Separate Decision-Making for Supermarket Leaders and Followers: The Case of Whether or Not to Offer Irradiated Ground Beef

Edward C. Jaenicke and Mitsuko Chikasada

Using supermarket survey data that include a store’s adoption of a new fresh irradiated ground beef product, this paper investigates whether the adoption decision-making process differs depending on whether adoption would make the store a leader or a follower. We model the adoption decision in two ways that take the leader-follower decision into account. Our results show only limited differences in store attributes across groups classified as leaders, followers, or non-adopters. More significantly, however, the results show that store attributes such as proximity to competitors and store size, among others, play separate roles in the decision to lead or follow.

From May 2002 to June 2003, at least 32 supermarket chains announced they would begin offering a fresh irradiated ground beef product packaged under a supermarket’s own name. The first announcement, by Rochester, N.Y.-based Wegmans Food Markets, came more than two years after the U.S. Department of Agriculture and the Food and Drug Administration gave final approvals allowing irradiation of fresh and frozen red meat to reduce food-borne pathogens such as E. coli (O157:H7). In the two years prior to Wegmans’ announcement, the only irradiated red meat products available in stores were boxed and branded frozen ground beef patties. A single company, SureBeam Corp., provided the irradiation technology first for the frozen patties and then for the fresh product adopted by Wegmans and the other 31 supermarket chains.

Approval of irradiated red meat, therefore, came after the nation’s largest recall of E. coli-contaminated ground beef in August 1997 but before the second largest recall in July 2002.

A second irradiation company, Food Technology Service Inc., announced in 2002 that one supermarket chain—Publix Super Markets—would use its technology. The two irradiation companies differed in at least one important way: SureBeam used high-voltage electricity to create ionizing radiation in the form of electron-beam beta rays, while Food Technology Services used the radioactive isotope Cobalt-60 to create ionizing radiation in the form of gamma rays.

In June 2003, supermarket adoption announcements stopped, and soon after, in January 2004, SureBeam declared bankruptcy and began liquidating itself under Chapter 7. Two years later, in January 2006, the only irradiated meat products found in stores are again branded frozen ground beef patties.

Despite the abrupt decline, the 14 months of active adoption of fresh irradiated ground beef by supermarket companies tell a story that may have important implications for new product adoptions beyond irradiated food products. During these 14 months, U.S. supermarket chains comprising over 3,800 individual stores began offering the new irradiated ground beef product. By June 2003, more than 10 percent of all U.S. supermarkets were offering fresh irradiated ground beef under their own labels. Jaenicke et al. (2006) provide some limited evidence that a store’s adoption decision is, in part, influenced by the adoption status of a store’s direct competitors. Figures 1 and 2, reproduced from Jaenicke et al. (2006), illustrate both the timing and geographic nature of adoptions. Taken together, these two figures suggest that a store’s proximity to a competing adopter might have influenced the store’s adoption decision.

In this paper, we examine the same store-level data as Jaenicke et al. (2006) but investigate more thoroughly the potential differences between leaders and followers regarding adoption of fresh irradiated ground beef. First, we use supermarket survey responses to separate stores into three groups: leading adopters—those that adopted the new product before their three direct competitors did; following/concurrent adopters—those that adopted only after or approximately concurrent with at least one of their competitors; and non-adopters. Second we test...
for statistical differences among the three groups on a number of store and demographic attributes. Third, we model adoption as a single three-choice decision (to be a leader, follower, or non-adopter) and investigate factors that influence that decision. Finally, we investigate a more reasonable, two-decision model in which stores face an initial decision of whether or not to adopt before any other competitor has, and then potentially a second decision of whether or not to adopt if a competitor has already adopted or is adopting. The assumption underpinning this last model is that store characteristics and demographics may play separate roles in the adoption decision depending on whether a store’s potential adoption would make the store a leader or a follower. Briefly, our results first suggest that some significant differences in store attributes do exist between leaders, followers, and non-adopters. More significantly, however, our results also show that proximity to competitors, store size, and other store attributes play separate and sometimes opposite roles in the adoption decision depending on whether the decision would make the store a leader or follower. Before we elaborate on these results, we first discuss existing research on supermarket competition and new product adoption, and describe data from a survey of supermarket store managers that we use to analyze stores’ adoption decisions.

Supermarket Competition and New Product Adoption

More than a dozen store formats, including the conventional supermarket, superstore, supercenter, and as many as ten others, co-exist and compete aggressively within the overall food-retailing market...
Within these formats, firms compete not only on price but also on the basis of their commitment to service, variety, and other merchandizing philosophies. Some food retailers have the reputation of being service, variety, or price leaders in their markets. For example, Kinsey et al.’s (2003) survey results find that 18 percent of store managers identify their own store as a price leader over three direct competitors; 77 percent identify themselves as a service leader and quality leader; and 36 percent as a variety leader. That survey also zeroes in on top-performing stores and finds significant differences between the top performers and others stores concerning whether or not a store identifies itself as a price, quality, service, or variety leader.³

Other studies examine the role of retail pricing, product assortment, and quality-of-service formats

³ Kinsey et al. (2003) group stores into two categories: those with 50 or fewer stores and those with more than 50 stores. Within those groups, top-performing stores are generally more likely to identify themselves as price leaders, but less likely to identify themselves as quality or service leaders. Results for variety leadership are mixed.
on consumer shopping decisions. For example, Bell and Lattin (1998), Bell, Ho, and Tang (1998), and Ho, Tang, and Bell (1998) find evidence that consumers buy higher-quantity market baskets per trip at stores with an “every day low pricing” format and smaller market baskets at stores with a “Hi-Lo” pricing format. Based on group interviews, Cude and Morganosky (2001) find that as the number of types of retail formats increase, consumers add the new formats to their existing mix instead of replacing less-preferred formats. Additionally, empirical and theoretical studies have examined shelf-space allocations (Chen et al. 1999); product variety decisions (Swann 1990; Ratchford 1990; Krishnan, Koelemeijer, and Rao 2002); and geographic and spatial forces (Allaway, Berkowitz, and D’Souza 2003; Sinha 2000; and Walden 1990).

Another set of studies closely related to this paper place new-product-adoption decisions within the competitive landscape. This research investigates the role of retailers as “gate keeper” buyers and examines how product, vendor, and store attributes affect profitability perceptions (Rao and McLaughlin 1989; McLaughlin and Rao 1990; McLaughlin and Fredericks 1994; Desai 2000; and Park 2001). Park (2001), for example, finds that the potential to increase overall store sales, profit, and product movement are the three attributes that receive the most consideration by gate-keeper buyers, which Park calls channel intermediaries. Based on survey results, McLaughlin and Fredericks (1994) find that the size of individual supermarkets and supermarket chains plays an important role in the acceptance rates of new products. After dividing supermarket chains into two groups, with the first group typically adding or deleting fewer than 500 items per year and the second group adding or deleting more than 1500 items per year, they find that the first group has fewer stores in the overall chain (251 versus 412) and fewer stock keeping units per store (16,909 versus 24,114).

One previous study (Jaenicke et al. 2006) specifically investigates store attributes that influence supermarket adoption of irradiated ground beef and finds that store size, an index of service-oriented offerings, and the adoption status and proximity of a store’s competitors all significantly influence adoption. In particular, Jaenicke et al. (2006) hypothesize that because stores are more likely to adopt if their competitors also adopted, leader-follower dynamics among competitors play an important role. However, that study finds only limited instances of significant differences between leader stores. Though this paper uses the same data, it differs from Jaenicke et al. (2006) by investigating a more thorough list of store and demographic attributes by comparing results across three groups (e.g., leading adopters, following or concurrent adopters, and non-adopters) instead of two and by modeling the store’s adoption decision not simply as a choice between adoption and non-adoption, but as a choice that also incorporates whether a store chooses to be a leader or a follower.

**Store Attributes for Leaders, Followers, and Non-Adopters**

The data used in this analysis are from The Food Industry Center’s (TFIC) 2003 Supermarket Panel (Kinsey et al. 2003). 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 that the USDA classifies as supermarkets 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. The Food Industry Center’s survey instrument contained 46 multi-part questions, which are described in detail by Kinsey et al. (2003).

For the 2003 survey, one of these 46 questions was a newly added question that asked store managers about the status of fresh irradiated ground beef for their own stores and for their three primary competitors. Figure 3 shows the exact structure of this question. Out of 361 valid responses to the irradiated ground beef question, 25 said their store has offered fresh irradiated ground beef for more than six months, 29 said they offered it within the last six months, 15 said they would start offering the product within the next three months, 46 said that adoption plans were under discussion, 143 said they

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4 Recent studies based on this annual panel of supermarkets include King and Park (2004), King, Leibtag, and Behl (2004), and King et al. (2001).

5 Kinsey et al.’s (2003) Table 2.1 (p. 4) shows how median store characteristics for TFIC’s survey results compare with those from two industry surveys.
Q34. Do you or any of the three stores that compete most directly with your store (those 3 competitors you listed previously in question 24) have any plans to offer FRESH irradiated ground beef?

<table>
<thead>
<tr>
<th></th>
<th>Offered for more than 6 months</th>
<th>Offered within the past 6 months</th>
<th>Plan to offer within the next 3 months</th>
<th>Plans for future use under discussion</th>
<th>No plans for use</th>
<th>Don’t Know</th>
</tr>
</thead>
<tbody>
<tr>
<td>a. Your store</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>b. Competitor 1</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>c. Competitor 2</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>d. Competitor 3</td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

Figure 3. Reproduction of Survey Question on Irradiated Ground Beef Status.

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 three top competitors.

To investigate differences between leaders and followers, data depicted in Figure 4 are first split into three groups (leading adopters, following/concurrent adopters, and non-adopters) using the multi-part categories depicted in Figure 3. We define a leading adopter as a store meeting two conditions: having adopted or being committed to adoption within the next three months, i.e., where a store responded with a 1, 2, or 3 to the “Your Store” line in Figure 3; and having identified none of their three closest competitors as having adopted earlier, i.e., where a store responded with a lower number for the “Your Store” line than for the Competitor 1, 2, or 3 lines. A following/concurrent adopter is defined as a store meeting the first condition but not the second, and a non-adopter is defined as a store that does not meet the first condition. There are far more non-adopters (291) than either leading adopters (50) or following/concurrent adopters (19), and there are more than twice as many leading adopters as following/concurrent adopters.6

Once the data are split into these three groups, we can compare store attributes and demographic information across groups. Table 1 presents the category averages for 27 continuous variables—store attributes and demographic variables based on zip code—that were collected by TFIC as part of the 2003 supermarket panel described in Kinsey et al. (2003). For eighteen of the variables (in italics), significant differences exist between at least two of the three group means. For example, the first five variables represent composite indices that TFIC constructed from survey responses to measure a store’s relative commitment to supply-chain practices (including those specifically related to technology and decision-making), service offerings, and variety offerings.7 In each case, the group mean of the leading-adopter group is different than that of the non-adopter group. For the variety-offering index, the overall supply-change index, and the decision-making supply-chain sub-index, the group mean of the following-adopter group is different from the non-adopter group mean. And finally, for the technology supply-chain sub-index, the group means for the leading-adopter and following-adopter groups are different. With an average score of 0.54, the leading adopters demonstrate a higher level of commitment to supply-chain technologies than do following adopters, who have an average score of 0.45.

6 Presumably, had the technology provider SureBeam Inc. not experienced financial troubles and had adoption continued past June 2003, the number of following adopters would have increased. However, because the survey was administered in January 2003, these developments do not affect the validity of the data.

7 These indices are partly described in King et al. (2001) and more thoroughly defined in Appendix C of Kinsey et al. (2003).
It is differences between these two groups—leading adopters and following/concurrent adopters—in which we are most interested. In Table 1, we find statistically significant differences for these groups in only one other instance: the number of stores with common ownership. (In Table 1, this variable name, along with the technology supply-chain index variable name, is printed in bold.) Leading adopters, on average, have a total of 407 stores in their chain, while following adopters have only 86. Several other results stand out in Table 1, though differences are not found to be statistically significant: on average, leading adopters are larger than following adopters (e.g., see Selling Area and Store Size) but have lower weekly sales and fewer stock-keeping units (SKUs) in the meat department. Also, leading adopters on average are located in zip codes with higher population (white, black, and Hispanic) and higher levels of median income and median housing values.

Table 2 presents a similar comparison for binary or categorical store attributes. Like Table 1, Table 2 shows a number of differences in responses between leading adopters and non-adopters and between following adopters and non-adopters, but few differences between leading and following adopters. We do find that there is a significant difference in stores identifying themselves as a variety leader: 57.1 percent of leading adopters identify themselves this way, while only 33.3 percent of following adopters do so. Also, when asked to rank store sales against direct competitors, leading adopters most commonly rank themselves first, while following adopters most commonly rank themselves second, a statistically significant result. We also find a large though not statistically significant difference associated with self-identified quality leadership, where more leading adopters identify themselves as a quality leader, and with product distribution, where a majority of leading adopters are self dis-
Table 1. Means Comparison of Continuous Attributes and Demographics for Leading Adopters, Following/Concurrent Adopters, and Non-adopters.

<table>
<thead>
<tr>
<th>Store variable/attribute*</th>
<th>Variable units/description</th>
<th>Leading adopter</th>
<th>Following / concurrent adopter</th>
<th>Non-adopter</th>
</tr>
</thead>
<tbody>
<tr>
<td>SCS: supply-chain index</td>
<td>0-1 index based SCS A and SCSB</td>
<td>0.60(^i)</td>
<td>0.54(^a)</td>
<td>0.43(^{1a})</td>
</tr>
<tr>
<td>SCS_A: SCS technology</td>
<td>0-1 index based on adoption of 15 store-level technologies</td>
<td>0.54(^{12})</td>
<td>0.45(^i)</td>
<td>0.37(^{2})</td>
</tr>
<tr>
<td>SCS_B: SCS decision-making</td>
<td>0-1 index measures extent to which parties outside the store are involved in store-level decisions</td>
<td>0.66(^i)</td>
<td>0.65(^2)</td>
<td>0.48(^{12})</td>
</tr>
<tr>
<td>SO: Service offering</td>
<td>0-1 index measures adoption rate for 17 services</td>
<td>0.44(^i)</td>
<td>0.41</td>
<td>0.36(^i)</td>
</tr>
<tr>
<td>VO: Variety offering</td>
<td>0-1 index measures adoption rate for 7 offerings</td>
<td>0.66(^i)</td>
<td>0.59(^2)</td>
<td>0.38(^{12})</td>
</tr>
<tr>
<td>Selling area</td>
<td>square feet</td>
<td>41,584(^i)</td>
<td>34,868</td>
<td>28,524(^i)</td>
</tr>
<tr>
<td>Store size</td>
<td>square feet</td>
<td>49,426(^i)</td>
<td>44,441</td>
<td>36,353(^3)</td>
</tr>
<tr>
<td># of stores</td>
<td>units</td>
<td>407(^i)</td>
<td>86(^{12})</td>
<td>263(^2)</td>
</tr>
<tr>
<td>Distance to primary competitor</td>
<td>miles</td>
<td>2.21(^i)</td>
<td>2.63(^2)</td>
<td>6.20(^{12})</td>
</tr>
<tr>
<td>Weekly labor hours, full-time</td>
<td>hours</td>
<td>1,217(^i)</td>
<td>1,449(^2)</td>
<td>833(^{12})</td>
</tr>
<tr>
<td>Weekly labor hours, part-time</td>
<td>hours</td>
<td>1,189(^i)</td>
<td>1,524(^2)</td>
<td>706(^{12})</td>
</tr>
<tr>
<td>Private label sales</td>
<td>% private label sales to total sales</td>
<td>16.4</td>
<td>13.7(^i)</td>
<td>20.4(^i)</td>
</tr>
<tr>
<td>Weekly inventory turns, meat department</td>
<td>units</td>
<td>34.9</td>
<td>38.2</td>
<td>42.4</td>
</tr>
<tr>
<td>#SKUs, meat department</td>
<td>units</td>
<td>22,924</td>
<td>24,364</td>
<td>16,406</td>
</tr>
<tr>
<td>Average weekly store sales</td>
<td>$</td>
<td>416,617</td>
<td>2,529,692</td>
<td>377,359</td>
</tr>
<tr>
<td># of customer transactions, weekly average</td>
<td>units</td>
<td>14,666</td>
<td>12,494</td>
<td>14,226</td>
</tr>
<tr>
<td>Annual change in average weekly customer transactions</td>
<td>units</td>
<td>-1,714</td>
<td>-333</td>
<td>129</td>
</tr>
<tr>
<td>Average gross profit as % of sales</td>
<td>%</td>
<td>26.6(^i)</td>
<td>25.8</td>
<td>23.5(^i)</td>
</tr>
<tr>
<td>Annual change in gross profit as a % of sales</td>
<td>%</td>
<td>0.42</td>
<td>0.11</td>
<td>0.58</td>
</tr>
<tr>
<td>Population per square mile</td>
<td>2000 Census info, by zip code</td>
<td>1,776</td>
<td>1,591</td>
<td>1,545</td>
</tr>
<tr>
<td>Population, White</td>
<td>2000 Census info, by zip code</td>
<td>22,747(^i)</td>
<td>21,223(^3)</td>
<td>15,478(^{1a})</td>
</tr>
<tr>
<td>Population, Black</td>
<td>2000 Census info, by zip code</td>
<td>3,526(^i)</td>
<td>1,896</td>
<td>1,666(^i)</td>
</tr>
<tr>
<td>Population, Hispanic</td>
<td>2000 Census info, by zip code</td>
<td>1,837</td>
<td>1,044</td>
<td>2,544</td>
</tr>
<tr>
<td>Owner-occupied housing units</td>
<td>2000 Census info, by zip code</td>
<td>7,505(^i)</td>
<td>6,560(^a)</td>
<td>4,902(^{1a})</td>
</tr>
<tr>
<td>Population, urban</td>
<td>2000 Census info, by zip code</td>
<td>26,176(^i)</td>
<td>22,317</td>
<td>16,937(^i)</td>
</tr>
<tr>
<td>Median household income</td>
<td>$, 2000 Census info, by zip code</td>
<td>47,237(^i)</td>
<td>44,963</td>
<td>41,055(^i)</td>
</tr>
<tr>
<td>Median house value</td>
<td>$, 2000 Census info, by zip code</td>
<td>129,130</td>
<td>112,816</td>
<td>117,623</td>
</tr>
</tbody>
</table>

\(^{1, 2, 3}\): Pair-wise t-test statistically significant at 5% level.
\(^a, b, c\): Pair-wise t-test statistically significant at 10% level.
Bold = some statistical differences between leading and following/concurrent adopters.
Italics = some statistical difference between leading or following adopters and non-adopters.
### Table 2. Percentage of Positive Responses for Binary and Categorical Attributes for Leading Adopters, Following/Concurrent Adopters, and Non-Adopters.

<table>
<thead>
<tr>
<th>Store variable/attribute</th>
<th>Variable units/description</th>
<th>Leading adopter</th>
<th>Following/concurrent adopter</th>
<th>Non-adopter</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Binary variables (% of positive responses)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carryout service</td>
<td>Answered Yes to key advantage or standard offering</td>
<td>72</td>
<td>78.9</td>
<td>79.9</td>
</tr>
<tr>
<td>Custom meat cutting</td>
<td>Answered Yes to key advantage or standard offering</td>
<td>84</td>
<td>84.2</td>
<td>81.8</td>
</tr>
<tr>
<td><strong>In-store franchises (e.g., Starbucks)</strong></td>
<td>Answered Yes to key advantage or standard offering</td>
<td>18</td>
<td>5.3</td>
<td>9.3</td>
</tr>
<tr>
<td>Home delivery</td>
<td>Answered Yes to key advantage or standard offering</td>
<td>18</td>
<td>10.5</td>
<td>25.9</td>
</tr>
<tr>
<td>Internet ordering</td>
<td>Answered Yes to key advantage or standard offering</td>
<td>28</td>
<td>21.1</td>
<td>6.9</td>
</tr>
<tr>
<td>Organic produce</td>
<td>Answered Yes to key advantage or standard offering</td>
<td>90</td>
<td>89.5</td>
<td>49.5</td>
</tr>
<tr>
<td>Private label brands</td>
<td>Answered Yes to key advantage or standard offering</td>
<td>98</td>
<td>89.5</td>
<td>92.8</td>
</tr>
<tr>
<td>Seating area for eating</td>
<td>Answered Yes to key advantage or standard offering</td>
<td>68</td>
<td>68.4</td>
<td>31.6</td>
</tr>
<tr>
<td>Collective bargaining agreement</td>
<td>Yes if &gt;25% of employees are covered</td>
<td>40</td>
<td>36.8</td>
<td>25.1</td>
</tr>
<tr>
<td>Self-identified price leader</td>
<td>Yes/no</td>
<td>26</td>
<td>21.1</td>
<td>26.4</td>
</tr>
<tr>
<td>Self-identified service leader</td>
<td>Yes/no</td>
<td>77.6</td>
<td>88.9</td>
<td>61.4</td>
</tr>
<tr>
<td>Self-identified quality leader</td>
<td>Yes/no</td>
<td>87.8</td>
<td>70.6</td>
<td>64.1</td>
</tr>
<tr>
<td>Self-identified variety leader</td>
<td>Yes/no</td>
<td>57.1</td>
<td>33.3</td>
<td>25.6</td>
</tr>
<tr>
<td>Everyday low prices program</td>
<td>Yes/no</td>
<td>72</td>
<td>68.4</td>
<td>74.3</td>
</tr>
<tr>
<td>Domestically owned</td>
<td>Yes/no</td>
<td>90.9</td>
<td>92.3</td>
<td>95.4</td>
</tr>
<tr>
<td>Self-distributing</td>
<td>Yes if self distributing; no if wholesaler supplied</td>
<td>62</td>
<td>47.4</td>
<td>36.1</td>
</tr>
<tr>
<td>Northeast region</td>
<td>Yes if in CT, DC, DE, MA, MD, ME, NH, NJ, NY, PA, RI, VA, or VT</td>
<td>26</td>
<td>42.1</td>
<td>10.3</td>
</tr>
<tr>
<td><strong>Categorical variables (mode)</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Corporate/store structure</td>
<td>1 Independent stores</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>2 Between 2 &amp; 10 stores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>3 Between 11 &amp; 50 stores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>4 Between 51 &amp; 750 stores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>5 More than 750 stores</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Average sales ranking</td>
<td>1, 2, 3, or 4: based on own-store and top three competitors</td>
<td>1</td>
<td>4</td>
<td>1</td>
</tr>
</tbody>
</table>

†: Three-category Pearson Chi Square statistically significant at 5% level.
††: Three-category Pearson Chi Square statistically significant at 10% level.
1, 2, 3: Pair-wise Pearson Chi Square statistically significant at 5% level.
a, b, c: Pair-wise Pearson Chi Square statistically significant at 10% level.
Bold = some statistical differences between leading and following/concurrent adopters.
Italics = some statistical difference between leading or following adopters and non-adopters.
A Single-Adoption-Decision Model with Three Choices

Taken collectively, evidence in Tables 1 and 2 echoes the results of Jaenicke et al. (2006) that leading adopters have some limited differences from following adopters. However, the results also provide substantial evidence that leading or following/concurrent adopters have different attributes from non-adopters. These results, therefore, provide some support for investigating whether or not the adoption decision is simply a binary one, i.e., to adopt or not. Rather, the adoption decision may instead be one that acknowledges that this decision is inseparable from the decision to be a leader or a follower. With the adoption decision framed this way, individual store attributes and demographic variables may affect the decision to lead, follow, or not adopt in different ways.

As a first step in modeling this more complicated adoption decision, we hypothesize that when contemplating a new product such as irradiated ground beef, stores choose to be in one of the three groups (leaders, followers, or non-adopters). More precisely, we hypothesize that a store’s attributes and demographics impact this three-way decision. We therefore propose that the probabilities for the three choices (leader, follower, or non-adopter) for a store with characteristics \( x \) follow a multinomial logit model with three unordered choices. The probabilities for the three choices \( Y = 0, 1, \text{ or } 2 \) are, therefore,

\[
\text{Prob} (Y = j) = \frac{\exp(x, \beta_j)}{1 + \sum_{k=1}^{2} \exp(x, \beta_k)} \quad \text{for } j = 1 \text{ and } 2, \text{ and}
\]

\[
\text{Prob} (Y = 0) = \frac{1}{1 + \sum_{k=1}^{2} \exp(x, \beta_k)}.
\]

For the set of factors in \( x \), our choice is guided both by the variables identified in Jaenicke et al. (2006), and by the results of Tables 1 and 2. Ultimately, we include eleven variables in \( x \); (1) the distance to a store’s primary competitor, (2) a store’s average sales rank among the group that includes its three main competitors, (3) a technology supply-chain index, (4) the store’s size, (5) store-size squared (so that size’s effect on choice probabilities can be nonlinear)\(^8\), (6) the median house value for the store’s zip code, and five dummy variables each equal to one if (7) the store is in the Northeast, (8) the store handles its own distribution, (9) the store identified itself as a service leader, (10) the store says that offering organic produce was a normal part of its operations, and (11) more than 25 percent of the store’s employees are covered by a collective bargaining agreement. Based on the group means reported in Tables 1 and 2, we can begin to form expectations about the signs the regressors have when comparing the leading-adopter and following-adopter groups to the non-adopter group in the multinomial logit model. For example, because the two adopting group means are greater than the non-adopter group mean for the technology supply-chain index, store size, organic produce rating, collective bargaining, self-identified service leader, self-distribution, and the Northeast variables, we expect the signs of these regressors to be positive. Conversely, we expect the signs of the distance to the primary competitor and the average sales rank to be negative because Tables 1 and 2 shows that the group means for the leading- and following-adopter groups are lower than that for the non-adopter group. Finally, because we observe that the leading-adopter group’s median house value is greater than the non-adopter group’s, but the following-adopter group’s is less than the non-adopter group’s, we expect the sign on this regressor to be opposite for the two groups.

Table 3, which shows the results of the multinomial logit model, confirms some but not all of these expectations. For example, for both of the adopter groups, the signs on the organic produce rating, self-identified service leaders, and northeast dummy variables are positive as expected and significantly different from zero. For the leading-adopter group but not the following-adopter group, we see that the technology supply-chain index is positive as expected and significant, as is the estimate for store size (but not store-size squared). Sales ranking has a statistically significant negative impact as expected for leading adoption but not following adoption. And median house value has a statistically negative impact for following adoption but not leading adoption. The estimated model fails to show statisti-

\(^8\) Jaenicke et al. (2006) finds that the probability of a binary adoption decision increases with store size up to 69,500 square feet and then decreases.
Table 3. Multinomial Logit Results for the Decision to Be a Leader, Follower, or Non-Adopter.

<table>
<thead>
<tr>
<th>Coefficient (t-stat)</th>
<th>Leading adopter</th>
<th>Following adopter</th>
<th>Non-adopters</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-3.725**</td>
<td>-4.936**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-3.09)</td>
<td>(-2.53)</td>
<td>(Reference case)</td>
</tr>
<tr>
<td>Dist. to primary competitor</td>
<td>-0.082</td>
<td>-0.128</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.30)</td>
<td>(-1.34)</td>
<td></td>
</tr>
<tr>
<td>Mean sales ranking</td>
<td>-0.602**</td>
<td>0.256</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-2.64)</td>
<td>(0.79)</td>
<td></td>
</tr>
<tr>
<td>Technology supply-chain index</td>
<td>3.156**</td>
<td>-0.895</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.00)</td>
<td>(-0.37)</td>
<td></td>
</tr>
<tr>
<td>Northeast region</td>
<td>1.379**</td>
<td>2.536**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(2.53)</td>
<td>(3.54)</td>
<td></td>
</tr>
<tr>
<td>Store size (1,000 sq ft)</td>
<td>4.728</td>
<td>6.592</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.76)*</td>
<td>(1.43)</td>
<td></td>
</tr>
<tr>
<td>Store size squared</td>
<td>-3.354*</td>
<td>-3.630</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.71)</td>
<td>(-0.95)</td>
<td></td>
</tr>
<tr>
<td>Self-distributing</td>
<td>-0.409</td>
<td>-0.834</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.84)</td>
<td>(-1.03)</td>
<td></td>
</tr>
<tr>
<td>Self-identified service leader</td>
<td>0.961**</td>
<td>1.516*</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.96)</td>
<td>(1.79)</td>
<td></td>
</tr>
<tr>
<td>Organic produce rating</td>
<td>1.199*</td>
<td>1.803**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(1.91)</td>
<td>(1.99)</td>
<td></td>
</tr>
<tr>
<td>Collective bargaining</td>
<td>-0.352</td>
<td>0.497</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-0.73)</td>
<td>(0.69)</td>
<td></td>
</tr>
<tr>
<td>Median house value ($1,000s)</td>
<td>-0.358</td>
<td>-2.028**</td>
<td></td>
</tr>
<tr>
<td></td>
<td>(-1.18)</td>
<td>(-2.25)</td>
<td></td>
</tr>
</tbody>
</table>

No. of observations 270  
Pseudo R-square 0.2777

* = statistically different from zero at the 0.90 confidence level  
** = statistically different from zero at the 0.95 confidence level.
cally significant impacts for collective bargaining, self-distribution, and distance to a store’s primary competition.

When examining all the results in Table 3, one sees that most of the statistically significant coefficients for the two adopter groups have the same sign. However, some differences between the two groups do exist: four coefficients are significant for only one of the adopter groups. In general, therefore, the multinomial logit model results suggest that the store attributes have similar influence on the adoption decision for both leaders and followers. Therefore, if we are correct to view the adoption choice as one where stores choose to be leaders, followers, or non-adopters, one can then conclude that the decisions to be leaders or followers are based on relatively similar criteria (though exceptions exist for average sales rank, technology supply-chain index, and median house value). In other words, the multinomial logit model results show only limited separation between the decision to be a leader or a follower.

Two Adoption-Decision Models Contingent on Competitor’s Status

However, modeling the adoption decision as a single three-choice decision may still be overly simplistic. Panel (a) of Figure 5 shows the single-decision framework that forms the basis for the multinomial logit model in the previous section. Panel (b) of Figure 5 suggests an alternate decision framework where any one store may have as many as two adoption decisions, depending on whether or not its competition has already adopted. Panel (b) shows these two separate decisions: first, if no competitors have previously adopted, a store’s decision is either to adopt and therefore lead or to not adopt; and second, if competitors have adopted or are in the process of adopting, a store’s decision is either to adopt and therefore follow or to not adopt.

Theoretically, these two decisions in Panel (b) are related. Hence if data existed on individual stores over time as industry adoption progressed, these two decisions could be modeled and estimated.

Figure 5. Alternative Decision Models for the Adoption of Irradiated Ground Beef by Supermarkets.
<table>
<thead>
<tr>
<th>Coefficient (t-stat)</th>
<th>Adoption - leader</th>
<th>Adoption - follower</th>
</tr>
</thead>
<tbody>
<tr>
<td>Constant</td>
<td>-3.785**</td>
<td>1.547</td>
</tr>
<tr>
<td></td>
<td>(-3.028)</td>
<td>(0.374)</td>
</tr>
<tr>
<td>Dist. to primary competitor</td>
<td>-0.059</td>
<td>-0.420**</td>
</tr>
<tr>
<td></td>
<td>(-0.982)</td>
<td>(-2.178)</td>
</tr>
<tr>
<td>Mean sales ranking</td>
<td>-0.684**</td>
<td>1.076</td>
</tr>
<tr>
<td></td>
<td>(-2.79)</td>
<td>(1.388)</td>
</tr>
<tr>
<td>Constant</td>
<td>4.101**</td>
<td>-15.942*</td>
</tr>
<tr>
<td></td>
<td>(2.392)</td>
<td>(-1.856)</td>
</tr>
<tr>
<td>Technology supply-chain index</td>
<td>1.724**</td>
<td>2.913*</td>
</tr>
<tr>
<td></td>
<td>(2.85)</td>
<td>(1.675)</td>
</tr>
<tr>
<td>Northeast region</td>
<td>5.226*</td>
<td>-39.504*</td>
</tr>
<tr>
<td></td>
<td>(1.826)*</td>
<td>(-1.953)</td>
</tr>
<tr>
<td>Store size (1,000 sq ft)</td>
<td>-3.768*</td>
<td>49.253**</td>
</tr>
<tr>
<td></td>
<td>(-1.855)</td>
<td>(2.124)</td>
</tr>
<tr>
<td>Store-size squared</td>
<td>0.905*</td>
<td>5.766**</td>
</tr>
<tr>
<td></td>
<td>(1.788)</td>
<td>(2.126)</td>
</tr>
<tr>
<td>Self-identified service leader</td>
<td>-0.594</td>
<td>4.205</td>
</tr>
<tr>
<td></td>
<td>(-1.148)</td>
<td>(1.594)</td>
</tr>
<tr>
<td>Self-distributing</td>
<td>1.243*</td>
<td>3.85*</td>
</tr>
<tr>
<td></td>
<td>(1.788)</td>
<td>(2.126)</td>
</tr>
<tr>
<td>Organic produce rating</td>
<td>-0.328</td>
<td>5.054*</td>
</tr>
<tr>
<td></td>
<td>(1.916)</td>
<td>(1.718)</td>
</tr>
<tr>
<td>Collective bargaining</td>
<td>-0.633</td>
<td>1.857</td>
</tr>
<tr>
<td></td>
<td>(-0.633)</td>
<td>(1.857)</td>
</tr>
<tr>
<td>Median house value ($1,000s)</td>
<td>-0.506</td>
<td>-1.186</td>
</tr>
<tr>
<td></td>
<td>(-1.499)</td>
<td>(-0.754)</td>
</tr>
</tbody>
</table>

No. of observations 223  47
Psuedo R-Square 0.3166  0.5791

* = statistically different from zero at the 0.90 confidence level
** = statistically different from zero at the 0.95 confidence level.
with a model that incorporates sample selection or partial observability. However, the TFIC data represent only a snapshot of time and contain only limited information on the timing of adoption in relation to competitors (i.e., recall the survey-response choices in Figure 3). Hence we draw the connection between the two decisions in Panel (b) of Figure 5 with a dotted line to note that, based on our data, we are unable to connect these decisions statistically.

Based on TFIC data, then, we model a firm’s decision to adopt or not as two separate decisions depending on the adoption status of the firm’s competition. Hence we separate stores into two groups \( \{ l, f \} \) depending on whether the adoption decision would potentially make the store a leader or a follower. The discrete-choice adoption-decision variable, \( y_i \), for \( i \in \{ l, f \} \), takes the value of 1 if the store adopts or 0 if the store does not adopt. The factors that explain this decision compose a vector \( x \) so that

\[
\text{Prob} ( y_i = 1 ) = F( x_i' \beta ), \quad \text{for } j \in \{ l, f \}, \text{and}
\]

\[
\text{Prob} ( y_i = 0 ) = 1 - F( x_i' \beta ), \quad \text{for } j \in \{ l, f \},
\]

where \( x_i' \beta \) takes a linear form. Choosing a logistic distribution transforms the above into

\[
\text{Prob} ( y_i = 1 ) = \frac{ e^{x_i' \beta} }{ 1 + \sum_j e^{x_j' \beta} }, \quad \text{for } j \in \{ l, f \}.
\]

In the two estimations that follow, we will assume that \( x_i = x_f \), though this need not be the case.

Table 4 presents the results for the two separate individual logit estimations side by side. Several results are similar to the results of the multinomial logit model. For example, coefficients for organic produce rating, self-identified service leader, and the Northeast region variables are significant and positive for both groups, just as they were with the multinomial logit model. Clearly, then, increases in a store’s commitment to service and to organic produce increase the likelihood that a store will adopt irradiated ground beef regardless of whether competitors have already adopted. Also, a store’s average sales ranking is negative and significant for the leading-adoption decision but positive and not significant for the following-adoption decision. This result, similar to that in Table 3 for the multinomial logit model, suggests that overall sales leaders are also more likely to be leaders regarding the adoption of fresh irradiated ground beef. Sales ranking, however, is not a statistically significant factor for the following decision.

Some differences between Table 4 and Table 3 results, however, do emerge. For example, in Table 4’s results for the individual logit model, the technology supply-chain index has an opposite influence on a firm’s adoption, depending on the status of the competition. More supply-chain technologies are associated with an increased likelihood of adoption for stores in competition with firms that have not already adopted; on the other hand, it leads to a reduced likelihood of adoption if at least one other competitor has adopted. The rationale for this result is not clear. Perhaps stores with a strong commitment to supply-chain technologies are more willing to “go their own way,” in the first case adopting irradiated ground beef even though no competitors have, or in the second case, not adopting despite a competitor’s previous adoption. Table 4 also suggests that store size has an opposite influence on adoption, depending on competitors’ status. When no competitors have adopted, larger stores (up to a point) are more likely to adopt; when competitors have adopted, larger stores (again up to a point) are less likely to adopt. This result points out a dichotomy associated with store size. With more selling area, larger stores may have more flexibility to introduce new products quickly. Yet, smaller stores may be more “nimble”—better able to respond to competition. The results also show that having more than 25 percent of employees covered under a collective bargaining arrangement increases the likelihood of adoption only for follower stores. Finally, a simple explanation may exist for the negative effect that distance to the primary competitor has for followers but not for leaders. Clearly, the farther away a store is from its competitors, the less likely it is to follow the competitors’ decisions. Distance is not significant for leaders’ adoption decisions because leaders, almost by definition, go it alone; on the other hand, proximity appears to amplify following behavior.

**Conclusions**

This study analyzes whether or not differences between supermarket store attributes and demographic variables can identify leaders and followers regarding the adoption of fresh irradiated ground beef, and whether or not the store attributes influence
the adoption decision differently depending on whether a store’s adoption would make it a leader or follower. Using data from a survey of supermarket store managers, our results show only limited evidence of significant differences in attributes. More importantly, however, the results provide substantial evidence that store attributes may play separate roles in the decisions to adopt as a leader or as a follower. We find that some store attributes, such as the distance to the primary competitor, average sales ranking, collective bargaining status, and median house value, play a significant role in one but not both decisions. We also find that two store attributes, a store’s technology-based supply chain index and its size, can actually play opposition roles in the two decisions.

This study is squarely focused on the adoption of fresh irradiated ground beef, a rather unique product that only recently received regulatory approval. Drawing conclusions about new product adoptions more generally is therefore not recommended. However, our results may suggest that new product adoption decisions, at least for irradiated ground beef, can be separated in terms of whether adoption makes a store a leader or a follower. Moreover, our results may help add a layer of complexity to the role that supermarkets play as channel intermediaries or gate keepers. When it comes to decisions about carrying a new product, we find that these supermarket gate keepers may reach their decisions in a different way depending on their competitors’ status.

References


