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Executive Summaries

RESEARCH

Does Product Diversity Signal Bargains in Australian Wine?

Ira Horowitz and Larry Lockshin

In the past few years, wine has become the alcoholic beverage with the largest penetration of consumers in both the US and the UK, replacing beer in both countries. Supermarkets have increased the size of their wine sections and the whole channel for wine has changed from one of small agricultural producers to more and more large companies selling branded products. Consumers are faced with a choice from 300-1500 items in a typical wine section as compared to 10-70 in other supermarket categories, so the decision process is more complex and difficult. We examine whether the quality of a single wine from a producer provides information as to the quality of different wines (product diversity) sold under the same producer brand. Does having a broad range signal quality or does being a small specialist producer of only one or two wines signal quality?

We use the residuals from linear regression equations predicting wine quality for each of eight Australian wine varieties to predict whether the predicted quality is higher or lower than should be expected. We use the quality ratings from well-known wine author James Halliday for hundreds of wines to examine our research question.

We find that the winery's reputation, price to some degree, and aspects of the region of origin and vintage predict wine quality. But the actual bottle purchased may exceed or fall short of the consumer's expectations for it. We found that specialization (making only one or two wines) does not necessarily signal quality, but that product diversity is a weak signal as to wine quality and a negative one at that.

Wine brands are different from other brands in the food industry in that they often represent products, whose quality varies from year to year and from type to type. Managers of these wine firms need to understand how consumers receive and interpret signals of quality. Product diversity, whether small or large, does not signal wine quality based on this research. Even price is a fault-ridden quality

signal for Australian wine. More research is needed to understand how and what signals quality to the average wine buyer.

Redesigning the Food Chain: Trade, Investment and Strategic Alliances in the Orange Juice Industry

Paulo F. Azevedo and Fabio Chaddad

Change in trade barriers and capital flow creates opportunities for redesigning the food chain. In the most prominent view, trade barriers foster foreign direct investment as an alternative to explore competencies that may be replicated in the host country (Dunning [1998]). On the other hand, the institutional harmonization that emerges with market integration – i.e. lower trade barriers – promotes foreign direct investments because firms are more likely to invest when they know the rules that govern market competition. This paper argues that the perspective of market integration may combine both effects in the same direction.

The orange juice chain in U.S. and Brazil, the key-players in the global frozen concentrated orange juice (FCOJ) market, provides an interesting illustration of how change in market integration provides incentives for foreign direct investment and the redesign of the food chain, particularly in order to deeply explore existing capabilities. The study focuses on the FCOJ industry in Florida and the Southeast region of Brazil, particularly São Paulo State. Firms expect institutional harmonization and market integration, opening new opportunities for strategic alliances and the re-design of the food chain in general. Meanwhile Brazilian orange juice firms face high import tariff rates and no perspective of significant fall in the short run. Thus there are strong incentives for them to redirect investments to orange crushing plants located in the US. The additional variable that explains the re-arrangement in the FCOJ chain was the existence of complementary capabilities among Brazilian crushing firms – particularly Citrosuco and Cutrale – and US beverage firms, such as Tropicana and Minute Maid.

This finding has relevant implications to agribusiness managers. First, trade barriers are not enough to support FDI and related internationalization decisions. Second, the perspective of market integration creates a positive environment, mainly due to institutional harmonization, for new strategic alliances and the re-design of the food chain. And third, the existence of complementary capabilities between foreign and domestic companies is a necessary condition for this type of supply chain re-arrangement.

Success Factors for New Generation Cooperatives

Jared G. Carlberg, Clement E. Ward, and Rodney B. Holcomb

The goal of the research reported in this paper was to determine the factors important to the success of value-added New Generation Cooperatives (NGCs). A survey of NGC managers was used to determine which potential success factors they considered to be important for their organizations. A self-explicated approach

was used to calculate weighted preference scores for each of 50 factors. Scores were calculated across all respondents as well as for respondents within five broad NGC groups, with the members of each group engaged in similar value-added activities.

Results indicate that factors in the "Planning and Development" category and the "Financing and Costs" category are considered critically important for success by NGC managers as a whole. However, when smaller subsets of NGCs with common characteristics are considered, important differences exist as to the factors considered to be important for success.

Three recommendations for value-added management are made at the end of the paper. It is hoped that this research will benefit persons engaged in the development or management of NGCs or similar value-added agribusinesses.

Protecting Your Turf: First-mover Advantages as a Barrier to Competitor Innovation

Brian C. Briggeman, Michael A. Gunderson, and Joshua D. Detre

Agribusinesses selling consumer goods constantly have to alter their products to meet ever-changing consumer demands. Consumers desire innovative products that meet their personal tastes, income levels, or expectations for improving the quality of their life relative to existing products. Firms that recognize these changes in tastes can innovate and meet this change in demand with improved products and, at least initially, capture a premium.

Innovators hope that first-mover advantages will allow them to recoup some of the costs associated with creating a new product and reward them for facing the uncertainty of the new market. That is, innovators would desire that initially they could extract a premium for being among the first competitors in a market (Conner 1988). Additionally, they desire that being the first in the market would create a degree of loyalty among consumers that result in consistently higher market share that is more easily defendable. Therefore, our objective is twofold: 1) calculate the size of first-mover advantages; 2) demonstrate that a first-mover strategy deters competitors from innovating. Using a fruit juice company's market data, we develop a stochastic net present value simulation model to analyze the introduction of a new juice product in an uncertain market. Results indicate that first mover advantages are large enough to justify entering the uncertain market. Also by entering the market now, the firm is able to maintain their long-term market share because the probability of competitor entry is decreased (i.e. barrier to competitor innovation is created). Finally, it is our contention that the presented model allows for a better-justified decision regarding the respective firm's market investments in a new product. Furthermore, this model is flexible enough to recognize differences in other markets in terms of the number of firms, start-up costs, competitiveness in industry, market share, and pricing responses.

Scorecarding and Heat Mapping: Tools and Concepts for Assessing Strategic Uncertainty

Joshua Detre, Brian Briggeman, Michael Boehlje, and Allan W. Gray

The dramatic changes occurring throughout the agriculture industry are creating new and different uncertainties than the traditional operational and financial uncertainties agribusinesses have faced in the past. These new uncertainties result from strategic choices and a turbulent business climate. The objective of this paper is to present a methodology that helps teach agribusiness managers how to understand, assess, evaluate, and manage these new and different strategic uncertainties. The approach is to present a mental model that frames assessment of strategic uncertainty from a potential and exposure perspective. Scorecarding and heat mapping assessment tools operationalize the mental model. Participants in an executive agribusiness educational workshop applied this mental model to one of three hypothetical seed companies.

The participants in the workshop found that by focusing on the potential of the uncertainty and the likelihood of this potential as well as the exposure and the likelihoods of exposure, allowed them to understand better the true impact uncertainty could have on their firm's value. In addition, their perspective was that the methodology was not only an effective way to facilitate understanding of strategic uncertainty, but it also provided useful assessment tools that management can easily incorporate into their company's strategic planning processes. In essence, the scorecard and heat mapping tools provided a time efficient and systematic method for analyzing as well as communicating the strategic uncertainties faced by the firm. Further development and testing is necessary and underway, but preliminary results suggest that the methodology is useful in understanding, analyzing, and communicating the potential as well as the exposure of strategic uncertainty.

Does Price Signal Quality? Strategic Implications of Price as a Signal of Quality for the Case of Genetically Modified Food

Yun-Jae Hwang, Brian Roe, and Mario F. Teisl

When products differ by quality and quality is highly subjective (e.g., fashion or art), novel (e.g., new technology), or difficult to verify prior to purchase (e.g., credence attributes), consumers may turn to price as a signal of quality. Products containing genetically modified (GM) ingredients meet each of these criteria, i.e., GM ingredients are novel, their presence is difficult to verify, and their impact on quality may be viewed differently across individuals with the same knowledge. This leads to additional difficulty for managers attempting to formulate pricing strategy in the presence of more a complex quality signaling environment.

We add to the limited empirical literature on consumers' use of price as a quality signal by testing if the traditional downward-sloping consumption-price relationship fails to hold for GM products using data collected from a nationally

representative mail survey featuring several hypothetical product choice scenarios. Graphical inspection of the results suggest that certain high and low prices may indeed act as a signal of quality and cause consumers to drive the GM products' market share to levels not predicted by standard theory. Statistical evidence is more mixed across the three products used in the survey (bread, corn, and eggs) but still suggests that survey respondents use price as a signal of the quality of GM products.

Food products with labeled GM ingredients are in an introduction (start-up) period of their life cycle in most product categories. Firms who try to gain public awareness for their products and to expand market share might, for example, decide between a low introductory pricing strategy, a price matching strategy, or strategy that sets price higher than competing, non-GM brands. If consumers use price as a signal of quality, however, some of these pricing strategies might be less effective or disastrous. For example, if products featuring GM ingredients are heavily discounted, either to stimulate trial purchases or by a retailer hoping to lower inventories of a new product, the long-term success of the GM product may fight an uphill battle in some markets because respondents may interpret low prices as a negative quality signal.

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Does Product Diversity Signal Bargains in Australian Wine?[1]

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Abstract

The residuals from a set of linear regression equations built to explain the quality of a bottle of Australian wine via eight quality signals are examined to determine whether there is any relationship between their signs for individual producers and the diversity of their offerings. Product diversity is found to be a fault-ridden signal of a quality-bargain, which we define as a bottle of wine whose quality rating exceeds its regression-based expectation. Indeed, to the extent that the signal does impart useful information, the message would be that consumers are less likely to get their money's worth the greater is the diversity of the producer's offerings.

Keywords: wine marketing, product diversity, wine quality, predicted quality, quality-bargain

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Introduction

Economists have long been aware that "the consumer is no longer an expert shopper. More and more, therefore, the consumer of today has to judge quality by some indices of quality. Hence the importance producers attach to goodwill and trademarks. Another important index of quality is price" (Scitovsky, 1944-5, p. 100). That is, at the time of purchase consumers observe intrinsic and extrinsic quality signals rather than experiencing the actual quality attributes (Steenkamp, 1990). This is especially true for services and some products, such as wine, which cannot be judged until actual consumption occurs.

Akerlof (1970) deduced some of the consequences of formally injecting into economic thought the notion that consumers often make purchasing decisions under uncertainty as to product quality. Subsequently, the implied ideas that "prices convey information other than that about scarcity" and that economically relevant information is conveyed in a variety of ways were also formalized (Stiglitz, 2000, p. 1449). Even in Scitovsky's time, however, the basic ideas were not novel. Rather, they had fallen between cracks that remained unfilled in microeconomic models built on a shaky foundation of a world populated by economic agents that had perfect information (Stiglitz, 2002). The burgeoning field of information economics allows that foundation to crumble, replacing it with one that incorporates ubiquitous and imperfect, but economically relevant, information that influences behavior.

Akerlof drew attention to the information asymmetries about product quality that might exist between buyers and sellers and suggested that "[N]umerous institutions would arise to counteract the effects of quality uncertainty" (Akerlof, 1970, p. 499). He cited guarantees and various types of branding as cases in point. Spence paid heed. After initially being intrigued by the potential implications of asymmetric information for job markets, he turned his attention to the implications of what he called information-conveying signals for market structure in general (Spence, 2002, p. 434). The signals might extend beyond those over which sellers have control and intentionally send to buyers (i.e., advertisements) or that buyers may infer from seller behavior (i.e., money-back guarantees), and include such things as buyer experience and third-party sources (Spence, 1977, p. 571).

The information conveyed through signals may impact the behavior of a market's agents, and their individual actions, and in turn may provide additional information to the other participants (Stiglitz, 2000. p. 1469). It therefore becomes incumbent upon sellers to know how buyers will interpret the signals they are being sent. For their part, buyers seek to separate the wheat from the chaff so as to take full advantage of those same signals in their own decision-making processes.

Although various quality signals, cues, or indicators have attracted considerable theoretical attention, the empirical evidence as to their quality is scarce and mixed (Kirmani and Rao, 2000). Gerstner (1985), for example, found higher prices to be poor signals of quality, and Hjorth-Anderson (1991) gave low marks to both price and seller reputation as quality indicators. By contrast, examining warranties for appliances and motor vehicles Wiener (1985) found them to be accurate quality (reliability) indicators. Kirmani and Rao (2000) conclude that from the perspective of a seller attempting to influence buyer behavior, sending a combination of complementary quality signals would be the most apt signaling strategy.

Horowitz and Lockshin (2002) sought to contribute to the latter literature. There, a quality measure for eight varieties of Australian wine serves as the dependent variable in linear regressions whose independent variables are many of the signals that others have used to explain wine quality. We now extend this earlier work to address two additional quality-related issues: (1) Will a producer who gives more or less bang for the Australian buck in a bottle of any one varietal on a retailer's shelf tend to do likewise in its other offerings? (2) Does the number of varietals that a producer offers signal anything about the bang for the buck provided by any one of them? Thus, whereas Oczkowski (2001) considers a bargain wine to be one that sells for a lower-than-expected price, given its quality, we look at the flip side of the coin and consider a bargain wine to be one that provides greater-than-expected quality for the price at which it sells. We call this a quality-bargain. This is a relevant issue for many product categories, including the wine sector. Quality improvements occur constantly in consumer products, while the price points remain constant. This has occurred in automobiles in regard to safety, reliability, and fuel consumption as well as in the wine industry. With wine, however, the quality-bargain issue is especially salient. Even knowledgeable consumers shopping for wine will often seek the counsel of a shop's wine expert. After eliciting some information as to the customer's preferences and/or what occasions the purchase, the expert will typically ask a question along the following lines: "What price range did you have in mind?" The expert's recommendations will then reflect his or her judgment as to the highest-quality wines – the quality-bargains – within that price range. We then ask (1) whether producers are prone to providing either quality-bargains or rip-offs across the entire range of their offerings, and (2) whether product diversity is a useful signal of a producer's tendency to do either. The answer to the first question is a soft-spoken "Yes" with respect to a few varieties, such as riesling when paired with shiraz, and a much louder "No" with respect to most other pairings, such as chardonnay and sauvignon blanc. The answer to the second question is a firm "Yes," with the tendency being to give less bang for the buck when more than two varieties of wine are on offer.

The Diversity Issue

Approximately 2000 wineries comprise the Australian wine industry. Some grow their own grapes and make, bottle and sell their own branded wine; others sell wine that is made elsewhere or wine produced from purchased grapes (Kyte-Powell and Hooke, 2000, p. 5). The three largest producers, Foster's Wine Estates (comprising Beringer-Blass and Southcorp Wines), Hardy Wines (part of Constellation Brands), and Orlando-Wyndham are groups that account for more than seventy-five percent of the industry's wine-grape crush. That crush has grown by almost fifty percent over the past five years and now exceeds 1.8 million tons. Over 50 percent of the wine produced from that crush, in excess of 500 million liters valued at over 2.2 billion Australian dollars ($) is exported. Almost half of those exports, and one-third of the production of the Big Three, go to the United Kingdom; another quarter goes to the United States (AWBC, 2003). The year 2000 was a hallmark year for the industry, one in which for the first, but surely not the last time Australia was the largest exporter of New World wine (Nicholson, 2001, p. 40).

One of the reasons the wine sector in Australia provides a useful test arena is due to the diversity of the product offer available. The standard supermarket category has between 3-10 brands and around 50-70 product variants. The wine category itself has a minimum of 300 brands and product variants, which stretches to over 1500 different wines in some more specialized outlets. All groups bottle wine under labels that are designed to appeal to all tastes and budgets. Foster's Wine Estates, for example, sells in the neighborhood of ten million cases of its Lindemans' Bin 95 Sauvignon Blanc, Bin 65 Chardonnay, Bin 99 Pinot Noir, Bin 50 Shiraz, and Bin 45 Cabernet Sauvignon, all of which retail for at most $10 a bottle; Foster's Wine Estates sells somewhat less of its Penfolds' Grange, the Australian pride and joy, a shiraz that retails for about $300 (Halliday, 2001, pp. 216-17, 287). By contrast, the Scarp Valley Vineyard produced only 24 cases of its sole label, Scarp Valley Darling Range Hermitage, a shiraz and cabernet sauvignon blend that retails for about $17, while Jollymont, perhaps Australia's smallest winery, produced 20 cases in total of a pinot noir and a chardonnay that retail in the $20-$25 range (Halliday, 2001, pp. 185, 341).

Looking down from the heavens, Adam Smith who believed that the division of labour "must always be limited by…the extent of the market" (Smith, 1776, pp. 1-21) might well be surprised at the variety of products offered by the multi-product firm that characterizes the Australian wine industry. Two centuries later and long after the multi-product firm became a global phenomenon, economies of scope was formalized into a commonly accepted concept in the economics literature, one that provides the multi-product firm with a raison d'être (Panzar and Willig, 1981, p. 168). Thus, like Rosen's suppliers, Australian wineries "either specialize their production in distinct varieties or produce several of them in a product line. Costs and production conditions, indivisibilities, the nature of competition, and

competitors' costs factor into these outcomes" (Rosen, 2002, p. 4), and firm size does not necessarily dictate the course of action taken by any one of them. Nonetheless, a small winery is more likely to concentrate its efforts on a few wines, whereas a larger winery or group is more likely to diversify its offerings. This raises two issues, the first being whether size signals quality. Is the mystique of the boutique winery justified? Has a large group gained market share at the expense of quality? We touched on these interesting questions in our earlier paper. A second issue is whether the diversity of a seller's product line reveals anything about whether those products are or are not quality-bargains. Do you get your money's worth when you buy one of the two varietals that are sold by a boutique winery? Quality considerations aside, do any economies of scope enjoyed by a large group translate into better wine for the money? In this paper, then, we explore whether product diversity signals quality-bargains in Australian wine.

Estimating Deviations from Quality Expectations for an Australian Wine

Horowitz and Lockshin (2002) hypothesized that an Australian winery's reputation and the price of any one bottle are effective, if imperfect, quality signals. Like brand advertising, price is an extrinsic attribute that consumers often use to assess product quality when the intrinsic attributes cannot be assessed (Ralston, 2003). The bottle's label typically contains additional potentially cogent information, with the location of the winery as a signal of its collective reputation (Landon and Smith, 1998, p. 632), and the vintage, being particular cases in point. Indeed, it is a poorly-kept secret that, in general, region of origin has the potential to influence consumer perceptions of a product and consequently the price consumers are willing to pay for it (Quagrainie et al., 2003), and wine is often offered as a classic case in point (e..g, van Ittersum et al., 2003, p. 215).

Consumer expectations may also be influenced by expert judgments, even though the latter are necessarily subjective and are also imperfect predictors of quality because, for example, "experts do not take into account all the information that they have…Ratings of wine experts do not predict in an efficient way the prices of mature Bordeaux wines for the same reasons' (Ginsburgh, 2003, p. 110). Still, wine producers hope their better efforts will be rewarded at wine exhibitions, say, in that they can subsequently mention of any notable awards a wine may have received as an addendum to the bottle's label (Orth and Krška, 2001).

From that jumping-off point, and with a wine-quality measure as the dependent variable and eight potential quality signals as the independent variables, Horowitz and Lockshin (2002) estimated individual linear regressions for eight varietals of wine, four whites and four reds: chardonnay, riesling, sauvignon blanc, and semillon are the whites, and cabernet sauvignon, merlot, pinot noir, and shiraz are the reds. Blends such as Fox Creek's JSM (shiraz 70%, cabernet franc 20%, and cabernet sauvignon 10%) were not included in the study because of comparability

problems. The more familiar sort of analysis uses similar cues and a quality measure to explain price in a hedonic price equation as in Combris et al. (1997, 2000), Landis and Smith (1997, 1998), and Ocskowski (1994, 2001). Unwin (1999) provides an excellent review of hedonic wine-price models. Insofar as price and quality are variables that are jointly determined by management and the market, explaining the two-way price-quantity relationship would require a simultaneous-equation model, such as the one used by Ling and Lockshin (2003). Our more modest aspirations were to focus solely on how individual consumers might use the available extrinsic cues on the price tag and label affixed to the bottle, in an attempt to glean some insights into a wine's intrinsic quality. In a sense, we are estimating what might be termed a hedonic quality regression, the flip side of the hedonic-price-regression coin (Rosen, 1974), wherein buyers shop around and compare the qualities of brands with different bundles of characteristics, including price. If, to modestly paraphrase Rosen (1974, p. 37), two brands offer the same bundle, but promise different qualities, consumers only consider the higher-quality one, and the identity of the sellers is irrelevant to their purchase decision. This is not a bargaining process in which the consumer and the producer negotiate themselves into a price-quality equilibrium. Rather, the consumer looks at the bottle and the price in a take-it-or leave-it situation and decides, based on his or her expectations as to the quality of the bottle's contents, whether the wine is going to be worth its cost.

The quality measure is the well-known and highly respected Halliday (1999) wine ratings, denoted H1. Halliday's ratings generally run from the mid 70s to the high 90s, and are always expressed as integers; the lowest-quality wines are not rated. Although this means that many of the very lowest-priced wines are not included in our database, the database does include a large number of low-priced wines and does indeed cover the full price range. Unfortunately it also means that any higher-priced wines that did not meet Halliday's minimum standards are also excluded.

Assuredly, any quality measure is open to dispute and prone to measurement error (Landon and Smith, 1997; Schamel and Anderson, 2001; Oczkowski, 2001). Oczkowski (2001, pp. 315-317), in particular, observes, that quality-measurement error can result in biased ordinary-least-squares (OLS) parameter estimates, which is the case when the measure is an independent variable in a hedonic price equation. When, however, when the quality measure is the dependent variable, even with measurement error OLS will give unbiased parameter estimates. The penalty paid for measurement error is less precision, in the sense of overestimated standard errors and an underestimated coefficient of determination (R2) (Hausman, 2001, pp. 59-60). But James Halliday's authoritative book on Australian wines has been published annually for more than a decade, and he has contributed to the wine literature on a regular basis for more than two decades. When Halliday speaks, albeit with a not completely infallible voice, the Australian wine industry and its customers listen. We do too.

The Halliday rating system has a particular virtue for the use to which it is put here: namely, it provides metric ratings that can serve as the dependent variable in an ordinary-least-squares regression, as opposed to count data, qualitative data, rankings, or categorizations, all of which would imply the need to use some discrete-choice estimation approach, such as multivariate logit (Greene, 2003, pp. 663-664). That is, unlike a system that might award stars to wines, for example, where the implied quality difference between a one-star wine and a two-star wine is not necessarily the same as that between a four-star wine and a five-star wine. A Halliday two-point difference between wines has the same implication whether the wines are modest bottles in the 70s or higher-quality wines in the high 80s.

Eight basic types of independent variables serve as our quality signals. Each winery's individual reputation, as opposed to a group's collective reputation, is measured here through Halliday's winery rating, denoted H2. The ratings run from 3 to 5 in half-point increments. Wineries not rated by Halliday were arbitrarily assigned a rating of 2.5. A winery's reputation depends on its past output. The collective reputation of a group will depend upon some average of the reputations of its individual wineries (Tirole, 1996). Landis and Smith (1998) include three different collective reputation measures along with individual firm reputation in their hedonic price equation. Many if not most of our wineries are not members of a group and their collective and individual reputations would be one and the same. Insofar as high-quality wines command price premiums, the latter can be viewed as in part reflecting returns to the individual winery's reputation (Shapiro, 1983).

Price as a quality signal enters in three different ways. First, the natural logarithm of the retail price, denoted P_{NL}, is included in every equation. Second a vector of dummy variables, denoted P_i, is introduced to reflect the so-called *pricing points* into which a particular bottle falls. The specific pricing points depend upon the varietal. Semillon and sauvignon blanc, for example, tend to sell for less than comparably-rated chardonnays. Thus, the pricing points considered for the former two wines are $P \leq 10$, $10.01 \leq P \leq 15$, $15.01 \leq P \leq 20$, and $P \geq 20.01$ and the vector P_i contains three dummy variables, one for each of the first three pricing categories. For chardonnay, however, two different pricing categories define dummy variables to replace the $P \geq 20.01$ category: namely, $20.01 \leq P \leq 30$ and $P \geq 30.01$. Finally, we capture any *interaction effects* of price within each price category through a vector of variables denoted $P_{NL} \times P_i$.

The winery's *experience* and potential exposure to the public eye is captured in the dummy variable $Y = 1$ for a winery established after 1990 and $Y = 0$, otherwise. This variable, too, may reflect an individual winery's reputation.

A vector of dummy variables, denoted V_j, distinguishes *vintage*. Depending upon the varietal, dummy variables were defined for either pre-1996 or pre-1997 vintages, as well as for each of the subsequent years.

Winery or group *size*, which again may be at least a partial determinant of reputation, is another quality signal that was explored through a vector of dummy variables, denoted Q, defined in accordance with the total tons of grapes processed, or Q. Four size categories were delineated: namely, $Q \leq 99$, $100 \leq Q \leq 999$, $1{,}000 \leq Q \leq 9{,}999$, and $Q \geq 10{,}000$.

Finally, the vector of dummy variables R_k indicates the wine-producing *region* in which the winery is located. The vector's components depend upon the varietal, because some regions, such as the Barossa Valley and Coonawarra, are notable for their cabernet sauvignons and shirazes, whereas the Clare Valley, say, is more noted for its aromatic white wines. The zero-one regional delineations serve as *collective reputation* indicators.

Let ε denote a random-error term with the usual normality properties and let β_m denote a population parameter; $\boldsymbol{\beta_m}$ denotes a vector of parameters. Suppressing subscripts that delineate specific wines, parameter estimates b_m and $\boldsymbol{b_m}$ were obtained for eight specifications of the following regression equation, corresponding to each of the eight varietals:

$$H_1 = \beta_0 + \beta_1 H_2 + \beta_3 P_{NL} + \boldsymbol{\beta_4 P_i} + \boldsymbol{\beta_5 P_{NL} P_i} + \beta_6 Y + \boldsymbol{\beta_7 V_j} + \boldsymbol{\beta_8 Q} + \boldsymbol{\beta_9 R_k} + \varepsilon. \quad (1)$$

After eliminating the variables whose coefficients were not statistically significant ($\alpha \leq 0.106$), the adjusted R^2s for the final estimated equations ranged from a low of 0.188 for merlot and a sample size of $N = 94$ (with four statistically significant [$\alpha \leq 0.026$] slope-parameter estimates) to a high of 0.472 for semillon and $N = 213$ (with nine statistically significant [$\alpha \leq 0.028$] slope-parameter estimates). The individual reputation signal was an important positive ($0.974 \leq b_1 \leq 2.602$) and statistically significant ($\alpha \leq 0.005$) factor in all eight estimated equations. In one form or another price also was an important positive ($b_3 > 0$ and/or $b_4 \geq 0$ and/or $b_5 \geq 0$) and statistically significant ($\alpha \leq 0.008$) factor in all eight estimated equations. The positive relationship, however, is not necessarily linear so that increases in price need not explain equal increases in quality. In only one case (merlot) was $b_6 = 2.949$ statistically significant ($\alpha = 0.015$). At least one vintage dummy entered into each final equation, implying that some vintages signal lower-quality or higher-quality wines.

The winery size dummies only entered into the final estimated equations for riesling, semillon, cabernet sauvignon, and pinot noir. Insofar as one can generalize this result, it would be to the effect that the largest wineries or groups tended to produce wines of these four varieties that are more highly rated than did the

wineries or groups in one or more of the other size categories. Finally, one or more of the regional dummies, or collective reputation signals, entered into the final estimated equation for every varietal, in some cases with a positive impact and in others with a negative impact on the quality rating.

In sum, then, as one might expect, price and winery rating are uniformly important and reliable quality signals across all varietals. Vintage, size of winery, and region can also provide cues as to the quality of an individual bottle for a particular varietal, but not necessarily for all varietals. The differences are in the details, which are available to the interested reader in Tables 2 and 3 of Horowitz and Lockshin (2002, pp. 14-15).

We use the residual,

$$e = H_1 - b_0 + b_1 H_2 + b_3 P_{NL} + \boldsymbol{b_4 P_i} + \boldsymbol{b_5 P_{NL} P_i} + b_6 Y + \boldsymbol{b_7 V_j} + \boldsymbol{b_8 Q} + \boldsymbol{b_9 R_k}, \quad (2)$$

as our *ceteris paribus* measure of the difference between the actual and the expected quality of a particular bottle of wine. To repeat, the question addressed here is not whether a particular winery or group offers consistently higher quality or lesser-quality wines. Rather, our concern is with whether the seller consistently offers higher quality or lesser-quality wines than the informed wine buyer has reason to *expect*, quality-bargains or rip-offs, given the seller's various characteristics, including its reputation, and those of the particular bottle, including its price, and whether product diversity signals such. Assuredly, consumers willing to bear the costs of search can always pick up a copy of Halliday's latest wine guide to inform themselves as to the quality of a particular bottle. Halliday, however, does not indicate whether the bottle is worth the price. Other guides or wine columnists, such as Kyte-Powell and Hooke (2000), indicate value for money, but their coverage is not as extensive as Halliday's.

Berrys Bridge ($H_2 = 4.50$), for example, which is located in Pyrenees ($R_{19} = 1$), was established in 1990 ($Y = 0$). The winery was not included in our study, but it produced 1,500 cases of the only two wines that it sells during the study period: the 1999 ($V_3 = 1$) Berrys Bridge Shiraz ($H_1 = 89$) and the 1999 Berrys Bridge Cabernet Sauvignon ($H_1 = 92$). The 1,500 cases translate into $Q < 35$ ($Q_1 = 1$). Both wines retail for $P = \$28$, so that $P_{NL} = 3.3322$, $P_7 = 1$, and $P_{NL}P_7 = 3.3322$, and "[N]ot surprisingly, the limited quantity sells out with great speed" (Halliday, 2001, p. 33). That is, the winery produces a reasonably high-quality product. Halliday's comment implies that both he and the public believe the wines to be more than reasonably priced, given their quality. In that sense they are quality-bargains. Focusing on the 1999 Berrys Bridge Shiraz and substituting the above data into the estimated equation for shiraz, all the dummy variables for the statistically significant parameters are set equal to zero. The *expected* quality rating for this wine is:

$E[H_1] = 69.154 + 1.938 \times 4.5 = 77.875.$

Thus the residual is: $e = 89 - 77.875 = 11.125$. As regards the 1999 Berrys Bridge Cabernet Sauvignon, here too all the dummy variables for the statistically significant parameter estimates are equal to zero and the expected quality rating is:

$E[H_1] = 62.741 + 1.951 \times 4.5 = 71.521.$

The residual is: $e = 92 - 71.521 = 20.479$. Thus, as informed consumers we too are not surprised that Berrys Bridge wines sell out with alacrity. Berrys Bridge 1999 vintage comprises two high-quality bottles that provide much *more* quality than its customers have reason to expect at that price. Both bottles are veritable bargains in this sense, too.

The Overall Results

Is Berrys Bridge unique among wineries specializing in cabernet sauvignon and shiraz in offering quality-bargains? Does Berrys Bridge do so as a matter of policy? There were 517 wineries or groups in our sample. Of those 517, disregarding any blends, 27 offered only shiraz and cabernet sauvignon. In some cases, however, more than one label of the varietal was on offer by the winery or group. The additional labels derive from, for example, different vintages of the same wine (e.g., 1998 and 1999), different wines of the same vintage from the same winery (e.g., a 1998 Shiraz and a 1998 Reserve Shiraz), and wines from different wineries in a group (e.g., a Coonawarra Shiraz and a Padthaway Shiraz). Averaging the residuals for each varietal, ten sellers other than Berrys Bridge exceeded the regression-based quality expectations for both wines and six fell short for both. If deviations from the estimated regression line were strictly a matter of chance, in about half the cases we would find $e \leq 0$, so that the likelihood of being either below or above the estimated regression line would be $p = ½$. Hence, the probability that a seller offering two varietals will have either $e \leq 0$ or $e \geq 0$ for both varietals, will be ¼. Therefore, an expected ¼×27 = 6.75 out of the 27 sellers would fall into each of the latter two categories. An expected 13.5 sellers, as opposed to 11 sellers, would be above the line for one varietal and below it for the other. Computing chi-square with two degrees of freedom yields $\chi^2 = 2.1111$, and we fail to reject the independence and matter-of-chance hypothesis. Thus, the Berrys Bridge data might very well reflect the winery's price and production policy and a management that considers itself to be in the wine-quality-bargain business. But nothing in the sample data suggests a quality-bargain or rip-off strategy in general for these 27 sellers, although the results for any one might reflect its quality vis-á-vis price and production policies.

The average of the residuals is our ceteris paribus measure of the difference between the actual and the expected quality of a particular varietal offered by a winery or a group. The number of varietals is our measure of product diversity,

although it captures only one dimension of product diversity. Other dimensions, such as the side-by-side appearance of the same varietal from different vineyards, or of different vintages, or by status (i.e., vintner's reserve), are subsumed in the averaging process.

To explore whether in general there is any relationship between the average residuals for one varietal and that for another, we first compute their 28 product-moment correlation coefficients. If there is no tendency for a seller that bottles higher-than-might-be-expected quality of one varietal to bottle either higher-than-might-be-expected or lower-than-might-be-expected quality of another, then each of these 28 coefficients should be equal to zero.

The correlation coefficients are the above-the-diagonal elements of Table 1. The number of paired observations for the particular varietals is given below the diagonal. Thus, 66 sellers produced at least one label of both riesling and chardonnay. The correlation between the averages of the residuals of the labels for those 66 is 0.3162. Only 12 sellers produced at least one label of both pinot noir and merlot, and the correlation between the averages of the residuals of the labels for those 12 is –0.5240. The former correlation is statistically significant ($\alpha = 0.05$), whereas the latter is not.

Table 1: Number of Paired Varietals\Correlation Coefficients Between Residuals

	Chard.	Riesling	Sau. Bl.	Semillon	Merlot	Pin Noir	Cab. Sau.	Shiraz
Chard	-	0.3162*	0.0335	-0.1014	0.2493	0.1142	0.2612*	-0.0090
Ries.	66	-	0.0831	-0.0540	-0.0199	0.1201	0.3372*	0.5474*
Sau. Bl.	51	28	-	0.4463	-0.3750	0.0956	0.3095	0.1617
Semillon	49	24	19	-	-0.0590	-0.2410	-0.0872	0.0440
Merlot	35	19	18	17	-	-0.5240	0.0310	0.0631
Pin. Noir	84	40	32	14	12	-	-0.2330	0.1039
Cab. Sau.	90	51	36	44	28	30	-	0.2444*
Shiraz	121	70	37	53	27	33	101	-

* Statistically significant at $\alpha = 0.05$.

Six of the coefficients, all of which are positive, ranging between 0.2444 and 0.5474, are statistically significant. Cabernet sauvignon, paired with chardonnay, riesling, and shiraz, is one of the varietals in half of the statistically-significant relationships. In effect, there is the weak hint of a possible positive carry-over effect from one varietal to another, at least with regard to certain specific pairings of varietals.

A more illuminating result is obtained from our second set of computations and a chi-square analysis. Consider the 175 sellers that contributed only a single varietal to the sample set. Bellingham, for example, only produced riesling and Beresford only produced chardonnay. Of these 175 observations, 93 of the residual averages were positive and 82 were negative. Suppose specialization in a single varietal does not necessarily signal quality-bargain status. Instead, whether the specialist's product is of higher or lesser quality than might be expected is likely a matter of chance. Then, half of the averages would be positive and half would be negative. Computing chi-square with one degree of freedom yields $\chi^2 = 0.6914$, which does not reject the matter-of-chance hypothesis. Whether as a matter of policy some Australian wineries that specialize in a particular varietal provide higher or lesser quality than might be expected from its price and its label, is a separate issue. It would, however, be erroneous for the consumer to infer anything either positive or negative about whether a bottle of wine is a quality-bargain from the signal that it contains the only varietal that the winery offers.

Table 2 extends this analysis to producers that contributed between two and four varietals to the sample set. With two varietals, $\chi^2 = 1.9938$, which again does not reject the matter-of-chance hypothesis. With three varietals and three degrees of freedom, however, we get a statistically significant ($\alpha = 0.05$) $\chi^2 = 6.0582$. Four varietals and four degrees of freedom also yield in a statistically significant $\chi^2 = 13.4493$. The latter two tests reject the matter-of-chance hypothesis in favor of the suggestion that when sellers offer more than two varietals the bang for a buck offered in one of these will tend to be related to the bang for the buck offered in another. Closer inspection of the elements contributing to the chi-square suggests what that relationship might be.

Table 2: Data For The Chi-Square Tests For One to Four Varietals

No. Positive (+) and Negative (-)		Actual	Expected	χ^2
	+	93	87.5	0.3457
One Varietal	-	82	87.5	0.3457
	Total	175	175	0.6914
	++	48	40.25	1.4927
Two Varietals	+-	75	80.5	0.3758
	--	38	40.25	0.1258
	Total	161	161	1.9938
	+++	13	13.625	0.0287
Three Varietals	++-	43	40.875	0.1105
	+--	32	40.875	1.9270
	---	21	13.625	3.9920
	Total	109	109	6.0582*
	++++	6	2.875	3.3967
	+++-	7	11.5	1.7609
Four Varietals	++--	10	17.25	3.0471
	+---	18	11.5	3.6739
	----	5	2.875	1.5707
	Total	46	46	13.4493*

* Statistically significant at $\alpha = 0.05$.

With three varietals, two-thirds of the $\chi^2 = 6.0582$ is attributable to 21 sellers with negative average residuals for all three of their varietals, as opposed to an expected 13.625 observations under the independence hypothesis. With four varietals we only have an expected 2.872 observations in the two extreme cells. When those cells are combined with their immediate predecessors to form categories of at least three positive (negative) residuals, we again obtain a statistically significant $\chi^2 = 7.7536$. Sixty percent of the latter value is contributed by the at-least-three-negatives category. In tandem, the three-varietal and four-varietal cases suggest that while there may be several sellers offering several varietals that as a matter of business policy and practice seek to offer their customers quality-bargains, many more of their counterparts do just the reverse.

Too few sellers offered more than four varietals to permit similar tests, but an analogous grouping of their results provides some interesting insights. In five of the fourteen cases of a seller offering five varietals, there were three positive and two negative residual averages; the reverse holds in six of the cases. In the remaining three cases, four of the residual averages were negative. Once again, when more than two varietals are on offer, lower-than-expected quality tends to be the result. Nine sellers offered six varietals. Of those, two had three positive and three negative residual averages, two had two positive and four negative residual averages, four had five negative averages and one positive average, and one contrived to produce six negatives. Five wineries or groups offered seven varietals. One of these had five positives and two negatives, one had four positives and three negatives, two had two positives and five negatives, and one had one positive and six negatives. These results are also supportive of the general notion that when more than two varietals are on offer, lower-than-expected quality tends to be the result. The lone departure from the suggestion comes from the three sellers that offered all eight varietals. One of these producers had six positive and two negative residual averages, one had five positive and three negative residual averages, and the third had four and four.

It would be erroneous to infer from the latter results a tendency for the larger sellers to bottle wine that will disappoint, given its price and other characteristics. First, any such inference relies on the erroneous presumption that only a large seller offers a broad array of products. Only one of the three sellers offering all eight varietals is in the Big Three and by contrast with the Hardy Wine Company and Foster's Wine Estates, with wine-grape crushes of over 200,000 tons during our sample year, one of the three had a crush of less than 500 tons. Second, the larger sellers are unlikely to have achieved their large market shares by focusing solely on high-quality, higher-priced, single-grape wines that merit Halliday's attention. And it would be equally erroneous to infer anything about the relationship of seller size and product quality from our results.

Doubtless many Australian producers can be relied on to offer higher-quality wines across the board than consumers have reason to expect, ceteris paribus, and doubtless others can be relied on to do just the reverse. The general implication of our results, however, is that product diversity is an especially fault-ridden signal as to the category, if either, into which any one producer falls. Several varietals from the same seller on a vintner's shelf might want to give the potential buyer modest pause, as this diversity hints at giving buyers less than their money's worth in any one bottle. In the overwhelming majority of instances, however, those in which a seller offers only one or two varietals, the lack of diversity provides not a shred of evidence as to where the bottle falls on the quality-bargain scale.

Conclusions

Economists have an unflappable belief in the disciplining force of the market. Yet, "you get what you pay for" remains a cliché that is regularly honored in the breech. Even as we write, some consumers are being pleasantly surprised by a bottle of wine because they think it's a quality-bargain. Others, however, are suffering the less pleasant experience of feeling that the bottle isn't worth the money. Even the repeat buyer is not immune. How often does one hear "This is not as good as I remembered it" or "This is better than I recalled"? A bottle of Australian wine could serve as an exemplar.

Experience aside, consumers take their cues as to what to expect from a product of uncertain quality from its price, from the producer's reputation, and from any number of other imperfect signals of product quality. A bottle of Australian wine could serve as an exemplar of such a product and one for which the practice is not entirely unjustified. Price and quality are indeed associated, and generally strongly so for Australian wine, but consumers will not necessarily get what they pay for. Sometimes they'll get more and sometimes they'll get less. The winery's reputation also is a strong signal as to what to expect from the bottle, because that is how the winery got its reputation in the first place. Nevertheless, given its price, the winery's reputation, and other specifics of the wine, the bottle might well exceed or fall short of the consumer's expectations for it.

Because sellers' actions and the signals that they send can affect buyer behavior, sellers must consider how those acts and signals will be interpreted and the reactions they will engender. A decision to offer an array of wines, a merlot as well as a shiraz, whites as well as reds, sends a signal. How that signal will or should be interpreted are two different things. We have shown that one should not consider specialization to be a virtue when anticipating whether an Australian wine will surpass or fall short of price-and-label-based expectations. Indeed, the signal that a seller offers only one or two varietals provides no new information as to whether or not a quality-bargain is at hand. By the same token, while the diversity signaled by more than two varietals should not necessarily be considered a vice in the

anticipation process, the evidence points that way. We refrain from speculating whether Australian wine also qualifies as an exemplar in this regard.

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Redesigning the Food Chain: Trade, Investment and Strategic Alliances in the Orange Juice Industry

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Abstract

Change in trade barriers and capital flow creates opportunities for redesigning the food chain. The orange juice chain in U.S. and Brazil provides an interesting illustration of how institutional harmonization, high import tariff rates and complementary capabilities open new opportunities for strategic alliances and the re-arrangement in the FCOJ chain. This finding has the following implications. First, trade barriers are not enough to support FDI and related internationalization decisions. Second, the perspective of market integration creates a positive environment for new strategic alliances and the re-design of the food chain. And third, the existence of complementary capabilities between foreign and domestic companies is a necessary condition for this type of supply chain re-arrangement.

Keywords: FTAA, foreign direct investment, Orange Juice Industry, strategic alliances

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Introduction

Change in trade barriers and capital flow creates opportunities for redesigning the food chain. In the most prominent view, trade barriers foster foreign direct investment (FDI) as an alternative to explore competencies that may be replicated in the host country (Dunning, 1998). Inasmuch as the relative cost of exporting increases when trade barriers are high, firms may prefer to expand its sales by investing in a new plant in the host country. As a consequence, the higher the trade barriers, the higher FDI will be. On the other hand, the institutional harmonization that emerges with market integration – including lower trade barriers – promotes FDI because firms are more likely to invest when they know the rules that govern market competition. Moreover, the institutional environment tends to be more stable in integrated economies, with a positive effect on investment level. Regional trade blocks such as NAFTA and Mercosur are illustrative cases where lower trade barriers were associated to an increase in FDI.

More important than knowing which effect prevails for a given level of trade barriers is that the perspective of market integration may combine both effects in the same direction. We submit that the orange juice chain in the United States (US) and Brazil, the dominant players in the global frozen concentrated orange juice (FCOJ) market, provides an interesting illustration of how change in market integration provides incentives for FDI and the redesign of the food chain. In particular, we argue that supply chain redesign in the form of vertical desintegration and cross-boder strategic alliances allows participants to deeply explore existing capabilities. This study explores FDI by western hemisphere food processors in the US market with focus on the FCOJ industry in Florida and Brazil's southeastern region, particularly the state of Sao Paulo. In order to address these issues, we first discuss the FCOJ industry structure in the relevant markets.

Industry Structure

Combined, Brazil and the United States are responsible for half of the world's total supply of oranges and 85% of total orange juice processing capacity. More strikingly, orange production and processing is concentrated in just two states: Florida and Sao Paulo. Both industries compete globally in intermediary product markets, particularly in frozen concentrated orange juice (FCOJ). Industry participants, however, are quite complementary in competencies: Brazilian processors focus on orange crushing and logistics while US companies dominate ready-to-drink and not-from-concentrate juice markets.

Since its beginning, the Brazilian orange juice industry has been connected to its Florida counterpart. The orange juice industry began operations in Brazil in 1962, when a severe freeze in Florida caused a shortage in the US market. At the time there was no significant international market for FCOJ and Brazilian production

was thus targeted to the US market. US companies arrived in Brazil with capital and technology, and formed strategic alliances with packinghouse owners that had access to orange growers.

Forty years later, the Brazilian orange juice industry is the largest in volume and the most competitive in the world. Brazilian FCOJ exports account for 85% of total international trade despite high tariff rates in major export markets, including in the US, in the European Union (EU) and in Southeast Asia. The competitiveness of the FCOJ industry in Brazil is based on low input costs, efficiency in plant operation and the bulk transportation system, which comprises tank-farm trucks, vessels and dedicated port terminals in each export destination. The bulk transportation system alone allows for cost savings of 15% of final FCOJ price relative to the use of the traditional 200-liter barrel. The Brazilian industry, therefore, has its main competitive advantage in logistics as competitors do not have sufficiently large scale to exploit bulk transportation systems. Even the US industry does not extensively use bulk transportation because orange juice deliveries are dispersed in several distribution channels.

The Brazilian orange juice industry is highly concentrated, since the four leading processors control over 85% of total crushing capacity. Two family-owned domestic companies founded in the 1960s as packing houses have a combined 60% share of total industry crushing capacity. The third ranked company is the French multinational Dreyfus with a 12% share, followed by Citrovita, another Brazilian based company, with 11%. The concentration in crushing capacity is similar to the one observed in FCOJ exports, with smaller changes due to idle capacity or toll processing contracts between some processors and growers' pools (Neves, Marino and Nassar, 2002). Concentration has been rising due to the ongoing consolidation process. In 2004 industry leaders Citrosuco and Cutrale acquired Cargill's assets in its Brazilian citrus division, which used to be the third ranked company. This transaction was approved by the Brazilian Competition Policy Agency (CADE) in 2005 (Brazilian Ministry of Finance, 2005).

The main variable that dictates competition in the FCOJ industry is control of the bulk transportation system. Although there are about 30 orange processing companies in Brazil, the four leading processors control the entire bulk transportation system. Since Brazilian exports are predominantly in FCOJ form and bulk transportation systems have cost savings of 15% of final FCOJ price, these four processors also hold dominant positions in export markets. Other orange processors have two alternatives: rent larger firms' bulk transportation systems or explore the small but growing domestic orange juice market.

It is also noteworthy that the Brazilian FCOJ industry has some features that make tacit collusion more likely. Not only is market concentration high, but also FCOJ is a homogeneous product with low price elasticity, stable demand and slow

technological change. Taken together, these industry structure characteristics reduce coordination costs among firms (homogeneous product and stability of demand and technology) and increase the benefits of cooperation (low price elasticity) thereby favoring industry coordination (Viscusi, Vernon and Harrington, 1997).

With regard to the US industry structure, data are available for the industry defined as frozen fruit, juice and vegetable manufacturing (NAICS code 311411) as the US Census of Manufacturers does not provide disaggregated data for the FCOJ industry. There are 177 processors in this industry with combined value of shipments reaching US$10 billion. The four largest processors account for 34% of total industry shipment value.

However, concentration is more pronounced in the narrowly defined orange juice market. According to Hodges et al. (2001), there are currently 52 citrus processing plants in Florida. Citrus juice products shipped by Florida processors were valued at US$3.5 billion in the 1999-2000 season. The two largest orange juice brands – Minute Made (Coca Cola Co.) and Tropicana (PepsiCo) – have a combined market share of over 50%. Citrus World, a marketing cooperative formed by citrus packinghouses in Florida, owns the third largest orange juice brand called Florida's Natural (Jacobs, 1994).

The four leading companies in Brazil are key players in the Florida industry, following the acquisition of incumbent plants during the 1990s. Since their entry in the US market, the two largest orange juice brands (Minute Mate and Tropicana) have discontinued crushing and focused in blending and marketing consumer-ready products. This strategic movement is analyzed in detail in the next section.

Vertical Coordination

There are several private organizational arrangements to govern transaction hazards. Transaction Costs Economics (TCE) has the merit of providing a model that, given the characteristics of a particular transaction, predicts the adopted governance structure. The argument initially presented by Williamson (1985) – and maintained in subsequent work (Williamson, 1991; 1996) – matches transaction dimensions (asset specificity, frequency and uncertainty) to the choice of a singular governance structure (market, hybrid or hierarchy), which is the most efficient among the set of possible structures in mitigating transactions costs.

The transactions between growers and crushing firms, both in the US and Brazil, are predominantly governed by non-market mechanisms. Oranges are highly perishable, which leads to temporal asset specificity, and the volume produced by growers and required by crushing firms is much greater than alternative sources of supply and demand for oranges, making assets dedicated to each other. In the

presence of such high levels of asset specificity it is expected that firms will employ governance structures that provides greater control over the transaction such as contracts and vertical integration (Williamson, 1985).

Indeed, 95% of citrus fruits in the US are transacted by means of non-market arrangements. In particular, 88% of citrus output is sold through marketing contracts between growers and processors, including contracts with farmer-owned packing houses. Additionally, 7% of citrus fruits are produced and processed by vertically integrated firms (Harris et al., 2002). The degree of vertical integration was higher in the late 1980s. In part, the reduction in vertically integrated orange production and processing in Florida is associated with the acquisition of crushing plants by Brazilian firms.

The coexistence of marketing contracts and vertical integration is also evident in the Brazilian orange industry, with two remarkable differences relative to the US: (i) the proportion of backward vertical integration into orange growing is higher among Brazilian processors; and (ii) marketing contracts are based on pound solids in Florida (directly related to processing efficiency) but on boxes delivered (volume) in Brazil. These distinct characteristics are interrelated, and suggest that vertical coordination in the US orange industry is more efficient than in its Brazilian counterpart (Fernandes, 2003).

Trade Barriers for FCOJ

Tariff and non-tariff barriers are used differently by Brazil and the US. Whereas the former generally levies higher average tariffs, the latter imposes lower average tariffs but with higher standard deviation. Additionally, Brazil mainly uses ad valorem tariffs in contrast to the US reliance on other forms of protection against imports, including specific lump-sum tariffs, quotas and non-tariff barriers such as SPS restrictions and direct subsidies to domestic producers. Consequently, the US tends to be more open to international trade while heavily protecting selected industries against foreign competition. Among those is the FCOJ industry, which receives protection against imports from several countries but particularly from the competitive Brazilian FCOJ industry.

Table 1 summarizes the available information supporting the distinctions drawn between the US and Brazil. Tariff rates applied to agrifood industries, including tobacco and textiles, are higher than the average in both countries. Tariff rates, however, are on average more than three times higher in Brazil than in the US. In addition, the standard deviation of agrifood industry tariff rates levied in the US is twice as high as in Brazil. This suggests that US tariff rates are selectively used to protect specific domestic industries. Indeed, the maximum tariff rate reaches 350% in the US versus 55% in Brazil. It is worth mentioning that both countries operate

with average tariff rates below the world agriculture tariff rate, which averages 62% (Gibson et al., 2001).

Table 1: Summary of Tariff Schedules for Brazil and the US

	Brazil		US	
	Total	*Agri-Food*	*Total*	*Agri-Food*
Number of items	9,408	1,165	10,311	2,102
Average tariff rate (%)	28.8	34.4	5.6	10.1
Standard deviation	10.5	12.2	12.9	25.6
Maximum tariff rate (%)	55.0	55.0	350.0	350.0
Minimum tariff rate (%)	0.0	0.0	0.0	0.0

Source: FTAA Hemispheric Database in Jank *et al.* (2001).

As Jank et al. (2001: 115) point out, the US strategy of "chirurgic protection impacts directly the main export products of the Brazilian agri-system." The orange juice is a remarkable example of this type of protection. To protect Florida citrus and orange juice production, imports from outside NAFTA have to pay a specific tariff rate of US$0.297 per SSE[1] gallon for FCOJ and US$0.175 per SSE gallon for not-from-concentrate (NFC) orange juice. As tariff rates for FCOJ are a fixed amount for a given volume, the effective protection increases when the price of the FCOJ falls and decreases when it becomes more expensive. For the average price observed in 2002, the specific tariff rate for FCOJ and NFC was equivalent to an ad valorem tariff rate of 56.7% and 13.7% respectively (Neves, Marino and Nassar, 2002). The effective protection of NFC seems lower but higher transportation costs provide an effective "natural" protection.

Table 2 presents the US import tariff rate for FCOJ for different countries in the last fifteen years and schedule until 2007. Two relevant conclusions may be drawn from the data. First, the protection of Florida's industry is not equitable as Mexico and Caribbean countries receive a favorable treatment as closer trading partners. Second, the tariff has been declining but there is no further perspective of lower trade barriers for Brazilian orange juice in the years ahead.

The changes in tariff rates in the last fifteen years had an important impact on US imports of FCOJ (Table 3). The main effect was a significant decrease in US imports in the beginning of the 1990s. The second effect was a reduction in the Brazilian share with concomitant increases in imports from Caribbean countries with no tariff protection. The expected fall of tariff rates on imports from Mexico after 2007 will probably have a negative effect on imports from Brazil. Also relevant is the perspective of hemispheric integration with the Free Trade Area of the Americas (FTAA), which will require increased institutional harmonization between its

[1] Single Strength Equivalent corresponds to a gallon at 11.8° Brix.

member-countries. The scenario of deep changes in trading rules between Brazil and the US not only affected trade flows, but created new investment opportunities, particularly towards the redesign of the citrus chain, with remarkable consequences on trade and foreign direct investment. The next section further explores this issue.

Table 2: Tariff Rate Quota Schedule for Imported FCOJ To US (US$/SEE gallon)

Year	Mexico			Canada	Caribbean	Brazil
	In Quota (a)	OverQuota (b)	Snapback (c)			
1989	n/a	n/a	n/a	0.3143	Free	0.3502
1991	n/a	n/a	n/a	0.2423	Free	0.3502
1993	n/a	n/a	n/a	0.1742	Free	0.3502
1995	0.1751	0.3327	0.3415	0.1022	Free	0.3415
1997	0.1751	0.3152	0.3237	0.0341	Free	0.3237
1999	0.1751	0.2977	0.3059	free	Free	0.3059
2001	0.1751	0.2977	0.2972	free	Free	0.2972
2003	0.1751	0.2977	0.2972	free	Free	0.2972
2005	0.1751	0.1786	0.2972	free	Free	0.2972
2007	0.0595	0.0595	0.2972	free	Free	0.2972

a. Tariff applied to first 40 million single strength equivalent (SSE) gallons of FCOJ imports from Mexico.
b. Tariff applied to imports from Mexico exceeding 40 million SSE gallons of FCOJ up to 70 million SSE gallons from 1994 through 2002, and up to 90 million SSE gallons from 2003 through 2008.
c. Tariff applied to imports from Mexico exceeding 70 million SSE gallons from 1994 through 2002 and to imports from Mexico exceeding 90 million SSE gallons from 2003 through 2008 if a price trigger is also eclipsed (a price-based safeguard will provide for the reimposition of higher MFN tariffs if FCOJ daily average prices for 5 consecutive days fall below the previous 5-year average for that month).
Source: NAFTA, Office of the U.S. Trade Representative in Fernandes (2003).

Table 3: US Imports of FCOJ by Countries (US$ 1,000)

Country	1989	1991	1993	1995	1997	1999	2001	2003
Brazil	463,169	220,843	202,282	103,949	124,572	218,820	109,115	196,323
México	58,092	43,907	16,503	63,929	43,481	49,526	28,189	6,905
Costa Rica	0,656	1,736	2,448	6,984	18,096	16,461	33,718	35,608
Belize	8,532	4,029	6,695	8,389	16,089	13,077	19,667	11,304
Canada	0,257	0,918	2,115	2,963	2,466	4,224	4,867	5,569
Honduras	0,602	0,547	1,674	2,818	3,632	1,437	4,776	1,794
Dominican Rep.	0,000	0,296	0,578	0,495	1,317	0,160	1,416	1,903
Other countries	7,914	2,481	1,962	1,834	0,894	2,298	0,956	5,507
Total	**539,222**	**274,757**	**234,257**	**191,361**	**210,547**	**306,003**	**202,704**	**264,913**

Source: U.S. International Trade Commission (USITC).

Food Chain Redesign: Entry of Brazilian Processors in Florida

In the 1990s, the four leading firms in the Brazilian orange juice industry – Cutrale, Citrosuco, Cargill and Dreyfus – started operations in Florida by acquiring existing plants formerly operated by US companies. The explicit motivation for this strategic movement was the increasing difficulties that these firms faced in accessing the US market, the world's largest in terms of orange juice volume. Since the late 1980s, Brazilian FCOJ exports to the US have been declining in both absolute and relative terms. In the 1990s the US became increasingly self-sufficient as orange production became less vulnerable to freezes, the result of the relocation of orange groves to southern Florida. Consequently, Brazilian FCOJ exports to the US fell from roughly half of total Brazilian exports in the 1980s to less than 20% in 1996.

Three factors caused the decline in Brazilian FCOJ exports to the US. First, as previously mentioned, FCOJ is a sensitive product under protection of the US tariff rate system. Second, other countries enjoy preferential tariff rates, which reduce the competitiveness of Brazilian exports. Third, orange juice consumption in the US has been marked by a trend towards NFC juice. The share of NFC in the US market accounts for almost 50% of total orange juice volume. There is a "natural" trade barrier in the case of NFC juice because it has more than five times the weight and volume of equivalent FCOJ and its transportation requires greater effort in quality control. Notwithstanding logistics barriers, Brazil began exporting NFC to the US in 2002 at approximately 3% of FCOJ exports.

The acquisition of US plants by processors based in Brazil is part of their growth strategy in response to the self-sufficiency of US domestic production. However, this movement caused a rearrangement of the US orange juice production chain and was beneficial to the beverage companies that were former owners of the acquired plants.

The orange juice industry is part of the beverage supply chain. Some beverage products use orange juice – in frozen, concentrated or pasteurized form – as a raw material input. The final product may be ready-to-drink orange juice, other beverages that use orange juice in their blends, or concentrated juice that is prepared at home by consumers or at food services. The recent acquisitions of US crushing plants by Brazilian firms are better understood as a reorganization of this supply chain in the US, with possible emulation in other countries.

In the early 1990s, the major US orange juice processors were large and diversified beverage companies, including Coca-Cola (Minute Maid) and PepsiCo (Tropicana). Although there is no technological similarity between processing carbonated soft beverages and FCOJ, those companies tend to be diversified in order to deeply explore intangible assets – such as brand name and marketing capabilities – that are key variables in their transaction with final consumers. As a consequence, their

main business is ready-to-drink beverages that require specific competencies in marketing and branding rather than in one specific beverage. By means of diversification, beverage companies are able to explore economies of scope in an extensive product line that make use of the same intangible assets. Among these assets, brand name, marketing research and access to marketing channels are noteworthy.

In the juice business, they need a reliable source of orange juice (NFC and FCOJ) both in terms of regularity and quality in order to keep up with their branding efforts. Until the early 1990s, transaction costs arguments help explain why Coca Cola and Pepsi operated their own citrus processing plants, which were dedicated assets to the beverage industry. In addition to the vertically integrated beverage companies, smaller independent citrus processors sold orange juice to beverage companies or retail chains by means of supply contracts.

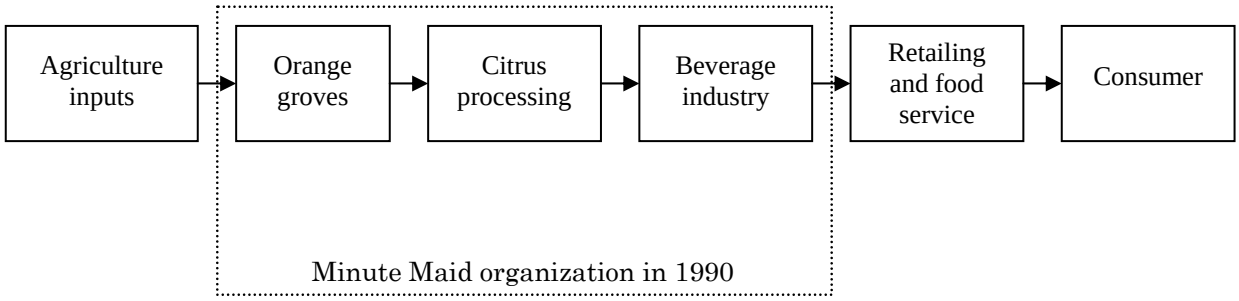

Figure 1: Orange Juice Production Chain

Figure 1 shows the orange juice production chain, from agricultural inputs to the final consumer. Until 1990, the largest beverage companies, such as Minute Maid and Tropicana, operated in the beverage industry, citrus processing and, in some cases, orange groves. Upstream vertical coordination – e.g. vertical integration on orange groves – is further explored latter in this section.

At the start of the 1990s there was a transformation in the US orange juice industry. The family-owned Brazilian company Cutrale acquired Minute Maid processing plants. Subsequently, Citrosuco bought the citrus processing plant of Alcoma, a citrus grower that used to be vertically integrated in processing. Then Cargill – whose citrus department was based in Brazil – also entered the Florida market, acquiring the Procter and Gamble plant. Dreyfus followed and bought the processing plant of Winter Garden (Fernandes, 2003). As already mentioned, Brazilian FCOJ exports to US has been decreasing for three main reasons: high tariff rates, preferential tariff rates for competing countries and the increased share of NFC juices in the US market. Nevertheless, we argue that decreasing exports

alone are not sufficient to explain why Brazilian companies were attracted to acquire Florida based companies.

We submit that two other factors are relevant to this strategic movement. First, there was a perspective of increasing integration in the western hemisphere with FTAA, which would lead to increased institutional harmonization. Second, Brazilian companies developed distinctive efficiencies in orange processing thatpartially explains these acquisitions. Besides having access to state-of-the-art orange crushing technology, the leading Brazilian companies also developed knowledge on logistics, lay-out and storage that were possible due to their larger scale. This capability could not be fully explored with plants located in Brazil as trade barriers and consumer trends towards NFC juices protect Florida production.

Table 4: Backward Vertical Coordination in Florida Citrus Processors

Type of Vertical Coordination	1989-1990 Season	2001-2002 Season
Grower-Processor	Alcoma B&W Canning Berry Caulkins Citrus Service Frostproof Groves Indian River Foods Lykes-Pasco Minute Maid (two plants) Orange-Co Silver Springs	Duda Southern Gardens
Cooperative	Citrus World Golden Gem Holly Hill Ocean Spray Winter Garden	Citrus World (two plants) Holly Hill Ocean Spray
Processor	Adams Packing Ardmore Farms B.C. Cook Caribbean Select Citrus Belle Erly Juice Juice Bowl Procter and Gamble Sun Pac Sun Pure Tropicana (two plants)	Cargill Citro Pure (three plants) Citrosuco Cutrale (two plants) Dreyfus (two plants) Peace River Silver Springs Tropicana (two plants)

Source: Fernandes (2003).

What is remarkable in the orange juice case, however, is that Brazilian FCOJ processors and US beverage firms are not in essence competitors. Instead of competing, Cutrale and Minute Maid developed a strategic alliance, which is the basis for the vertical disintegration in the US orange juice production chain in the 1990s. Counting on a reliable and efficient orange juice supply, beverage companies focused on their core business in order to fully explore competencies in marketing – particularly in blends, branding and distribution channels – and economies of scope in their beverage product line. Consequently, the acquisition of US citrus processing plants by Brazilian companies is part of the orange juice chain restructuring, which led to a more efficient form of organization.

The effects of recent acquisitions by Brazilian companies are also evident in vertical coordination strategies between orange growers and processors. Table 4 shows the incidence of three types of vertical coordination arrangements and captures a dramatic transformation in the backward vertical integration strategies of Florida processors. In 1990, the dominant mode of organization was grower-processor integration, followed by non-integrated processors and cooperatives. In contrast, focused, non-integrated orange juice processors were the dominant players in 2002, with a lower participation of vertically integrated grower-processors.

This industry arrangement differs from that observed in Brazil, where processors have their own orange groves, supplying on average 30% of their raw input needs (Table 5). Contrasting to the trends observed in Florida, the degree of vertical integration in Brazil, although always present, increased since the late 1980s. It is noteworthy that companies that operate in Brazil and Florida rely only on contracts with orange growers to supply US based plants, as opposed to their strategy of partial vertical integration in Brazil.

Table 5: Backward Vertical Coordination in Brazilian Citrus Processors

Company	Vertical Integration on Orange Groves (%)
Citrosuco	30
Cutrale	30-40
Dreyfus	15
Cargill	30
Citrovita	80

Source: Brazilian Orange Growers Association data in Brazilian Ministry of Finance (2005).

According to Fernandes (2003), several factors explain different vertical coordination patterns in Brazil relative to the US, including industry concentration, the risk of drought and different contractual design features – such as payment by pound solids in US and by boxes delivered in Brazil – which are more effective in the US because of closer incentive alignment between processors and orange

growers. Moreover, the organization of orange growers is quite different in the two countries, which may have consequences on vertical coordination strategies. While orange growers in Brazil count on collective organizations with weak conditions for promoting horizontal coordination (Marino and Azevedo, 2003), growers in the US are better organized and have access to political resources, which explain the persistence of protection against FCOJ imports. One of the important differences in the way growers organize themselves in both regions is the historical role of cooperatives in the US as opposed to the short-lived experience of Brazilian cooperatives in the orange juice chain – the most prominent case being Frutesp, which lasted 13 years until Dreyfus acquired it in 1991.

Vertical alliances between orange juice processors and beverage companies may be replicated in other countries, including Brazil, where the ready-to-drink orange juice segment is growing fast but is still rather small. In order to explore this emergent market segment, Brazilian orange processors have established vertical alliances with dairy firms and retailers with competitive advantages in branding and distribution of perishable goods, such as milk and NFC orange juice. It is likely that this type of alliance will progressively incorporate beverage companies with international brands such as Minute Maid.

The orange juice case provides an interesting example of the interaction between trade, FDI and strategic alliances among US and Brazilian companies. The impact of the FTAA will largely depend on the effective removal of trade barriers for FCOJ in the US. Without such trade barriers, Brazilian companies may reduce orange juice production in Florida and substitute for imports originating from their Brazilian operations. Nevertheless, the strategic alliance between orange juice processors and beverage companies will probably expand to other countries in the region.

Discussion and Conclusions

Trade barriers are traditionally seen as an incentive for FDI, which may be an alternative to exports as an internationalization strategy. This traditional view only partially explains the FDI activity of Brazilian orange juice firms. The perspective of market integration with continuing negotiations of FTAA signals a trend to institutional harmonization that affect firm-level investment strategies. The perspective of integration fosters FDI because firms tend to integrate foreign markets in their strategies, making room for strategic alliances and the 'reinvention' of food chains.

The two effects are rarely observed in conjunction, inasmuch as barriers are high or low. However, the Brazilian FCOJ industry experienced both effects: high trade barriers and the perspective of economic integration in the FTAA. As a consequence, firms expect institutional harmonization and market integration, opening new

opportunities for strategic alliances and the redesign of the food chain in general. Meanwhile, Brazilian orange juice firms face high import tariff rates and no perspective of significant tariff reduction in the near future. Thus there are strong incentives for them to redirect investments to orange crushing plants located in the US.

The strategic move observed in the FCOJ industry differs from those of other Brazilian food processors that cope with high trade barriers when exporting to the US. For example, the Brazilian poultry industry faces sanitary restrictions when exporting to the US, which should have a positive effect on direct investments in the US. This evidence suggests that the existence of significant trade barriers is not a sufficient condition for FDI.

The additional variable that explains FCOJ chain redesign is the existence of complementary capabilities among Brazilian crushing firms (particularly Citrosuco and Cutrale) and US beverage firms (Tropicana and Minute Maid). This was not the case of the main Brazilian poultry firms (Sadia and Perdigao), which have core capabilities that are similar to those of Tyson Foods and other US poultry processors. In short, the perspective of market integration creates opportunities to direct investment and strategic alliances as long as there are complementary capabilities to be explored in those new arrangements.

As there is a cost of redesigning a supply chain, the combination of FDI and strategic alliances occurs only when there are significant gains, such as exploring more intensely the relevant capabilities. This finding has relevant implications to agribusiness managers. First, trade barriers are not enough to support FDI and related internationalization decisions. Second, the perspective of market integration creates a positive environment, mainly due to institutional harmonization, for strategic alliances and the redesign of the food chain. And third, the existence of complementary capabilities between foreign and domestic companies is a necessary condition for this type of supply chain re-arrangement.

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Success Factors for New Generation Cooperatives[1]

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Abstract

The goal of this research was to determine success factors for New Generation Cooperatives (NGCs). A self-explicated approach was used to assess the importance of various factors grouped in broad categories using data collected from a mailout survey of NGC managers. Results suggest that factors in the "Planning and Development" and "Financing and Costs" categories are considered to be critically important by NGC managers, though differences in factor rankings exist between managers of enterprises involved in the processing of different commodities.

Keywords: New Generation Cooperative, self-explication

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Introduction

Agricultural producers have long sought to capture a greater share of the downstream value their commodities create. As rural population and incomes dwindle, the need to do so is becoming increasingly more pressing. Farmers have a long tradition of cooperative behavior, both in purchasing inputs and in collectively marketing their raw commodities. In 2002, there were 2.8 million members in 3,140 farmer cooperatives in the United States. These enterprises employed over 166,000 people, earned net income of over $3.1 billion, and had net worth of nearly $20 billion (USDA-RBS). Though the part cooperatives have played in shaping the landscape of U.S. agriculture has been a prominent one, cooperatives have largely been limited to marketing and farm supply roles, and generally have engaged in processing activities only to a limited extent. Rogers and Marion hypothesize that these traditional cooperatives have historically lacked the financial resources to forward integrate into that type of value-added activity. Royer and Bhuyan show that if a cooperative is able to devise a non-price method of restricting the quantity of raw product that it handles, it will be profitable to forward integrate into processing activities.

In an effort to add value to their products, farmers have begun to vertically integrate, often in the form of New Generation Cooperatives (NGCs). Typically, an NGC retains the traditional cooperative tenets of one member/one vote (though this may vary by state) and dividends based on patronage, but has two important additional characteristics (Stephanson, Fulton, and Harris). The first is delivery rights tied to share issuance. Investors in NGCs typically help fund construction or purchase of a processing facility through the purchase of shares which entail the obligation to deliver one unit of the applicable commodity per share. This addresses the undercapitalization problem cited by Rogers and Marion. The second unique NGC characteristic is restricted membership. Membership is limited to those who provide the equity capital (and thus incur the risk) for the venture, and new shares are generally not issued unless the processing facility requires expansion. Such a condition of membership provides a non-price method of restricting the amount of raw product handled. This is cited by Royer and Bhuyan as necessary for cooperative forward integration into value-added processing. Usually, shares in NGCs can be traded, although the approval of the NGC board of directors is often required. This practice is intended to prevent private corporations from acquiring control of the cooperative. Cook proposes a four-stage model of cooperative genesis, growth, and demise, and shows how NGCs are a natural outcome in the process.

Torgerson asserts that research is essential to learning about the success and failure of cooperatives. The purpose of this paper is to determine the relative importance of various factors to the success of NGCs, and then to make recommendations for the management of NGCs and other types of value-added agribusinesses. In the late 1980s, Sexton and Iskow identified factors important to

cooperatives' success based on a survey of members and management. This research adds to their work, but focuses specifically on new generation cooperatives, most of which have formed since their research was conducted. In addition, this research exclusively targeted managers, enabling them to identify success factors. Data from a mail-out survey of NGC managers is used to determine those factors considered critical to success for these value-added enterprises. Important factors for success across all NGCs, as well as for those in specific agricultural sectors, are identified.

Results of the research reported here will quantify the perceptions that exist about the factors important to NGCs. These enterprises have purposes and goals that are distinct from traditional cooperatives, but are also distinct from investor owned firms. As such, knowledge about those factors important to NGC success can provide guidance to both existing and new NGCs, as well as to extension agents and government personnel who are involved in their development. As well, the results reported here can be generalized to the management of most value-added agribusinesses, especially those in the formative and early operational stages.

Self-Explicated Factor Rankings

Opinions of NGC managers on the factors important to the success of their enterprises were obtained via a mailed survey, sent out early in 2002. The list of potential respondents came mainly from the Illinois Institute for Rural Affairs' (IIRA) "Directory of New Generation Cooperatives", a listing of all new generation co-operatives known to the IIRA in the U.S. A few additional NGCs were identified via discussions with extension personnel and an internet search. A list of 72 potential respondents was identified, representing most of the NGCs in existence at the time. Each NGC was contacted in advance to identify a suitable recipient and solicit participation, and the survey was then mailed accordingly. Reminder letters were sent two and four weeks after the initial letter.[2] After these three mailings, a 75% response rate was attained. The instrument asked respondents to identify their position within the NGC; in most cases the survey was completed by the general manager, although in some cases it was the CEO or another senior manager.[3] Respondents were then placed into one of five groups, each representing closely related commodities or processing activities. If a respondent did not clearly fit into one of the five commodity/activity groups, it was placed in a sixth group, which included one anonymous response. Table 1 identifies the six groups and gives the number of respondents in each.

[2] Repeat mailings, while potentially expensive, help increase response rates and reduce nonresponse bias (Warde; Salant & Dillman). A few examples of recent applied analyses employing repeat mailings include Vergara et al.; Jensen et al.; Wachenheim and Lesch; and Bernard, Pesek and Fan.
[3] There was no evidence of differences in factor rankings between general managers and CEOs or other senior managers.

Table 1: Groupings of NGC Survey Respondents

Group	Respondents	Activity/Commodity
1	14	Corn Processing/Ethanol/Energy
2	6	Livestock
3	7	Processed/Semi-processed Foodstuffs
4	7	Oilseed & Wheat Processors
5	10	Table Vegetables/Organic/Seafood
6	6	Other
Total	**50**	

A self-explication approach is used to rank success factors. This approach, originally designed for use in multiattribute utility estimation (Huber, Sahney & Ford; Huber), is the foundation for many of the modern tools used to measure and predict consumer preferences, including hybrid conjoint analysis (Green, Goldberg and Montemayor), adaptive conjoint analysis (Johnson), and customized conjoint analysis (Srinivasan and Park). Respondents were presented with ten broad categories, each containing five factors, and were requested to rank the factors in each category from most important within the category (rank = 1) to least important (rank = 5). Each rank was used only once in each category. Srinivasan and Park note that self-explication minimizes the information overload problem that would result if the entire set of factors had to be considered simultaneously. Only five factors needed to be considered at a time, rather than each of fifty total possibilities. Self-explication next required the NGC managers to rank the categories themselves, from most important (rank = 1) to least important (rank = 10). These category rankings serve as the importance weights in calculating overall preference scores for the individual factors.[4] The scores are the product of the within-category factor ranking and the category ranking itself (Green; Srinivasan & deMaCarty).

Once scores have been calculated for each factor, preferences can be pooled by averaging the scores for each factor over all respondents (Allenby, Arora & Ginter; Dubas & Mummalaneni; Simonson & Taversky). These averaged scores can then be interpreted as a measure of the relative importance or unimportance of the associated factors within the context of the set of factors being considered. Caution should be exercised in interpreting the relative importance of closely scored factors; nevertheless, it is clear that highly ranked factors within highly ranked categories are regarded as critical to their success by NGC managers.

[4] The literature reveals several possibilities for assigning importance weights. Green and Krieger discuss a number of options (ranking of preferences, constant sum, ranking within a subset of preferences, etc.). Srinivasan and Park outline alternatives for importance weights, including equal weighting. Green observes that ordered categories, ratings, and constant sum point allocations are the main types of response data used.

Table 2: NGC Success Factors and Categories

Category (Avg. Rank) Factors	Rank Cat.	Rank Cum.	Score	*Category (Avg. Rank)* Factors	Rank Cat.	Rank Cum.	Score
Planning/Development (3.7)				*Product Related (5.6)*			
local champion/leader	1	1	7.21*	product quality	1	7	9.69**
steering committee	2	3	8.60*	customer service	2	22	14.32**
feasibility study	3	5	9.15**	tech. incorporated	3	35	18.55*
alliance/partnership	4	21	14.23	product uniqueness	4	41	20.23
proximity to other successful co-ops	5	26	16.24	brand recognition	5	44	22.11
Financing & Costs (3.9)#				*Industry Related (6.1)#*			
low operating costs	1	2	8.29*	reputation	1	19	14.10*
member capital base	2	4	8.67**	market size	2	29	16.84
low financing costs	3	12	12.45	no. of competitors	3	37	19.31
output price stability	4	17	13.65	competitors' prices	4	39	19.88
input price stability	5	20	14.18	economic climate	5	43	21.10
Managerial (4.0)##				*H.R./Organizational (6.6)#*			
mgrs. know industry	1	6	9.22	labour force quality	1	18	14.00**
experienced mgrs.	2	8	10.35*	internal communication	2	27	16.82*
full-time gen. mgr.	3	10	11.22**	comm. with Board	3	34	18.37*
continuity of mgt.	4	13	12.86**	comm. with members	4	45	22.88
ongoing mgr. training	5	31	17.27	use of outside experts	5	47	26.20
Operational (4.7)##				*Logistics (6.9)##*			
selling/mkting. effort	1	9	10.80**	proximity to inputs	1	25	15.94*
risk management	2	14	13.22	trans/dist infrastructure	2	33	18.31
volume of business	3	16	13.59*	site selection	3	40	19.98*
targeted customer base	4	23	14.35**	proximity to customers	4	42	20.88**
vertical integration	5	36	19.06	geographical member dispersion	5	50	29.90
Strategic (5.5)				*Gov't/Regulatory Environment (7.3)*			
product focus	1	11	11.96*	co-op existence laws	1	24	15.78
business strategy	2	15	13.52	co-op tax advantages	2	30	17.09*
multiple market sales	3	28	16.83*	gov't agency funding	3	38	19.38**
planning/checking	4	32	17.65**	demand enhanced by regulation	4	48	26.44
enforcement of member agreements	5	46	24.10	gov't planning support	5	49	27.87

Note: For the category average rankings, ## indicates a statistically significant difference in average ranking between a category and the next highest-ranked category at the $\alpha = 0.10$ significance level; # indicates a statistically significant difference in average ranking between a category and the second next-highest ranked category. * and ** asterisks are analogously used to denote differences between factor scores within categories.[5]

[5] Mann-Whitney tests carried out on the within-category factor rankings supported the results of the tests of equivalence between preference scores. There were no cases where a significant difference was found between preference scores for two factors but not between within-category factor rankings.

Table 2 shows the categories and factors, the average category ranking, and the within-category ranking and the averaged score for each factor. Because distributional assumptions about the category rankings and averaged factor scores should not be made, a non-parametric test is needed to detect statistically significant differences in average scores between factors in the same category. The Mann-Whitney test, a powerful non-parametric alternative to the two-sample t-test, is used (Harnett & Murphy). Lowry notes that the effect of replacing raw measures (in this case, respondent factor scores) with ranks allows users to focus on the on the ordinal relationships between the raw measures – relatively more or less important, in this case – without assuming that the raw measures derive from an equal-interval scale. Test results are presented in Table 2 and explained in the note beneath. For instance, in the "planning and development" category, "local champion/leader" had a higher score than "steering committee", but the scores are not statistically different at the 10% significance level. However, the score for "local champion/leader" is statistically higher than that for "feasibility study". And the score for "feasibility study" is statistically higher than for "alliance/partnership". The methodology used here is but one means of estimating the importance of each factor and making comparisons within and across industry groups. Even though the factors are assigned overall scores, one should be hesitant to interpret any single factor as most or least important. Rather, factors should perhaps be viewed as relatively important or unimportant, vis-à-vis other factors, in the aggregate opinions of NGC managers.

The importance of factors in the "planning and development" stage is evident – three of the five factors with the highest overall preference scores come from that category. This is due in part to the fact that so many of the respondents are fairly new businesses, with the overwhelming majority having been in operation for less than ten years. Accordingly, difficulties encountered in the early stages of operation and, more importantly, the successes achieved by struggling through these difficulties are likely still fresh in respondents' minds. Overall, the existence of strong local leadership in the beginning stages was recognized as critically important across all respondents, as was the related "steering committee". Cooperative development personnel can relate stories of how now-successful NGCs were sustained through their earliest days by the tireless efforts of organizers who refused to let a good idea die. In many cases, these local champions spend considerable amounts of their own time and money organizing meetings to garner support for a start-up. Also from the "planning and development" category, "feasibility study" was chosen as one of the most important factors of the fifty considered.

Two factors from the "financing and costs" category were also among those success factors identified as extremely important to the success of value-added cooperatives. "Low operating costs" had the second highest preference score, and in fourth place was "member capital base". The former was important across all types of NGCs. In

some cases, large NGCs exist in industries that are quite competitive, in terms of both output and input prices, and businesses can only affect their margins by controlling operating costs. For other, smaller cooperatives, certain types of fixed costs must be spread across relatively few units of output, and there are few opportunities to take advantage of economies of scale. For this reason, operating costs for the cooperative must be carefully monitored, and paying for management or sales expertise, a marketing campaign, or even part-time staff may not be feasible. A sufficient pool of member capital is also critically important to most NGCs. Oftentimes, a processing facility must be purchased or constructed, and the cost of doing so can run into the tens of millions of dollars for even a modest facility. Lenders are usually unwilling to back such a project without at least forty or fifty percent of capital provided by members in the form of equity. Sometimes, even once a plant is completed, further injections of capital are required of members. A number of potentially successful value-added cooperatives have failed because of a lack of either start-up money or operating capital.

Factor Rankings by Commodity Groups

Ethanol NGCs

Table 3 shows the five highest-scored factors for respondents in each of the six NGC groups. The largest group, with 14 respondents, consists of cooperatives engaged in the production of ethanol from corn. Farmer-owned ethanol plants account for 40% of total ethyl alcohol production in the U.S. (Urbanchuk). Livingson et al. note that for Northeast Missouri Grain, project leaders played an important role in educating producers about what was at that time the first NGC in Missouri, and that they were also instrumental in encouraging that state to update its legal institutions to be able to accommodate the new type of venture. Similar experiences in other areas help explain why, as Table 3 shows, strong local leadership during the developmental phases was rated as a very important success factor for ethanol NGCs.

"Strong selling/marketing effort" was also scored very highly by ethanol NGCs. The importance of this factor to co-operatives in this group is somewhat unique; it was not scored among the most important factors by NGCs in any other commodity group. Thongchua, Powell, and Lawless observe that marketing is one of the toughest challenges facing Southwest Minnesota Agrifuels Co-op, majority owner of Ethanol2000, LLP. A strong selling/marketing effort is important to ethanol NGCs because the market for their output has become increasingly competitive: in 2003, 74 ethanol plants produced 3.5 billion gallons of the fuel additive; another 13 plants representing 500 million gallons were expected to come on-line in 2004 (Urbanchuk). With such a large number of potential competitors, a good marketing plan is critically important for profitability.

Table 3: Top Five Success Factors by Group – Factor Scores

Rank	Group					
	Ethanol	Livestock	Food Processing	Wheat/Oilseed	Organic	Other
1	local champ.	local champ.	operating costs low	labour force quality	customer service	mgrs.w/ ind.know.
2	selling/ mkting	product quality	mgrs. w/ ind. know.	market size	product quality	member capital
3	full time G.M.	multiple mkt. sales	steering committee	steering committee	local champ.	local champ.
4	member capital	member capital	low finance costs	feasibility study	unique product	steering committee
5	feasibility study	reputation	member capital	product quality	operating costs low	operating costs low

Tiffany and Eidman note that ethanol plant managers play a critical role in maintaining product throughput and good conversion rates of corn to ethanol. Additionally, general managers of ethanol plants are often responsible for procurement of inputs, managing personnel, dealing with member concerns, marketing the final product, and a myriad of other day-to-day tasks. Many ethanol NGCs have production capacities between 15 and 40 million gallons per year, which typically does not allow for the hiring of specialized managers to handle the diverse responsibilities outlined above. Thus, the general manager must be capable of handling all of these duties, and it is for that reason that "full-time general manager" was scored highly for the success of ethanol NGCs.

Construction of a new processing facility is necessary for almost every group hoping to form an ethanol co-operative, and the costs associated with doing so can be considerable. Given construction costs of up to $2.00 per gallon of yearly capacity, even a relatively small facility producing 15 million gallons per year could cost as much as $30 million to build. Karg relates the experience of Adkins Energy, an ethanol NGC that was able to raise only $9 million of the $16 million needed for plant construction. As a result, the organizing group was forced to take on partners in order to complete financing – not an uncommon occurance for ethanol NGCs. It is thus evident why "member capital base" was scored highly by ethanol NGCs.

Related to the significance of a strong local champion or leader is the importance of carrying out a feasibility study for any new large-scale enterprise, also considered important by managers of ethanol NGCs. It is critical that a prospective ownership group gauge producer interest in the NGC, determine the availability of inputs, assess the suitability of available sites, evaluate prospective partners for

design/construction of the processing facility, and carry out various other tasks to ensure that the project is feasible before embarking on the road to full-scale production. In discussing the formation of Golden Triangle Energy Cooperative, Fink describes a feasibility study as a "key ingredient" to the success of that NGC. Many other authors and NGC development experts have echoed that sentiment, noting that failure to plan properly is often a recipe for failure when organizing a value-added enterprise.

Livestock NGCs

There were six respondents engaged in various value-added activities grouped together into the "livestock" category of NGCs. Many such enterprises are inspired by the success of U.S. Premium Beef (USPB), an NGC that initially acquired a significant ownership stake in Farmland National Beef, thus gaining access to its lucrative branded beef sales. Subsequently, the demise of Farmland allowed USPB to acquire the entirety of Farmland National Beef. USPB has been successful at not only enhancing returns for producer-members, but also at helping those producers raise better animals by providing significant carcass data feedback and pricing on a carcass-merit grid. As Table 3 shows, the presence of a strong local champion/leader was identified as being critically important for livestock NGCs. Holz-Clause notes that the early organizing efforts were integral to the success of USPB. Because of the notorious independence of livestock producers, a strong early organizing effort is critical to generate sufficient interest in what generally turns out to be a very expensive proposition.

Merlo argues that the beef industry's reputation as a whole has suffered from its inability to produce a consistent, convenient product that is as affordable as chicken or pork. The inextricably linked factors "product quality" and "reputation" were scored quite highly for livestock NGCs. The importance of these factors is not surprising given the emergence of branded products as the most profitable elements in the line of livestock originating consumer-ready products. Livestock NGCs who have hoped to emulate the success of USPB have found it difficult to do so without the ready-made brand recognition that USPB acquired through its interest in Farmland National Beef.

One of the reasons for the demise of Pork America's short-lived foray into hog processing was the difficulty of selling into the markets for various cuts and byproducts, according to a former board member (Miller). Similarly, for beef processors, there are distinct markets for cuts from the various primals and sub-primals, as well as for trimmings and byproducts such as hides, bones and offal/renderings. Marketing the whole animal and its byproducts is thus one of the most important tasks falling to managers of this type of cooperative. Thus, it is not surprising that "multiple market sales" was identified as an important success factor for livestock NGCs. Selling into international markets can also be important

for these NGCs, for instance, USPB sells into more than five dozen countries, and has field offices in South Korea and Japan.

"Member capital base" was selected as an important factor for the success of livestock NGCs. Oftentimes, livestock producers want to vertically integrate into processing in order to capture what they perceive to be excess rents being earned by meatpackers. But packing plants are very expensive to build, and even the cost of purchasing a recently abandoned facility can be prohibitive. For instance, Great Lakes Pork Cooperative was unable to raise the necessary funds to acquire a plant previously used for veal production in South Bend, Indiana (Campbell). In the later mid-1990s, Northern Plains Premium Beef was unable to generate sufficient capital to proceed with its plans for an integrated beef production, processing, and marketing enterprise. Even start-up costs can strain the resources for start-up NGCs; the cost of hiring a consultant to carry out a feasibility study combined with legal costs and administrative expenses can approach one million dollars for a new enterprise. Given high start-up and construction cost for processing facilities, it is easy to see why livestock NGCs depend critically upon a sufficient member capital base for success.

Food Processing NGCs

Seven NGCs that process commodities into table-ready or oven-ready products were placed together into a "processed/semiprocessed foodstuffs" group. Cooperatives engaged in the processing of sugar beets, table nuts, coffee, poultry, and eggs were included in this category. The NGCs in this group are distinct from those in other groups in a number of important ways: they are often older businesses, typically are engaged in very capital-intensive processing activities, often control a large share of the domestic market for their products, and many are readily identifiable with easily recognizable brand names.

As Table 3 shows, "low operating costs" was chosen as the factor most important to the success of cooperatives in this group. This is due in part to the complex nature of the operation of this type of NGC: Bushette describes, for instance, the multifaceted system employed by Golden Oval, an egg processing cooperative, for keeping their laying hens comfortable and for cracking, separating, and further processing eggs. Also, a number of the NGCs in this group operate in industries with very tight margins. For instance, Boland and Barton (2000) note that the sugar and corn sweetener industry, in which a number of NGCs operate, pricing is extremely competitive. As such, firms must focus on controlling operating costs, as they may not be able to exert much influence over output prices.

Given the competitive, often low-margin nature of the sectors in which some food processing NGCs operate, effective management can often be the difference between success and failure. Holmes and Curry observe that when Kraft Foods decided to

close its turkey processing plant in West Liberty, Iowa in 1996, the Iowa Turkey Growers Cooperative placed a great deal of importance upon selecting the right person to serve as the general manager of the plant, which the producers were able to purchase. They also relate how it was in large part due to that manager's contacts and expertise in the industry that West Liberty Foods was able to gain a toehold in the market. That NGC is now widely considered one of the most successful in the country, and helps illustrate why "managers with industry knowledge" was identified as an important success factor for food processing NGCs. Also identified as critical was "steering committee", again demonstrating the importance of planning in the early stages of NGC formation.

"Low financing costs" was ranked highly by food processing NGCs for two reasons: first, the investment in fixed assets can be considerable for this type of enterprise. Often, plant upgrades and expansions are financed, at least in part, through borrowing. Second, a few NGCs in this group have been actively expanding through acquisitions. For example, American Crystal Sugar acquired the assets of a number of small sugar beet processing companies in the last few years, as well as constructing a molasses desugarizing plant and taking a controlling interest in the start-up ProGold LLC. With an interest expense in 2003 of $16.871 million on long-term debt of almost $287 million (American Crystal Sugar 2003 annual report), it is clear that financing costs are an important consideration for that firm.

Also important to NGCs in this group was "member capital base". It is important that start-up food processing ventures, with significant plant and equipment costs, are sufficiently capitalized. Holmes and Curry relate how West Liberty Foods was financially sustained during its earliest stages only by cash infusions from members. In the case of the Michigan Turkey Growers Cooperative, a mere 15 producers were responsible for the equity necessary to acquire and renovate a processing plant for their birds when Bil-Mar Foods unexpectedly canceled production contracts. Total costs to acquire and refurbish the facility approached $20 million (Kopenkoskey).

Wheat/Oilseed NGCs

Farmer-owned cooperatives that process wheat or oilseeds (mainly soybeans) were considered as a single group; there were seven such NGCs responding to the survey. A few of the wheat processing businesses in this group were vertically integrated all the way from farm production to sales of bakery or partially-baked products; others were engaged in the production of pasta from durum semolina. On the oilseed side, most respondents consisted of producer groups who had banded together to purchase or construct a facility for processing their soybeans because no suitable facility was located close to them, or because they were dissatisfied with pricing arrangements being offered by existing processors. Commonalities were that both types of NGCs in this group were almost without exception less than five years old,

and that they had taken an ownership position in a processing facility at considerable risk and expense to producers. These factors may make this group seem similar to ethanol NGCs – but wheat and oilseed processing cooperatives typically are not favored by having their demand enhanced by regulatory factors, nor do they receive the same levels of financial assistance as do ethanol producing cooperatives.

Managers of NGCs dedicated to the processing of wheat or oilseeds identified "labour force quality" as critical to the success of their enterprises. Though the processes through which these businesses refine their products is not particularly labor-intensive, it is nevertheless the case that careful supervision and maintenance of the operation of plant equipment is crucial. Also, since many of these NGCs are located in small rural centers – indeed, NGCs are often viewed as a strategy for local economic development – the supply of semi-skilled labor can be viewed as a precious commodity, indeed. For NGCs vertically integrated into consumer-ready products, skilled labor can be even more difficult to find. For instance, in a case study of Mountain View Harvest Cooperative, Carter notes that scarcity of trained labor is the biggest concern of in-store bakery operators.

The cost of construction of a new facility or purchase of an existing one is considerable for a wheat or soybean processing NGC. In some cases, the financial commitment required of producer/members seems considerable given what some view as very limited delivery rights attached to membership. For instance, Carter notes that at Mountain View Harvest, 400 shares were offered at $12,500 each. In return, farmers could deliver 900 bushels per share – wheat production from between twenty and thirty acres – to the co-op. Farmers generally expect farm-gate returns for their commodities to improve due to NGC memberships, but often membership only provides a hedge for only a very small proportion of farm production. Not only is market size for producer commodities a concern, the size of the market for the NGC's products is also important. Walzer and Holmes argue that for the Southwest Iowa Soy Cooperative, not enough emphasis was placed on identifying and/or establishing markets prior to beginning operations. The failure of that cooperative, for this and other reasons, demonstrates the importance of "market size" for wheat and oilseed NGCs.

As with other commodity groups, wheat and oilseed processing NGCs described factors in the "planning and development" category as being critically important to their success, identifying "steering committee" and "feasibility study" in particular. Holcomb and Kenkel discuss the importance of planning activities to the success of Value Added Products, a successful Oklahoma NGC producing partially baked bread products. Zeuli et al. assert that South Dakota Soybean Processors would never have come to fruition were it not for the dedication of the steering committee toward construction of a much-needed processing facility. As an important element of the early planning for a new processing venture, feasibility studies are a must –

they will determine producer interest in the new venture, availability of inputs, and potential markets for the finished product. The president of Minnesota Soybean Processors described a feasibility study as the "first step" toward construction of its plant (Lemke).

"Product quality" was also selected as an important success factor for this type of NGC. Boland et al. note that providing consistent quality to customer specifications is one of the principle competitive advantages in the pasta producing industry. Dakota Growers Pasta, now a corporation but for most of its history an NGC, has taken advantage of consistent quality and both brand name and private label production to become extremely successful. For oilseed processors, quality of oil and the ability to produce suitable meal consistent with specific protein requirements for animal feed is of considerable importance – Boland and Barton (2003) observe that in the soybean crushing industry, firms compete on product quality, among other factors.

Organic/Vegetable/Seafood NGCs

The second-largest NGC group consisted of ten enterprises engaged in the marketing of organic or conventional table vegetables and seafood. This is a unique category of cooperatives – often, NGCs are thought of as requiring considerable financial outlays by producer-members to fund the purchase or construction of large-scale processing facilities. For organic/vegetable/seafood NGCs, this is not necessarily the case. Rather, for a number of the cooperatives in this group, adding value to their produce consists of little more than assembling boxes of produce at some common collection point to be collectively marketed to customers by a single seller. Sometimes, there are as few as a dozen members in these cooperatives; other times, there are several hundred, marketing under well-known brand names. In any case, these cooperatives qualify as NGCs because they are closed cooperatives where members have banded together to add value to their products. As will be explained below, the factors that are important to the success of this type of enterprise are often quite different than those for other kinds of NGCs.

A number of NGCs marketing organic products and/or vegetables have found that close contact with customers has helped facilitate repeat and growing sales. In some cases, sales by NGCs are occurring to buyers who were previously supplied by individual members, and it has been important for these cooperatives to demonstrate the superior buyer support that they can offer – perhaps that is why "customer service" was rated as critically important for this type of enterprise (Table 3). Huber and Parker describe how the GROWN Locally Cooperative has instituted a 24/7 web interface to make it easier for customers to take stock of what produce is available and place orders whenever it is most convenient for them. Similarly, CROPP, the nation's largest organic cooperative, places a toll-free

number on all its packaging and carries out surveys of customers to learn about their preferences and needs (King).

Two factors from the "product related" category were ranked among the most important by managers of vegetable/organic NGCs. One of them was "product quality" – no surprise given that consumers of these products expect consistent good taste and freshness. Lerman and Parliament observe that lack of quality can keep producers from earning the quality premiums that they rely upon for profitability. Providing high quality produce was cited by Lawless as one of the reasons for the success of Home Grown Wisconsin. Also ranked highly by vegetable/organic NGCs was "unique product". There are two main reasons for this: first, purchasers of organic food are not only interested in the natural production of the products they buy because of health concerns, they also place importance upon the social and environmental benefits that organic production often represents (Dimitri and Richman). As such, organic products, and in some cases non-organic locally grown products, are seen as unique. Second, branded sales have become important to some of the NGCs in this category. Sales of products in the "Organic Valley" branded line have been tremendously important to the success of CROPP (Powell and Lawless).

Strong local leadership in the planning stage was identified as an important success factor for vegetable/organic NGCs. King describes how in the early days of the Whole Farm Cooperative, one local leader was responsible for much of the early marketing effort, contacting local food service growers and undertaking internet-based marketing in an effort to generate sales. Similarly, Heartland Organic Marketing Cooperative, one of the earliest NGCs (formed in 1992), would never have come to be were it not for the organizing efforts of two local leaders (Merrett). That NGC was a successful marketer and exporter of organically-grown soybeans for over a decade, but in late 2003 it was dissolved.

For many of the NGCs in this group, margins provided by the uniqueness of their products are barely enough to justify or even provide for the hiring of a manager or salesperson for the cooperative – especially if higher returns from collective marketing are expected by members. The selection of "low operating costs" as an important success factor by NGCs in this category reflects this circumstance. Even though there are significant premiums to be earned for organic or locally grown products, there are substantial per-member costs for operations of cooperatives with relatively few members. As such, minimization of costs is an important consideration for these businesses.

Other NGCs

Six of the respondents did not fit into any of the categories described above and so were placed together in the "other" group. Their activities range from forestry to alfalfa production to wine production, as well as two so-called "producer alliances",

and one anonymous response. Each of the five factors this group identified as important were also identified as very important by at least one of the other NGC groups. This further demonstrates that even though there are important differences among the rankings of various factors by certain groups, there are commonalities between them that represent the importance of particular factors to all types of NGCs.

Summary and Conclusions

New Generation Cooperatives are becoming increasingly common as agricultural producers strive to increase their share of the value produced by their commodities. NGCs, distinguishable from traditional cooperatives by limited delivery rights and restricted membership, often require large initial investments on the part of members. These enterprises retain the important cooperative principles of one-member/one vote (although some states allow flexibility in this area) and dividends based on patronage, but are more akin to investor-owned firms than their traditional counterparts. As such, the factors influencing success for NGCs may not be exactly the same as for those on either end of the ownership spectrum. Nevertheless, the lessons learned here can apply to all types of agribusinesses – not just NGCs.

The purpose of this paper was to determine the importance of various factors to the success of New Generation Cooperatives. To do so, a self-explicated approach was used whereby within-category factor rankings were weighted by category importance rankings to arrive at an overall score for each factor for each respondent. Preferences were then pooled by averaging scores across all respondents as well as across members of six NGC commodity groups. There were both important differences and striking similarities in factor rankings between these groups – some factors are important to all NGCs, whereas others are important only for particular NGCs, depending on the type of value-added activity they carry out.

These results should aid in the development of new NGCs as well as in the management of existing ones, and in the operation of other types of agribusinesses. Based on the research reported here, three key recommendations for persons or groups involved with NGC development can be made:

- *Planning is paramount.* Most NGC managers identified factors in the planning and development category as critically important to success.

- *Control your costs.* Running a tight ship with respect to operational costs and minimizing financing costs helps protect the bottom line.

- *One size does not fit all.* Though some commonalities (such as the above) exist among successful NGCs, factors important to NGC success can vary significantly depending upon commodity group.

Examples of NGCs that have failed due to poor planning or operation abound. Cognizance of the factors which are important to a particular type of NGC should help raise the success rate for NGCs, and for all value-added agribusinesses, and thus enhance opportunities for producers to capture more of the value that is added to their commodities. Producer-owned, value-added agribusinesses can make important contributions to agricultural producers and to rural areas, keeping people and resources from relocating elsewhere. It is in helping accomplish that goal that the results presented here are most important.

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Protecting Your Turf: First-mover Advantages as a Barrier to Competitor Innovation

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Abstract

Product innovation for a juice company and its associated first-mover advantages are analyzed. Stochastic simulation is used to model market size, price, competitive intensity, and the likelihood of competitor entry. Results of moving first allow the firm to capture market share, realize first-mover advantages in excess of $2 million, and deter competitor innovation. In addition, the proposed model is flexible enough to be applied in other industries.

Keywords: Product innovation, first-mover advantages, barriers to entry, stochastic simulation, uncertainty

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Introduction

Businesses selling consumer goods constantly have to alter their products to meet ever-changing consumer demands. Consumers desire innovative products that meet their personal tastes, income levels, or expectations for improving the quality of their life relative to existing products. Firms that recognize these changes in tastes can innovate and meet this change in demand with improved products and, at least initially, capture a premium over existing products. As other firms become aware of successful innovations, they will try to imitate and drive the price towards the competitive equilibrium. This is certainly true in food and beverage industries. Often viewed as a mature market, the demand for food products and beverages is relatively well established and existing consumer preferences are well known. However, unexpected changes in the U.S. buying habits do occur, such as the recent shift for some to a low-carbohydrate diet. Such shifts in demand create opportunities for firms to innovate products that satisfy consumers' existing taste expectations, but that meets their new demands regarding another characteristic such as carbohydrate or calorie content.

Innovation in current product lines will create other problems for firms currently in the existing product market. Lomax et al. (1996) indicate that cannibalization occurs when the new brand or innovation can be considered a direct substitute for an existing brand. Usually this happens when the new brand is a line extension within the same product class. Executives of food companies have vocalized their concern of cannibalizing existing sales. In 1996, Frito-Lay executives indicated that product innovation causing cannibalization of existing sales was 'something that they worry about' (US Dept. of Justice). Typically, successful firms will recognize that cannibalizing existing sales might be painful in the short term as sales of an existing product suffer. This short-term pain is soothed by the potential long-term success of the new product. Companies realize that even though innovation brings with it the risk of cannibalization it is necessary if they want to retain market leadership (Tellis and Golder 1996).

For example, in the 1970s there did not appear to be much demand for 'diet beer.' Anheuser-Busch feared creating a new, lower calorie beer would cause sales of its largely successful 'King of Beers,' Budweiser, to suffer. Thus, they did not pursue creating a new low-calorie line. It was not until Miller Brewing Company introduced Miller Lite in 1972 that it became clear there existed strong demand for a lower-calorie beer. As Miller Lite stole market share from Budweiser, Anheuser-Busch finally responded with a low-calorie beer, Bud Light. However, Miller brewing had clearly established itself as a strong competitor in this new market. Unwilling to make the same mistake again as the low-carbohydrate (low-carb) craze came into being in the early 2000s; Anheuser-Busch innovated early and introduced a new line meant to minimize the impact on existing sales of Budweiser and Bud Light. They launched their low-carb beer under a different label, Michelob Ultra,

and offered it as a premium alternative to Miller Lite. This successful innovation was partially responsible for a 7.9% growth in 2003 second quarter earnings at Anheuser-Busch (Lagorce 2003).

Innovators hope that first-mover advantages will allow them to recoup some of the costs associated with creating a new product and reward them for facing the uncertainty of the new market. That is, innovators would desire that initially they could extract a premium for being among the first competitors in a market (Conner 1988). Additionally, they desire that being the first in the market would create a degree of loyalty among consumers that result in consistently higher market share that is more easily defendable. Therefore, our objective is twofold: 1) calculate the size of first-mover advantages; 2) demonstrate that a first-mover strategy deters competitors from innovating. Using a fruit juice company's market data (Fresh Juice Inc.[1]), we simulate the benefits and costs associated with introducing a new juice product, Genetically Enhanced (GE) Juice[2], in an uncertain market. Results indicate that Fresh Juice Inc.'s first-mover advantages are large enough to justify entering the uncertain market. Also by entering the market now, Fresh Juice Inc.'s is able to maintain their long-term market share because the probability of competitor entry is decreased. Finally, it is our contention that the presented model allows for a better-justified decision regarding the respective firm's market investments in a new product. Furthermore, this model is flexible enough to recognize differences in other markets in terms of the number of firms, start-up costs, competitiveness in industry, market share, and pricing responses.

From here, the paper addresses the background of our objective; followed by the methods, data, and empirical models applied to meet our objective; next is a discussion of the results; final remarks and potential extensions conclude the paper.

Background

The purpose of innovation is not to match or beat competitors in a current market but to make them irrelevant, thus it is regarded as a business strategy that typically leads to success and business growth (Christensen, Suarez, and Utterback 1998; Akhigbe 2002; Kim and Mauborgne 2004). In addition, product innovation is also linked with long-term financial performance and profitability of a firm (Comanor 1965; Mansfield et al; Druecker 1971; Capon, Farely, and Hoening 1990; Schmookkler 1996). Product innovation is accompanied by two types of risks, technology risk or "will it work" and marketplace risk or "will people buy it" (Tracey 2004). This 'downside' to innovation has been termed the 'innovators dilemma' (Christensen 1997). Both new and existing firms face this additional uncertainty

[1] Fresh Juice Inc. is a fictitious name. The data underlying FJI is based on a case study developed by Gray et al. (2005). The name of the company is changed to protect the proprietary nature of the data.
[2] This is an internal name for the product.

regarding market size. However, existing firms likely have greater understanding of the current market and are potentially more prepared to respond to demand changes. Using data regarding past introductions of innovative products, existing firms can model the impact and profitability of product introductions. This is often known as incremental product innovations that lock in current customers (Tracey 2004). By making only incremental changes to their existing products during the innovation process, firms increase the likelihood they maintain and retain current customers.

Conner (1988) extends the innovator's dilemma through a Stackleberg Leader-Follower Model on the race for a new patent. She emphasizes the importance of accounting for the potential that existing product sales will be cannibalized by the new product. In addition, if the leading firm introduces a new product with uncertain future earnings, the leading firm should consider the potential responses of their competitors (i.e. followers) to the new product introduction. Conner concludes that first-mover advantages have an important impact on the payoff and the outlay of R&D investment by the leading firm (i.e. leading firms can afford more R&D because of first-mover advantages).

Alternatively, it could be the case that a firm is able to imitate and quickly steal market share from innovators. This might cause first-mover advantages to be too small to justify their innovation. The uncertainty regarding market size is resolved as firms enter the new product market. Competitors reduce their risk of failure by utilizing a 'wait-and-see' strategy to capture second-mover advantages. Second-mover advantages occur in those industries where research and development costs are significant and/or when the possibility for informational spillover exists (Lieberman and Montgomery 1988; Tellis and Golder 1996; Hoppe and Ulrich, Hoppe 2001). One of the most well documented second-mover advantages was Sony beating all competitors to market with their Beta VCR. Sony was in the VCR market before most of their competitors had their VHS VCRs off the drawing board (Gilbert 1984). Sony quickly found out that consumers preferred VHS to Beta, and as result, their competitors gained second-mover advantages that dominated Sony's first-mover advantages.

To ensure that first-mover advantages are not dominated, a firm must first quantify them. This will influence an incumbent firm's investment decision in an uncertain market environment. Uncertainties include the size of the market, the development of the market over time, the potential for new entrants, and the impact on the incumbent firm's market share.

Methodology

This paper focuses on a situation facing an existing firm in the juice industry, Fresh Juice Inc. (FJI), in assessing the impacts of introducing a new product, GE Juice.

We aim to identify if the first-mover advantages associated with GE Juice are enough to offset the risks associated with entering the market first. The reality of first-mover-advantages is that they only exist if the pioneering firm is able to better develop its resources and capabilities through learning curve advantages and superior customer resources relative to its competitors (Leiberman and Montgomery 1998). Therefore, we assume that FJI is ready to launch GE Juice in the marketplace. We quantify the first-mover advantages via a net present value (NPV) simulation model on the investment of GE Juice to see if they justify cannibalizing sales and if they act as a barrier to entry for new competitors. To accomplish this we model four key factors: the market size, price, competitive intensity, and competitor entry.

Market Size

A key element in assessing first-mover advantages is correct simulation of the market size. Using historical annual sales data from FJI, we simulate the potential market size for GE Juice. Diffusion models capture the development of a market based on a similar product's life cycle. In the marketing literature, the most well used diffusion model is the Bass Model (Bass 1969). Bass' Model is a way to predict the market size for a product when few points of historical annual sales data of a similar product are available. The Bass Model captures adoption of a new product by consumers through internal factors (e.g. inter-personal) and external factors (e.g. mass media communication).

Mahajan, Sharma, and Buzzell (1993) extended the Bass Model to consider the impacts of an additional firm entering the market. In particular, they develop a model that assesses market size, sales of incumbent firms, word-of-mouth communication, and the substitution effects between differing brands upon entry by a competing firm. They indicate that an improvement to their model would be the consideration of the effects of price on the aforementioned impacts. Although we do not explicitly alter the Bass Model, we do consider this suggestion in the context of our model. That is, market size or demand is estimated via the Bass Model, which in turn drives the price estimation throughout time.

Price

Price in our model is driven by the market size estimation. In order to forecast the price within the model, demand and supply elasticities are needed. Once again, the historical data from FJI is utilized to estimate these elasticities. Price, market level demand, and market level supply of a similar juice product are used in a regression model to estimate the price responsiveness of consumers and suppliers.

Pricing responses to product innovation is considered by Bayus and Chintagunta (2003). Their results suggest that price is not used to deter entry into an innovative

product market, but rather the innovation itself serves as a deterrent to entry. This is particularly true for current competitors that might be unwilling to innovate for fear of cannibalizing sales. Furthermore, it could be the case that the innovator causes further hesitation by competitors because the innovator advertises heavily in an effort to create customer loyalty. Lieberman and Montgomery (1998), note that this occurs when customers develop preferences that have been shaped to favor the product of the pioneer through the molding of the cost structure of the customer. Bayus and Chintagunta (2003) further suggest that an interesting angle to pursue would be to attempt to quantify the benefits of pioneering (first-mover) advantages, which is one of the objectives of this paper.

Competitive Intensity

A firm must first address market power of itself and its competitors. Market power is often quantified via a Herfindahl or Lerner index. These indices require a set of data that can often times be proprietary and unavailable to a firm. Powell (1997) developed a framework that takes the logic of economic market power theory and applied it to management science to arrive at a relative measure of market power. Using historical information on a similar competitor's product, Powell suggests a conjoint regression analysis that models a firm's market share response to competition. Historical data on a competing product for FJI's is available and used to arrive at market share measures within our model.

Competitor Entry

Entry decisions are often times made on some *a priori* expectation. Our model utilizes the expectations of FJI to capture the value they bring to the firm. In particular, we consider the probability of a competing firm entering the market based on FJI's initial conjecture. Therefore, the model simulates different market situations and these scenarios drive the decision for competing firms to enter the market or not. These entry decisions are contingent on the market power of the competing firm and short run profits of the competing firm.

It may be the case that an incumbent firm has undertaken successful product research and development, but would wait to introduce the product in the absence of competition (Conner 1988). Here, the firm wants to wait until the existing product has reached maturity in its marketing life. It is competition or the threat of competition that would induce firms to cannibalize sales early. Thus, there has to be some benefit associated with introducing the product that exceeds the opportunity cost caused by cannibalizing sales of the existing product. Presumably, these benefits come from delayed entry into the new product market by competitors. One way in which firms do this is by introducing a new product into the market. By broadening their product line, they attempt to preemptively block a competitor's entry into the market (Leiberman and Montgomery 1998). Therefore, we are

interested in the impacts that introducing GE Juice will have on competitor entry in the relatively stagnant juice market.

Why Simulation?

This paper deals with the issues of how do competitors react and affect a market that is relatively stagnant and how does the firm in question protect their market position. Studies have considered these issues using a game theoretic framework (e.g. Chen and MacMillan 1992). Many of these studies only look at the case in which 2 to 3 firms are playing the game. A relatively small number of firms are considered due in large part to the complexities of solving for equilibrium within the construct of the game. A potential solution for firms to deal with this problem is to look for guidance in the decision making process rather than a closed form solution. Simulating the key elements of the problem will allow managers to address this complex issue in a more meaningful manner.

Data

FJI is a leader in the finished consumer juice industry. They have been producing and distributing competitively priced high quality fruit juices to leading national grocery chains for a number of years (Gray et al. 2005). While demand for fruit juice has remained steady over the last 10 years, the increase in the number of competitors continues to place pressure on FJI's leader status. The intense competition for shelf space and the continuing fragmentation of consumer's tastes and preferences has kept competitors battling each other on price, advertising, and packaging just to maintain their market share. The product development team's latest product, GE Juice, just may be the ticket to give FJI the new competitive advantage they need in an industry that has not seen an innovative product in fifteen years.

Gray et al. (2005) outlines the necessary data to construct the parameters for estimating the simulation model. ENER Juice is the most recent product launched by FJI that has similar characteristics of GE Juice. This data will serve as the historical data for estimating the simulation parameters for market size, demand elasticity, and supply elasticity. FJI has 10 years of price, demand, supply, and cost information for ENER Juice. FJI also has historical information about their competitors' products introduced in response to FJI's ENER Juice. This data will be used in estimating the response of competitors to the introduction of GE Juice. The data consists of the number of competitors entering the market and market share of competitors relative to FJI's market share.

Empirical Models

Many firms are faced with the decision to invest in an innovative product line. The following empirical models can be incorporated into an existing firm's investment decision tool kit to account for the many facets of uncertainty. In particular, we focus on market size and market competitiveness. To account for these uncertainties, a stochastic simulation model is developed that looks at the NPV decision of long-term profits for FJI investing in and marketing GE Juice:

$$NPV = \sum_{t}^{10}\left[\frac{1}{\left(1+\delta^{t}\right)}\left(\pi_{t}\left(N_{t},M_{t},P_{t},C_{t}\right)\right)\right] - INV \qquad (1)$$

t represents the year GE Juice is marketed over a 10 year period; δ is the discount factor for FJI which is 15%; π is the profit received at time t from GE Juice sales and is a function of N or the estimated total market size for GE Juice, M is the market share of FJI relative to its competitors, P or market price of GE Juice, and C is the cost of production; INV is the initial investment outlay for FJI which is $1,375,000. Emphasis is on the long run NPV or the present value of profits, which address the long-term viability of the firm. Therefore, a positive NPV states that the discounted profit received from GE Juice is enough to cover the initial investment outlay or this investment adds economic profit to FJI and should be undertaken. Attention is now given to the π function.

A modified Bass Model is implemented to have a measurement of the market size or more importantly the classic product life cycle curve. Winston (2000) proposes the following modified Bass Regression Model:

$$N_{t} = \phi\left(\overline{N} - \sum_{t=1}^{T-1} N_{t}\right) + \theta\left(\frac{\sum_{t=1}^{T-1} N_{t} * \left(\overline{N} - \sum_{t=1}^{T-1} N_{t}\right)}{\overline{N}}\right) + \varepsilon_{t} \qquad (2)$$

where N_t is product sales during period t; $\sum_{t=1}^{T-1} N_{t}$ is the cumulative product sales throughout the product's life cycle; $\overline{N}$ represents the long run total number of consumers; Φ is the parameter estimate of external influence or people who have not yet adopted; θ is the parameter estimate of internal influence or diffusion of the product through the market; ε_t is the error term. It is assumed that all consumers will eventually adopt the product. This allows the market size estimate to be treated as demand within the model. Kumar and Swaminathan (2003) applied the proposed modified Bass Model as a way to capture unmet past demand on future

demand. In particular, they focus on a sales-build up plan for a firm and rigorously prove this modified Bass Model.

Winston's (2000) framework for estimating a firm's market share based on its conjectures is derived for FJI. Using historical information on a similar competitor's product, market share is estimated via a regression model:

$$M_t - M_{t-1} = \beta\left(L_t - M_{t-1}\right) + \mu_t$$
$$\textit{where} \qquad (3)$$
$$L_t = \frac{1}{\Lambda + \sum_i \lambda_i}; \;\; \lambda_i < 1 \;\; \forall \;\; i$$

where M_t is FJI's share of the market in time period t; L_t is FJI's long-term share of the market, which is based on FJI's market power (Λ) relative to the power of all firms in the market ($\sum_i \lambda_i$); λ_i represents the i^{th} competitive firm's market power relative to the market leader; β measures the decay of the firm's initial market share to the firm's long-term market share; μ_t is the error term. Using Powell's (1997) logic to arrive at market power conjectures, estimates λ_i are now discussed. He states that Λ is equal to 1 and represents the firm in question, in our case FJI. The λ_i's are relative to FJI and are listed in table 1. Here, FJI is the market leader because all λ_is are less than 1. Powell states that firms could have a λ_i greater than 1 (i.e. the firm in question is no longer the market leader). Therefore, L_t is equal to .33 for FJI.

Table 1: Relative Market Power Index

Firm i	Index
λ_1	0.2700
λ_2	0.2500
λ_3	0.6
λ_4	0.3600
λ_5	0.5500

Realized price in the simulation model is based on estimates of demand and supply elasticities. Historical data on the ENER Juice market provides the necessary data for estimating demand and supply elasticities in the following regression equation:

$$\left(\frac{P_t}{P_{t-1}}-1\right)=\hat{e}_S\left(\%\Delta D\right)+\hat{e}_D\left(\%\Delta S\right)+\nu_t$$

where

$$\%\Delta D=\frac{D_t}{D_{t-1}}-1 \qquad (4)$$

$$\%\Delta S=\frac{S_t}{S_{t-1}}-1$$

where P_t is the price in period t; $\hat{e}_S$ is the parameter estimate of the elasticity of supply; $\hat{e}_D$ is the parameter estimate of the elasticity of demand; D_t is the demand estimated from equation 2 above (i.e. N_t) for period t; S_t is supply which is a capacity measure based on the sum of λ_i in period t; ν_t is the error term. Since supply is a capacity measure, it is assumed that demand is met by all firms in the market. The amount each firm supplies/produces is based on their market share.

These prices are used for all firms and costs are estimated off the market leader's average total cost function[3]. These estimated costs are based on the λ_i of each firm. It is assumed that each λ_i accounts for an efficiency measure with the market leader being the most efficient. Therefore, competing firms face a fraction of FJI's average total cost function based on their λ_i.

The final part of determining competitor entry is the decision rule of entry employed throughout the simulation. Initially each firm faces *a priori* expectations of entering the market in the first year as described earlier. Each subsequent year entry decision is based on the realization of the market size in the previous year, if there were potential short-run profits in the preceding period, and the assumption that all firms make their decisions simultaneously.

Results

Simulation of the NPV model was implemented in the add-on package @Risk for Microsoft Excel. NPV results converged after 5,000 iterations. Correlation between market size, market share, and price was controlled for within the empirical distributions. A 10-year period is simulated for the GE Juice market. These results show the impact of a dominate firm's entry, FJI, on the size of the market and the market share of FJI and its competitors. After assessing the market impacts of introducing GE Juice, we use this information to identify the size of first-mover advantages in a market where a new product is introduced (i.e. waiting a year, 2 years, etc. to enter the market when demand is 'strong'). Finally, we quantify the

[3] Please see Gray et al. (2005) for a detailed description of the average total cost function of FJI.

net benefits of first-mover advantages for existing firms, use this as an indicator of market power, and as a barrier to entry for potentially innovative new firms.

Market Size and Share

Typically, Bass Models are applied to durable goods. Although GE Juice is not a durable good, we feel that the proposed modified Bass Model does a good job in fitting the ENER Juice data. This is based on the regression results received and the fact that the classic product life cycle is reproduced consistently in the simulation. Remember that the $\overline{N}$ described earlier is interpreted as being total number of ENER Juice cases sold over its product life.

Table 2 shows the results received from the Bass Model estimation of ENER Juice. An R^2 of 0.9867 indicates that the Bass Model fits the data well. In addition, the parameter coefficients are found to be statistically significant. The coefficient θ represents the internal influence or the amount of diffusion within the marketplace of ENER Juice (i.e. word-of-mouth sales). Since the ENER Juice data contains repeat sales, θ also captures repeat purchases of ENER Juice. This may explain why θ is much larger than Φ (the external influence on people who have not adopted).

Table 2: Bass Regression Model Results

Coefficients	Estimates
Φ	0.0307
	(0.0044)
Θ	0.3061
	(0.0171)
R^2	0.9867

Notes: 1) Standard errors are in parentheses
2) Degrees of freedom are 13

From this regression model, error terms are collected and an empirical distribution is created for the simulation of market size throughout time. Because time is part of the simulation of market size, a moving average component is created which is based on the error distribution. Figure 1 shows the fitted Bass Model product life cycle. This model does indeed yield the classic product life cycle curve and the moving average component allows for the simulation of market size to not be mean reverting. The point here is that we want to simulate multiple scenarios of potential cases of GE Juice sold over the product life cycle and the Bass Model accomplishes this.

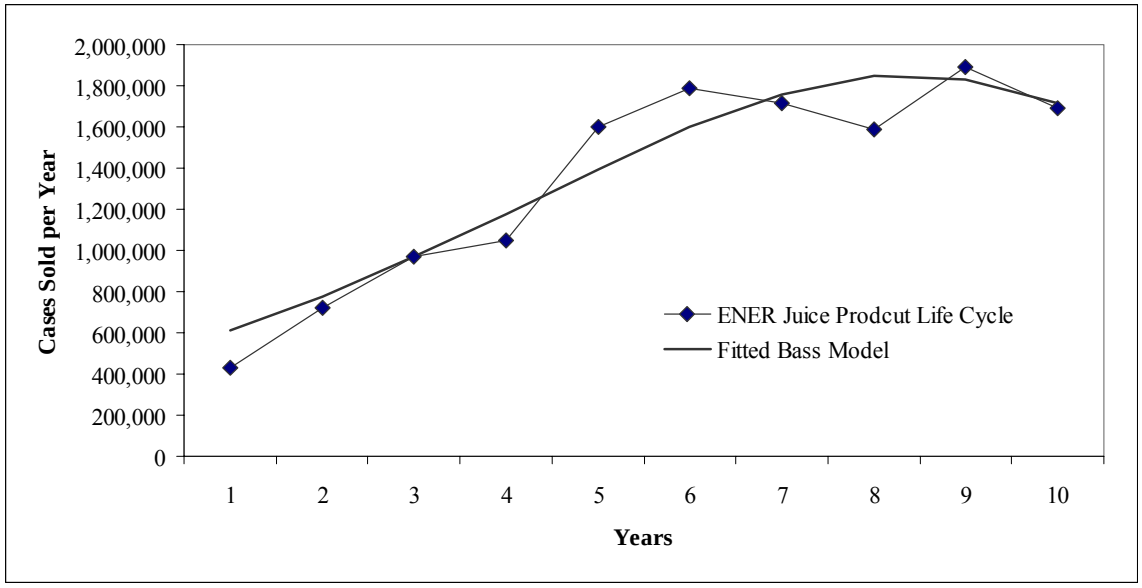

Figure 1: Estimated Bass Model from ENER Juice Data

The market share regression is based on equation 3 described earlier. Table 1 shows the relative market power index of each competing firm relative to FJI (who is the market leader with an index equal to 1). With these indices and the historical data of competitors, the market share decay parameter is estimated (β from equation 3). The results of this regression yield a β equal to .3016 with a standard error of .0385 and the regression model has an R^2 of .825. This β variable enters the NPV simulation model and captures the rate at which a firm approaches its long-term share. A reason why a firm, including FJI, may not reach its long-term share immediately is consumer preferences or loyalty. There is a switching cost involved with a consumer going to another firm's product.

Competitors' Entry Decisions

One of the most interesting results from the model is the competitors' entry decisions. In the model, we used FJI's most informed estimates of the likelihood that competitors would enter. They were certain that one firm (Firm 3) would introduce the new product immediately. However, all of the other competitors were less likely to enter to varying degrees. The *a priori* expectations served as the likelihood that any of the competitors would enter in period one.
The competition's decision in following years is more interesting (see Tables 3 -5). Now the entry decision by competitors is made contingent upon the potential to have earned a profit in the previous period. The decision trigger for the i^{th} firm is as follows:

$$P_{t-1} > MC_{t-1,i} \qquad (5)$$

If the realized market price-per-unit in the last period (P_{t-1}) is greater than the i^{th} firm's marginal cost in the last period ($MC_{t-1, i}$), then the i^{th} firm will enter the market. It is further assumed that once the firm is in the market they do not exit. Marginal costs for competitors were modeled based on the relative competitiveness measure. Thus, we would expect more firms to enter when the market size is large and fewer firms to enter when it is small. The ability of the innovative firms (FJI and Firm 3) to bear the uncertainty regarding market size appears to serve as a barrier to entry/innovation for other less competitive firms. These firms employ a delay strategy, waiting instead to see the realized market share.

Table 3: Competitors' Simulated Entry Probability when Fresh Juice Inc. Enters in Year 1

	Year									
Firm	1	2	3	4	5	6	7	8	9	10
1	15.00%	0.00%	0.00%	0.00%	0.38%	0.69%	3.38%	43.19%	11.42%	3.77%
2	0.00%	0.00%	0.00%	0.00%	0.15%	0.50%	2.31%	48.42%	14.08%	4.35%
3	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
4	5.00%	0.00%	0.00%	0.15%	1.23%	2.62%	8.38%	46.31%	11.38%	4.04%
5	70.00%	1.96%	0.00%	0.81%	3.27%	4.50%	6.88%	9.42%	1.38%	0.58%

Note: It is assumed that once a competitor enters the market they do not exit.

Table 4: Competitors' Simulated Entry Probability when Fresh Juice Inc. Enters in Year 2

	Year									
Firm	1	2	3	4	5	6	7	8	9	10
1	15.00%	0.35%	0.00%	0.00%	0.00%	0.00%	0.12%	7.73%	6.04%	3.46%
2	0.00%	0.23%	0.00%	0.00%	0.00%	0.00%	0.04%	7.92%	6.62%	2.54%
3	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
4	5.00%	2.85%	0.00%	0.00%	0.00%	0.04%	0.38%	10.27%	7.08%	2.81%
5	70.00%	8.50%	0.00%	0.00%	0.00%	0.19%	0.85%	8.73%	3.35%	1.46%

Note: It is assumed that once a competitor enters the market they do not exit.

Table 5: Competitors' Simulated Entry Probability when Fresh Juice Inc. Enters in Year 3

	Year									
Firm	1	2	3	4	5	6	7	8	9	10
1	15.00%	22.85%	0.00%	0.00%	0.00%	0.00%	0.00%	4.58%	5.19%	3.19%
2	0.00%	24.38%	0.00%	0.00%	0.00%	0.00%	0.00%	4.27%	6.62%	3.38%
3	100%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%	0.00%
4	5.00%	27.65%	0.00%	0.00%	0.00%	0.00%	0.00%	6.12%	5.27%	4.12%
5	70.00%	29.35%	0.00%	0.00%	0.00%	0.00%	0.00%	0.12%	0.08%	0.04%

Note: It is assumed that once a competitor enters the market they do not exit.

For example, if FJI decides to enter into the market in year one (Table 3), then all other firms tend to delay entry until after year four. Similarly, if FJI enters in year two (Table 4), then competitors tend to delay entry even longer, i.e. not until year eight. A similar pattern emerges for the scenario when FJI delays its own entry until year three (Table 5).

It is notable that when FJI (modeled as one of two market leaders and innovators) delays its production introduction two or even three years, weaker competitors are much more likely to enter in earlier years. For example, when FJI introduces the product immediately then only Firm 5 has any appreciable probability of entry. This probability itself is less than 2%. However, when FJI delays until year three, then the other three firms all have entry probabilities in year two exceeding 20%.

First-Mover Advantages

To quantify the first-mover advantages gained by FJI, it is useful to look at the simulation results regarding the different entry-year-scenarios (Table 6). Clearly, entry in year one is the only profitable strategy. If FJI delays entry until year 2, 3, or 4, the mean NPV for FJI is negative. Furthermore, negative NPVs account for more than 75% of the simulated values when FJI decides to delay entry.

Table 6: Net Present Value Model Results of Introducing GE Juice

Statistics on Simulated NPV	Entry Year 1	Entry Year 2	Entry Year 3	Entry Year 4
Mean	$1,247,701	($1,362,579)	($1,503,668)	($1,068,025)
Standard Deviation	$1,745,178	$1,348,560	$1,594,390	$1,054,259
5th percentile	($1,505,794)	($3,458,511)	($4,162,945)	($2,674,506)
25th percentile	$81,203	($2,289,440)	($2,681,316)	($2,039,413)
75th percentile	$2,372,430	($485,216)	($285,312)	($255,292)
95th percentile	$4,254,431	$958,744	$616,772	$528,273

A conservative estimate of the first-mover advantages for FJI would be the difference in the mean NPV in entering immediately (first-mover) and delaying until the 4th year. Even in this scenario, these first-mover advantages amount to more than $2 million. These can be attributed to greater market share captured due to delayed entry by these other competitors when FJI enters immediately. Delaying entry creates a situation where FJI must compete more aggressively to establish and grow market share.

Conclusions

The model developed allows firms to apply their conjectures, historical data, and current data/market results to an investment decision. This general approach emphasizes the flexibility of this type of analysis across a wide range of firms.

However, particular focus was given to the incumbent firm having developed a product and seeing if it should launch this product. We quantified this by looking at first-mover advantages and their magnitude relative to profits of the investment. Finally, it was of interest to see if we could create a barrier to innovation for FJI by moving first.

We have used a scenario facing a firm in a relatively stable juice market to quantify first-mover advantages. A well-developed simulation model suggests that first-mover advantages are substantial, and are likely the result of competitors delaying entry in response to the innovator entering the market immediately. These relatively large first-mover advantages ($2 million) show that if we do not move first in the market, existing firms will take the sales from us. The delay by competition allows the innovator to capture valuable market share early and relatively easily. This result supports Leiberman and Montgomery (1998) which indicate that one of the key drivers in the successes of pioneering firms is the ability to gear consumer preferences towards their products.

These results demonstrate that the proposed methodology is a tool that managers can use to aid in their decision for bringing a new product to market. Additional implications exist relative to the empirical results and how these results influence the decision process of a management team. If careful analysis of the new product's market including size, share, price, and competitor entry is thoroughly completed, then the management team can arrive at probabilistic estimates of first-mover advantages and assess the impact of these advantages on the firm's bottom line. It is important for a firm, when contemplating introduction of a new product, to consider the long-term profitability of the new product. Our results indicate that launching GE Juice immediately yields an approximate 80% chance it will provide an economic profit to FJI. Furthermore, we have demonstrated that immediate product introduction creates a delay strategy option for FJI's competitors and growth option for FJI. That is, FJI's competitors wait-and-see how the uncertain GE juice market develops and enters when they can capture a profit for their respective firm. In addition, FJI should enter the market immediately because the growth potential of immediate entry dominates the option of delaying entry. Finally, the proposed simulation model allows a firm's management team the flexibility to implement multiple sensitivity analyses on variables that are pertinent to the success of a given firm (e.g. altering advertisement cost of the new product).

A limitation of our study is that FJI is treated as being risk neutral. A further extension of this model would be to incorporate a utility function to capture the characteristics of a risk averse firm. In addition, our proposed model focuses on a firm with limited data. More extensive data on competitor's market power relative to FJI would enhance these measures beyond firm level conjectures. However, this data can be difficult to collect or observe and the proposed model allows managers to make a more informed decision when bringing an innovative product to market.

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Scorecarding and Heat Mapping: Tools and Concepts for Assessing Strategic Uncertainty

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Abstract

The dramatic changes occurring throughout the agriculture industry are creating new and different uncertainties that result from a turbulent business climate. The objective of this paper is to present a methodology to understand, assess and evaluate, and manage strategic uncertainty. The approach is to present a mental model that frames assessment of strategic uncertainty from a potential and exposure perspective. Scorecarding and heat mapping assessment tools operationalize the mental model. Participants in an executive agribusiness educational workshop applied this mental model and the assessment tools to one of three hypothetical seed companies. The participants then provided an evaluation of the usefulness and effectiveness of uncertainty scorecarding and heat mapping.

Keywords: Uncertainty, scorecarding, strategic uncertainty, heat mapping, potential, exposure, likelihood

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Introduction

The dramatic changes occurring throughout the agriculture industry, including disease and food safety crises such as bird flu and BSE, and changes in government policy including energy policy particularly renewable energy incentives and increased (or decreased) farm subsidies; are creating new and different uncertainties than the traditional operational and financial uncertainties agribusinesses have faced in the past. These new uncertainties result from strategic choices and a turbulent business climate. From both an analytical and managerial perspective, a major challenge in the future will be to assess both the frequency of occurrence and the magnitude of these uncertainties (Economist 2004 and Nottingham 1996). The objective of this paper is to present a methodology that helps teach agribusiness managers how to understand, assess, evaluate, and manage these new and different strategic uncertainties.

The approach is to present a mental model that frames assessment of strategic uncertainty from both a potential and an exposure perspective. Scorecarding, a process for taking qualitative discussions about strategic uncertainty and turning these discussions into quantitative rankings, and heat mapping, a process of taking the rankings from scorecarding utilizing both colors/symbols and generic strategies to communicate the impact of the uncertainty on the business, are assessment tools which operationalize the mental model. In essence, the mental model in this paper is designed to promote and generate discussion around key areas of uncertainty through a systematic framework that directs the firm in selecting an appropriate uncertainty management strategy. Participants in an executive agribusiness educational workshop applied this mental model and the assessment tools to one of three hypothetical seed companies. The participants then provided an evaluation of the usefulness and effectiveness of uncertainty scorecarding.

Strategic Uncertainty

The first step in assessing strategic uncertainty requires an understanding of the sources of strategic uncertainty. Boehlje et al. (2005) note that "strategic uncertainty is the sensitivity of the company's value to inappropriate strategic choices, ineffective strategy implementation, or uncertainties in the business climate[2]. These uncertainties include: 1) political, government policy, macro-economic, social and natural contingencies, and 2) industry dynamics involving input markets, product markets, competitive and technological uncertainties."

[2] Knight (1921) would argue that risk and uncertainty are separate entities. With risk, the firm would have a priori knowledge of the underlying probability distribution but with uncertainty, there is not a priori information about the probability distribution. Hillson (2003), whose views reflect our own, notes that risk is any uncertain event or set of circumstances that, should it occur, would have an effect on one or more objectives. Thus, firms must utilize all available information to form best-guess estimates about the impacts of these risks through quantitative and qualitative methods to determine the realm of possible outcomes and choose strategies based on these outcomes.

Therefore, firms must evaluate and manage strategic uncertainty through proactive strategies that capture the potential benefits of the uncertainty and mitigate the exposures if they fail to act. Teach (1997) developed a taxonomy of total risks faced by a firm. Within this taxonomy, he provides a detailed discussion of the different strategic risks faced by a firm. Table 1 summarizes our adaptation of Teach's taxonomy. The synopsis provided in Table 1 illustrates that strategic uncertainties are more complex and more pervasive than is often perceived.

Firms must be proactive in managing uncertainty to create long-term value because uncertainty has upside potential as well as a downside exposure (Pascale et al. 2000). The dimension of potential refers to the incremental value the uncertainty category offers to the firm, while exposure refers to the downside loss that an

Table 1: Dimensions of Uncertainty in Agribusiness*

Categories of Strategic Uncertainty		Sources of Strategic Uncertainty
Business /Operational	Operations and Business Practices	Contractual uncertainty, internal processes and controls, management transitions
	People and Human Resources	Recruiting, training, retention, organizational culture
	Strategic Positioning and Flexibility	Mergers and acquisitions, joint ventures, resource allocation and planning, organizational agility, information access
Financial	Financing and Financial Structure	Debt structure, non-equity financing
	Financial Markets	Portfolio misalignment
Market Conditions	Market Prices and Terms of Trade	Contract terms, market outlets, market access
	Competitors and Competition	Antitrust, industrial espionage
	Customer Relationships	Poor market timing, inadequate customer support
	Reputation and Image	Corporate image, brand image, reputation of key employees, community relationships
Technology	Technological	Complexity, obsolescence, workforce skill-sets, adoption rate, diffusion rate
Business Relationships	Business Partners and Partnerships	Interdependency, confidentiality, cultural conflict, information sharing
	Distribution Systems and Channels	Access, dependence on distributors
Policy & Regulation	Political	Enforcement of intellectual property rights, change in leadership, revised economic policies, budget shortfalls
	Regulatory and Legislative	Government trade negotiations, government farm subsidies

* Adapted From Teach (1997)

uncertainty poses for the firm. It is important for firms to account for the potential or opportunity of the uncertainty as well as the downside or exposure (risk) if proper strategic management decisions are to be made (Nottingham 1996). The focus on the upside potential of uncertainty is one of the key factors that differentiates this set of assessment tools from other tools that emphasize only risk exposure[3]. Focusing only on uncertainty avoidance could cause a firm to overlook opportunities to create value; uncertainty management should involve assessing both potential and exposure (Talavera 2004).

Assessing Uncertainty

Assessing uncertainty through qualitative rankings is not a new concept and methods for doing so have been suggested by others (see Groth 1992 for a summary). To understand fully how to manage uncertainty, firms should first assess the four critical dimensions of each source or category of uncertainty: potential, exposure, the likelihood of potential, and the likelihood exposure. These dimensions characterize the uncertainty in terms of the impact each category can have on the firm's profitability, image, and competitive position in the marketplace. Table 2 provides an illustrative listing of various potentials and exposures associated with each category of uncertainty. Systematic assessment of these dimensions of uncertainty is the key to understanding uncertainty management. Considering the size of the potential or the exposure of the uncertainty without accounting for the likelihood, can cause management to make incorrect assumptions about the uncertainty and its ability to impact company profit (Baldoni 2001).

Potential is often overlooked in managing uncertainty and may result in conservative decisions that ignore the opportunity to create long-term value. Potential can be thought of as the opportunity to create additional profits if the firm exploits an uncertainty (Hillson 2003). When outcomes are favorable, the firm may find itself with such benefits as a new market, more loyal customers, or a distinct cost advantage over rivals. Initiating the uncertainty assessment process by measuring potential can frame the firm's goals in the context of how it can manage the uncertainty to create increased profits or improved financial performance. For example, a business relationship uncertainty in terms of supply chain arrangements might create potential in the form of loyal retailers who promote our agribusiness products over our competitors.

The second dimension, exposure, asks, "if this category of uncertainty has a negative outcome, how bad will it be?" Exposure is often defined in terms of how many dollars the negative outcome will cost the company because of lost customers, a tarnished image, legal fines, etc. By assessing the exposure, management is aware

[3]See Boehlje, Gray, and Detre 2005 for an example of tools focused on managing downside risk.

of the dangers of the uncertainty and can make informed decisions based on the possible exposure. An exposure that may arise in supply chain arrangements would be if retail sellers reneged on the terms of a contract.

Likelihood is the chance a potential or exposure event will occur. Having determined the potential (exposure) of a particular uncertainty category, it is critical to assess the chances or likelihood that this potential (exposure) could be realized. In essence, what are the odds that the potential can be captured, and what are the odds that exposure will occur? For each uncertainty category the likelihood of the potential and the exposure need not be the same or symmetric. For example, the assessment might determine that there is a "medium" likelihood that the potential consequence occurs and "high" likelihood that the exposure consequence occurs.

Table 2: Examples of Potentials and Exposures for the Strategic Uncertainties

Categories of Strategic Uncertainty	Examples of Potentials	Examples of Exposures
Business /Operational	Superior cost control/operational efficiency, Superior workforce, Creating synergies through scope	Business interruption, Loss of key employees
Financial	Strong financial position, Access to equity funds/investors, Attractive financing terms (amounts and terms), Financial reserves (pursue unanticipated opportunities, weather financial shocks, etc.)	Rising interest rates, Loss of lender, Highly leveraged
Market Conditions	Strong brand, Strong complementary products and bundling potential, First mover advantages, Create high switching costs (create loyalty)	Pricing pressure/discounting by competitors, Loss of market share, Consolidation of customer industry, Hyper-competition
Technology	Speed of innovation and commercialization, Niches not attractive to others, Enhanced learning capacity	Limited acceptance of biotechnology, Slow to commercialize new products, Competitor has preferred standards/platform
Business Relationships	Strong market position of distributors, Strong relationship with processors, Enhanced learning, Access to future opportunities	Dependence on distributors, Not a preferred supplier to processor, Not a key account to suppliers
Policy & Regulation	Increasing market from more open trade, Patent protection, Speed of approval	Changes in intellectual property law, Changes in farm income support, Local limits on technology adoption

A Scorecard for Assessing Uncertainty

Anthens (2004) indicates that the impact and effectiveness an Information Technology (IT) risk scorecard had on managing IT risks at Delta Airlines came from its ability to enable managers to focus their attention on the risk in an easy-to-understand framework. The strategic uncertainty scorecard proposed here transforms qualitative discussions into quantitative rankings that facilitate prioritization and focus managerial energy. In addition, it ensures that agribusiness managers recognize the potential or opportunity of the strategic uncertainty as well as the downside or exposure.

The scorecarding process facilitates discussion/dialogue among key members of the management team as to the strategic opportunities and challenges they face. Each category of strategic uncertainty may have varying degrees of impact on the business units in a firm. In essence, an uncertainty may present an opportunity for one business unit and create a threat for another business unit. The development of a consensus scorecard is necessary to assess accurately the opportunities and threats of each uncertainty as they relate to the entire firm. This tool provides a mental model to focus the assessment process and consequently should be a recurring complement of any strategy planning activity. It is anticipated that the scorecarding activity is initiated at the business unit level but for multiple unit firms, the business unit scorecarding can be critical input into the assessment of growth or downsizing decisions and the overall strategic direction of the company.

Table 3 provides a scorecard for assessing each category of uncertainty. The scorecard presented in Table 3 contains the six broad categories of uncertainty identified in Table 2, which are then rated or assessed on a scale of 1 to 5. A 1 indicates that this uncertainty category is low, unimportant, or has minimal impact and a 5 implies it is high, very important, or has a large impact. To illustrate the scorecarding concept, suppose that the business relationship uncertainty potential is rated 2 with a likelihood of 2, and the exposure a 4 with a likelihood of 3 by a member of the management team. Where do these ratings come from? In essence, these are a manager's informed assessments about the uncertainty.

Each member of a firm's management team should complete a scorecard; multiple views of uncertainty often arise because of an individual's responsibilities within the firm. An individual's rating is useful, but more valuable is the management team's discussion of why individuals rated an uncertainty at a particular level. For example, the manger of the finance department may feel that the business relationship uncertainty has the ability to create substantial opportunity for the company because the company has long-term contracts in place with input suppliers, while the production manger sees this as a threat because they have no other qualified suppliers. The ensuing discussion between these two managers as well as all other members of the management team would focus on why these

Table 3: Strategic Uncertainty Scorecards

Strategic Uncertainty Assessment Scorecard for Potential

Categories of Strategic Uncertainty	Potential					Likelihood				
	Low				*High*	*Low*				*High*
Business/Operational	1	2	3	4	5	1	2	3	4	5
Financial	1	2	3	4	5	1	2	3	4	5
Market Conditions	1	2	3	4	5	1	2	3	4	5
Technology	1	2	3	4	5	1	2	3	4	5
Business Relationships	1	2	3	4	5	1	2	3	4	5
Policy & Regulation	1	2	3	4	5	1	2	3	4	5

Strategic Uncertainty Assessment Scorecard for Exposure

Categories of Strategic Uncertainty	Exposure					Likelihood				
	Low				*High*	*Low*				*High*
Business/Operational	1	2	3	4	5	1	2	3	4	5
Financial	1	2	3	4	5	1	2	3	4	5
Market Conditions	1	2	3	4	5	1	2	3	4	5
Technology	1	2	3	4	5	1	2	3	4	5
Business Relationships	1	2	3	4	5	1	2	3	4	5
Policy & Regulation	1	2	3	4	5	1	2	3	4	5

perspectives are different and what is the true nature of the uncertainty. This discussion provides insight into the opportunities and challenges these uncertainties provide and allows individuals to reassess their perspectives in response to the discussion. The objective is to create a consensus among the management team that results in a company-wide perspective of the strategic uncertainties facing the firm.

Interpreting the Uncertainty Scorecard

Having assessed the potential, exposure, and the likelihoods of the categories of uncertainty, the next step is to choose a strategy for managing that uncertainty that mitigates the downside exposure and exploits the upside potential. Traditional uncertainty management strategies focus on risk mitigation to prevent an uncertainty from occurring, and if it does occur, minimize the exposure (Wilkerson 2003). In contrast, we assess the scores from the company-wide uncertainty scorecard via a heat map to choose strategies which exploit potential as well as mitigate exposure. Buehler and Pritsch (2004) used a heat map to communicate effectively the dollar value exposure for a given risk by business unit. They indicate that the heat map is an effective method for assessing and communicating uncertainty because it utilizes both numbers and colors (reds and greens) to describe the severity of the risk. Their heat map, however, only considered dollar exposure and did not encompass potential or likelihood of potential.

The proposed strategy matrix or heat map used here is a visual aid that highlights the potential, exposure, and likelihood dimensions of the strategic uncertainties. The heat map utilizes the colors of the stop light: green, yellow, and red as indicators of the impact the uncertainty would have upon the firm's value. The color green indicates to the firm that this uncertainty has a positive impact on firm value. The color red indicates that the uncertainty negatively influences firm value, while the color yellow informs the firm that the effect on a firm's value might be positive or negative. Furthermore, this visual aid motivates a rich and in-depth discussion because the participants are forced to focus their efforts on the most pressing strategic uncertainty. In addition, the generic strategies on the heat map serve as a filter for choosing a specific set of actions or activities for managing a strategic uncertainty.

Using the numbers from the consensus scorecard, the management team can plot each uncertainty's likelihood/potential and likelihood/exposure score on the graphs of Figures 1 and 2, respectively. The likelihood score is plotted on the vertical axis while the potential/exposure score is plotted on the horizontal axis. Each axis is measured from a score of low to high, where a low score corresponds to a number from the scorecard which is less than or equal to three and a high score is a number that is greater than three. For example, if an agribusiness company's scorecard has the potential of the technology category scored a 5 with a likelihood score of 4, they have assigned technology a high potential score and a high likelihood score -- thus mapping technology uncertainty in the upper-right quadrant of the likelihood/potential graph. This procedure is completed for each of the six categories of uncertainty for both potential and exposure.

These graphs provide a visualization of the uncertainty scorecard; the quadrants are color-coded and hand-gestures are utilized to show how a firm has assessed the uncertainty. To illustrate, we will analyze Figure 1, the likelihood/potential graph, beginning in the upper-right quadrant and moving clockwise through the quadrants. The upper-right quadrant is shaded dark green and contains a thumbs-up gesture, indicating that an uncertainty in this quadrant is beneficial to the company because of the high potential and the high likelihood. The next quadrant, high potential and low likelihood, is shaded light green and is represented by a hand-gesture signifying okay. In this quadrant, the uncertainty is unlikely to occur, but if it does, the payoff to the company is significant. The next quadrant is colored red with a thumbs down hand-gesture; here, the uncertainty has low scores for likelihood and potential, indicating that there is no benefit from the uncertainty. The upper-left quadrant contains a yield hand-gesture and is colored yellow. Even though the uncertainty occurs often, the payoff to the company is small.

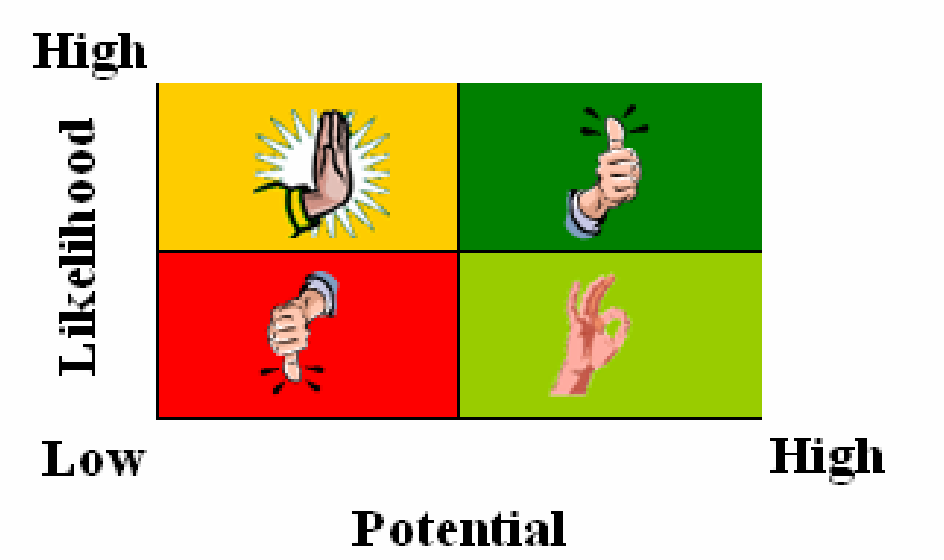

Figure 1: Likelihood/Potential Graph

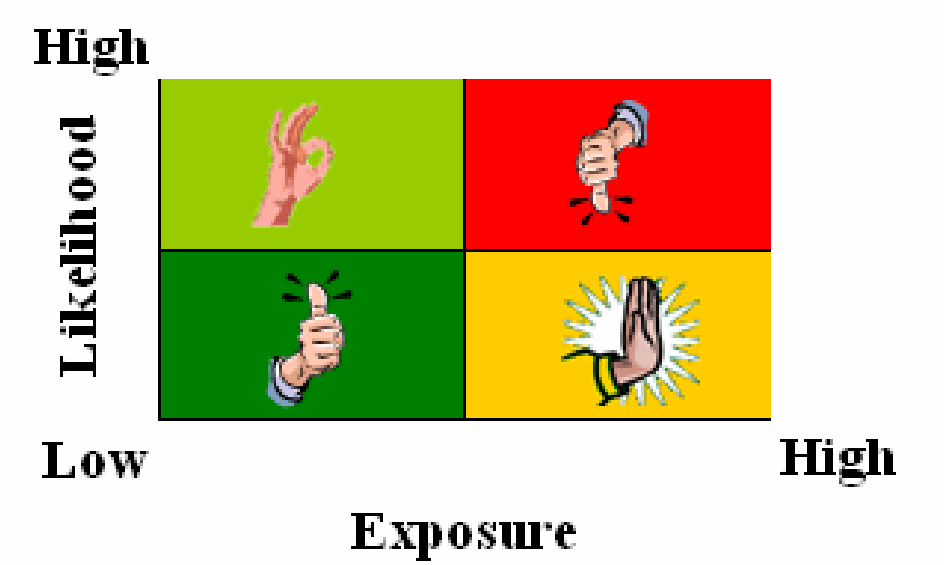

Figure 2: Likelihood/Exposure Graph

The quadrants for the graph in Figure 2, the likelihood/exposure graph, will also be examined in a clockwise manner beginning in the upper-right quadrant. The upper-right quadrant is colored red because an uncertainty in this category has a high likelihood of occurring and when it occurs the impact on the company is detrimental; the thumbs down hand-gesture indicates that the company needs to avoid this uncertainty. The lower-right quadrant has a yield hand-gesture and is colored yellow because an uncertainty in this category has a damaging impact on the company even though the likelihood of occurrence is low. The next quadrant is colored dark green and contains a thumbs up sign because uncertainties in this quadrant are unlikely to occur and even if they do, there is little impact on the company; these are uncertainties the firm should absorb. The final quadrant, the upper-left, contains the okay hand-gesture and is colored light green; here the uncertainty has little impact on the company even though it has a high likelihood of occurrence.

Notice that the color-coding of the quadrants in Figure 1 and 2 is opposite. This should make intuitive sense; when assessing potential (Figure 1), a high likelihood and high potential (upper-right quadrant) is preferred. When assessing exposure (Figure 2), a low likelihood and low exposure (lower-left quadrant) for the uncertainty is preferred. Thus, both of these quadrants are colored dark green.

To illustrate the heat mapping process, suppose an agricultural seed company's management team has completed a consensus scorecard. Assume the company has state-of-the-art research laboratories, which allows them to capture first-mover advantages and attract lifetime customers. Thus, they have assigned technology a potential score of 4.3 (high) and a likelihood score of 3.9 (high), which maps the uncertainty in the upper-right quadrant of Figure 1. The management team has also assigned an exposure score of 4.6 (high) and a likelihood score of 3.1 (high) which maps the uncertainty in the upper-right quadrant of Figure 2. The exposure scores were awarded because the firm is concerned about having tunnel vision concerning their technology as well as concern about obsolete technology platforms.

The next step in the heat mapping process is integrating the graphs from Figures 1 and 2 into a single heat map. By integrating potential and exposure, we are ensuring that the company considers both the upside and downside of the uncertainty when making strategic decisions. The bottom graph in Figure 3 is a visual representation of the integration of the graphs. The likelihood/potential graph in Figure 1 serves as the base, and embedded in each of its four quadrants is the likelihood/exposure graph. Thus, each quadrant of the likelihood/potential graph is now divided into four quadrants, giving us 16 quadrants for classifying uncertainty. The reason for using the likelihood/potential assessment as the base is that many businesses often fail to recognize the potential an uncertainty offers and concentrate on the exposure of that uncertainty. Plotting the potential first reduces the prospect that management overlooks opportunities.

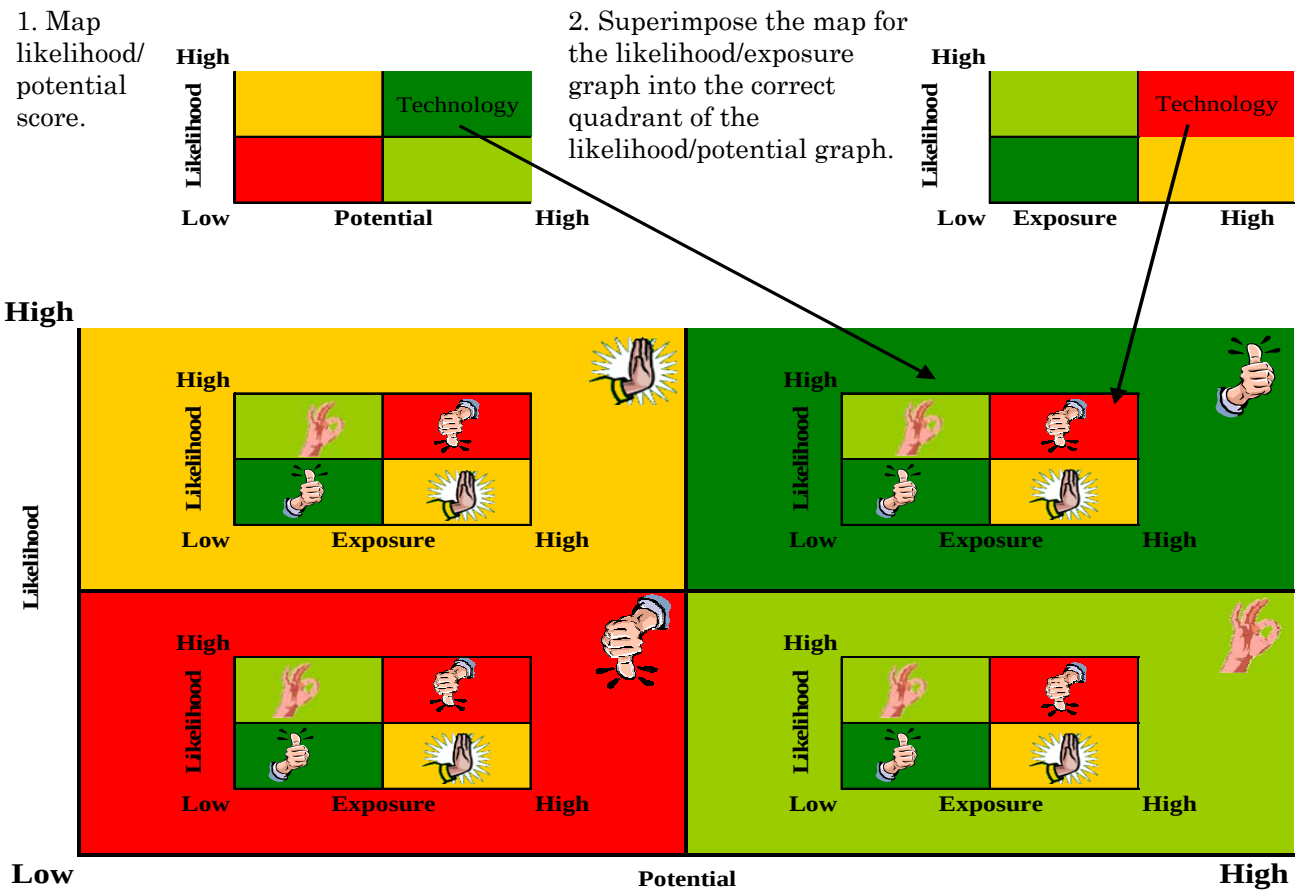

Figure 3: Integrated Likelihood/Potential and Likelihood/Exposure Graph

To illustrate integrating potential and exposure we return to the example concerning the agribusiness firm and the technology uncertainty it faced. The firm scored technology in the upper-right quadrant for the likelihood/potential graph i.e. high likelihood and high potential. Focused on this quadrant, recall that the exposure score and the likelihood of this exposure were high. This maps the technology uncertainty in the upper-right quadrant of the integrated likelihood/exposure graph. Visually in Figure 3, it can be seen that for potential, the quadrant is dark green representing an uncertainty that should be exploited by the firm, but the embedded likelihood/exposure graph indicates trouble (red color) because of the exposure faced from this uncertainty.

Uncertainty Management Strategies

So what does this analysis indicate management should do to manage the various types of uncertainty? As Baldoni (2004) indicates, many companies have identified the uncertainties their company faces, but do not have policies for mitigating the exposures or capturing the potential. The bottom graph in Figure 4 contains the integrated heat map with one or more of six generic strategies for managing the

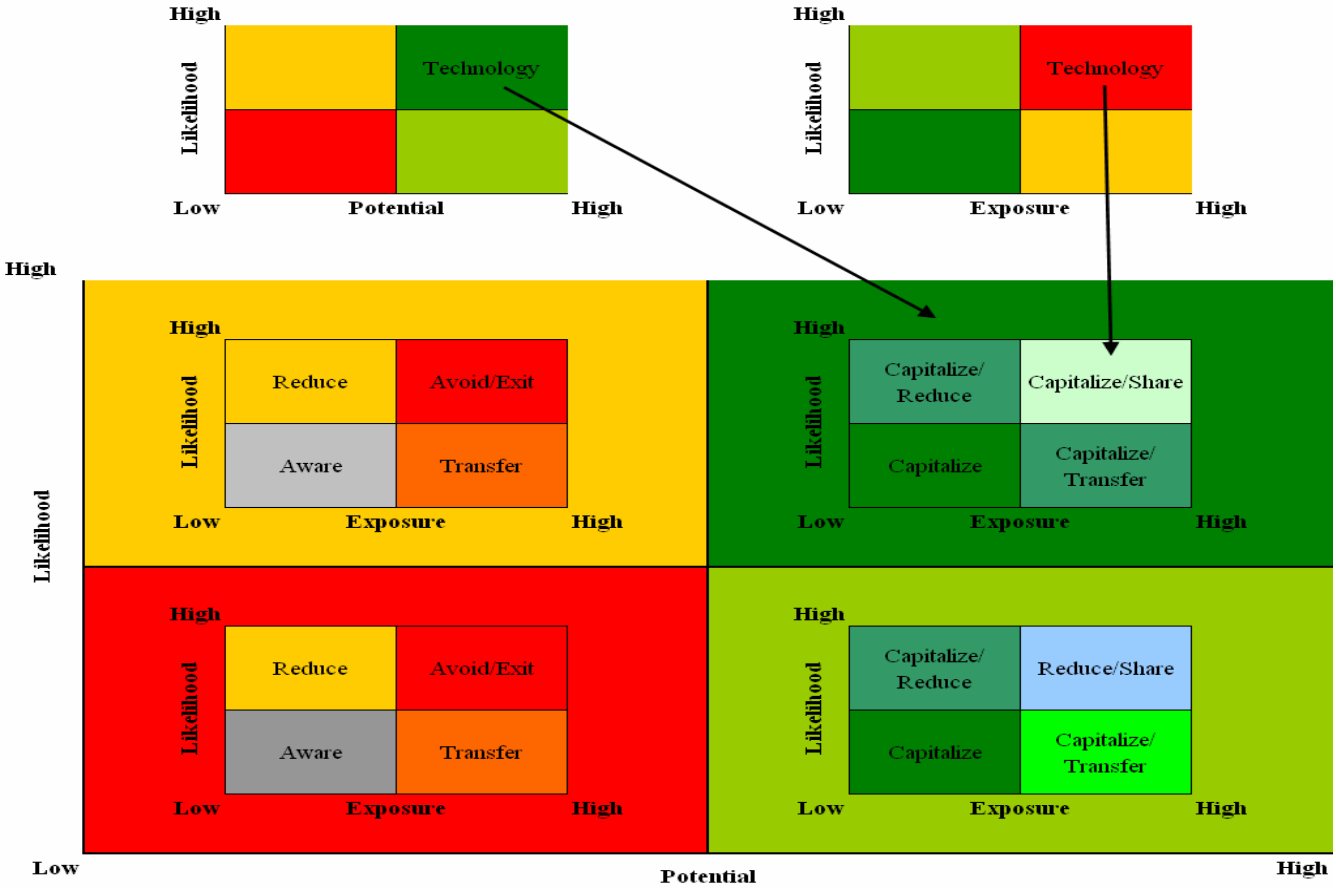

Figure 4: Generic Strategies for the Quadrants of the Integrated Likelihood/Potential and Likelihood/Exposure Graph with a Technology Uncertainty Example*

*Strategies adapted from Centrec Consulting Group LLC (2002)

uncertainty identified for each of the 16 quadrants. The generic strategies are capitalize, share, transfer, reduce, avoid, and monitor. These generic strategies serve as a filter for concentrating the firm's effort on choosing a specific action or set of actions to manage the uncertainty -- to simultaneously capture the potential and mitigate the exposure. Specific actions are beyond the scope of this paper but are important for a companies' strategic decisions; see Trigeorgis (1995, 1996, 1999), Luehrman (1997, 1998a, 1998b), Courtney (2001), Mun (2003), and McGrath and MacMillan (2001) for a discussion of these choices and options.

The capitalize strategy applies to an uncertainty that has desirable potential with minimal exposure, i.e. *high potential + high likelihood of potential* and *low exposure + low likelihood of exposure*. Capitalizing on this uncertainty creates opportunities to generate economic profit. Here a firm might want to think about attempting to shape the future of the industry based upon their perceived advantage with this uncertainty. For example, a firm may want to enter a new market, introduce a new

product, or make an acquisition if the uncertainty is characterized the capitalize strategy.

In contrast, for an uncertainty, that has *low potential + low likelihood of potential* and *high exposure + high likelihood of exposure*; the strategy that should be employed is avoid. In essence, the consequences in this case warrant immediate exploration of actions to eliminate the uncertainty through some type of avoidance or exiting strategy. Perhaps the firm would want to consider a divesture of a business unit if multiple sources of uncertainty are heat mapped into this category.

Most strategic uncertainties are not easily managed with a capitalize or avoid strategy and present the greatest dilemma in strategic uncertainty management. A firm might want to share an uncertainty that has a desirable potential, yet creates adverse consequences. To mitigate these consequences, sharing the potential and exposure through joint ventures and strategic alliances is a possible strategy. Uncertainties where this type of strategy is most appropriate exhibit *high potential + high or low likelihood of potential* and *high exposure + high likelihood of exposure*.

Uncertainties which exhibit *low potential + high or low likelihood of potential* and *high exposure + low likelihood of exposure* should be managed with a transfer strategy. The transfer strategy is used because there are other institutions or firms that have better risk management capabilities for this strategic uncertainty. By outsourcing the exposure portion of the uncertainty to another entity, perhaps for example through the purchasing of weather derivatives, the firm is able to capture the potential while truncating their exposures to large losses.

The reduction strategy is preferred when exposure is very likely but the consequence is minimal; here, outsourcing is often difficult. For example, insurance firms may refuse to cover a trucking company whose drivers have a history of multiple auto accidents and frequently file claims. The reduction strategy is focused on decreasing the likelihood of exposure. For example, a firm might rely upon sequential decision-making -- making incremental investments as opposed to a full-scale investment -- that allows the firm to reserve the right to play if the market develops, but protects the firm if the market fails to materialize. This strategy is appropriate for uncertainties exhibiting *high or low potential + high or low likelihood of potential* and *low exposure + high likelihood of exposure*.

Monitor, the final strategy, is used to manage those uncertainties with *low potential + high or low likelihood of potential* and *low exposure + low likelihood of exposure*. This type of uncertainty warrants monitoring or the firm being aware of changes in the dimensions of the uncertainty. However, management efforts should be focused elsewhere, since impact on profit is minimal.

Let us return to the earlier example concerning technology to illustrate the application of these concepts (see Figure 4). The generic strategy appropriate to manage the technology uncertainty is the capitalize/share strategy. The capitalize strategy indicates that the firm wants to capture the potential of the uncertainty if possible, but the heat map indicates that the firm should consider transferring at least part of the uncertainty to another entity. A possible share strategy would be acquiring licensing agreements with several smaller independent R&D firms to access their technology platforms while maintaining their own platform. This allows the firm to maintain their technology potential while minimizing the tunnel vision and obsolescence problem that could arise if they relied solely on their own technology. In essence, if one of the contracted firms develops a platform that the market desires, the licensing agreement enables access to that platform, thus mitigating the exposure from technological obsolescence.

Application of the Scorecard and Heat Map

To test the applicability of the aforementioned methods for assessing and communicating the challenges and opportunities of strategic uncertainty, the concepts and tools were presented and discussed with participants at the 2005 American Seed Trade Association Advanced Management (ASTAAM) Forum -- an advanced management forum sponsored by Purdue University's Center for Food and Agricultural Business in conjunction with the American Seed Trade Association's Management Skills Committee. Participants in this forum ranged from a Contract Business Development Manager to the President/CEO of a seed company. In addition, the size of the companies varied from privately held firms to publicly traded multi-national firms. This diversity led to a rich discussion of the assessment tools and concepts as well as their usefulness in a company's strategic planning process.

The assessment concepts and tools were presented to the participants in a classroom teaching session in conjunction with three vignettes (hypothetical seed companies) to assist in the learning and application of the concepts. Figure 5 provides the vignettes used for the application activity. The initial workshop session introduced the sources of uncertainty and the scorecarding concepts, and then the participants were assigned one of the three case vignettes and asked to complete a scorecard for that vignette. Upon completion of the individual assessment, participants were grouped by vignette and asked to develop a consensus or group scorecard. Each group then provided a synopsis of their completed assessment and reasons for scorecarding the strategic uncertainties for their group's vignette.

Upon completion of the group presentations and discussion of their consensus scorecards, the participants were introduced to the heat map and the six generic management strategies. The participants then used the consensus scorecard they

Company #1 – Regional Midwestern Seed Company

- Corn and Soybean products with latest technology
- 3 states (Illinois, Indiana, Ohio)
- Direct sales to customers
- Market share hovering around 8 percent
- Technology purchased from others under license agreements
- Family-owned business
- $10,000,000 in Assets
- Debt-to-Asset Ratio of 50%
- Return on Equity averaging 8-10% last 5 years

Company #2 – National (US) Vegetable Seed Company

- Large selection of vegetable seeds with latest technology
- Independent dealerships in all major growing areas
- Market share near 30 percent
- Technology acquired through JV with R&D company
- Currently engaged in a JV with a vegetable processor to develop new varieties specific niche markets
- Closely held LLC
- $100,000,000 in Assets
- Debt-to-Asset Ratio of 65%
- Return on Equity average 12-15% last 5 years

Company #3 – Multinational Seed Company

- Division of large Chemical Company
- All major types of seed (corn, beans, cotton, rice, wheat, vegetables, forages, etc.)
- Multiple distribution channels
- Market share in North America is strong in commodities (near 30% in corn, beans, cotton)
- Market share in North America is about 15% in vegetables and forages
- R&D activities for commodities is done in-house
- R&D activities for vegetables and forages are purchased from either their wholly owned subsidiary or others depending on the need.
- Public traded company
- $1 Billion in assets
- $300 Million in Debt
- Stockholder returns averaging 10 percent over the last 5 years

Figure 5: Vignette Descriptions

had developed in the prior session to develop a heat map for their vignette. After viewing the heat map, each group was asked to choose the two uncertainties on which their case firm should concentrate their management efforts, and suggest and justify specific actions or activities to manage these uncertainties.

Application to the Regional Midwestern Seed Company

To illustrate the application of the concepts and the discussion and dialogue of the group from the educational session, we will highlight the group discussion of the Regional Midwestern Seed Company vignette. The group assigned to this vignette noted that when they began initial discussions there were large discrepancies in how each of them individually scorecarded the uncertainties. For example, one individual in the group argued that the financial uncertainty exhibited a high exposure with low potential because of the high debt-to-asset ratio. A second individual in the same group with experience in finance indicated, "if the firm's debt cost them only 4 percent and they were generating an 8-10 percent Return on Equity (ROE), then the financial uncertainty had high potential and low exposure, especially given the information concerning market share." After extensive discussion among the members in the group and the utilization of the group's collective body of knowledge, they were able to reach the consensus scorecard found in Figure 6 for the Regional Midwestern Seed Company.

Strategic Uncertainty Assessment Scorecard for Potential

Categories of Strategic Uncertainty	Potential	Likelihood
Business/Operational	2.7	2.5
Financial	4.1	2.6
Market Conditions	4.8	4.3
Technology	4.3	3.9
Business Relationships	4	3
Policy & Regulation	2.3	1.6

Strategic Uncertainty Assessment Scorecard for Exposure

Categories of Strategic Uncertainty	Exposure	Likelihood
Business/Operational	4.6	4.1
Financial	2.9	4.2
Market Conditions	1.3	2.4
Technology	4.6	3.1
Business Relationships	4.1	3.8
Policy & Regulation	1.8	2.4

Figure 6: Consensus scorecard: Regional Midwestern Seed Company

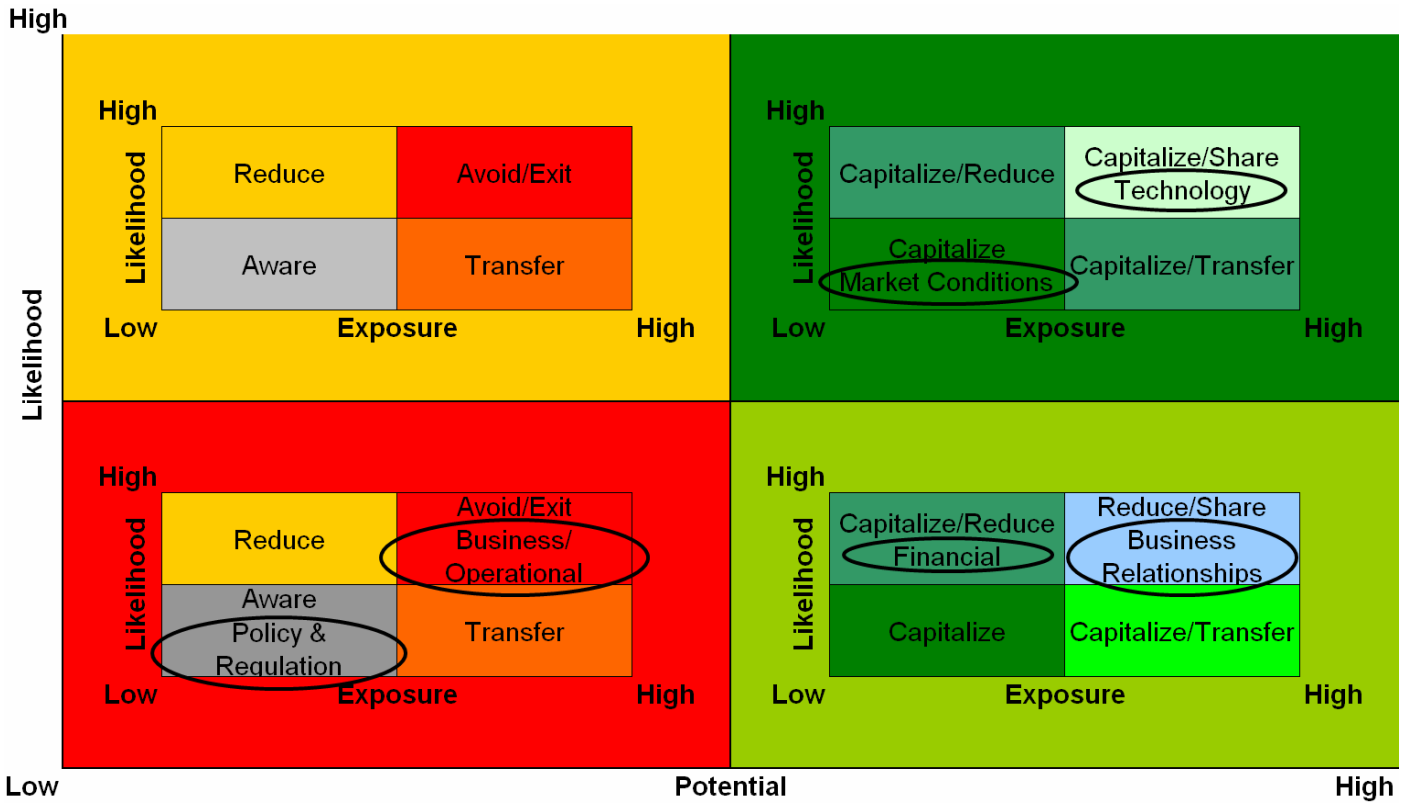

Figure 7: Suggested generic strategies for Regional Midwestern Seed Company

The group used the consensus scorecard to develop a heat map (Figure 7) and determine the two most pressing exposures facing the Regional Midwestern Seed Company. They began this exercise by working with the likelihood/potential and likelihood/exposure graphs (Figures 1 and 2). The group plotted each uncertainty into the appropriate quadrant based on the consensus scores. They noted that almost immediately the colors and hand signals in this graph generated conflicting messages about key uncertainties facing this firm. For example, the policy & regulation uncertainty is mapped in the lower left quadrant of the potential/likelihood graph (red color/ thumbs down). However, it is also mapped into the lower left quadrant of the exposure likelihood graph (green color/ thumbs up). Thus, the heat mapping indicates that as to exposure, this uncertainty presents no risk to the firm, but on the potential side the uncertainty is unlikely to generate any profit. The market conditions uncertainty was placed in the dark green/thumbs up quadrant for both the exposure and potential measures. Thus, an obvious choice for this uncertainty is to find a way for the firm to maintain their current position. Ultimately, the group agreed that technology uncertainty and business and operational uncertainty were the two most critical uncertainties to be managed.

Originally, the group thought that technology uncertainty could only have a negative impact on firm value; however, after the heat mapping process they

realized technology uncertainty had an upside that could not be overlooked. To determine how to manage this uncertainty the group superimposed the generic strategies for each quadrant onto the heat map. The suggested generic strategy for technology was capitalize/share. This generated intense discussion about the specific actions the firm should implement to capture the potential of the technology uncertainty while limiting its downside. They suggested that the firm consider developing multiple licensing arrangements with their technology suppliers. In addition, they felt that since the company has strong customer relationships, they could leverage this knowledge with these technology suppliers, thus providing the technology firms with information on what attributes the customer needs and wants in their seeds.

While the technology uncertainty had upside potential, the business and operational uncertainty had little or no upside potential and only generated detrimental consequences to the firm. The group concluded that the firm was not large enough to capitalize on the economies of scale available to larger seed companies who bagged and distributed multiple species of seeds. The generic strategy suggested by the heat map was avoid for the business and operational uncertainty, i.e. there was high likelihood of a large exposure and low likelihood of a high potential. With the generic strategy serving as a guide, the group suggested selling off the assets associated with the bagging and distribution facilities and using some of the proceeds to pay down debt to achieve a debt-to-asset ratio between 35-45%. The company should then focus on being a market driven company that worked more closely with their customers and technology suppliers to develop seed varieties valued in the market. They concluded that for a small seed company, customer relationships along with reputation and image have great potential. Meanwhile, the company could effectively contract with another firm to bag and ship the products at a cost level comparable to larger competitors on a per unit basis.

Participant Evaluations

The participants completed a workshop evaluation and provided additional written and verbal feedback on the assessment tools and concepts. Several of the participants indicated in their final evaluations that the strategic uncertainty assessment tools and concepts were useful in helping them understand and prioritize strategic uncertainty. These comments are reflected in the overall ranking for this workshop, which was 4.62 on a scale of 1 to 5, with a one being not relevant and a 5 being extremely relevant.

The participants indicated that the taxonomy encompasses most all uncertainties faced by firms, and a company could tailor the scorecard to meet the needs of their firm by adding or removing uncertainty categories. They also noted that the individual assessments, followed by the group discussion to build a consensus

scorecard proved invaluable in resolving the differences between viewpoints. This process was beneficial in obtaining a more complete understanding of the uncertainty facing the company in their vignette. One participant noted that after hearing the other members in his group discuss their scores, he changed his individual assessment of the uncertainty because his current functional responsibilities limited his ability to accurately assess properly the uncertainty in some areas.

The participants also valued the inclusion of potential and the likelihood of potential as dimensions in the scorecard. They indicated that it is very difficult to recognize the potential of an uncertainty when most of the past focus in managing uncertainty has emphasized exposure management. The inclusion of potential affected their prioritization in assessing and managing that uncertainty, i.e. when focusing only on the exposure measure many of the participants indicated they would want to avoid some uncertainties at all cost, but with the inclusion of the potential this was not the case.

The workshop participants indicated that the heat map with the embedded generic strategies for managing uncertainties visually communicated not only how important the uncertainty is to the company, but also gave them clear guidance on the strategy that should be taken to manage the uncertainty. One participant noted specifically that the six strategies focus efforts to a subset of the available options for managing the uncertainty.

Our *a priori* expectations were that most groups would determine that uncertainties with avoid or capitalize strategies would be the most vital to the company since these are the uncertainties that have the biggest impact on profitability. The presentations by the groups supported this expectation, with each group indicating that these uncertainties should be managed first. However, participants also indicated that without the guidance of the generic strategies they would have struggled in addressing the strategic uncertainty that did not have avoid or capitalize as the generic strategy. The other four generic strategies gave them direction in determining how they should manage uncertainty. Without these additional strategies the participants stated that their firm would often choose between the two extremes of avoid or capitalize strategy. Doing so limits the firm's ability to create value.

One of the participants summarized his perspective as follows:

> "The uncertainty scorecard and heat map provides a framework that guides the business through the strategic planning process in a sequential manner as opposed to the more traditional brute force methods we have been using in our strategic planning sessions. In

addition, I found this method more succinct and time effective than the traditional strategy tools."

A Final Comment

Agribusiness firms are increasingly facing more uncertainty, not just from changes in prices, costs, and productivity/efficiency, but also from dramatic changes in market conditions, competitor behavior, and government policy and regulations. Analyzing these new uncertainties is difficult and strategies to manage them are complex. Furthermore, these uncertainties provide opportunities to create value and enhance profits as well as expose the firm to significant losses.

A mental model for assisting in the assessment, management, and communication of these strategic uncertainties has been presented in this discussion. The concepts and tools use scorecarding and heat mapping to bring both structure and specificity to the subjective assessment of a firm's strategic uncertainties. A primary focus of the tools is an explicit recognition of both the potential and exposure of the firm's strategic uncertainty. A beta test of these concepts was completed at the ASTAAM Forum. The participants in the forum found that by focusing on the potential of the uncertainty and the likelihood of this potential as well as the exposure and the likelihood of exposure, they better understood the true impact uncertainty could have on their firm's value. In addition, their perspective was that the methodology was not only an effective way to facilitate understanding of strategic uncertainty, but it also provided useful assessment tools that management can easily incorporate into their company's strategic planning processes. The scorecard and heat mapping tools provide a time efficient and systematic method for analyzing as well as communicating the strategic uncertainties faced by the firm. Further development and testing is necessary and underway, but preliminary results suggest that the methodology is useful in understanding, analyzing, and communicating the potential as well as the exposure of strategic uncertainty.

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Does Price Signal Quality? Strategic Implications of Price as a Signal of Quality for the Case of Genetically Modified Food[1]

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Abstract

We add to the limited empirical literature on consumers' use of price as a quality signal by testing if the traditional downward-sloping consumption-price relationship fails to hold for GM products using data collected from a nationally representative mail survey featuring several hypothetical product choice scenarios. Statistical evidence is mixed across the three products investigated but suggests that survey respondents use price as a signal of the quality of GM products. Implications for firm strategy are discussed.

Keywords: Conjoint analysis, genetically modified food, pricing strategy, price-quality relationship

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Introduction

The mantra preached in nearly every introductory economics course is simple and universal – holding all else equal, when price goes up, consumption falls. However, this truism may not hold for scenarios more involved than those discussed in *Economics 101*. For example, when a consumer is not entirely sure of a product's quality because quality is highly subjective (e.g., fashion or art), novel (e.g., a new technology), or difficult to verify prior to purchase (e.g., credence attributes like organic or dolphin-safe certifications), consumers may turn to one or more signals – including price – to form quality perceptions.

Products containing genetically modified (GM) ingredients meet each of the aforementioned criteria, i.e., GM ingredients are novel, their presence is difficult to verify, and their impact on quality may be viewed differently across individuals with the same knowledge. This leads to additional difficulty for product managers attempting to formulate pricing strategy in the presence of more a complex quality signaling environment. The purpose of this article is to determine whether consumers might use price as a complex signal of quality when judging GM products and to discuss the strategic implications if consumers do use price to infer quality.

Economists have posed many theoretical models to predict whether price or some combination of price and another quality signal such as advertising can effectively signal product quality when consumers are not fully informed (e.g., Klein and Leffler, 1981; Wolinsky, 1983; Milgrom and Roberts, 1986) and to better understand how the introduction of price as a quality signal may impact the shape of consumer demand functions (Pollak, 1977) and alter the nature of market equilibrium (Balasko, 2003). Jones and Hudson (1996) developed a model of the price-quality relationship at different price levels and concluded that there is a critical price interval in which price is used as a signal of quality. However, the results of their paper exclude the role of price as a signal of quality at lower price levels. They suggest that the price above a critical price is used to signal quality while discounted prices are not.

While empirical tests are not as common as theoretical work in this area, several authors have explored the predictions of various signaling models by correlating objective quality assessments of various consumer goods with price, advertising and other signals of product quality within particular markets (Landon and Smith, wine, 1998; Nichols, cars, 1998; Esposto, cigars, 1998) or across several markets (e.g., Hjorth-Andersen, 1991; Caves and Greene, 1996). Caves and Greene (1996) show that quality-price correlations exist in many markets and that the level of correlation is higher for product categories that include more brands and is lower for convenience goods.

Although all these papers approached the issues differently, they each suggest that price acts as a signal of quality. However, most of these papers focus on the empirical relationship itself rather than the behavioral effects induced from the relationship. In other words, most of these papers analyze the relationship between observed price and objectively-measured quality rather than individual consumer's purchase decisions induced by particular combinations of price and non-price quality signals. For instance, Caves and Greene (1996) analyze the correlations between product quality and price using data from *Consumer Reports*, in which experts rate the quality of various products. Esposto (1997) analyzes the relationship between price and quality by estimating a hedonic equation in which price is explained by experts' product quality ratings. However, these papers do not analyze consumers' consumption choice as a function of price and non-price quality signals.

The social and private efficacy of GM technology in food production is an increasingly studied issue in food consumption research. Many studies have examined GM acceptance as a food safety issue because, for some people, the perceived safety of GM technology is unresolved. That is, for some, food produced with GM technology indicates low quality. However, others suggest that the application of GM technology in food production could decrease food expenditures, reduce production costs, improve food attributes such as nutritional content and limit environmental problems such as agricultural chemicals residues (the Institute of Food Science & Technology, 2004). For example, Baker et al. (2001) document consumer segments that believe GM technologies represent high quality in the corn flakes cereals market.

Individuals' perceptions of the risk associated with particular products vary by product and can be greatly influenced by emotion and other subjective factors. In fact, some researchers define risk perception as psychological interpretation of product properties (Rozin et al., 1986; Yeung and Morris, 2001). Hence, signals of food safety and other dimensions of quality enter into the consumer's decision calculus. In the case of GM technology, food safety is likely to be more subjective because the safety of its adoption does not meet with uniform perception across all segments of consumers, i.e., GM ingredients may horizontally differentiate the product, finding favor with some consumers and disfavor with others. This heterogeneity leads to a particularly interesting interaction with price, which is often used as a signal of quality. For consumers with an initial view that GM food is safe or beneficial, a higher price may reinforce this initial view of high quality and reinforce decisions to purchase the product despite the higher price. However, for consumers with an initial view of GM food as low quality, a low price may reinforce these low quality perceptions and nullify price discounts as a means of enticing product trial or expanding market share. Hence, the classical downward-sloping relationship between price and demand may be challenged.

This paper is concerned with the role of price as a quality signal in GM foods. To explore the price-quality relationship, we analyze data collected from the administration of a mail-based survey that featured a conjoint (stated-preference) instrument in which a national cross-section of consumers chose among differentiated bread, corn and egg products. Product attributes such as price, GM content level and negative and positive GM attributions for each product in a choice set were experimentally manipulated and randomly assigned across respondents.

These data are used to test the hypothesis that GM product prices act as quality signals and the hypothesis that the effectiveness of price as a quality signal differs by the type of product. The remaining structure of this paper is as follows. The next section describes the data and reports summary statistics. The following section explores the relationship between price and respondents' product choices from our survey. The final section summarizes and concludes. A technical appendix featuring detailed econometric analysis follows.

Data

The data were collected from a survey that was sent to 5,462 US residents nationally and to an over-sample of 710 residents from one of the authors' home state (Maine). Two thousand and twelve people from the general sample and 375 people from the home-state sample returned surveys for a response rate of 37% and 53%, respectively. In the econometric analysis, the responses were weighted to account for the over-sampling of the home-state residents.

The basic framework of the survey is as follows. First respondents answer several sections of questions that deal with food consumption, food technology and genetic modification. Then, respondents are presented with a choice set for a particular product (bread, frozen corn, and eggs) where each set features three options: the respondent's normal brand, a brand with 100% GM content, and brand with no GM content. Labels for the GM and non-GM product were presented and included information concerning relative price (cents more or less than normal brand), GM content, benefits or warnings associated with GM content, and the name of a firm or agency that certified the presence or absence of GM content. No label was presented for the respondent's normal brand; rather, the words 'your normal brand' were mentioned in a parallel fashion as a possible choice.

Respondents were asked to assume that their normal brand was produced with a particular mix of both GM and Non-GM ingredients; the exact percent of ingredients that respondents were told to assume came from GM sources was randomly assigned across respondents. Respondents were also told that all brands shared the same appearance, taste, texture, and smell.

After viewing the product choices and being reminded of their household budget constraint, respondents chose the most preferred option. Some respondents viewed one of the three product choice sets, some viewed two product choice sets and others viewed all three product choice sets with the number and order of viewing randomized across respondents. Usable responses include 1,336, 793 and 950 choices made for the bread, corn and eggs categories, respectively. The prices used in the survey ranged from 40 cents more to 40 cents less than the cost of a package of the normal product.

Table 1: Descriptive Statistics for Socio-Demographics (N=1,967)

	Summary statistics [a]			U.S. Census [b]		
	Average		%	Average		%
Gender		Male	45.0		Male	48.3
		Female	55.0		Female	51.7
Age	52			47		
No. of Children	0.6			0.9		
Household Income($)	63,000			57,000		
Education	15	0-11 years	5.5	13	0-11 years	19.6
		12 years	27.1		12 years	28.6
		1-3 years college	28.5		1-3years college	27.3
		College graduate	22.5		College graduate	15.5
		More than college	16.4		After college	8.9
Race		White	90.0		White	77.1
		Black	4.6		Black	12.9
		Hispanic or Spanish origin	2.2		Asian/Pacific Islander	4.5[c]
		Asian or Pacific Islander	1.9		Others	6.6[d]
		Others	1.4		Hispanic/Latino	12.5
Concern with GM	3.7	1- Not at all	5.2		Not available	
		2	9.8			
		3 – Somewhat	23.2			
		4	23.5			
		5 – Very	38.3			
Concern with Hormones	4.0	1- Not at all	4.0		Not available	
		2	6.7			
		3 – Somewhat	19.0			
		4	21.4			
		5 – Very	48.9			
Concern with Preservatives	3.3	1- Not at all	8.5		Not available	
		2	16.6			
		3 – Somewhat	31.0			
		4	19.9			
		5 – Very	24.0			

[a] The summary statistics are based on the modified data for the paper. The income data and education data were collected in ranges and midpoints of each range were used for the table. The concern ratings were for a Likert scale where 1 is 'Not at all concerned', 3 is 'Somewhat concerned, and 5 is 'Very concerned'.

[b] Source: U.S. Census Bureau, Census 2000.

[c] Asian or Pacific Islander includes Asian, Native Hawaiian and other Pacific islander.

[d] Others include all other respondents not included in the categories of White, Black, and Asian or Pacific Islanders.

Other elements of the survey provide considerable data that is used to improve the explanatory power of econometric models. Earlier portions of the survey required respondents to provide ratings of concern for GM and other food processing technologies and to rate a number of different potential benefits and risks associated with GM technologies. The final portion of the survey asks for respondents' gender, age, education level, race, income level, and household composition (see Table 1 for descriptive statistics). We do note that our sample features more females, is older, has fewer children in the household, is richer, has obtained more formal education, and features fewer minority respondents than the general U.S. population.

Several non-price product-specific attributes were also included on some product labels. Some randomly assigned GM products included the following health (environmental) warning statement: "Long-term health (environmental) effects are currently unknown." Some randomly assigned GM products featured claims stating that the product was genetically modified to improve either a health attribute (increased levels of antioxidants for bread and corn and reduced levels of cholesterol for eggs) or an environmental attribute (reduced pesticide use for bread and corn). All claims of GM content or absence were accompanied by a certifying statement endorsed by either a government agency, environmental organization, or an independent certification firm.

Table 2 features a summary of the product choices made by respondents. About half of the respondents chose the non-GM brand in each product category while about 20% chose the GM brand.

Table 2: Preferred Product in Choice Set

	Bread	Corn	Eggs
GM	242 (18%)	167 (21%)	165 (17%)
Non-GM	675 (51%)	406 (51%)	523 (55%)
Normal	419 (31%)	220 (28%)	262 (28%)
Total	1,336 (100%)	793 (100%)	950 (100%)

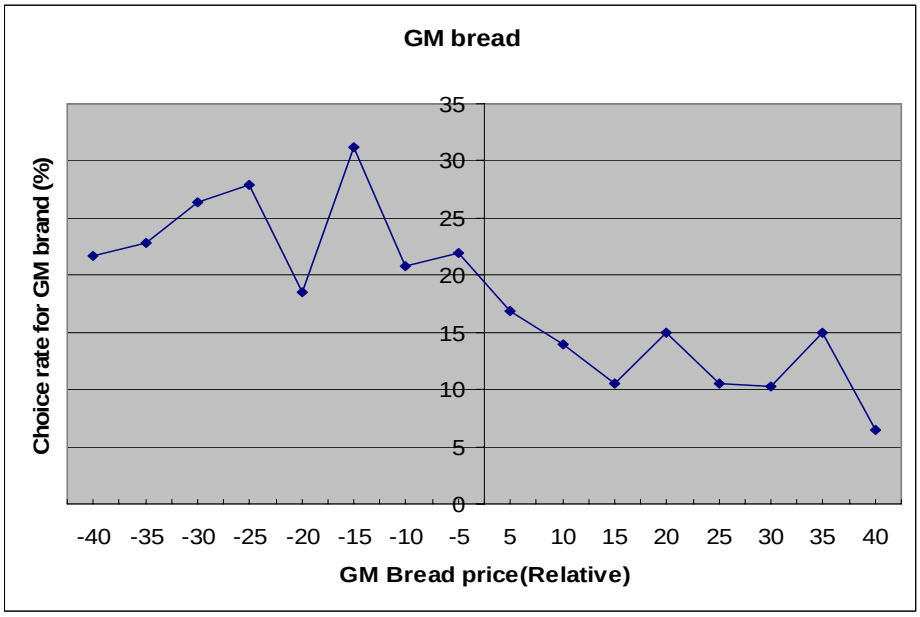

Figure 1: The Relationship between the Price of GM Bread and Respondents' Consumption Choice

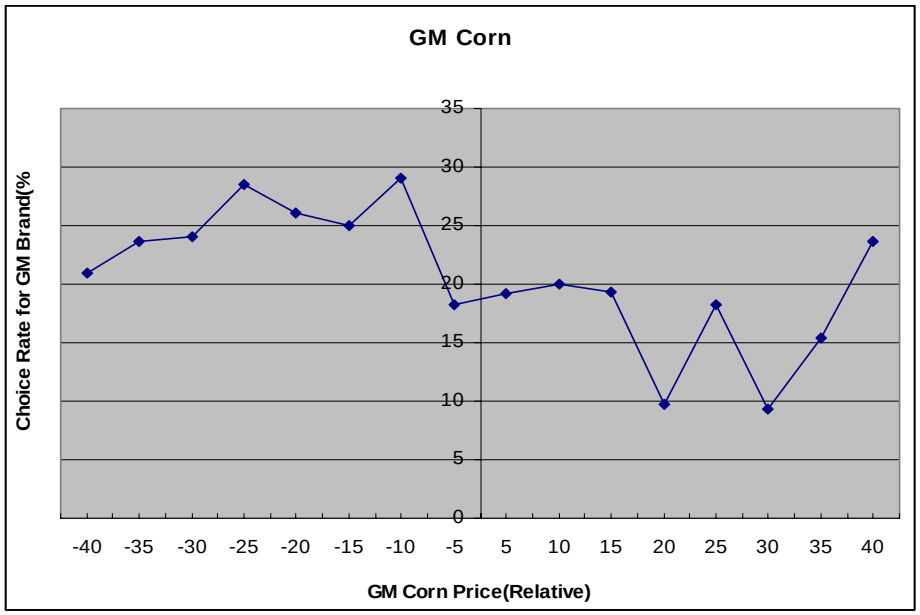

Figure 2: The Relationship between the Price of GM Corn and Respondents' Consumption Choice

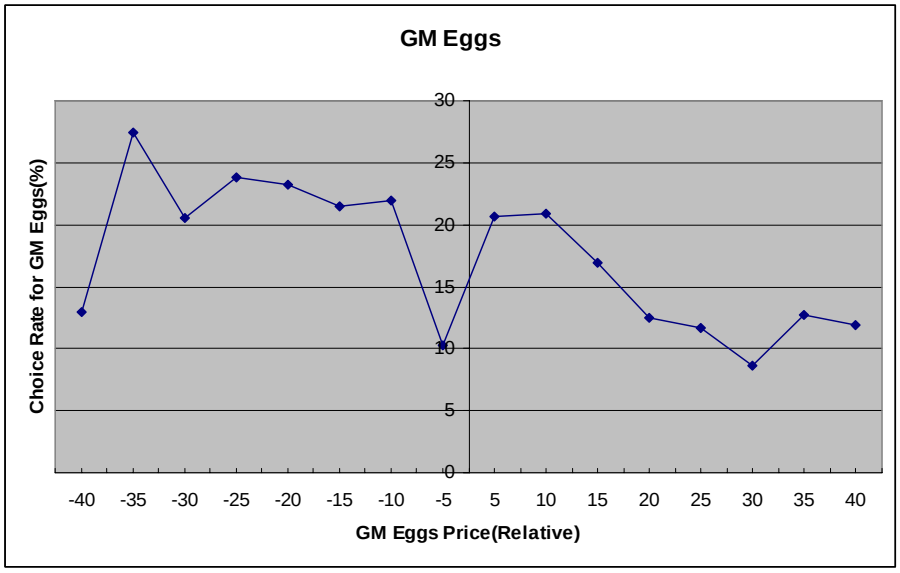

Figure 3: The Relationship between the Price of GM Eggs and Respondents' Consumption Choice

Results

The percent of respondents who choose the GM brand in each product category (call this the GM market share) is plotted for each price level used in the survey design (Figures 1 – 3). Because the other attributes of GM brand (e.g., health claims and warnings) are randomly assigned across respondents in a fashion that is not correlated with the relative price that is assigned, the average profile of the GM products for each relative price level is similar, meaning one can draw intuition from these simple plots.

None of the three graphs reveal a simple, linear, down-hill relationship between price and the resulting market share that one might expect. That is, lowering the price does not appear to guarantee an increasing market share for the GM good among our respondents.

For the bread product, there is a steady decline in market share for prices within 15 cents of normal brand's price (+/-). However, discounts deeper than 15 cents appear counter productive while price premiums in the 20 to 35 cent range appear to have a negligible effect on market share.

The corn product features a similar pattern with two slight differences. First, there is very little difference in market share responsiveness for prices that range from a nickel discount to a 15-cent premium. Second, the highest price premium was

associated with the largest market share of any price premium, suggesting a possible role for high price as a positive quality signal.

The egg product is perhaps the closest to the traditional, down-hill relationship between price and market share. Two price discounts do appear to prompt strong negative reactions from the sample of respondents. The greatest discount offered in our survey – 40 cents – is associated with a marked reduction in market share as is the smallest price discount – five cents. Both suggest that respondents may use discounts as a signal of low quality, though the exact level of discount that can trigger such decisions can be large or small.

Taken together, these graphs indicate that some consumers may interpret prices below a certain threshold as a negative signal of quality (a "something must be wrong with it" heuristic) and choose other options. This pattern contradicts theoretical results forwarded by Jones and Hudson (1996) who suggested that only prices above a critical price premium are used for signaling quality (a "if its this expensive, it must be good" heuristic). The GM corn graph is supportive of the Jones and Hudson concept, as some of the largest market shares correspond with the highest prices.

A more formal, econometric test of the above intuition is conducted using respondents' choices in each product category and using other variables to control for potentially confounding explanations. A more detailed, technical report of the methods and results of that investigation is provided in the appendix.

The econometric results suggest that the simple down-hill relationship between price and market share is not present for most products and, for the one category in which it holds (bread), it is only statistically significant when crossing from discounts (prices that are less than the normal brand's reference price) to premiums (prices that are greater than the reference price). A more flexible model, which doesn't force the data to be fit to a regression line but instead allows the data to be fit to a regression curve, provides the best statistical fit for the corn category. In other words, the statistical results suggest that, once all the potentially confounding factors such as labeling treatments and respondent characteristics are controlled, price is not linearly related to market share. Rather, market share initially increases when moving from deep discounts to modest discounts, then declines as prices move from modest discounts to modest premiums, and finally increases once again prices move from modest premiums to larger premiums.

Conclusion

The purpose of this paper is to analyze how prices of GM products may act as quality signals and affect consumers' purchase decisions. Three products (GM bread, corn, and eggs) are analyzed using conjoint data generated from a national

mail survey. Plots of the relationship between price and the share of consumers choosing GM products in each category suggest the relationship between price and market share may not adhere to a simple linear relationship where an increase in price decreases market share. Econometric analysis confirms that nonlinear relationships may best describe the relationship between price and respondents' choices of GM products.

This evidence suggests that consumers may use price as a signal of product quality when price deviates enough from the normal brand's price. Consumers' purchase intentions for GM bread increased as price declined modestly below the reference price down to a critical price level; after this price threshold, lowering prices had no real traction in increasing market share in GM bread. The plot of GM eggs showed little significant difference from general economic theory. That is, the price-demand relationship was linear and downward sloping over the whole price range. The only indication of the existence of price signaling quality was that the very largest and the very smallest price discounts were associated with marked reductions in market share. When combined with evidence from econometric models of respondents' choices of GM products, it suggests that respondents use the price of GM products as a signal of quality. Further survey work would need to be conducted where respondents are specifically asked to rate perceived product quality after viewing price and non-price information for GM and non-GM products. Furthermore, one must realize that the current investigation used products that were not branded in other ways (e.g., with company or product-line brand names). The introduction of such information onto the label may change some of the results, giving either more or less latitude to enact pricing strategies featuring deeper discounts or greater premiums.

Food products with labeled GM ingredients are in an introduction (start-up) period of their life cycle in most product categories. Firms who try to gain public awareness for their products and to expand their market share might, for example, have to decide between a low introductory pricing strategy, a price matching strategy, or strategy that sets price higher than competing, non-GM brands. If consumers use price as a signal of quality, however, some of these pricing strategies might be less effective or disastrous in certain product categories. For the hypothetical GM corn product in our research, for example, firms pursuing a low-introductory price strategy may fight an uphill battle because respondents may interpret low prices as a negative quality signal and avoid the trial purchases necessary to spur current and future sales. Furthermore, if retailers unilaterally discount GM products (e.g., in order to clear shelves of slow-moving trial products), the discounting could send an unintended message to consumers that GM ingredients are of low quality. There exists a possibility that this might spill over to consumers' perceptions of other GM products as well.

Consumption patterns for GM products are likely to vary widely across different consumer segments, where each segment may hold distinct ideas concerning the value, efficacy and safety of GM ingredients. Hence, choosing a marketing strategy will not be a simple matter. In fact, applying a pricing strategy alone as a marketing strategy without considering consumers' characteristics might not be effective for expanding market share of GM products. Pricing strategies may need to be tailored to the type of retail outlet (e.g., high-end food emporiums versus discount chains) and coordinated with non-price quality signals (advertising and in-store promotions) and existing regulatory interventions (labeling or public position papers on the safety of genetically modified foods).

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Appendix

To estimate the factors that drive respondents' choices of GM versus non-GM products, an econometric model is estimated that links a respondent's decision concerning whether to choose the GM brand (instead of either their normal brand or the GM-free brand) to characteristics of GM product (including price), the price of a GM-free option, and characteristics of the respondent. The variables used to represent the GM product's and the respondent's characteristics are detailed in Table A1.

Table A1: Description of Variables for Logit model of GM Brand Choice

Variable Name	Description
Dependent Variable:	($i \in$ {B, C, E} where B=Bread, C=Corn, E=Eggs)
Choice_B, Choice_C, Choice_E	= 1 if respondents choose GM brand for product i = 0 if respondents choose other brands for product i
Independent Variable:	
DP_i	The price of the normal brand less the price of the GM brand in cents for product category i.
$D_{i,k}$	$D_{i,k}$ = 1 if the price of the normal brand in category i less the price of the GM brand in cents is in the range of [k, k + 5] for k = -40, -30, -20, -10, 5, 15, 25, 35; = 0 otherwise.
DP_i_SQ	$(DP_i + 40)^2$
DP_i_TR	$(DP_i + 40)^3$
$DPNGM_i$	The price of the normal brand less the price of the non-GM brand in cents for product category i
GOV	= 1 if certifying agency was a government agency = 0 otherwise
ENV	= 1 if certifying agency was an environmental agency = 0 otherwise
IND	= 1 if certifying agency was an independent certifier = 0 otherwise
BANTIA, CANTIA	= 1 if GM bread (BANTIA) and GM corn (CANTIA) claims to be more healthful due to heightened levels of antioxidants = 0 otherwise
BLTHA, CLTHA, ELTHA	= 1 if GM bread (BLTHA), GM corn (CLTHA), and GM eggs (ELTHA) have a health warning label 0 otherwise
BLTEA, CLTEA, ELTEA	= 1 if GM bread (BLTEA), GM corn (CLTEA), and GM eggs (ELTEA) have an environmental warning label = 0 otherwise
LBPREDA	ln(% reduction in pesticides used in growing wheat for GM bread + 1)
LCPREDA	ln(% reduction in pesticides used in growing GM corn + 1)
LEPREDA	ln(% reduction in cholesterol due to use of GM eggs + 1)
GMCONCERN	= 1 if respondent rated GM technology a '5' on a 5-point scale of concern, = 0 otherwise
OWNBEN	Respondent factor score relating to GM's benefits for consumers
PRODBEN	Respondent factor score relating to GM's benefits for producers
OWNCOST	Respondent factor score relating to GM's cost reductions for consumers
PRODCOST	Respondent factor score relating to GM's cost reductions for producers
BREADGM	Respondent's estimate of % of normal bread made from GM wheat
CORNGM	Respondent's estimate of % of normal corn made from GM corn
EGGSGM	Respondent's estimate of % of normal eggs made from GM eggs
MALE	= 1 if male, = 0 if female
RACE	= 1 if White, = 0 otherwise
AGE_30	= 1 if under 30 years old, = 0 otherwise
AGE_70	= 1 if over 70 years old, = 0 otherwise
ED16	= 1 if obtained a Bachelor's degree or more, = 0 otherwise
INC_L	= 1 if annual household income ≤ $5,000, = 0 otherwise
INC_H	= 1 if annual household income ≥ $95,000, = 0 otherwise
CHILD	= 1 if children present in household, = 0 otherwise

Our key hypothesis is that the price of the GM product might act as a signal of the product's quality to the respondent. So, relatively low prices for the GM product might signal low quality and cause consumers to reject it, while high prices might signal high quality and cause consumers to embrace it. If prices are not acting as a signal of quality, low prices should stimulate sales while high prices will depress sales.

The statistical challenge is how to test for this unusual correspondence between price and sales. Usually price enters as a single explanatory variable in econometric models, which implies a simple, linear relationship between sales and price – e.g., every dime increase in price will lead to the same reduction in sales.

This does not allow us to test for our key hypothesis. Therefore, we alter the standard model in two ways. First, in addition to using price as an explanatory variable in our econometric model, we also add in the square and cube of price (e.g., price^2 and price^3). An econometric model that uses the square and cube of price allows for a more flexible relationship between sales and price, e.g., sales could first increase with an increase in price (e.g., when going from deep discounts to modest discounts), then decline with an increase of price (e.g., for prices near competing brands), and finally increase with increases of price (e.g., for prices at a modest premium above competing brands). Using econometric methods, we can then test to see if the data reveals this non-linear relationship between sales and price.

Our second approach is to treat each price category separately within the econometric analysis. Therefore, we create eight categorical variables for each 10-cent price interval and include these variables in the econometric analysis. Using econometric analysis, we can then test for differences between pricing intervals. If the traditional price-consumption relationship holds, we should find that sales of products with discounts of, say, 40 and 35 cents, will be greater than sales of products with discounts of 25 and 30 cents, etc.

To statistically isolate the effect of price on sales, we must control for all other possible explanations that might drive a respondent's choice. Hence, we add explanatory variables that will control for the randomly assigned attributes of the GM product (claims and warnings), the randomly assigned price of the GM-free brand, and for respondent's attitudes toward GM technology and personal characteristics. Summary statistics for each variable is presented in Table A2.

The econometric approach that is used involves the estimation of a binomial logit model for each GM product of the form:

A1) $$Y^* = \alpha_0 + \Sigma\, \alpha_i F_i\,(p_{GM}) + \boldsymbol{X}'\boldsymbol{\beta} + \varepsilon$$

where Y^* is a latent preference index that, when it is greater than zero, represents the intended purchase of the GM product (i.e., causes, Y, the observed variable, to equal one if the GM product is purchased and equal zero otherwise); α_0 is an intercept parameter; $F_i(\bullet)$ is the ith function of the relative price of the GM brand (p_{GM}); α_i is the ith parameter associated with the ith function of price; $\boldsymbol{X}$ is a vector of all independent variables except GM brand prices; $\boldsymbol{\beta}$ is a conformable vector of parameters; and ε is the error term. Two general forms of the $F_i(\bullet)$ functions were articulated in Table A2: one where dummy variables are created to represent eight different price categories and one where a polynomial in the price of the GM food is created (e.g., price^2 and price^3). The polynomial representation is $F_j = (DP + 40)^j$, where 40 is added to all relative prices of GM products, i.e., all prices are normalized to the lowest possible price offered, to avoid squaring a negative number.

The estimation results for each product are in Tables A3-A5. To test the hypothesis that the market share of GM products adheres to the classical downward-sloping pattern, the following hypotheses are formulated when price is represented by categorical dummy-variables:

A2) H_0: $\alpha_i > \alpha_{i+1}$ $i = 1, 2, \ldots, 7$
H_1: $\alpha_i \leq \alpha_{i+1}$ $i = 1, 2, \ldots, 7$

A3) H_0: $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = \alpha_7 = \alpha_8$
H_1: $\alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq \alpha_5 \neq \alpha_6 \neq \alpha_7 \neq \alpha_8$

A4) H_0: $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4$
H_1: $\alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4$

A5) H_0: $\alpha_5 = \alpha_6 = \alpha_7 = \alpha_8$
H_1: $\alpha_5 \neq \alpha_6 \neq \alpha_7 \neq \alpha_8$

The first hypothesis (A2) postulates seven separate inequalities where the parameter for each lower price category is strictly larger (i.e., more likely to induce the choice of the GM product) than the parameter for the higher, adjacent price category. Rejection of this hypothesis means that market share is not strictly downward sloping across adjacent pairs of price categories. The second hypothesis (A3) flips the approach by postulating that all price parameters are equal; rejection merely confirms all price points do not have the same effect on market share. Hypotheses (A4) and (A5) are limited versions of (A3) and test for insensitivity to price across all price discounts (α_1 - α_4) and all price premiums (α_5 - α_8). Hypothesis testing results for each product category are listed in Table A6.

Table A2: Summary Statistics for Variables of Logit model of GM Brand Choice

Variable Name	Average	Share (%)	MIN	MAX
Choice_B		18.0		
Choice_C		21.0		
Choice_E		17.0		
GOV		77.1		
ENV		4.8		
IND		7.1		
BANTIA		8.6		
CANTIA		7.2		
BLTHA		34.0		
CLTHA		33.8		
ELTHA		32.8		
BLTEA		33.4		
CLTEA		30.8		
ELTEA		34.4		
LBPREDA	2.01		0	4.62
LCPREDA	1.99		0	4.62
LEPREDA	2.14		0	4.62
GMCONCERN		37.7		
OWNBEN	-0.02		-3.87	2.99
PRODBEN	0.01		-3.76	2.80
OWNCOST	0.02		-4.57	2.63
PRODCOST	-0.01		-3.91	3.53
BREADGM	42.50		2	90
CORNGM	42.00		1	90
EGGSGM	41.50		1	90
MALE		45		
RACE		90		
AGE_30		9.8	18	29
AGE_70		17.5	70	93
ED16		22.1		
INC_L		4.2		
INC_H		16.3		
CHILD		32.5		

Table A3: Regression Results for Bread (binary logit) (N=1,336)

Explanatory Variable	Polynomial Approach		Dummy Variable Approach	
	Estimated Coefficient	t-ratio [a]	Estimated Coefficient	t-ratio [a]
Dependent Variable: Choice_B				
INTERCEPT	**-2.61**	**-6.82*** **	-	-
DP_B	**-0.02**	**-5.22*** **	-	-
$D_{B,-40}$	-	-	**-2.14**	**-5.22*** **
$D_{B,-30}$	-	-	**-1.97**	**-4.79*** **
$D_{B,-20}$	-	-	**-2.37**	**-5.40*** **
$D_{B,-10}$	-	-	**-2.34**	**-5.58*** **
$D_{B,5}$	-	-	**-2.89**	**-6.51*** **
$D_{B,15}$	-	-	**-2.93**	**-6.42*** **
$D_{B,25}$	-	-	**-3.09**	**-6.70*** **
$D_{B,35}$	-	-	**-3.16**	**-6.85*** **
$DPNGM_B$	**0.01**	**1.90***	**0.01**	**1.90***
GOV	**0.44**	**1.65***	0.44	1.64
ENV	-0.37	-0.71	-0.33	-0.64
IND	-0.09	-0.23	-0.09	-0.21
BANTIA	**1.06**	**3.81*** **	**1.02**	**3.63*** **
BLTHA	**-0.58**	**-3.07*** **	**-0.57**	**-3.02*** **
BLTEA	-0.30	-1.64	-0.29	-1.61
LBPREDA	**0.29**	**6.68*** **	**0.30**	**6.64*** **
GMCONCERN	**-0.60**	**-3.41*** **	**-0.61**	**-3.45*** **
OWNBEN	-3.10E-03	-0.05	-0.01	-0.16
PRODBEN	3.47E-03	0.06	0.01	0.16
OWNCOST	**-0.16**	**-2.54** **	**-0.16**	**-2.58*** **
PRODCOST	**0.16**	**2.53** **	**0.16**	**2.57** **
BREADGM	0.01	1.60	0.01	1.54
MALE	-0.03	-0.21	-0.04	-0.28
RACE	1.53E-03	1.52	1.61E-03	1.60
AGE_30	**-0.82**	**-2.21** **	**-0.83**	**-2.26** **
AGE_70	0.23	1.17	0.22	1.10
ED16	**0.46**	**2.53** **	**0.46**	**2.53** **
INC_L	-0.01	-0.05	-0.02	-0.11
INC_H	0.01	0.05	0.02	0.11
CHILD	**-1.56E-03**	**-2.00** **	**-1.65E-03**	**-2.12** **

[a] *, **, ***: significant at the ten, five, and one % level, respectively.

Table A4: Regression Results Corn (binary logit) (N=793)

Explanatory Variable	Polynomial Approach		Dummy Variable Approach	
	Estimated Coefficient	t-ratio [a]	Estimated Coefficient	t-ratio [a]
Dependent Variable: Choice_C				
INTERCEPT	**-1.82**	**-3.55*****	-	-
DP_C	0.05	1.64	-	-
DP_C_SQ	**-1.89E-03**	**-2.00****	-	-
DP_C_TR	**1.53E-05**	**1.95***	-	-
$D_{C,-40}$	-	-	**-1.66**	**-3.46*****
$D_{C,-30}$	-	-	**-1.43**	**-3.01*****
$D_{C,-20}$	-	-	**-1.48**	**-2.93*****
$D_{C,-10}$	-	-	**-1.41**	**-2.91*****
$D_{C,5}$	-	-	**-1.94**	**-3.76*****
$D_{C,15}$	-	-	**-2.17**	**-4.30*****
$D_{C,25}$	-	-	**-2.17**	**-4.00*****
$D_{C,35}$	-	-	**-1.94**	**-4.03*****
$DPNGM_C$	1.76E-03	0.48	1.87E-03	0.51
GOV	0.11	0.36	0.10	0.34
ENV	-0.22	-0.39	-0.26	-0.47
IND	**-1.40**	**-2.09****	**-1.45**	**-2.15****
CANTIA	**0.59**	**1.65***	0.58	1.62
CLTHA	**-0.66**	**-2.85*****	**-0.67**	**-2.85*****
CLTEA	-0.26	-1.21	-0.26	-1.20
LCPREDA	**0.24**	**4.81*****	**0.24**	**4.86*****
GMCONCERN	**-0.45**	**-2.08****	**-0.45**	**-2.06****
OWNBEN	0.11	1.55	0.12	1.62
PRODBEN	-0.11	-1.55	-0.12	-1.62
OWNCOST	**-0.14**	**-1.93***	**-0.14**	**-1.88***
PRODCOST	**0.14**	**1.93***	**0.14**	**1.87***
CORNGM	-1.19E-03	-0.22	-8.68E-04	-0.16
MALE	0.28	1.44	0.29	1.50
RACE	-2.48E-05	-0.02	-6.94E-05	-0.06
AGE_30	0.04	0.10	0.03	0.07
AGE_70	0.31	1.22	0.30	1.18
ED16	0.33	1.53	0.32	1.50
INC_L	0.26	1.15	0.26	1.12
INC_H	-0.26	-1.16	-0.26	-1.12
CHILD	9.98E-04	0.66	1.02E-03	0.68

[a] *, **, ***: significant at the ten, five, and one % level, respectively.

Table A5: Regression Results for Eggs (binary logit) (N=950)

	Polynomial Approach		Dummy Variable Approach	
Explanatory Variable	Estimated Coefficient	t-ratio [a]	Estimated Coefficient	t-ratio [a]
Dependent Variable: Choice_E				
INTERCEPT	-2.11	-4.68***	-	-
DP_E	-0.01	-2.98***	-	-
$D_{E,-40}$	-	-	-1.78	-3.60***
$D_{E,-30}$	-	-	-1.82	-3.64***
$D_{E,-20}$	-	-	-1.70	-3.27***
$D_{E,-10}$	-	-	-2.18	-4.30***
$D_{E,5}$	-	-	-1.92	-3.80***
$D_{E,15}$	-	-	-2.32	-4.45***
$D_{E,25}$	-	-	-2.62	-4.81***
$D_{E,35}$	-	-	-2.47	-4.64***
$DPNGM_E$	0.01	2.91***	0.01	2.88***
GOV	0.45	1.32	0.46	1.34
ENV	0.06	0.11	0.07	0.12
IND	-0.23	-0.42	-0.23	-0.42
ELTHA	-0.21	-0.96	-0.21	-0.96
ELTEA	-0.42	-1.86*	-0.42	-1.87*
LEPREDA	0.20	4.35***	0.20	4.31***
GMCONCERN	-0.56	-2.80***	-0.56	-2.80***
OWNBEN	0.14	1.98**	0.13	1.89*
PRODBEN	-0.14	-1.98**	-0.13	-1.89*
OWNCOST	-0.15	-2.15**	-0.15	-2.15**
PRODCOST	0.15	2.15**	0.15	2.15**
EGGSGM	0.01	0.94	4.16E-03	0.83
MALE	-0.02	-0.08	-0.02	-0.10
RACE	8.02E-05	0.10	-4.93E-06	-0.01
AGE_30	-0.41	-1.20	-0.38	-1.10
AGE_70	-0.34	-1.29	-0.34	-1.27
ED16	0.01	0.06	0.02	0.11
INC_L	0.19	0.79	0.19	0.81
INC_H	-0.19	-0.79	-0.19	-0.81
CHILD	-1.69E-04	-0.20	-7.30E-05	-0.08

[a] *, **, ***: significant at the ten, five, and one % level, respectively.

Table A6: Likelihood Ratio Test Results

Hypothesis	i	Bread	Corn	Eggs	Critical Values
(3) H_0: $\alpha_i > \alpha_{i+1}$ H_1: $\alpha_i \leq \alpha_{i+1}$ $i = 1, \Lambda, 7$	1	0.39	0.45	0.02	3.84(5%) 2.71(10%)
	2	2.16	0.02	0.14	
	3	0.01	0.04	1.87	
	4	3.36*	2.08	0.54	
	5	0.02	0.31	1.23	
	6	0.18	4.40E-05	0.57	
	7	0.43	0.32	0.12	
(4) H_0: $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4 = \alpha_5 = \alpha_6 = \alpha_7 = \alpha_8$ H_1: $\alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4 \neq \alpha_5 \neq \alpha_6 \neq \alpha_7 \neq \alpha_8$		31.76**	9.94	11.39	[1.69, 16.01](5%) [2.17, 14.06](10%)
(5) H_0: $\alpha_1 = \alpha_2 = \alpha_3 = \alpha_4$ H_1: $\alpha_1 \neq \alpha_2 \neq \alpha_3 \neq \alpha_4$		2.97	0.65	2.42	[0.22, 9.35](5%) [0.35, 7.81](10%)
(6) H_0: $\alpha_5 = \alpha_6 = \alpha_7 = \alpha_8$ H1: $\alpha_5 \neq \alpha_6 \neq \alpha_7 \neq \alpha_8$		0.81	0.64	3.44	[0.22, 9.35](5%) [0.35, 7.81](10%)

*,** signifies the hypothesis is rejected at the ten and five % level, respectively.

The null hypothesis in (A2), i.e., uniform downward-sloping demand across price categories, is rejected at the ten percent significance level for all adjacent price points of all products except for $i = 4$ in the bread category, which means that downward-sloping demand between the price categories of [-$0.10, -$0.05] and [$0.05, $0.10] cannot be rejected. For all other adjacent price points and all products, cheaper GM products are not significantly more likely to be chosen than ones slightly more expensive.

The null hypothesis of (A3), i.e., equivalence of the effect of all price categories on purchase decisions, is rejected at the ten percent significance level only in the bread category. It suggests that there is significant sensitivity of choice to price in the bread category but not much price sensitivity in the corn and egg categories. The null hypotheses of (A4) and (A5) refine the results by validating that, across all relative prices that share the same sign, there is no significant difference in market share's response across price categories. Taken together the test results suggest that a downward sloping relationship is not present for most products and, for the one category in which demand slopes downward in some price regions, it is only significant when crossing the threshold from prices that are greater than the normal brand's reference price to prices that are less than the reference price.

Despite a lack of price category by price category change in market share, a simpler regression featuring choice as a linear function of price may reveal the expected negative relationship. Therefore, a second approach to examining the slope of demand is used: we test for the significance of higher-order terms in polynomial representations of GM price, i.e., to see if the price^2 and price^3 terms are statistically significant. For the model of GM bread and GM egg choices, however,

only the linear relative price variables (DP_B and DP_E) were significant; results featuring higher order terms are omitted. DP_B and DP_E affected consumer choices of GM bread and eggs in negative manner, which is consistent with standard theory and suggests that the role of price in signaling quality is not strong enough to cause a curvilinear relationship between price and market share.

For the model of the GM frozen corn choice, the square and cube of the relative price of GM corn are significant (DP_C_SQ and DP_C_TR, respectively). This suggests the possibility of a significant, curvilinear change in the consumption pattern as price changes. At lower prices, the probability of choosing the GM corn decreases even if price is lowered further. However, the probability of choosing GM corn increases at higher prices when price is raised further. This retains the basic shape observed from the raw data plot in figure 2. The ability of such a cubic relationship to hold beyond the narrow price range explored is, of course, highly questionable. Minimally as price continues toward zero market share can go no lower than zero, while, at very high prices, market share will suffer.

Discussion

Taking the results from the price-category approach and the polynomial approach together, there appears to be some evidence that demand for the GM products does not uniformly decrease with price. The most convincing evidence exists for GM corn: both the dummy variable and polynomial approaches reject uniform, downward sloping demand. The weakest case exists for GM bread: the dummy variable approach suggests demand drops going from categories featuring price discounts to categories featuring price premiums and no higher-order terms are significant in the polynomial approach. An intermediate case exists for GM eggs: the dummy variable approach finds no case for downward sloping demand in price while the polynomial case finds no significance for higher-order terms.

While there is some evidence against a downward-sloping demand in price, one may argue that factors other than price-quality signals drive this lack of adherence to the classical case. One argument could be that respondents faced hypothetical choices and, hence, did not seriously weigh price when contemplating GM product choice. Indeed, such critiques of hypothetical questionnaires are common in the early literature concerning hypothetical choices. However, more recent research involving parallel hypothetical and market decisions suggests that analysis of hypothetical choices provide an unbiased view of individual preferences in many settings, particularly those involving familiar private goods, though estimates are typically noisier, i.e., individual parameter estimates have a greater variance (Louviere et al. 1999).

Our own data suggest that respondents did treat price variables seriously: the price of non-GM products, which are presented to the same respondents in the same

manner, are significant in two of the three product regressions. This suggests that prices were impacting respondent decisions in a traditional way for non-GM goods. The category in which the non-GM price was insignificant was corn, which is also the category for which downward-sloping demand of the GM product was the weakest. All tolled this leaves a mixed though intriguing case for the possibility that respondents were using price as a signal of quality when evaluating GM products.

