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International Food and Agribusiness Management Review
Volume 9, Issue 1, 2006

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,

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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.

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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.

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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

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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

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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.

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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

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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:

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

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 ith 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:

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

$$\textit{where}$$

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

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

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.

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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.

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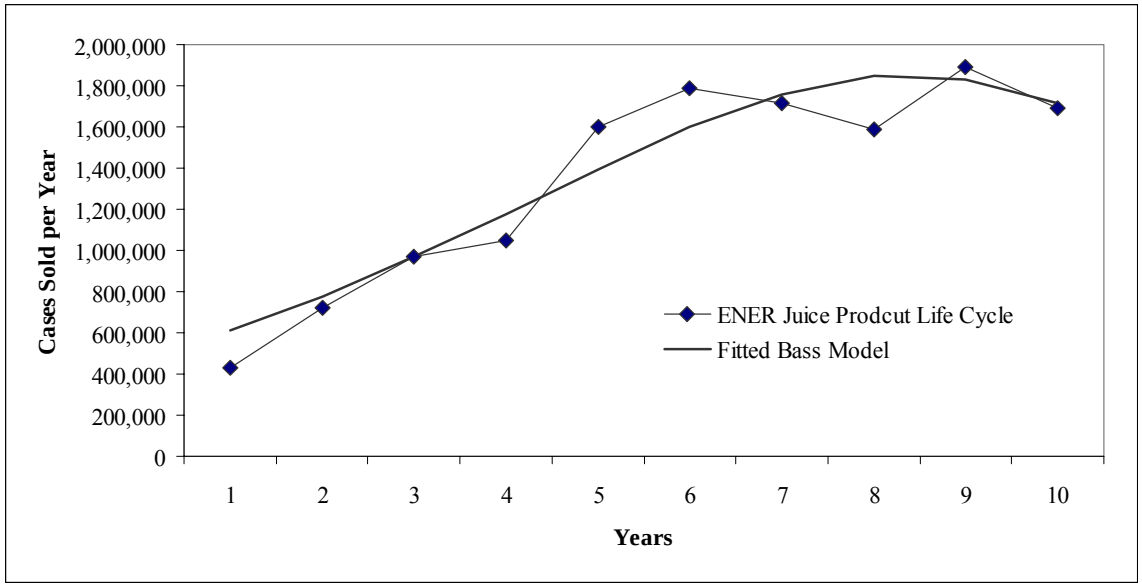

Figure 1: Estimated Bass Model from ENER Juice Data

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 ith firm is as follows:

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

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If the realized market price-per-unit in the last period (P_{t-1}) is greater than the ith firm's marginal cost in the last period ($MC_{t-1,\,i}$), then the ith 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.

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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.

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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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