

## **The Effect of Expiration Dates on the Purchasing Behavior for Grocery Store Perishables**

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# **The Effect of Expiration Dates on the Purchasing Behavior for Grocery Store Perishables**

## **Abstract**

This paper examines consumers' awareness of and response to expiration dates for grocery store perishable products. We develop a conceptual framework that captures the frequency with which consumers check expiration dates and their willingness to pay for a perishable over its shelf-life. Our framework is rooted in the notion that these behaviors are largely influenced by the perceived risks associated with purchasing and consuming perishable goods. A better understanding of these behaviors, and the role risk plays in influencing them, can help managers better educate consumers about the risks associated with perishables as they approach their expiration dates and implement more effective promotional strategies for these products over their shelf-lives, both of which could ultimately result in greater sales and reduced shrinkage (waste due to spoilage).

**Key words:** perishable goods, expiration dates, risk theory, grocery shopping behavior

## 1. Introduction

In today's era of super-grocery stores, it is no longer the branded items that bring in business, but rather the full-service deli, the fresh baked goods, the premium meats, and an elaborate array of produce. Simply stated, perishable products drive grocery store traffic. "In today's world, branded grocery items are the same everywhere; Coke is Coke and Tide is Tide," says Glen Terbeek, managing partner of Andersen Consulting in Chicago, "but perishables and their presentation are unique," and this is what draws consumers into the store (Hennessy 1998).

The importance of perishables for store profitability and store image is supported by the following facts: Sales of perishable goods rose 4.5% in 1999 and accounted for 69.4%, or about \$305 billion, of all retail food sales that year and just over 50% of all supermarket retail sales (*Supermarket Business* 2000), produce represents 12.7% of total store sales and is the second most profitable category in the store next to frozen foods (Berner 1999), and meat and produce tend to be the departments upon which consumers make value judgments about the store (Kerin, Jain and Howard 1992). This explains why grocery stores advertise 19 varieties of peppers and carry over 400 produce items (Turcsik 2003).

Despite their importance, perishable products are difficult to manage due to their random weights, lack of specific UPC codes for different product variations, and different forms of sale (e.g., raw, semi-prepared, fully prepared), to name a few. In fact, perishable categories are so complex that many retailers have become unable to implement any type of category management strategies in these categories (Litwak 1997). However, according to Blattberg, Chaney and Associates consulting, the key to successful management for perishable goods is "to understand how the consumer makes category decisions" (Litwak 1997).

A better understanding of consumer behavior in grocery store perishable categories can benefit grocery store managers, public policy makers, and consumers alike. For managers of perishable goods, shrinkage (waste due to spoilage) is a major problem. Departments such as produce, bakery and meat lose anywhere between 4.1%-4.6% of their goods to spoilage (compared to 2% overall), costing a grocery store anywhere from \$70,000-\$340,000 per year, depending on the size of the store (*Supermarket News* 1997). Furthermore, it is estimated that a grocery store can increase profits by as much as 15% by minimally reducing shrinkage of perishable goods (Hennessy 1998). Discounting perishables as they approach their expiration dates would seem like an effective means of selling aging inventory to reduce shrinkage. In fact, there is evidence to support that the short- and long-run effectiveness of price promotions is greater for perishable goods than for other categories (Nijs, Dekimpe and Steenkamp 2001). However, managers of perishables are reluctant to use such promotions for fear that doing so will tarnish the reputation of their products and store, even though there is no research to prove or refute this point. Furthermore, it would be difficult and perhaps imprudent to implement such discounting strategies without a better understanding of consumers' awareness and interpretation of expiration dates, as well as the manner in which their willingness to pay (WTP) for a perishable varies over its shelf-life. Once implemented though, discounting perishables as they approach their expiration dates could create trust in customers as managers would no longer be selling products approaching their expiration dates at full price.

Our research is also relevant for consumer advocates in their efforts to educate about, and regulate the use of, food dating (date found on product packaging). Currently, there is ambiguity surrounding the usage and regulations of what consumers refer to as expiration dates. Except for infant formula and baby food, the FDA does not require manufacturers to date their products, nor

does it have any federal regulations governing them (*Tufts University Health & Nutrition Letter* 1997). Therefore, food dating is a voluntary process that is typically reported in one of three forms: 1) “Best before,” which indicates the date after which a product is no longer of its “best” quality and is typically used with products such as baked goods, cereals, snacks, and some canned foods, 2) “Use by,” which indicates the date after which a product is no longer of “sufficient” quality and should not be consumed and is typically used with products such as eggs, yeast, and refrigerated dough, and 3) “Sell by” dates are the most commonly used form of food dating for perishables such as meat, seafood, poultry, milk and bread. A “sell by” date indicates the last day a product should be sold; however, depending on the way the perishable is stored, most remain safe to eat up to seven days past this date, or much longer if stored in a freezer. Furthermore, there seems to be some misconception among consumers about the meaning of these expiration dates.<sup>1</sup> If consumer advocates had a better understanding of consumers’ awareness and interpretation of expiration dates, and their perceived risks of perishables approaching these dates, they could better utilize their resources to educate consumers about the meaning of “sell by” dates, and the hazards (or lack thereof) of products approaching their “sell by” date, for example, through in-store signage or public service announcements.

Finally, a better understanding of behavior in perishable categories can benefit consumers by providing them with more options in the grocery store. For example, evidence has shown that consumers are willing to trade risks against a discounted price (Yeung and Morris 2001). If, as a result of this research, managers are more willing to discount perishables approaching their expiration dates, then they will provide consumers the opportunity to make the tradeoff between

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<sup>1</sup> Consumer “misconception” of how grocery store perishables age over their shelf-lives was identified in a pilot study in which the majority of consumers (61%) perceived expiration dates to represent the last day on which the product should be consumed rather than sold. Furthermore, a large proportion of consumers (42%-82% depending on the category) reported that the quality of a perishable deteriorates continuously from the time it is put on the shelf. These results are available from the authors.

buying a more expensive, but fresher item versus one that is discounted and perhaps perceived as riskier because it is approaching its expiration date (although it is still safe to consume).

Despite the evidence supporting the importance of understanding consumer behavior with grocery store perishable goods, these categories have received little to no attention in the marketing literature (Krider and Weinberg 2000). Hence, the main objectives of this paper are to examine 1) consumers' awareness and use of expiration dates, 2) their *WTP* for a perishable over its shelf-life, and 3) the role risk plays in the choices consumers make when buying perishable goods. To do this, we begin by developing a conceptual framework that suggests behavior in perishable goods categories is largely influenced by the perceived risks associated with buying and consuming perishable goods.<sup>2</sup> While the influence of perceived risks on consumer behavior has been studied in brand preference (Dunn, Murphy and Skelly 1986), product classification (Murphy and Enis 1986), and attitudes toward pesticide use on produce (Huang 1993), to name a few, this is the first attempt to investigate their impact on behavior in grocery store perishables with printed expiration dates on the packaging. We use our framework to develop a set of hypotheses that we test empirically via a survey of consumers' perceptions and behaviors in the following important perishable categories: chicken, beef, milk, yogurt, lettuce, and carrots. The findings support many of our hypotheses, and we use them to make recommendations for the management of grocery store perishable goods and to develop a research agenda for future studies in these under-researched, but important categories.

## **2. Literature Review**

Much of the research to date on perishable goods has come from the operations research literature and has focused on problems such as determining the optimal pricing, ordering, and

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<sup>2</sup>We thank two anonymous reviewers for suggesting perceived risks as an important driver of behavior in perishable goods categories in an earlier draft.

restocking strategies for aging goods. Table 1 presents a subset of these studies and summarizes the problems investigated, the characteristics of the categories studied, and their findings.

[Insert Table 1]

While these studies address issues relevant to managers of perishable goods, such as pricing, restocking, and order policies, the characteristics of the products studied differ from consumable grocery store perishables. Therefore, the findings from these studies are not practical for managing grocery store perishables. For example, a grocery store perishable has a relatively short shelf-life, typically one to three weeks. Therefore, the ability to update information over the life of the product, as done in some of the studies above, is limited. Also, the quality of grocery store perishables eventually decreases and they spoil, at which time they can no longer be sold. This is different from products like fashion goods where, although the utility of the product may decay over time, it never reaches zero, or broadcast spots, where the value of the good may actually increase over time if the expected number of viewers increases prior to the sale of the broadcast spot (e.g., when two teams from big, metropolitan cities advance to the Super Bowl). However, the most important distinction between our work and those in the OR literature is that most of the studies in Table 1 make assumptions about the demand-side effects in their models. However, we explicitly study the consumer side of the problems we investigate via a survey study that directly measures consumers' perceptions and behaviors in the perishable categories under investigation.

The limited studies that have looked at perishable grocery store goods, and those with similar characteristics, have modeled optimal inventory policies (Giri and Chaudhuri 1998; Hariga 1997; Khouja 1996), pricing policies (Gold 1981; Rajan and Steinberg 1992), ordering and issuing (restocking) policies (Fujiwara, Soewandi and Sedarage 1997), and the impact of

perishable goods on store choice (Krider and Weinberg 2000). The products studied here include fresh-meat-carcass, poultry, and dairy, to name a few. While the management of such goods clearly depends on the many factors captured in these studies (e.g., elasticity of demand, seasonality, inventory, and buy-back deals from the manufacturer), an understanding of consumer-side effects is missing, specifically consumers' awareness of, perceptions of, and behavior with respect to, expiration dates. As a result, many studies either ignore demand effects or make assumptions about them with little support to back them up. One study that is similar to ours in spirit is that by Huang (1993) who studied the effect of risk perceptions of pesticide use on consumers' WTP for residue-free produce. However, this paper does not incorporate the important variable we study here, expiration dates. Furthermore, it focuses solely on perishables that utilize pesticides, whereas we focus on a broader range of perishables that include meat, poultry, and dairy products, as well as produce.

Our study is different from those mentioned above in that we explicitly focus on consumers' perceptions and behaviors in specific and important grocery store perishable goods categories. This represents the only known study to explicitly investigate consumers' awareness of expiration dates, their willingness to pay for a perishable as it ages on the shelf, and the influence perceived risk has on such behavior. The following presents our conceptual framework for how these aspects of perishable good buying relate to each other.

### **3. Conceptual Framework**

Over the past fifteen years, numerous perishable food scares, such as salmonella in eggs, milk and poultry, listeria in pate and certain soft cheeses, and bovine spongiform encephalopathy (BSE, more commonly known as mad cow disease) in meat, to name a few, have caused health concerns among consumers and brought about significant changes in their purchasing habits

(Mitchell 1998). For example, retail volume sales of beef and veal dropped 63% in 1996 after a public announcement linked BSE to Creutzfeldt-Jakob disease (CJD), a fatal brain disease in humans, and in 1989 retail sales of eggs dropped 21% after an outbreak of salmonella (Mintel 1997). Furthermore, these scares have caused investors to devalue stocks of companies that sell such products (e.g., McDonald's, Jack-in-the-Box, Outback Steakhouse) by up to 5% (Shell 2003). The main factor driving the behavior of consumers and investors in these situations is the perceived risks associated with purchasing and consuming an unhealthy perishable good.

Perceived risk not only influences consumers in categories affected by highly publicized food scares, it is also prevalent in everyday, common purchase decisions. Empirical evidence shows a negative relationship between perceived risk and purchase likelihood, and as a result, consumers will take actions to lower the perceived risks associated with a purchase by 1) shifting or postponing their purchase, 2) purchasing well-known brands, 3) seeking advice or endorsement from a trusted source (Yeung and Morris 2001), or 4) in the case of perishable goods, searching for visual and other cues of freshness, such as the printed expiration dates we study. The following describes the past research conducted in the area of perceived risk.

### ***Perceived Risk***

Perceived risk has been defined as the expected negative utility associated with the purchase of a particular brand or product (Dunn, Murphy and Skelly 1986). Researchers have identified a set of risks that most frequently influence consumer decision-making: functional, performance, physical, psychological, social, and financial (Greenleaf and Lehmann 1995; Jacoby and Kaplan 1972; Roselius 1971; Havlena and DeSarbo 1990), all defined in Table 2.

[Insert Table 2]

The influence of the different types of risk on shopping behavior has been shown to vary depending on the brands considered or the categories of interest. For example, Dunn et al. (1986) studied the influence of perceived risk on the preference for generic, store, and national packaged goods brands (e.g., Tide, Scot Lad) and found that social risk plays a relatively minor role relative to financial and performance risks. Alternatively, Murphy and Enis (1986) classified product categories based on consumers' shopping effort and price risk dimension. They report that convenience goods, which include produce and other grocery staples, tend to be the lowest, relative to preference, shopping and specialty goods, in terms of the effect of effort and risk on shopping behavior. However, the recent evidence demonstrating the importance of perishables in terms of store choice and shopping experience, and the flood of recent and publicized food scares involving perishable goods, may provide different results today from those found nearly twenty years ago. Finally, many studies have supported the idea that most purchasing decisions are made based on two main factors related to risk evaluations: 1) the likelihood of the loss occurring and 2) the consequences or importance of the loss should it occur (Bettman 1973; Havlena and DeSarbo 1990; Peter and Tarpey 1975).

We draw upon these findings from the risk literature to build our conceptual model of the frequency with which consumers check expiration dates and their *WTP* for a perishable over its shelf-life (see Figure 1). The following presents our model and the resulting hypotheses.

[Insert Figure 1]

We attempt to capture in our model the two evaluation criteria of risk developed in the literature and mentioned above: 1) the likelihood of the loss occurring and 2) the consequences or importance of the loss should it occur. In the context of perishable goods, a "loss" may include the product spoiling and having to be disposed of before being consumed or the

consumer becoming ill from consuming a “bad” product, to name a few. The “importance of the loss occurring” increases as perceptions of risk increase (Oglethorpe and Monroe 1987) and hence is represented in our framework by the different dimensions of risk established in the literature. We argue that the “importance of loss occurring” affects both the frequency with which consumers check expiration dates, as well as their *WTP* for a perishable over its shelf-life. The “likelihood of loss occurring” is captured by 1) the expected time remaining before a product spoils, 2) the household consumption rate, and 3) the measures taken by the consumer to extend the life of the product. We propose that these aspects of shopping behavior affect consumers’ *WTP* because they are directly related to the remaining life of the product and therefore should influence the value of the product to the consumer.

### ***Frequency of Checking Expiration Dates***

Past studies have shown that as the risks associated with a product increase, the greater the desire for information prior to making a purchase (Blackwell, Miniard and Engel 2001; Greenleaf and Lehmann 1995; Dowling and Staelin 1994). In an attempt to reduce the risks associated with a loss, consumers may search for product attributes and information that is available to them before purchase. A relevant piece of information for a perishable good is its expiration date. Therefore, we propose:

H1: The greater the perceived risks associated with a perishable product, the more frequently a consumer will check expiration dates.

The types of risk included in our model are those defined in Table 2. As mentioned earlier, there is no conclusion in the literature about the relative importance of these risks in the contexts previously studied, let alone in the context of perishable grocery store goods. However, we expect that functional, performance, and physical risks may dominate the other risks due to the highly publicized and important health risks associated with the products we study.

Knowledge and expertise have been recognized in consumer research as characteristics that influence consumers during the various stages in the decision-making process (Bettman and Park 1980). Furthermore, it has been shown that consumers with greater category experience are better able to search out, encode, and recall information than those with less experience (Alba and Hutchinson 1987; Johnson and Russo 1984; Maheswaran and Sternthal 1990). As expiration dates provide valuable information about the shelf-life of the product, we expect that consumers with greater category experience will be more likely to search out expiration dates.

H2: Consumers with high category experience will check expiration dates more frequently than consumers with low category experience.

Beyond these two main constructs (perceived risks and category expertise), we include a set of personal characteristics about consumers in an exploratory effort to assess whether certain consumer groups are more likely to check expiration dates than others.

### ***The Willingness to Pay (WTP) for a Perishable Over Its Shelf-Life***

When buying a perishable product, the probability of a loss (e.g., spoilage) occurring is largely dependent on whether the consumer feels that he/she can consume the entire product before its expiration date. Furthermore, as the likelihood of loss increases, the *WTP* should decrease. This has been shown in studies, for example, that have examined the risks associated with pesticides and have found that as perceived risks increased, *WTP* decreased (Eom 1994; Huang 1993). In the context of perishable goods, we would expect that the fewer the number of days remaining before the product reaches its expiration date, the higher the probability of loss and therefore the lower the *WTP* for the product.

H3: *WTP* for a perishable product will decrease as the number of days remaining before the product reaches its expiration date decreases.

However, the probability of loss occurring can be influenced by the consumer. For example, households with high consumption rates in a category should have a lower risk of experiencing a loss. Therefore, household consumption rate should moderate the impact of the number of days before the product expires on *WTP*.

H4: As a perishable approaches its expiration date, *WTP* for the product will increase as the household consumption rate increases.

In addition, consumers can take measures to stop or extend the aging process, for example, by freezing or cooking the product upon arriving home. This should reduce the perceptions of risk associated with the perishable as it approaches its expiration date and in turn increase consumers' *WTP* for the product. Hence, we propose:

H5: As a perishable approaches its expiration date, the *WTP* will be greater when consumers plan to stop the aging process of the product (e.g., cook, freeze) upon arriving home than if they do not plan to stop the aging process.

Finally, we propose that the importance of loss occurring will impact *WTP*. The importance of the loss can be linked to the perceived risks associated with the product (Oglethorpe and Monroe 1987). With a higher risk for failure (performance, financial, etc.), consumers are willing to trade off some of the risk by reducing the resources they are willing to allocate to acquire the product (Huang 1993; Yeung and Morris 2001). As the perceived risks associated with a product increase, consumers will be willing to pay less for a product in return for accepting a greater risk.

H6: The greater the perceived risks associated with a perishable product, the lower the *WTP*.

Finally, we also include a set of personal characteristics about the consumer to capture individual differences in *WTP* for a product over its shelf-life. Table 3 summarizes the hypotheses developed above and the variables used to test them.

[Insert Table 3]

#### 4. Empirical Research

We conducted a survey to test our hypotheses and conceptual framework. Our empirical study investigated consumer behavior in six perishable categories: pre-washed/pre-cut lettuce, pre-washed/pre-cut carrots, milk, yogurt, chicken, and beef. We included products from the meat and poultry categories, the fresh produce categories, and the dairy categories, due to the large percentage of all grocery store perishable sales in these categories -- 30.4%, 22.5% and 16.9%, respectively (*Supermarket Business* 2000). We chose two products from each perishable type (i.e., produce, dairy, and meat/poultry) to provide insights about behavior *across* products and *within* product types, both of which we suspected varied on the dimensions of risk studied.

A convenience sample of 300 consumers participated in our study, in which the only screening criterion was that the individual did a substantial amount of grocery shopping for his/her household. The participants came from two large metropolitan areas in the Midwest and the Southeast. To assess consumers' *WTP* over the shelf-life of the products studied, three versions of the survey were equally distributed over participants inquiring about consumers' *WTP* for a perishable with 7 days, 4 days, or 1 day remaining before the product reached its expiration date. After cleaning the data of missing observations, 270 usable surveys remained. Summary statistics about consumers in the sample, the products studied, and consumers' perceptions of those products are reported in Table 4.

[Insert Table 4]

Interestingly, an overwhelming majority of consumers (69%-84%, depending on the product category) believe that the quality of the perishables we investigate deteriorates over the shelf-life of the product, when in fact retailers suggest the quality remains relatively constant

until the product passes its expiration date. This suggests that educating consumers about the manner in which perishables age may be necessary, but until then, discounting those categories could be an effective way to sell inventory of perishable goods before they expire on the shelf.

### **Model Specification**

The model specifications required to test our hypotheses were as follows:

$$\begin{aligned}
 Freq\_Check_{ij} = & \beta_0 + \beta_1(Funct\_Risk_{ij}) + \beta_2(Perform\_Risk_{ij}) + \beta_3(Physical\_Risk_{ij}) + \\
 & \beta_4(Psych\_Risk_{ij}) + \beta_5(Social\_Risk_{ij}) + \beta_6(Finance\_Risk_{ij}) + \\
 & \beta_7(CatExp_{ij}) + \beta_8(Gender_i) + \beta_9(Age_i) + \beta_{10}(Income_i) + \\
 & \beta_{11}(FullTime_i) + \beta_{12}(HHSIZE_i) + \varepsilon_1
 \end{aligned} \tag{1}$$

$$\begin{aligned}
 WTP_{ij} = & \beta_0 + \beta_1(Days_j) + \beta_2(Days_j * HHConsume_{ij}) + \beta_3(Days_j * Stop_{ij}) + \beta_4(Funct\_Risk_{ij}) + \\
 & \beta_5(Perform\_Risk_{ij}) + \beta_6(Physical\_Risk_{ij}) + \beta_7(Psych\_Risk_{ij}) + \\
 & \beta_8(Social\_Risk_{ij}) + \beta_9(Finance\_Risk_{ij}) + \beta_{10}(Gender_i) + \beta_{11}(Age_i) + \\
 & \beta_{12}(Income_i) + \beta_{13}(FullTime_i) + \beta_{14}(HHSIZE_i) + \varepsilon_2
 \end{aligned} \tag{2}$$

where  $j$  indicates the category of interest (1-6),  $Gender_i = 1$  if consumer  $i$  is male, 0 otherwise;  $Age_i = 1$  if consumer  $i$  is over 45 years of age, 0 otherwise;  $Income_i = 1$  if the household income for consumer  $i$  is  $> \$50,000$ , 0 otherwise;  $FullTime_i = 1$  if consumer  $i$  is working fulltime, 0 otherwise;  $HHSIZE_i$  is the number of people living fulltime with consumer  $i$ , and  $\varepsilon_1$  and  $\varepsilon_2$  are random error terms.<sup>3</sup> To normalize  $WTP$  across categories, we defined the variable as the consumer's  $WTP$  for the perishable divided by the original shelf-price.<sup>4</sup> All other variables are defined in Table 3.

Before estimating these equations, we conducted a factor analysis on the six risk dimensions to see if they could be reduced to a few main constructs of risk. We used principle components method with Varimax rotation to obtain the factor loadings.<sup>5</sup> In all six categories, a two-factor solution provided the best fit, where both factors had Eigen values greater than one and the remaining were less than one. The results of this analysis are reported in Table 5.

<sup>3</sup> The cutoffs for each variable were determined from a median split analysis.

<sup>4</sup> We thank an anonymous reviewer for this suggestion.

<sup>5</sup> Oblique rotation gave a similar solution.

[Insert Table 5]

We see that in all six cases, functional, performance and physical risk load more heavily onto Factor 1, and psychological, social and financial risk load more heavily onto Factor 2. The first factor captures the perceived risks associated with product quality as a perishable approaches its expiration date and the health risks associated with this. We label this factor *Product Quality Risk (PQR)*. The second factor captures the risks associated with the negative emotions a consumer will experience should the product fail. These include the impressions others will form about the consumer, the way a consumer feels about him/herself, and the financial loss experienced were the product to fail. We label this factor *Personal Risk (PR)*. We use these two factors, rather than the six individual ones, when estimating Equations 1 and 2.

We also tested alternative, yet reasonable, model specifications of the model such as two-way and three-way interactions of the variables, alternative functional forms of the variables in the model (e.g., linear, log-linear, curvilinear, etc.), and different operationalizations of the demographic variables. The best fitting models are those shown below:

$$Freq\_Check_{ij} = \beta_0 + \beta_1(PQR_{ij}) + \beta_2(PR_{ij}) + B_3(CatExp_{ij}) + \beta_4(Gender_i) + \beta_5(Age_i) + \beta_6(Income_i) + \beta_7(FullTime_i) + \beta_8(HHSize_i) + \varepsilon_1 \quad (3)$$

$$WTP_{ij} = \beta_0 + \beta_1(Days_j) + \beta_2(Days_j * HHConsume_{ij}) + \beta_3(Days_j * Stop_{ij}) + \beta_4(PQR_{ij}) + \beta_5(PR_{ij}) + \beta_6(Gender_j) + B_7(Age_i) + \beta_8(Income_i) + \beta_9(FullTime_i) + \beta_{10}(HHSize_i) + \varepsilon_2. \quad (4)$$

## **Results**

To test H1 and H2, we estimated Equation 3 for each category separately, except for milk due to the lack of variance on the dependent variable (93% of consumers “always” or “usually” check expiration dates in this category<sup>6</sup>), using maximum likelihood OLS regression.<sup>7</sup> The results are shown in Table 6.

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<sup>6</sup> This information is found in Table 4 and is referenced often in this section.

[Insert Table 6]

To begin, we find support for H1, that the greater the risks associated with a product, the more frequently consumers will check expiration dates (see Table 6). However, we find this only holds true for *PQR*. This suggests that perceived risks associated with the quality of a perishable approaching its expiration date, and the resulting health risks, are positively correlated with the frequency with which consumers check expiration dates. The results for *PR*, however, are not significant, suggesting that an increase in the more personal risks (e.g., financial, social, psychological pain) associated with purchasing a perishable is not associated with a greater frequency of checking expiration dates. This finding provides insights about the influence of the various dimensions of risk on behavior in perishable categories, something that has never been studied before. Furthermore, this result might be generalized to other product categories, suggesting that consumers are more likely to check expiration dates in cases where *PQR* is high, as this would require further investigation and is a direction for future research.

Next, we find that H2 is also strongly supported.<sup>8</sup> In all five categories, we find that consumers with greater category experience are more likely to check expiration dates.

Finally, looking at the demographic variables (see Table 6), we find that younger consumers in chicken and beef, and fulltime working consumers in carrots, are less likely to check expiration dates. However, there does not seem to be any consistency across categories in

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<sup>7</sup> We also estimated Equation 3 using Generalize Least Squares (GLS) to test the assumption that the frequency with which consumers check expiration dates was related across the five categories and warrant joint estimation (e.g., Seemingly Unrelated Regression or SUR). The results were no different than the OLS results and did not provide a better fit to the data. This was not surprising given that Zellner (1962) and Dwivedi and Srivastava (1978) state that if the explanatory variables are identical across equations and behavior is expected to vary over the equations (product categories in our case), then SUR does not provide more efficient estimates over OLS.

<sup>8</sup> Additional support for this hypothesis was found through an observation study and personal interviews, which revealed that consumers who infrequently shop in a category rarely, if ever, check expiration dates, and many do not even know expiration dates exist in those categories (e.g., carrots and lettuce).

the relationship between the demographics included in our model and the frequency of checking expiration dates to warrant a comprehensive strategy for the store.

A dilemma for managers is whether or not to use discounts in perishable categories. For individuals who frequently check expiration dates (e.g., experienced shoppers or those with high *PQR*), or in categories in which the frequency of checking expiration dates is high in general (e.g., see milk in Table 4), a discount may be necessary to sell inventory approaching its expiration date. On the other hand, for a consumer who is unaware of expiration dates or shops in categories in which consumers rarely check expiration dates (e.g., see carrots in Table 4), discounting would seem to be an unnecessary promotion to move inventory as the product approaches its expiration date. The risk in these cases, however, is the potential bad-will created among these consumers when the product they just purchased at full price spoils before it can be consumed and they then blame the store for the product failure rather than blaming themselves for their lack of knowledge about the product's age.

Therefore, discounting seems to make sense in the short- and long-run. In the short-run, discounting is worthwhile if targeted at consumers who more frequently check expiration dates. Our results suggest that these are 1) consumers with more experience in a category, which could easily be identified using scanner data, 2) consumers who perceive perishables to have high *PQR*, which unfortunately was not consistently correlated with any of our demographic variables, and 3) categories in which consumers check expiration dates more often (e.g., see milk, yogurt, beef, chicken in Table 4). On the other hand, discounting, in conjunction with educating consumers about the reason for the discount (e.g., because the product is close to its expiration date), would avoid the potential long-term bad-will among consumers who infrequently check expiration dates as mentioned above. Our findings suggest that these include

1) inexperienced consumers, 2) consumers with low *PQR*, and 3) consumers in categories that have a low frequency of checking expiration dates (e.g., see carrots and lettuce in Table 4).

To estimate Equation 4 (*WTP*), we again used maximum likelihood OLS regression and report the results in Table 7.

[Table 7]

H3 was supported in all six categories. Furthermore, we note that *WTP* decreases linearly for produce and dairy products as the number of days left before expiration decreases, and exponentially for beef and chicken<sup>9</sup> (see Table 7). Figure 2 graphs the decline in *WTP* from seven days to one day before the product reaches its expiration date, holding all other variables constant. The manner in which *WTP* decreases over the shelf-life can provide information about how consumers perceive product quality deteriorating over this time. For example, if *WTP* was relatively constant over the shelf-life, this would suggest that consumers do not perceive product quality to deteriorate over the life of the product (something that our results in Table 4 already revealed was not the case), and hence discounting would provide no benefit to the manager. However, because we find *WTP* decreases linearly or exponentially over the shelf-life of the products studied, when in fact retailers claim that the quality of the product does not deteriorate until it passes its expiration date, this suggests an opportunity for managers and consumer advocates to educate consumers about the true value of, and risks associated with, grocery store perishables as they age on the shelf. It also suggests that until consumers are fully educated on this point, discounts may be necessary to sell products close to their expiration dates.

[Insert Figure 2]

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<sup>9</sup> These same functional forms were supported in other similar studies we conducted for this research and are available by the authors.

The different functional forms for chicken and beef suggest that a deeper discount (as a percentage of shelf-price) might be necessary earlier in the shelf-life of these products to encourage a purchase. Interestingly, chicken and beef were the only products discounted as they approach their expiration dates within the stores we studied. This may explain the different functional forms for these two categories, suggesting that consumers become conditioned to expect a discount when discounting is practiced. It is also interesting to note that chicken and beef were statistically the most risky of the six categories in terms of  $PQR$ .<sup>10</sup> Therefore, another possible explanation for the exponential relationship between  $WTP$  and  $Days$  for beef and chicken is that for products with high  $PQR$ , the size of the discount necessary to entice a purchase becomes multiplicative instead of additive over the shelf-life of the product. However, more research on this topic would be necessary in order to decisively make this conclusion.

In addition to the different functional forms, we note that the  $WTP$  as a percentage of list price is the lowest for milk with only one day left before expiration. This is perhaps because milk is the one product that cannot be cooked (except perhaps in a recipe) or frozen. Therefore, the only means of stopping the aging process is by consuming the gallon of milk – a task that would most likely require a couple of days for an average household. As such, the value of the product with only one day before expiration should be very low, and hence so should the  $WTP$ .

Next, we see that as the product approaches its expiration date,  $WTP$  is significantly greater for consumers with a greater household consumption rate in every category but chicken (though in the right direction), supporting H4. This suggests that consumers who are able to consume the perishable more quickly, before it spoils, are likely to pay more for that product than those who do not consume it as quickly. This presents an opportunity for managers to target

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<sup>10</sup> This was based on an ANOVA analysis that tested for statistical differences in  $PQR$  and  $PR$  across the six product categories. These results are available from the authors.

discounts at households with lower consumption rates in order to sell perishables nearing their expiration dates. As mentioned above, the retailer will be better off in this case should the product spoil for these households (which is more likely) as such consumers will take responsibility for the loss of product (e.g., they elected to make the tradeoff between price and freshness) rather than placing blame on the retailer who sold them an aging perishable at full price, which they could not reasonably consume in the remaining life of the product.

Next, we find support for H5, that as the product approaches its expiration date, consumers who plan to stop the aging process will have a greater *WTP* for a perishable. In fact, this is strongly supported in all categories except milk, which as we commented above is the product for which cooking, freezing, or consuming quickly is the most difficult. These findings should prompt managers to encourage consumers (at the point of purchase) to stop the aging process of a perishable upon arriving home. Some ideas might include communicating the importance of freezing a product upon arriving home if it is not going to be consumed immediately, providing recipe ideas for the appropriate quantity of the perishable packaged and sold, or simply selling smaller packages of perishables such that the product could be consumed or used in a recipe on the day it was purchased.

Next, we see that, similar to H1, H6 is supported with respect to *PQR*, but not *PR*. This suggests that as consumers' perceived risks related to product quality and health risks increase, their *WTP* for the product will decrease. However, this relationship does not hold for the risks related to social and financial forces. The fact that *PR* is not significant is perhaps not surprising given the products we study are not "status" goods and do not require substantial financial investment. Hence, consumers are not as concerned with the social and psychological risks associated with product failure, at least not when placing value on the product to determine their

*WTP*. These findings suggest that for consumers who have high perceptions of *PQR*, managers need to consider discounting perishables earlier in the shelf-life. This would especially be true for categories in which *PQR* seems to be higher in general, such as chicken and beef in our study. Other products that might fall into this category would be fish or lunchmeat. Alternatively, discounting may not be as crucial early in the shelf-life for consumers and/or perishables where *PQR* is lower, even if *PR* tends to be high.

Lastly, looking at the demographic variables, we see that older consumers and larger households are willing to pay more for perishables, all else equal. It is not surprising, for example, that larger households have a higher *WTP* if we assume that they are able to consume the same amount of perishable goods more quickly than smaller households. Hence, their risk of not being able to consume the product before it expires is lower, and therefore, their value of, and *WTP* for, the product should be higher.

## **5. Conclusions and Future Research**

This paper investigates consumers' behavior in six important perishable grocery store categories: yogurt, milk, pre-cut lettuce, pre-cut carrots, beef and chicken. We focus on three main aspects of decision-making in these categories: 1) the frequency with which consumers check expiration dates, 2) their willingness to pay (*WTP*) for a perishable over its shelf-life, and 3) the perceived risks associated with perishables as they approach their expiration date.

We develop a conceptual framework (Figure 1) depicting the relationship between these three aspects of decision making and develop a set of hypotheses from this framework, which we test using a survey study. A summary of our results is presented in Table 8.

To begin, we find that the six most commonly used dimensions of risk affecting consumers' decision making can be reduced to two factors in perishable good categories. We

label these *Product Quality Risk (PQR)*, which captures functional, performance and physical risk, and *Personal Risk (PR)*, which captures psychological, social and financial risk.

When investigating the frequency with which consumers check expiration dates, we find that fluctuations (increases) in *PQR* have a greater (positive) impact on the frequency with which consumers check expiration dates than do *PR*. We also find that consumers with greater category experience check expiration dates more frequently, which confirmed the findings of an observation study and personal interviews conducted earlier to motivate this research.<sup>11</sup>

Because it seems reasonable that discounts may be necessary to sell aging inventory among consumers who are aware of expirations dates, our findings suggest that such promotions should be targeted at 1) experienced consumers, 2) consumers whose perceptions of *PQR* are higher, or 3) consumers shopping in categories in which there is a greater tendency to check expiration dates, such as beef and chicken. Experienced shoppers, for example, could be identified via scanner data, and technology to target these consumers with price promotions is on the horizon; “with new gadgets such as electronic shelves and digital price labels coming down the pike, retailers may eventually be able to change prices in the blink of an eye – and send electronic messages to shoppers’ carts for custom-made deals.” (Keenan 2003, p. 63).

On the other hand, we also suggest that marketers pay special attention to educating consumers who infrequently check expiration dates (e.g., inexperienced consumers and consumers with low *PQR*) about the existence of expiration dates and the importance of checking them. This would especially be true in categories such as carrots and lettuce in which *PQR* is low for most consumers. This will avoid the potential bad-will created when these uninformed consumers are “tricked” into buying a perishable that is soon to expire. In addition,

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<sup>11</sup> The results from this study are available from the authors.

marketers can also educate consumers about the different meanings of expiration dates or try to adopt a more uniform classification method of food dating.

With respect to *WTP*, we find support for the hypothesis that *WTP* decreases over the shelf-life of the product. This suggests the need to educate consumers that the quality of perishables does not significantly decline as the product approaches its expiration date. However, in the meantime, this also suggests that discounting may be an effective way to entice consumers to purchase a perishable close to its expiration date. Interestingly, we find differences across categories in the way *WTP* decreases over the shelf-life of the product. Specifically, we find that *WTP* decreases linearly for lettuce, carrots, milk and yogurt (products with relatively lower *PQR*) and exponentially for beef and chicken (products with relatively higher *PQR*). This suggests a deeper discount (as a percentage of the shelf-price) may be necessary to sell a perishable with similar characteristics to beef and chicken earlier in the shelf-life of the product.

Next, we find that *WTP* is lower for households with lower consumption rates, for smaller households, and for younger consumers. This suggests that discounting perishables approaching their expiration dates will be most effective when targeted at these segments.

Finally, we find that *WTP* is higher in situations in which consumers plan to stop the aging process upon arriving home. This should prompt managers to take actions such as remind consumers at the point-of-purchase of the importance of freezing a product upon arriving home, provide recipe ideas for the appropriate quantity of the perishable sold, provide common combinations of food items (e.g., strawberries next to angel food cake) to encourage ideas for immediate consumption, or to simply sell smaller package sizes such that the perishable can be consumed or used in a recipe on the day it was purchased.

In conclusion, we recognize that the ultimate decision of how to market grocery store perishables (e.g., whether, and by how much, to discount them as they approach their expiration date) requires a more in-depth analysis of the profit margins of each product and a quantitative measure of the effect of discounting on store traffic, category volume, and cross-category effects. However, the results from this research provide grocery store managers some insights about the impact discounting perishables might have on consumers' behavior and perceptions. Furthermore, we have shown how perceived risks, a widely studied topic that has not been applied to perishable goods, can be used to better understand and generalize behavior in these important categories. We hope that this research will encourage others to examine consumer behavior in these profitable and important categories in an effort to aid managers in their management strategies of these products.

Future research attempts may investigate the important risk dimension, *PQR*, which we have identified as affecting behavior in perishable categories, in order to determine if the results could be generalized across other perishable categories. It would also be worthwhile to investigate whether certain segments of the market (e.g., based on demographics, psychographics, etc.) tend to view perishables as more risky on this dimension. This would put a "face" on consumers who perceive perishables to have high *PQR* and hence more frequently check expiration dates and have a lower *WTP* for a perishable as it ages over its shelf-life such that these consumers could more easily be identified and targeted. It would also be beneficial to conduct a controlled field experiment to explicitly test our framework of the impact of discounting perishables on purchase behavior. This would allow for a more comprehensive analysis of consumers' *WTP* for a perishable over its shelf-life and could answer questions like *when* (over the shelf-life), and by *how much*, the product should be discounted. It would also be

interesting to examine how the *WTP* function changes once a fresher, more expensive batch of goods is shelved along side of an older, discounted set of products.

Finally, a more in-depth look at the management of perishables on store image would be interesting. Interviews with managers revealed that many discount beef and chicken but were reluctant to discount dairy or produce for fear that such actions would tarnish store image. Our findings revealed that consumers do not perceive any differences between the products examined in our study in terms of the effect of discounting them on store image (see Table 4).

Furthermore, some of the products that managers traditionally do not discount (e.g., carrots, lettuce, yogurt) are less likely to negatively affect store image when discounted than those managers already discount (e.g., chicken and beef). Given this information, managers can begin to weigh the tradeoffs between the potential benefits of discounting to move inventory versus the potential negative aspects of discounting on store image for each product category. However, more research into this topic would be useful.

Furthermore, recent research suggests that organizations may publicize socially responsible programs in order to create a substantial competitive advantage for themselves in the marketplace (Lichtenstein, Drumwright and Braig 2003). By presenting discounting as an alternative to throwing away the product, stores can promote a socially responsible policy that may provide both short- and long-term benefits for the store.

Table 1  
Summary of Selected Research on Perishable Goods from the OR Literature

Reference	Problem Investigated	Category Characteristics/Assumptions	Findings/Contribution
Hahn, Hwang and Shinn (2004)	Use a period-review inventory model under LIFO and FIFO issuing policies to examine retailers' operating policies for perishables	Products where the supplier agrees not to buy back unsold products but provides the retailer some discount on the wholesale price	Cases under which the retailer and supplier are better/worse off due to a no-return policy
Abad (2003)	Present an analytical model for pricing and lot size decisions	Perishable goods under finite production, exponential decay and partial backordering	When demand is price sensitive, pricing and production are related, and the retailer may need to backlog demand in order to avoid high costs due to deterioration
Chun (2003)	Study 1) optimal product pricing based on demand rate, buyer preference, and length of sales period and 2) the optimal ordering quantity that maximizes the seller's total expected profit	Perishable commodities where demand is represented by a negative binomial, the seller must determine the price for several units of a perishable with a limited shelf-life, and any product not sold at the end of the selling period will be disposed of at a lower price	Present superior solutions than those previously found in the literature
Li (2001)	Use a series of linear programming models to study optimal pricing decisions	Non-storable perishable goods or services (e.g., airline seats, hotel rooms)	Show that there exists an optimal pricing policy of at most three prices
Hariga (1997)	Present analytical solution methods to determine optimal replenishment schedules	Exponentially decaying items and perishable products with fixed lifetimes	Provide two efficient solution methods that determine the optimal replenishment schedules for the types of products studied
Subrahmanyam and Shoemaker (1996)	Present an optimal pricing and restocking model that allows for demand to be updated over the life of the product	Products with uncertain demand, a limited selling season, and where the inventory left at the end of the selling season is greatly reduced in value (e.g., fashion goods, toys)	Present a model that offers advantages for new items with the characteristics studied
Lodish (1980)	Present a dynamic model for pricing and ordering that accounts for inventory, anticipated demand during current and future periods, and future pricing decisions	Products whose value to the customer changes over time (e.g., broadcast spots)	Provide modelers an easily implemented framework for structuring and solving dynamic pricing problems

Table 2  
Dimensions of Perceived Risk Associated with Shopping Behavior

<i>Dimension of Risk</i>	<i>Definition</i>	<i>Cited Study</i>
<i>Functional Risk</i>	The risk that the product will not perform as expected	Jacoby and Kaplan (1972)
<i>Performance Risk</i>	The risk that the product will not meet one's standards of quality	Roselius (1971); Dunn, Murphy and Skelly (1986)
<i>Physical Risk</i>	The risk to a consumer's or others' safety in using the product	Jacoby and Kaplan (1972)
<i>Psychological Risk</i>	The risk that a poor product choice will harm the consumers' ego	Jacoby and Kaplan (1972); Roselius (1971)
<i>Social Risk</i>	The risk that a product choice may result in embarrassment before one's family or friends; the risk that others will think less of you as a result of a poor product choice	Jacoby and Kaplan (1972); Roselius (1971); Dunn, Murphy and Skelly (1986)
<i>Financial Risk</i>	The risk that the product will not be worth the financial price	Jacoby and Kaplan (1972); Roselius (1971); Dunn, Murphy and Skelly (1986)

Table 3  
Summary of Hypotheses, Variable Definitions and Variable Measurement

Hypothesis	Dependent Variable	Independent Variable	Pred. Sign	Support	Question Used to Capture Construct	Scale
H1	<i>Frequency of checking<sup>a</sup></i>	<i>Functional Risk</i>	+	Yes	“How likely is it that the following product will not meet your expectations as it approaches its expiration date?”	1=very unlikely, 5=very likely
“	“	<i>Performance Risk</i>	+	Yes	“How likely is it that the quality of the following product gets worse as the product approaches its expiration date?”	“
“	“	<i>Physical Risk</i>	+	Yes	“How likely is it that consuming a spoiled product of the following grocery item may lead to a health risk?”	“
“	“	<i>Psychological Risk</i>	+	No	“How likely are you to think less of yourself as an experienced shopper if you were to buy the following grocery item and find it did not meet your standards of quality?”	“
“	“	<i>Social Risk</i>	+	No	“How likely would guests in your home be to think less of you for serving them a poor quality product?”	“
“	“	<i>Financial Risk</i>	+	No	“How likely would you be to feel financial angst from paying for the following product and then having it not perform up to its expectation?”	“
H2	“	<i>Category Experience</i>	+	Yes	“How often do you purchase in the product category in an average month?”	1= 2+ times/month; 0= < 2/month
H3	<i>WTP<sup>b</sup></i>	<i>Days</i>	+	Yes	The number of days remaining before the product reaches its expiration date	<i>Days = 7, 4 or 1</i>
H4	“	<i>Days* HHConsume</i>	+	Yes	“How often do you purchase in the product category in an average month?”	0=never; 4=four or more times/month
H5	“	<i>Days*Stop</i>	+	Yes	An indication of whether the consumer plans to stop the aging process (e.g., cook, freeze) of the perishable upon arriving home	1= cook or freeze; 0= otherwise
H6	“	<i>Functional Risk</i>	-	Yes		See Above
“	“	<i>Performance Risk</i>	-	Yes		“
“	“	<i>Physical Risk</i>	-	Yes		“
“	“	<i>Psychological Risk</i>	-	No		“
“	“	<i>Social Risk</i>	-	No		“
“	“	<i>Financial Risk</i>	-	No		“

<sup>a</sup> “How often do you check for an expiration date when buying each of the following products?” 1=never, 5=always

<sup>b</sup> “What is the most you would be willing to pay for product *j* if it were due to expire in (7, 4, 1) days?”/shelf-price

Table 4  
Summary Statistics About the Sample and Product Categories Investigated

<b><i>Consumer Information</i></b>						
% females						75%
% over 45 years old						50%
% household income <\$50,000						37%
% with college or graduate degree						64%
% working fulltime						57%
Average household size						2.67
<b><i>Product Information</i></b>						
	<i>Avg. Shelf-Life (Days)</i>	<i>Avg. Retail Price</i>	<i>% Aware of the Existence of Exp. Dates</i>	<i>% Who "Always"/ "Usually" Check Expiration Dates</i>	<i>% Whose Perception of Store Quality Would Decrease if the Store Were to Discount Perishable Goods</i>	<i>% Who Believe Quality Deteriorates As the Product Approaches Its Exp. Date</i>
Pre-cut/Pre-washed lettuce	10	\$2.49	53%	42%	44%	84%
Milk	14	\$2.70	99%	93%	47%	84%
Chicken breast	7	\$2.99	80%	74%	46%	82%
Pre-cut/Pre-washed carrots	21	\$1.69	35%	29%	40%	69%
Yogurt	21	\$0.62	87%	70%	44%	74%
Beef	7	\$2.68	78%	59%	47%	84%

Table 5  
Factor Loadings

	<i>Lettuce</i>		<i>Milk</i>		<i>Chicken</i>		<i>Carrots</i>		<i>Yogurt</i>		<i>Beef</i>	
<i>Risk Variable</i>	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2	Factor 1	Factor 2
<i>Functional</i>	.884	.082	.864	-.014	.833	.084	.822	.067	.865	.042	.863	.083
<i>Performance</i>	.877	.160	.837	.015	.747	.159	.773	.007	.836	.089	.745	.254
<i>Physical</i>	.472	.261	.468	.205	.648	-.029	.513	.329	.649	.159	.681	-.042
<i>Psychological</i>	-.070	.791	-.064	.806	-.056	.817	.009	.737	-.062	.785	-.047	.820
<i>Social</i>	.089	.744	.065	.751	.088	.799	.089	.778	.128	.794	.113	.794
<i>Financial</i>	.299	.486	.290	.504	.304	.432	.136	.616	.301	.551	.303	.416
<i>Cronbach Alpha</i>	.70	.72	.70	.71	.73	.71	.74	.75	.81	.74	.77	.72
<i>% Variation Explained</i>	.317	.308	.323	.282	.330	.285	.291	.310	.360	.294	.345	.288

Table 6  
OLS Regression Results for the Frequency of Checking Expiration Dates

	Lettuce	Chicken	Carrots	Yogurt	Beef
<i>Intercept</i>	.70 (.58) <sup>a</sup>	2.98** (.55)	1.48** (.51)	2.67** (.51)	1.70** (.56)
<i>PQR (H1)</i>	.24** (.06)	.05** (.02)	.09** (.03)	.07** (.02)	.11** (.05)
<i>PR (H1)</i>	-.08 (.05)	-.01 (.05)	-.02 (.05)	-.04 (.05)	-.01 (.05)
<i>Category Experience (H2)</i>	.27** (.08)	.19** (.07)	.35** (.09)	.42** (.06)	.38** (.07)
<i>Gender</i>	-.12 (.25)	-.15 (.21)	-.37 (.24)	-.20 (.21)	-.10 (.22)
<i>Age</i>	.26 (.22)	.46** (.19)	.28 (.21)	.10 (.19)	.63** (.20)
<i>Income</i>	.25 (.23)	.13 (.19)	.20 (.22)	.12 (.19)	-.13 (.20)
<i>Fulltime</i>	-.31 (.21)	-.14 (.18)	-.44* (.20)	.08 (.18)	.10 (.19)
<i>Household Size</i>	.21 (.41)	-.03 (.15)	.32 (.21)	.07 (.08)	-.13 (.10)
<i>R<sup>2</sup></i>	.37	.41	.36	.39	.42

\* p<.05

\*\* p<.01

<sup>a</sup> Numbers in parentheses are standard errors

Table 7  
 OLS Regression Results for Willingness to Pay (WTP) for a Perishable

	Lettuce	Milk	Chicken	Carrots	Yogurt	Beef
<i>Intercept</i>	.12 (.14) <sup>a</sup>	.105 (.15)	.32* (.13)	.51** (.12)	.32* (.13)	.36** (.12)
<i>Days</i> <sup>b</sup> (H3)	.11 (.02)	.09** (.02)	.0004 (.0001)	.05* (.02)	.10* (.02)	.0003 (.0001)
<i>Days*HHConsume</i> (H4)	.01 (.003)	.01** (.004)	.0001 (.0001)	.01* (.004)	.003 (.001)	.0002 (.0001)
<i>Days*Stop</i> (H5)	.06** (.02)	.04 (.03)	.0002** (.0001)	.07** (.02)	.06** (.01)	.0003 (.0001)
<i>PQR</i> (H6)	-.02* (.01)	-.02* (.009)	-.02* (.01)	-.04** (.01)	-.02** (.008)	-.02* (.01)
<i>PR</i> (H6)	.01 (.01)	-.01* (.009)	-.01 (.01)	-.002 (.01)	-.01 (.01)	-.01 (.01)
<i>Gender</i>	.04 (.04)	-.01 (.04)	.07 (.04)	-.006 (.04)	-.06 (.04)	.05 (.04)
<i>Age</i>	.08* (.04)	.08* (.04)	.12** (.04)	.03 (.04)	.07* (.04)	.11* (.04)
<i>Income</i>	.07* (.04)	-.02 (.04)	.04 (.04)	.05 (.04)	.07 (.04)	.03 (.04)
<i>Fulltime</i>	.02 (.03)	-.01 (.04)	-.01 (.03)	-.04 (.04)	.01 (.04)	-.003 (.03)
<i>Household Size</i>	.03* (.01)	-.001 (.02)	.04** (.01)	.03* (.01)	.04** (.01)	.02* (.01)
<i>R</i> <sup>2</sup>	.43	.47	.41	.42	.48	.52

\* p<.05

\*\* p<.01

<sup>a</sup> Numbers in parentheses are standard errors

<sup>b</sup> The best fitting model for Chicken and Beef operationalized *Days* as  $e^{days}$

Table 8  
Main Findings and Implication

Behavior	Main Findings	Implications
<i>Frequency of checking expiration dates</i>	As <i>PQR</i> decreases, consumers are less likely to check expiration dates.	Because lack of awareness of expiration dates is bad for consumers (they make uninformed decisions) and marketers (who may be blamed by consumers for tricking them to purchase products close to expiration at full price), marketers must pay special attention to educate consumers whose perceptions of <i>PQR</i> tend to be low. This is especially true for categories in which the majority of consumers tend to have low perceptions of <i>PQR</i> (e.g., carrots and lettuce).
	Consumers with greater category experience more frequently check expiration dates.	Discounting perishables approaching their expiration dates may be most effective when targeted at consumers with greater category experience. In addition, marketers must pay special attention to educate inexperienced consumers about expiration dates so they can make more informed decisions.
<i>Willingness to pay (WTP) for a product over its shelf-life</i>	<i>WTP</i> decreases over the shelf-life of a product.	Discounting may be a necessary and effective way to entice consumers to purchase a perishable close to its expiration date. Furthermore, it suggests the need to educate consumers that the quality of perishables does not significantly deteriorate as the product approaches its expiration date.
	<i>WTP</i> decreases linearly for products with low <i>PQR</i> and exponentially for products with high <i>PQR</i> .	A deeper discount may be necessary to sell a perishable with a high <i>PQR</i> (e.g., beef, chicken) earlier in the shelf-life of the product.
	<i>WTP</i> is lower for younger consumers and consumers with lower household consumption rates.	Marketers could target younger consumers and consumers shopping for households with lower consumption rates with price incentives to purchase perishables close to their expiration dates.
	The greater the perceptions of <i>PQR</i> , the lower the <i>WTP</i> .	Marketers must educate consumers about the true product quality and health risks associated with a perishable before it reaches its expiration date. Specifically, that the quality of perishables does not deteriorate as the product approaches its expiration date.
	<i>WTP</i> is higher in situations in which consumers plan to stop the aging process.	Marketers should provide recipes, cooking suggestions, reminders to freeze the product upon arriving home, etc. to encourage consumers to stop the aging process upon arriving home. They may also offer smaller package sizes to serve the same purpose.

Figure 1  
The Influence of Risk on Consumer Behavior in Grocery Store Perishable Categories

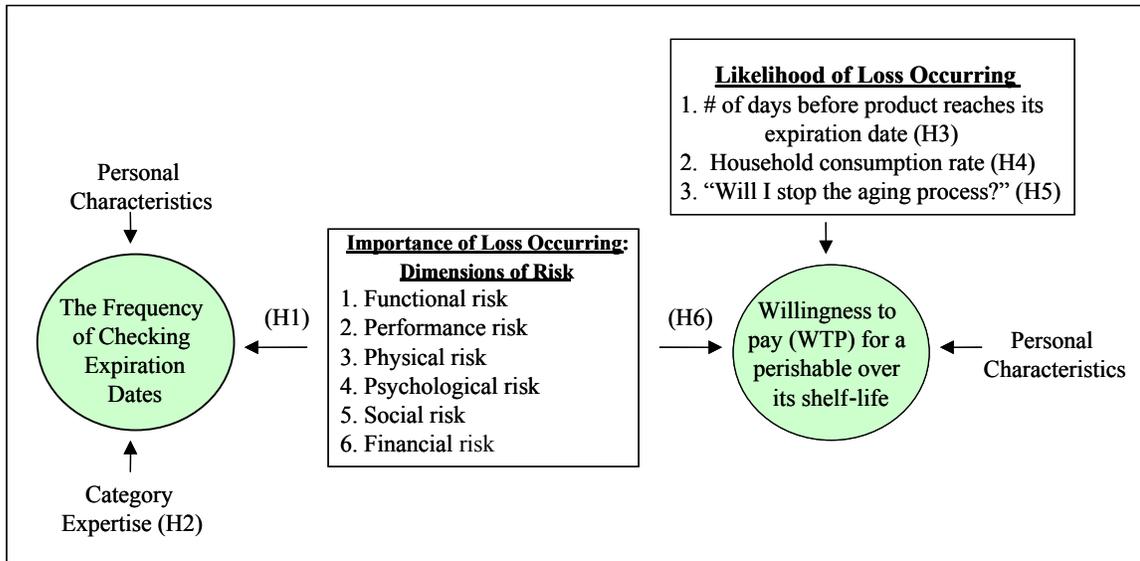
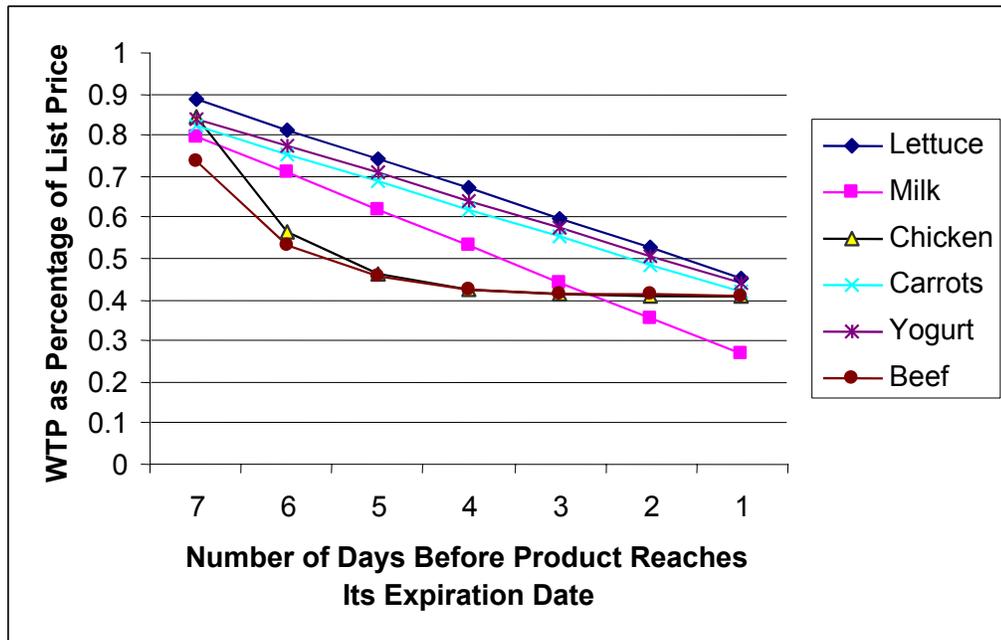


Figure 2  
Willingness to Pay (WTP) As a Percentage of List Price Over the  
Shelf-Life of a Perishable



## References

- Abad, P.L. (2003), "Optimal Pricing and Lot-Sizing Under Conditions of Perishability, Finite Production and Partial Backordering and Lost Sale," *European Journal of Operations Research*, 144 (3), 677-685.
- Alba, Joseph W. and J. Wesley Hutchinson (1987), "Dimensions of Consumer Expertise," *Journal of Consumer Research*, 13 (March), 411-454.
- Berner, Robert (1999), "A Battle Fought With Kiwis and Kale," *Wall Street Journal*, March 15, B1.
- Bettman, James R. (1973), "Perceived Risk and Its Components: A Model and Empirical Test," *Journal of Marketing Research*, 10, 184-190.
- and C. Whan Park (1980), "Effects of Prior Knowledge and Experience and Phase of the Choice Process on Consumer Decision Processes: A Protocol Analysis," *Journal of Consumer Research*, 7 (3), 234-248.
- Blackwell, Roger D., Paul W. Miniard, and James F. Engel (2001), *Consumer Behavior*, (Ninth Ed.), Hartcourt, Fort Worth.
- Chun, Y.H. (2003), "Optimal Pricing and Ordering Policies for Perishable Commodities," *European Journal of Operations Research*, 144 (1), 68-82.
- Dowling, Grahame R. and Richard Staelin (1994), "A Model of Perceived Risk and Intended Risk-Handling Activity," *Journal of Consumer Research*, 21(1), 119-134.
- Dunn, Mark G., Patrick E. Murphy and Gerald U. Skelly (1986), "The Influence of Perceived Risk on Brand Preference for Supermarket Products," *Journal of Retailing*, 62(2), 204-216.
- Dwivedi, T. and K. Srivastava (1978), "Optimality of Least Squares in the Seemingly Unrelated Regressions Model," *Journal of Econometrics*, 7, 391-395.
- Eom, Y.S. (1994), "Pesticide Residue Risk and Food Safety Valuation: A Random Utility Approach," *American Journal of Agricultural Economics*, 76 (4), 760-772.
- Fujiwara, Okitsugu, Hanijanto Soewandi, and Dayani Sedarage (1997), "An Optimal Ordering and Issuing Policy for a Two-Stage Inventory System for Perishable Products," *European Journal of Operations Research*, 99, 412-424.
- Giri, B.C. and K.S. Chaudhuri (1998), "Deterministic Models of Perishable Inventory with Stock-Dependent Demand Rate and Non-linear Holding Costs," *European Journal of Operations Research*, 105, 467-474.

- Gold, F. (1981), *Modern Supermarket Operations*, (Third Ed.), Fairchild Publications, New York.
- Greenleaf, Eric A. and Donald R. Lehmann (1995), "Reasons for Substantial Delay in Consumer Decision Making," *Journal of Consumer Research*, 22 (September), 186-199.
- Hariga, Moncer (1997), "Optimal Inventory Policies for Perishable Items with Time-Dependent Demand," *International Journal of Production Economics*, 50, 35-41.
- Havlena, William J. and Wayne S. DeSarbo (1990), "On the Measurement of Perceived Consumer Risk," *Decision Sciences*, 22, 927-939.
- Hahn, Kyu Hun, Hark Hwang, and Seong Whan Shinn (2004), "A Returns Policy for Distribution Channel Coordination of Perishable Items," *European Journal of Operational Research*, 152, 770-780.
- Hennessy, Terry (1998), "Where Category Management Really Counts," *Progressive Grocer*, 77 (2), 63.
- Huang, Chung L. (1993), "Simultaneous-Equations Model for Estimating Consumer Risk Perceptions, Attitudes, and Willingness-to-Pay for Residue-Free Produce," *The Journal of Consumer Affairs*, 27 (2), 377-396.
- Jacoby, Jacob and Leon B. Kaplan (1972), "The Components of Perceived Risk," in *Proceedings, Third Annual Conference of the Association for Consumer Research*, ed. M. Venkatesan, College Park, Maryland: Association for Consumers Research, 382-393.
- Johnson, Eric J. and J. Edward Russo (1984), "Product Familiarity and Learning New Information," *Journal of Consumer Research*, 11 (June), 542-550.
- Keenan, Faith (2003), "The Price Is Really Right," *BusinessWeek*, March 31, 62-67.
- Kerin, Roger A., Ambuj Jain, and Daniel J. Howard (1992), "Store Shopping Experience and Consumer Price-Quality-Value Perceptions," *Journal of Retailing*, 68 (4), 376-397.
- Khouja, Moutaz (1996), "The Newsboy Problem with Multiple Discounts Offered by Suppliers and Retailers," *Decision Sciences*, 27 (3), 598-599.
- Krider, Robert E. and Charles B. Weinberg (2000), "Product Perishability and Multistore Grocery Shopping," *Journal of Retailing and Consumer Services*, 7, 1-18.
- Li, M.Z. F. (2001), "Pricing Non-Storable Perishable Goods by Using a Purchase Restriction with an Application to Airline Fare Pricing," *European Journal of Operations Research*, 143 (3), 631-647.

- Lichtenstein, Donald R., Minette E. Drumwright, and Bridgette M. Braig (2003), "The Effect of Corporate Social Responsibility on Customer Donations to Corporate-Supported Nonprofits," *working paper*.
- Litwak, David (1997), "So Many Programs, So Little Data," *Supermarket Business*, 52 (9), 165-169.
- Lodish, Leonard M. (1980), "Applied Dynamic Pricing and Production Models with Specific Applications to Broadcast Spot Pricing," *Journal of Marketing Research*, (17) May, 203-211.
- Maheswaran, Durairaj and Brian Sternthal (1990), "The Effects of Knowledge, Motivation, and Type of Message on Ad Processing and Product Judgments," *Journal of Consumer Research*, 17 (June), 66-73.
- Mintel (1997), "Food Safety," *Mintel*, August.
- Mitchell, V. -W. (1998), "A Role for Consumer Risk Perceptions in Grocery Retailing," *British Food Journal*, 100 (4), 171-183.
- Murphy, Patrick E. and Ben M. Enis (1986), "Classifying Products Strategically," *Journal of Marketing*, 50 (July), 24-42.
- Nijs, Vincent R., Marnik G. Dekimpe, and Jan-Benedict E.M. Steenkamp (2001), "The Category-Demand Effects of Price Promotions," *Marketing Science*, 20 (1), 1-22.
- Oglethorpe, Janet E. and Kent B. Monroe (1987), "Risk Perception and Risk Acceptability in Consumer Behavior: Conceptual Issues and an Agenda for Future Research," in *AMA Winter Marketers Educators' Conference*, eds. Russell W. Belk et al., Chicago: American Marketing Association, 255-260.
- Peter, J. Paul and Lawrence X. Tarpey, Sr. (1975), "A Comparative Analysis of Three Consumer Decision Strategies," *Journal of Consumer Research*, 2 (June), 29-37.
- Rajan, Arvind, and Richard Steinberg (1992), "Dynamic Pricing and Ordering Decisions by a Monopolist," *Management Science*, (38) February, 240-262.
- Roselius, Ted (1971), "Consumer Rankings of Risk Reduction Methods," *Journal of Marketing*, 35 (January), 56-61.
- Shell, Adam (2003), "No Surprises on the Street: Beef Stocks Falter," *USA Today*, December 26, 2B.
- Subrahmanyam, Saroja and Robert Shoemaker (1996), "Developing Optimal Pricing and Inventory Policies for Retailers Who Face Uncertain Demand," *Journal of Retailing*, 72 (1), 7-30.

*Supermarket Business* (2000), Annual Consumer Expenditures Study.

*Supermarket News* (1997), "Study: Supermarkets Battling High Shrink in Perishables," April 7<sup>th</sup>, 1997, 47 (14), 25-26.

*Tufts University Health & Nutrition Letter* (1997), "Decoding the Freshness Dates on Food Labels," November, 15 (9), 3.

Turcsik, Richard (2003), "Midtown Magic: Roundy's Prototype Supermarket Turns a Failed Mall Into a Gleaming Urban Renewal Project in the Milwaukee Melting Pot," *Progressive Grocer*, February 1, 2003.

Yeung, Ruth M.W. and Joe Morris (2001), "Food Safety Risk Consumer Perception and Purchase Behaviour," *British Food Journal*, 103 (3), 170-186.

Zellner, A. (1962), "An Efficient Method of Estimating Seemingly Unrelated Regressions and Tests of Aggregation Bias," *Journal of the American Statistical Association*, 57, 500-509.