any of their three competitors; followers were those stores that adopted but were not leaders. A total of 46 stores were classified as leaders; 22 were classified as followers. Based on the two groups, we reexamined the Food Industry Center's panel data to look for statistically significant differences in store attributes or demographic variables. For example, the variables we investigated included the following: supply-chain, service, and variety indexes created by the Food Industry Center; self-identified price, service, quality, or variety leadership variables; whether the store was domestically owned; size of selling area; number of employees, the percentage of total sales assigned to private label products; the number of inventory turns; the number of SKUs, and the average weekly store sales. We found very few significant differences in these variables between leader and follower groups. More specifically, we found significant differences (using a one-tail t-test) in only three variables: a technology-focused supply chain index constructed by the Food Industry Center, the median household income based on Census information, and the median house value from Census information.⁵ For example, the median

⁵ After this finding, these variables were added to the logit model found in Table 2, but the estimated coefficients were not found to be significantly different from zero.

income for the area served by leader stores is more than \$4,000 higher for leader stores, and the median house value is more than \$20,000 higher for leader stores. Table 3 presents these results.

Conclusions and Implications

Taken collectively the Logit results generally describe an adoption rationale that is consistent with the spatial and chronological patterns shown in Figure 2. The supermarket adoption maps in Figure 2 suggest that once a leader enters the market, other supermarkets in the same geographic market are more likely to follow suit. The Logit results corroborate this result by providing evidence that a supermarket is more likely to adopt if its competitors have also adopted, and if it is in close proximity to the competitor. The results also indicate that other factors such as store size and corporate structure play an important role.

In addition, the results support the hypothesis that supermarket decisions to offer fresh irradiated ground beef moved beyond a number of controversial issues surrounding unusual product attributes and uncertain consumer acceptance. Instead, the results suggest that this new product offering may be part of broader strategies that involve non-price competition between local or regional rivals. For example, we find that supermarkets are more likely adopt and offer irradiated ground beef if they scored higher on an index that reflects a store's commitment to a service philosophy.

While the issue of irradiated ground beef adoption has been placed in limbo, at least temporarily, by the bankruptcy of the industry's primary technology provider, this research may have important implications for other retail food products where attributes are associated with a particular production technology. Examples of these types of products include certified organic fresh and processed foods, so-called nutraceuticals and functional foods, and in some international markets genetically modified foods. When considering the potential adoption of generically modified foods, for example, European supermarkets may play an even stronger

gatekeeper role than their U.S. counterparts. In this case, European supermarkets may draw a qualified lesson both from Wegmans' successful introduction of fresh irradiated ground beef and our study's results. Wegmans successfully diffused some consumer concerns by emphasizing consumer choice. Further, our results provide evidence that supermarkets were more comfortable introducing the new irradiated ground beef product if their competitors did likewise. This lesson is qualified, however, by stressing our study deals only the adoption of irradiated ground beef in the U.S. and not in Europe or any other international market.

While these results demonstrate the influence that a leader can have in a geographic market, they only begin to provide insight into what attributes might characterize the leader, i.e., the first supermarket in a region to adopt irradiated ground beef. We now know that Wegmans Food Stores' decision in May 2002 was an important spark to subsequent adoptions. But we can say very little about why Wegmans became the leader in this issue. We see, for example, that only a very few store demographic variables or store attributes separate leaders from followers. Continuing to investigate what separates the leaders from the followers would be the logical continuation of this line of research. Knowing this answer would be very valuable to marketers who are tasked with introducing a new product target. In the case of irradiated ground beef, supermarket adoption seemed stalled until the technology provider SureBeam found a leader like Wegmans (or vice versa).

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Table 1: Data Used in Adoption Model

Variable	Type	Minimum	Maximum	Mean
Adoption Status (Dependent)	Binary	0	1	0.181
Competitor Status	Binary	0	1	0.187
Distance to 1 ⁰ Competitor (miles)	Continuous	0.01	130	5.533
Service Index	Continuous	0	0.88	0.377
Store Size (1,000 sq.ft.)	Continuous	2.5	210	38.28
Store Size squared (10 ⁶ sq.ft.)	Continuous	6.25	44,100	2,377
Corporate Structure Stratum	Ordered*	1	5	2.658
East Region Dummy	Binary	0	1	0.143
Midwest Region Dummy	Binary	0	1	0.503
South Region Dummy	Binary	0	1	0.137

* Corporate Structure Stratum takes the following values: 1 if the store is independent; 2 if the store belongs to a company with between 2 and 10 stores; 3 if between 11 and 50 stores; 4 if between 51 and 750 stores; and 5 if more than 750 stores.

Table 2a: Logit Results for Adoption Status of Fresh Irradiated Ground Beef

Variable	Coefficient	t-stat	Marg. prob.	p-value
Constant	- 6.301	- 6.261	- 0.527 [#]	0.000
Competitor Status	0.709	1.925*	0.071	0.111
Distance to Competitor	- 0.085	- 1.683*	- 0.007 [#]	0.061
Service Index	2.315	2.076	0.193 [#]	0.049
Store Size	5.63x10 ⁻⁵	2.146	0.000 [#]	0.003
Store Size Squared	- 4.05x10 ⁻¹⁰	- 1.904*	- 0.000	0.440
Corp. Structure Stratum	0.266	1.653*	0.022	0.110
East Dummy	3.227	4.384	0.557 [#]	0.000
Midwest Dummy	1.735	2.595	0.153 [#]	0.012
South Dummy	1.770	2.424	0.244 [#]	0.072

Chi squared 82.256 (p-value = 0.000)

Pseudo R-squared 0.2540

Notes: All coefficients differ significantly from at the 95% level except those marked with an *, which are significant at the 90% level. Only those marginal probabilities marked with an # are significant at the 90% level.

Table 2b: Frequencies of Actual and Predicted Outcomes

<u>Actual</u>	<u>Predicted</u>		<u>Total</u>
	<u>0</u>	<u>1</u>	
<u>0</u>	273	7	280
<u>1</u>	39	23	62
<u>Total</u>	312	30	342

Table 3: T-Test Results for Statistical Differences Between Leaders and Followers

Number of Leaders: 46

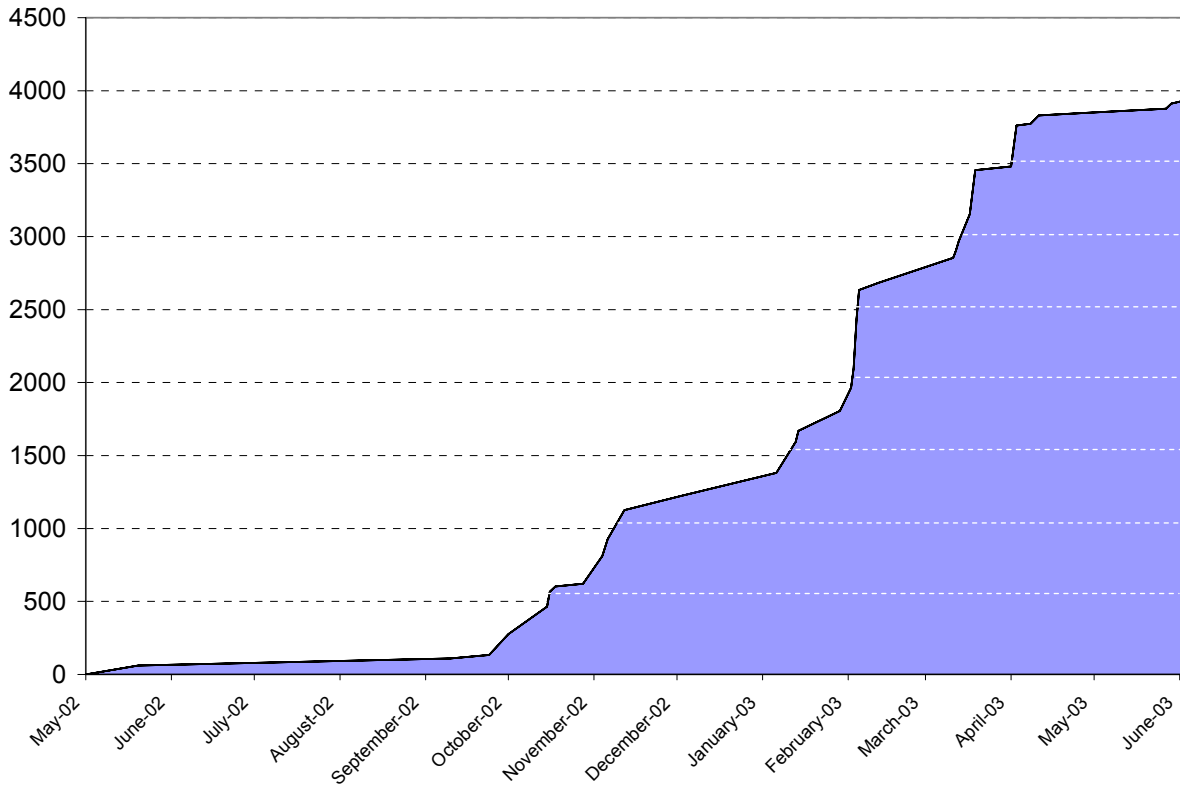
Number of Followers: 42

<u>Variable</u>	<u>Mean-Leader</u>	<u>Mean-Follower</u>	<u>t-stat</u>	<u>p-value (one tail)</u>
Supply change-technology index*	0.538	0.461	1.735	0.046
Median Household Income	\$47,985	\$43,863	1.328	0.095
Median House Value	\$131,941	\$110,030	1.791	0.039

Note:

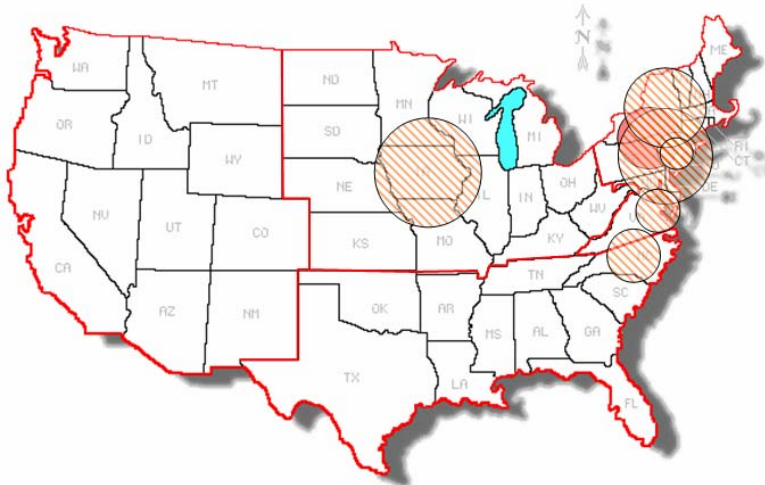
The Supply change-technology index equally weights a store's adoption of 15 store-level technologies related to supply chain management. Included among the 15 technologies are the following: electronic invoices from vendors or warehouse, electronic transmission of movement data or orders, electronic shelf tags, internet links to corporate headquarters or key suppliers, scan-based payment, scan-based inventory refills, vendor-managed inventory, and loyalty card program.

Figure 1: Number of Stores Adopting Fresh Irradiated Ground Beef and Timing of Adoption Announcements



Source: Press releases, SureBeam Corporation, various dates.

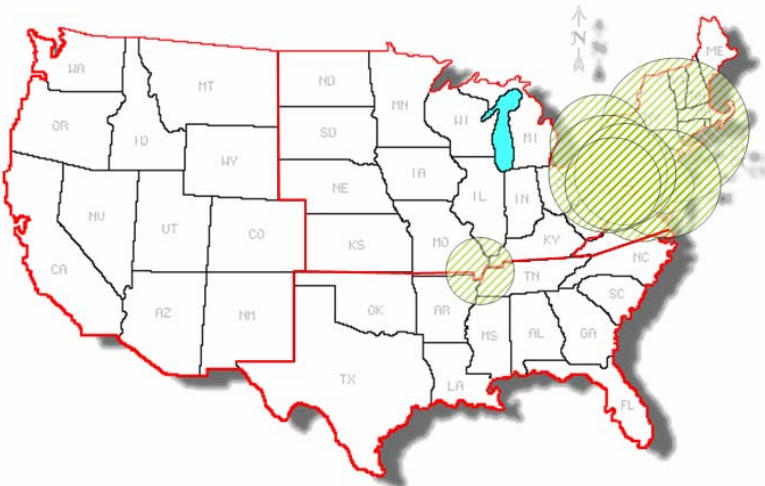
Figure 2: Chronological and Geographic Patterns of Irradiated Ground Beef Adoption



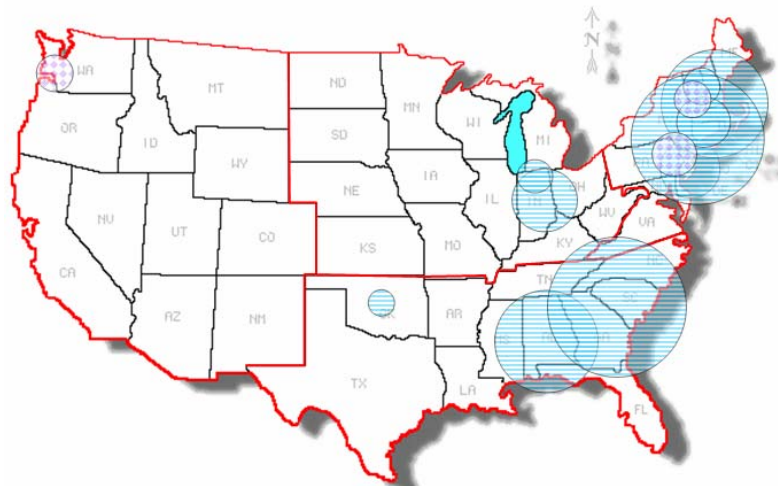
A. May 20, 2002 through Oct. 31, 2002



B. Nov. 1, 2002 through Dec. 31, 2002



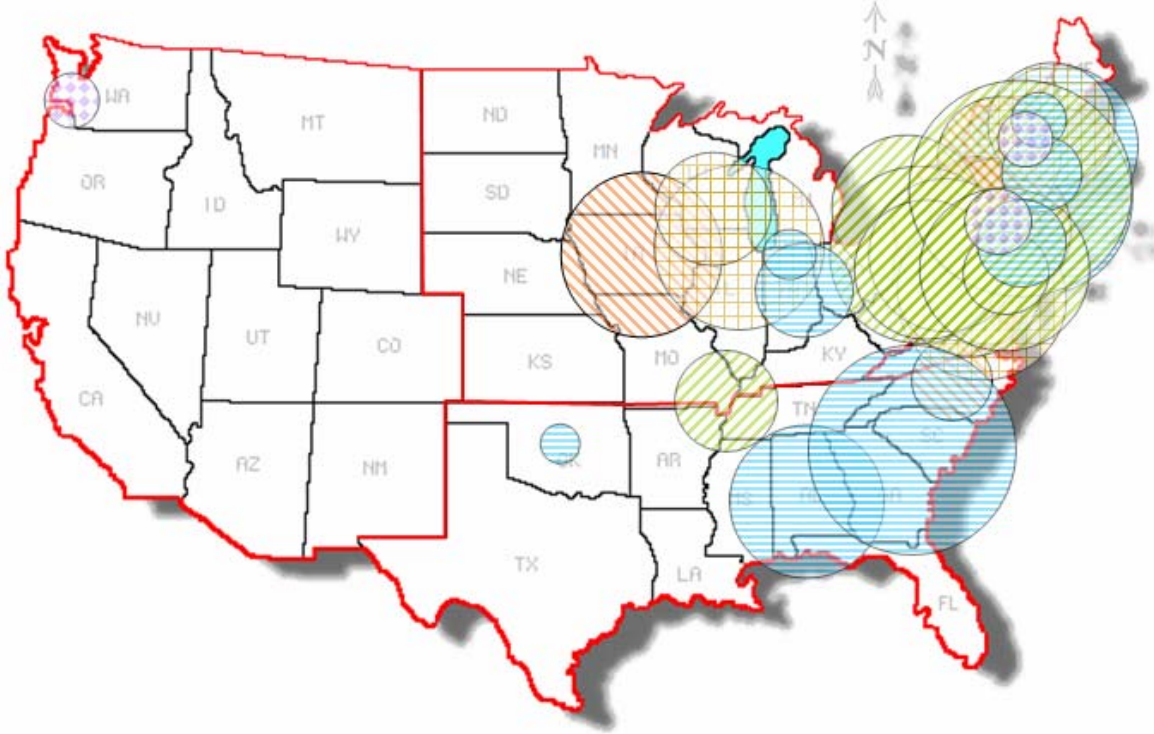
C. Jan. 1, 2003 through Feb. 28, 2003



D. March 1, 2003 though June 3, 2003

Note: Circle placements are approximate. Circle sizes accurately reflect the relative number of stores in each operating company.

Figure 3: Cumulative Irradiated Ground Beef Adoption



Notes: Circle placements are approximate. Circle sizes accurately reflect the relative number of stores in each operating company

Source: Press releases, SureBeam Corporation, various dates.

Figure 4: Survey Responses Regarding Adoption Status of Own Store and Top Three Competitors

