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Research Note

How Much Should You Invest in Each Customer Relationship? A Competitive Strategic Approach

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We analyze firms' decisions to invest in customer relationship management (CRM) initiatives such as acquisition and retention in a competitive context, a topic largely ignored in past CRM research. We characterize each customer by her intrinsic preference towards each firm, the contribution margin she generates for each firm, and her responsiveness to each firm's retention and acquisition efforts. We show that a firm should invest most heavily in retaining those customers that exhibit moderate responsiveness to its CRM efforts. Further, a firm should most aggressively seek to attract those customers that exhibit moderate responsiveness to their provider's CRM efforts and those that are moderately profitable for their current provider. Investing more in customers that are more responsive does not always lead to higher firm profits, because stronger competition for such customers tends to erode the effects of higher CRM efforts of an individual firm. When firms develop a customer relationship over time to generate higher contribution margin or customer responsiveness, we show that such developments may not always be desirable, because sometimes these future benefits may lead to more intense competition and hence lower profits for both firms.

Key words: customer relationship management; competitive strategy; game theory; customer lifetime value; customer equity; customer acquisition; customer development; customer retention; services marketing; relationship marketing

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1. Introduction

Customer relationship management (CRM) has become an important topic in the industry today, with Forrester Research (Band et al. 2007) projecting global CRM revenue growth from $8.6 billion in 2007 to $10.9 billion in 2010. Academic interest in CRM is also on the rise, as reflected in recent work on service quality and customer satisfaction (e.g., Boulding et al. 1993, Zeithaml et al. 1996, Bolton 1998, Bolton and Myers 2003, Seiders et al. 2005, Bolton et al. 2006, Gupta and Zeithaml 2006), management of customer relationships (e.g., Lemon et al. 2002, Reinartz and Kumar 2003, Johnson and Selnes 2004, Rust et al. 2004, Gupta et al. 2004, Payne and Frow 2005, Rust and Verhoef 2005, Rust and Chung 2006, Sun 2006) and development and estimation of probabilistic models of customer relationships (Schmittlein and Peterson 1994, Kamakura et al. 2004, Lewis 2004, Neslin et al. 2006). Strategically, a firm's CRM initiatives can be organized along the *customer life cycle* as customer *acquisition*, *development*, and *retention* (Kamakura et al. 2005). The goal of acquisition is to obtain profitable customers, the goal of development is to grow revenues from existing customers, and the goal of retention is to minimize "churn" of customers. Current literature offers few normative recommendations for firms' CRM decisions along this life cycle. A decision calculus tool developed by Blattberg and Deighton (1996) maximizes a single firm's customer equity to determine an optimal mix of retention and acquisition spending. Ho et al. (2006) generalized a version of the Schmittlein et al. (1987) model that incorporates investments in customer satisfaction as a decision variable for a single firm, to show that a firm pursuing a high customer satisfaction strategy may overinvest if it ignores changes in customer behavior due to variation in customer satisfaction. Drèze and Bonfrer (2008) evaluate the consequences of using alternative CRM objectives (maximizing customer equity versus customer lifetime value) to show that a firm maximizing customer equity does not invest enough in customer acquisition if it relies only on

customer lifetime value metrics. Rust and Verhoef (2005) present an application of a fully personalized model for optimizing marketing interventions. Finally, several papers relying on dynamic programming solution techniques (e.g., Bitran and Mondschein 1996; Gönül and Srinivasan 1996; Gönül and Shi 1998; Lewis 2004, 2005a, b) provide rich models of how a firm should make decisions (e.g., catalog-mailing policies) or how consumers behave (e.g., promotion responsiveness) in dynamic settings. Surprisingly, a common feature in all this research is that interfirm competition is not explicitly modeled. Boulding et al. (2005, p. 161) note: "…We find it surprising that the CRM literature…[is] largely silent on this issue of competitive reaction…We find this omission in the CRM literature especially surprising given that the evolution of CRM can be traced back to the market orientation literature…."

In this paper, we seek to bridge this important gap by analyzing firms' strategic decisions of how much to invest to acquire or retain a customer relationship in the presence of a competitor fighting for the same customer. Each customer is characterized by her intrinsic preferences towards each firm, the contribution margin she generates for each firm, and her responsiveness to each firm's retention and acquisition efforts. Consistent with current knowledge, we allow the firm that succeeds at attracting and retaining a customer to benefit from developing the customer relationship in terms of potential improvements in each of these characteristics: (i) contribution margin (e.g., due to cross-selling initiatives), (ii) intrinsic preferences (e.g., due to switching costs), and (iii) effectiveness of CRM efforts (e.g., due to increased marketing intelligence on customer needs). We do so by considering two time periods, where we allow a firm's CRM efforts in the first period to have an impact on a customer's behavior in the second period. The customer's decision to choose a firm is driven by her utility for the firm's CRM investments. Within this setup, we ask the following questions: (1) Which customers should a firm target with its greatest retention efforts? (2) Which customers of a firm would be the target of strongest incentives to switch from the competitor? (3) For which customers would the firms compete most aggressively? In equilibrium, which customers would be most profitable for each firm? (4) What are the long-term benefits of developing a customer relationship? Does developing a relationship always lead to greater profitability? If not, why?

Although competitive issues have been relatively ignored in CRM research, these issues have been analyzed for targeted price promotions (e.g., Chen et al. 2001, Shaffer and Zhang 2002, Fruchter and Zhang 2004, Shin and Sudhir 2007, Villanueva et al. 2007). Our analysis differs from this literature in two major ways. First, the main source of customer heterogeneity in the targeted price promotions literature is the intrinsic preference for a firm (e.g., in a Hotelling setting, the proximity of a customer to a firm). We allow for heterogeneity not only in intrinsic preferences, but also in responsiveness to CRM efforts and profitability. In addition, we let these characteristics evolve over time with repeated interactions. Second, in the targeted price promotions literature, firms incur costs only after the customer makes a purchase (e.g., only customers that purchase receive the benefits of the price promotion).[1] In contrast, in our model, firms may incur retention or acquisition costs without succeeding at retaining or acquiring the customer. For example, firms may spend on training customer service employees, or visiting customers to explain the economic benefits of switching to a new technology, hoping that these actions lead to better retention or acquisition. These inevitable costs of CRM introduce a different type of strategic interaction between the competing firms.

In this setting, we obtain four main results: (1) Retention Strategy: A firm should target its moderately responsive customers with its greatest retention efforts. Highly responsive customers do not require high effort to be retained, whereas CRM efforts are less likely to increase retention of less-responsive customers. (2) Attraction Strategy: A firm's attraction efforts should be most aggressively targeted towards customers that are moderately profitable for the competitor. A competitor's highly profitable customers are very hard to attract, because the competitor invests heavily to retain them. Similarly, a competitor's less-profitable customers do not require high efforts to be persuaded, because the competitor allocates fewer resources towards them. (3) Competitive Interactions: A customer that is more responsive to a firm's retention efforts may, in fact, generate lower profits for the firm. Given this customer's higher responsiveness to retention, the competitor responds by increasing attraction efforts for this customer. This strategic interaction leads to an escalation of resources being allocated to this relationship, triggering aggressive spending by both firms, and resulting in lower equilibrium profits. (4) Customer Relationship Development: The prospect of owning a relationship that becomes more profitable or responsive in the future provides stronger (unilateral) incentives for firms to attract that customer. However, competing for a customer with increasing contribution margin or responsiveness may sometimes lead to lower profits for the firms. This result is particularly

[1] So is the case with reward programs (e.g., Kim et al. 2001, Kopalle and Neslin 2003): Reward costs are incurred only after a certain volume of interaction between firms and customers.

informative in lieu of our current understanding of the effects of CRM. It has been argued that developing loyal customers is profitable for many reasons, including higher contribution per customer due to more spending or lower costs (e.g., Reichheld and Sasser 1990). Empirical observations have indicated that this is not always true (Reinartz and Kumar 2000). We show that even if a customer may become more profitable or responsive in the future, such an outcome may not always be desirable for the firm. An increase in the efforts from one firm can be compensated and potentially neutralized by its rival (Shugan 2005a) and may lead to an equilibrium with lower profits for both firms. Consequently, a firm that fails to identify and take into account its competitive environment may incorrectly assess the benefits of a customer development initiative and potentially make managerial decisions that may trigger unattractive outcomes for the firm.

In the next section, we begin our analysis by introducing a two-period game between two firms competing to acquire and retain customers.

2. A Model of CRM Competition

Consider two firms, A and B, competing for customer relationships in two periods by investing in acquistion and retention efforts. Because a CRM approach allows a firm to customize its offerings for each customer, we start by analyzing how two firms compete for a single customer.[2] In the first period, both firms invest to acquire the customer. In the second period, the firm that succeeds at acquiring the customer invests to retain the customer, whereas its competitor invests to persuade the customer to switch.[3] Let a_{1A} and a_{1B} denote the first-period acquisitions efforts of firms A and B, respectively. The customer chooses the firm that offers her the highest utility, where utility is specified as follows:

$$U_{1A} = \ln(l_A + \theta_A a_{1A}) + \epsilon_{1A}, \quad \text{and}$$
$$U_{1B} = \ln(l_B + \theta_B a_{1B}) + \epsilon_{1B}, \tag{1}$$

where l_A and l_B measure the intrinsic customer preference for A and B; θ_A and θ_B measure the effectiveness of CRM efforts of each firm; ϵ_{1A} and ϵ_{1B} capture the impact of factors unobserved to the firms on the utility of the customer in period 1; and the natural logarithm function ensures that the utility of each alternative exhibits decreasing returns to firms' efforts (e.g., Rust and Zahorik 1993, Rust et al. 1995, Blattberg and Deighton 1996).[4] To derive explicit expressions for the retention and acquisition probabilities, we assume that ϵ_{1A} and ϵ_{1B} are i.i.d. according to an extreme value distribution with parameters 0 and 1, as is common in the marketing and economics literature (Guadagni and Little 1983, Anderson et al. 1992, Berry 1994). Consequently, the probability that each firm succeeds at acquiring the customer is

$$p_{1A} = \frac{l_A + \theta_A a_{1A}}{l_A + \theta_A a_{1A} + l_B + \theta_B a_{1B}}, \quad \text{and}$$
$$p_{1B} = \frac{l_B + \theta_B a_{1B}}{l_A + \theta_A a_{1A} + l_B + \theta_B a_{1B}}. \tag{2}$$

In this period, if firm A attracts the customer, it earns a margin equal to m_A, whereas if firm B attracts the customer, it earns a margin equal to m_B. Margins are inclusive of all revenues and costs for that period, except the CRM spending in that period. If a firm acquires the customer, the firm will not only enjoy this first-period contribution margin, but it may also develop the customer relationship to capture additional benefits in the next period. These additional benefits can be of three types: (1) *Evolution of customer profitability*: A retained customer may, over time, become more familiar with the products and services offered, and consequently increase spending and number of transactions (Reichheld and Sasser 1990, Reichheld and Teal 1996). Increased familiarity may also lead to lower transaction costs, because experienced customers may require less information to complete a transaction. To capture this dynamic aspect in our model, we allow the contribution margin for a retained customer to increase by f_m in the subsequent period. For instance, if firm A attracts the customer in the first period and retains that customer in the second period, then firm A's margin in the second period is equal to $\widetilde{m}_A = f_m \cdot m_A$.[5] (2) *Customer relationship intelligence*: Customer interactions may provide additional information to the firm about customer preferences, leading to more effective marketing actions (Rossi et al. 1996). For example, financial services firms combine transactional data and

[2] Our analysis can be applied to a large customer base by repeating it for each individual customer, as long as firms do not face *binding* budget constraints (e.g., Bitran and Mondschein 1996), and customer behavior is unaffected by experiences of other customers. In Technical Appendix B, found at http://mktsci.pubs.informs.org, we analyze optimal CRM investments under binding budget constraints. We also acknowledge that if a firm's goal is to study responsiveness of different customers, then it may no longer be optimal to implement a separate maximization for each customer.

[3] This two-period framework can be extended to analyze multiple periods, and closed-form solutions can be derived for multiperiod formulations. For simplicity, we shall focus on the two-period model.

[4] This utility function exhibits decreasing returns in terms of intrinsic preferences as well. We considered other functional forms that are not concave with respect to intrinsic preference, and most of our results remain qualitatively unchanged (these results are available upon request).

[5] Relationship duration may sometimes be negatively correlated with customer profitability (e.g., Reinartz and Kumar 2000). This can be captured in our model by allowing $f_m < 1$.

market research to classify customers according to likely usage of financial services (Rust et al. 2000). This information can allow firms to customize service for individual customers (e.g., additional support for investments in mutual funds). We capture this improvement in effectiveness of firms' actions via f_θ. For instance, if firm A attracts the customer in the first period, then the effectiveness of its marketing efforts improves from θ_A to $\tilde{\theta}_A = f_\theta \cdot \theta_A$. (3) *Increased loyalty and switching costs*: Customers that repeatedly interact with a firm may become accustomed to that particular firm and may find it more costly to switch their transactions to a different firm (Klemperer 1987).[6] For example, a customer managing most of her financial needs through the same provider (e.g., checking account, investments, retirement, mortgage, credit card) may not want to move individual services to a different provider. We incorporate these switching costs by allowing the intrinsic preference towards a service provider to develop after the customer has interacted with the firm for one more period. For instance, if firm A acquires the customer in the first period, then the intrinsic preference of the customer for firm A in the second period is $\tilde{l}_A = f_l \cdot l_A$.[7]

We now consider the second-period decisions of this game. Denoting by A and B the scenarios where firms A and B, respectively, acquire the customer in the first period, two subgames must be defined. In the first subgame, firm A decides in the second period how much to invest (q_{2A}) to *retain* the customer for one more period, whereas firm B decides its efforts to persuade the customer to *switch* to firm B (a_{2A}). With a similar setup as the first period, the probabilities that the customer who chose firm A in the first period will choose firm A or B in the second period are

$$p_{2A|A} = \frac{\tilde{l}_A + \tilde{\theta}_A q_{2A}}{\tilde{l}_A + \tilde{\theta}_A q_{2A} + l_B + \theta_B a_{2A}}, \quad \text{and}$$
$$p_{2B|A} = \frac{l_B + \theta_B a_{2A}}{\tilde{l}_A + \tilde{\theta}_A q_{2A} + l_B + \theta_B a_{2A}}, \tag{3}$$

where the parameters $\tilde{l}_A$ and $\tilde{\theta}_A$ capture the customer relationship development in terms of loyalty and responsiveness for firm A. If firm A retains the customer in the second period, it will enjoy higher profitability ($\tilde{m}_A$) from this relationship. In contrast, if firm B persuades the customer to switch, it earns a margin of m_B. Accordingly, profits in this subgame are

$$\pi_{2A|A} = \frac{(\tilde{l}_A + \tilde{\theta}_A q_{2A})\tilde{m}_A}{\tilde{l}_A + \tilde{\theta}_A q_{2A} + l_B + \theta_B a_{2A}} - q_{2A}, \quad \text{and}$$
$$\pi_{2B|A} = \frac{(l_B + \theta_B a_{2A}) m_B}{\tilde{l}_A + \tilde{\theta}_A q_{2A} + l_B + \theta_B a_{2A}} - a_{2A}. \tag{4}$$

In the second subgame, firms' roles are reversed: Firm A decides its efforts (a_{2B}) to persuade the customer to *switch*, whereas firm B decides its efforts to *retain* its acquired customer (q_{2B}). If firm B retains the customer, it earns a second-period margin of $\tilde{m}_B$; if firm A attracts the customer, it earns a margin of m_A. The probabilities for each outcome are

$$p_{2A|B} = \frac{l_A + \theta_A a_{2B}}{l_A + \theta_A a_{2B} + \tilde{l}_B + \tilde{\theta}_B q_{2B}}, \quad \text{and}$$
$$p_{2B|B} = \frac{\tilde{l}_B + \tilde{\theta}_B q_{2B}}{l_A + \theta_A a_{2B} + \tilde{l}_B + \tilde{\theta}_B q_{2B}}, \tag{5}$$

and the profit for each firm in this subgame is

$$\pi_{2A|B} = \frac{(l_A + \theta_A a_{2B}) m_A}{l_A + \theta_A a_{2B} + \tilde{l}_B + \tilde{\theta}_B q_{2B}} - a_{2B}, \quad \text{and}$$
$$\pi_{2B|B} = \frac{(f_l l_B + f_\theta \theta_B q_{2B})\tilde{m}_B}{l_A + \theta_A a_{2B} + \tilde{l}_B + \tilde{\theta}_B q_{2B}} - q_{2B}. \tag{6}$$

Let β be the discount factor. Then, the total expected discounted profits associated with this customer can be determined by considering the probability of reaching each subgame (p_{1A}, p_{1B}) and the corresponding benefits under each of these outcomes:

$$\pi_A = p_{1A}(m_A + \beta \pi_{2A|A}) + p_{1B}\beta \pi_{2A|B} - a_{1A}, \tag{7}$$
$$\pi_B = p_{1B}(m_B + \beta \pi_{2B|B}) + p_{1A}\beta \pi_{2B|A} - a_{1B}. \tag{8}$$

We now analyze the equilibrium properties of this game. The next section discusses the second-period subgames, whereas §4 discusses the equilibrium of the full game.

3. Investing to Attract or Retain a Customer

Given symmetry in the two second-period subgames (see Equations (4) and (6)), without loss of generality, we focus on one of these two subgames. Consider subgame A, where firm A acquires the customer in the first period. For ease of exposition, let $q_{2A} = q_2$ and $a_{2A} = a_2$. The best-response (BR) functions for firms' retention and acquisition efforts are

$$q_2^{BR} = \frac{\sqrt{\tilde{m}_A \tilde{\theta}_A (l_B + a_2 \theta_B)} - \tilde{l}_A - (l_B + a_2 \theta_B)}{\tilde{\theta}_A},$$
$$a_2^{BR} = \frac{\sqrt{m_B \theta_B (\tilde{l}_A + q_2 \tilde{\theta}_A)} - l_B - (\tilde{l}_A + q_2 \tilde{\theta}_A)}{\theta_B}. \tag{9}$$

[6] Klemperer (1987) studies a two-period pricing game where firms charge the same price to all customers in each period. Therefore, his analysis does not permit implementing different actions for different consumers.

[7] In principle, our model also allows for f_θ as well as f_l to be less than one.

From Equation (9), if a customer has a strong intrinsic preference for firm A, then firm A's retention efforts q_2^{BR} are low. Similarly, if the customer has a strong intrinsic preference for firm B, then firm B's attraction efforts a_2^{BR} are low. Because CRM investments are nonnegative, for sufficiently high $\tilde{l}_A$ or l_B, CRM investments tend to zero, and the equilibrium involves a corner solution with either $q_2^* = 0$, $a_2^* = 0$, or both zero. We focus on the more interesting case where $\tilde{l}_A$ and l_B are sufficiently small that both q_2^* and a_2^* are positive.[8]

Proposition 1. *When intrinsic preferences towards both firms are sufficiently small, i.e.,*

$$\tilde{l}_A < \tilde{m}_A \tilde{\theta}_A \frac{\tilde{m}_A \tilde{\theta}_A m_B \theta_B}{(\tilde{m}_A \tilde{\theta}_A + m_B \theta_B)^2}, \quad \text{and}$$
$$l_B < m_B \theta_B \frac{\tilde{m}_A \tilde{\theta}_A m_B \theta_B}{(\tilde{m}_A \tilde{\theta}_A + m_B \theta_B)^2}, \tag{10}$$

then the unique Nash equilibrium for the second-period subgame corresponds to

$$q_2^* = \tilde{m}_A \frac{\tilde{m}_A \tilde{\theta}_A m_B \theta_B}{(\tilde{m}_A \tilde{\theta}_A + m_B \theta_B)^2} - \frac{\tilde{l}_A}{\tilde{\theta}_A}, \tag{11}$$

$$a_2^* = m_B \frac{\tilde{m}_A \tilde{\theta}_A m_B \theta_B}{(\tilde{m}_A \tilde{\theta}_A + m_B \theta_B)^2} - \frac{l_B}{\theta_B}. \tag{12}$$

Let us define $m_j \theta_j$ $(j = A, B)$ as the attractiveness of a customer to company j. As either m_j or θ_j increases, the customer's attractiveness to firm j increases. Accordingly, Proposition 1 implies that in equilibrium, each firm chooses its CRM investment such that the deterministic utility that it provides to the customer is proportional to the attractiveness of the customer to that firm: $(\tilde{l}_A + \tilde{\theta}_A q_2^*)/(l_B + \theta_B a_2^*) = \tilde{m}_A \tilde{\theta}_A / m_B \theta_B$. Consequently, the firm that finds the customer relationship more attractive offers a greater deterministic utility.

3.1. Identifying Customers for Retention

A central question in CRM is: How should a firm design and implement programs to manage its relationships with different customers? For instance, financial services firms use transactional data to determine which customers exhibit a higher risk of closing their accounts (e.g., using an early-warning system). Then, they may decide to contact these customers and offer them additional benefits to prevent such an outcome. These actions may not only be a function of the risk of losing a given customer, but also of other factors such as profitability and responsiveness of their customers. Intuitively, a firm should allocate more resources to relationships with a higher contribution margin and greater risk of defecting (i.e., lower intrinsic preference). However, when two customers differ in their responsiveness, it is not clear which customer should be allocated more resources. On one hand, one could argue that the firm should focus on the more responsive customer to benefit from the higher retention effectiveness. On the other hand, one could also argue that the firm should direct more resources to the less-responsive customer, given that stronger actions are needed to influence this customer. Proposition 2 addresses this issue:

Proposition 2. *Ceteris paribus, firm* A*'s equilibrium retention efforts* (q_2^*) *increase with contribution margin* $(\tilde{m}_A)$*, decrease with intrinsic preference* $(\tilde{l}_A)$*, and exhibit a nonmonotonic relationship* (*first increasing, then decreasing*) *with retention effectiveness* $(\tilde{\theta}_A)$.

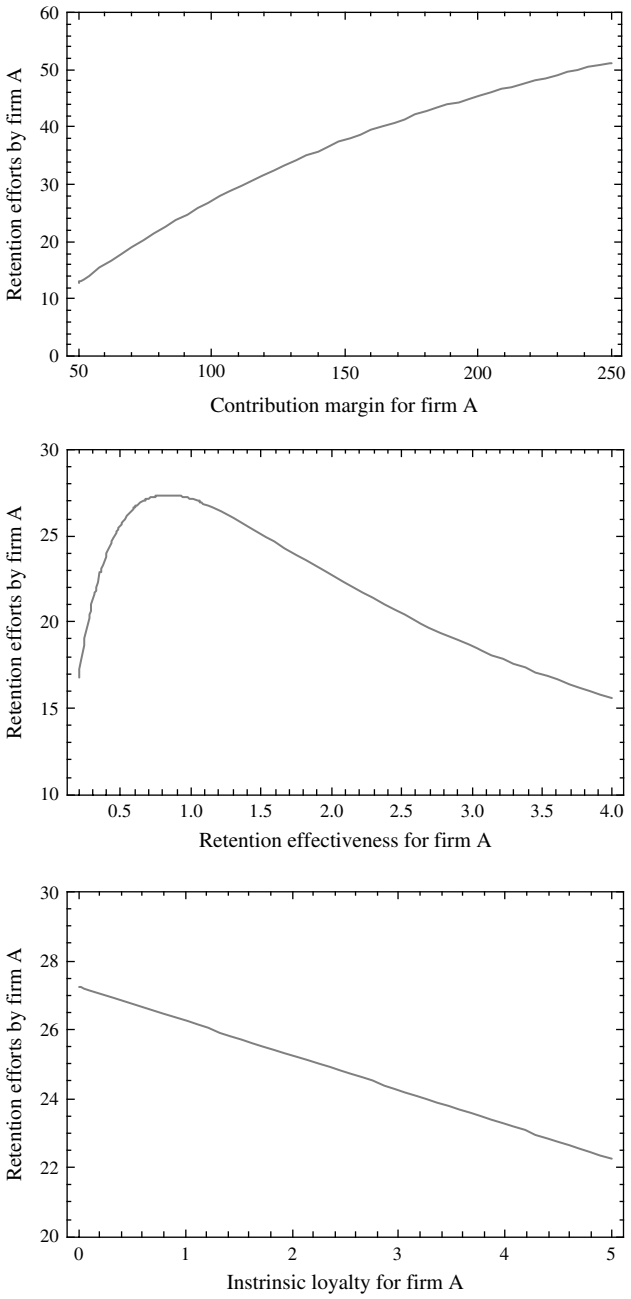
Figure 1 illustrates how the optimal retention efforts of a firm should vary with margin, effectiveness, and loyalty.[9] As shown in Figure 1, retention efforts are higher for customers with higher margin. A higher-margin customer is more profitable to the firm, warranting an increase in the associated CRM effort. Further, retention efforts follow a nonmonotonic pattern with the effectiveness of the retention efforts $(\tilde{\theta}_A)$. When responsiveness is low, firm A allocates more resources to its more responsive customers. A more responsive customer provides firm A with an opportunity to increase the likelihood of retaining that customer in a cost-effective manner (i.e., the monetary benefits of this higher retention probability are larger than the corresponding increase in retention costs). In contrast, when responsiveness is high, firm A allocates fewer resources to its more responsive customers. Given high levels of responsiveness, a further increase in responsiveness enables firm A to reduce its CRM efforts, achieving a cost reduction without significantly diminishing the probability of retaining the customer. As effectiveness approaches infinity, efforts tend to zero. Finally, firm A should invest more in customers with a lower intrinsic preference, which are at a higher risk of switching to firm B.

Although investing less in customers with stronger intrinsic preferences $(\tilde{l}_A)$ makes sense from a retention perspective, this is at odds with conventional wisdom that recommends investing more in loyal customers, who are likely to generate higher margins in the future. We revisit this issue in §4, in the context of developing customer relationships.

[8] For the proofs of all propositions, please refer to Technical Appendix A, which can be found at http://mktsci.pubs.informs.org.

[9] For the effects of contribution margin, $m_B = 100$, $\theta_A = \theta_B = 1$, $l_A = l_B = 0.1$, $f_i = 1.1$, $i = m, \theta, l$. For the effects of retention effectiveness, $m_A = m_B = 100$, $\theta_B = 1$, $l_A = l_B = 0.1$, $f_i = 1.1$, $i = m, \theta, l$. For the effects of intrinsic preference, $m_A = m_B = 100$, $\theta_A = \theta_B = 1$, $l_B = 0.1$, $f_i = 1.1$, $i = m, \theta, l$.

Figure 1 Retention Strategy for Firm A



3.2. Identifying Customers for Attraction

After analyzing which of its customers should be the focus of firm A's retention efforts, we now analyze which of firm A's customers should be the focus of attraction by firm B.[10] In particular, firm B's options fall into three categories: targeting customers with the highest, lowest, or intermediate levels of contribution margin or responsiveness for firm A. The next proposition describes which of these options should constitute firm B's equilibrium strategy.

Proposition 3. *Ceteris paribus, when the customer is relatively less* (*more*) *attractive to firm* A, *i.e.,* $\tilde{m}_A\tilde{\theta}_A < m_B\theta_B$ ($\tilde{m}_A\tilde{\theta}_A > m_B\theta_B$), *then the equilibrium attraction efforts* (a_2^*) *of firm* B *increase* (*decrease*) *with both the contribution margin* ($\tilde{m}_A$) *as well as the retention effectiveness* ($\tilde{\theta}_A$) *towards firm* A.

Figure 2 illustrates the results of Proposition 3, that firm B's attraction efforts should be highest for customers that provide a moderate contribution margin to firm A.[11] Customers that are highly profitable for firm A will be hard to attract, because firm A invests heavily to retain them. Similarly, customers with low profitability for firm A do not warrant high efforts to be persuaded, given that firm A allocates fewer resources to them. A similar argument holds for customer responsiveness to firm A's efforts. Customers that are insensitive to firm A can be more easily persuaded by firm B, requiring lower attraction efforts. Likewise, it is not efficient for firm B to waste resources on customers highly responsive to firm A's efforts.

3.3. Industry CRM Investment Behavior

How do firms' optimal CRM efforts vary when compared against each other? From Equation (9), a firm's best response has a nonmonotonic relationship with the competitor's efforts (e.g., a_2 appears in two terms in Equation (9); the first increases with a_2 while the second term decreases with a_2). When firm B's attraction efforts are low, firm A's best response to an increase in firm B's efforts is to raise its retention efforts. However, when firm B's attraction efforts are high, firm A's best response is to reduce its retention efforts. Thus, when starting from a baseline with no CRM spending by either firm, it is optimal for *both* firms to seek a competitive advantage by increasing their CRM efforts, leading to a *joint* escalation. The next proposition describes how far this escalation will continue.

Proposition 4. *In equilibrium, when a customer is relatively more attractive to firm* B, ($\tilde{m}_A\tilde{\theta}_A < m_B\theta_B$), *an increase in* $\tilde{m}_A$ *triggers a joint escalation of CRM efforts from both firms. On the other hand, when a customer is relatively more attractive to firm* A, ($\tilde{m}_A\tilde{\theta}_A > m_B\theta_B$), *an increase in* $\tilde{m}_A$ *results in an escalation of CRM efforts from firm* A, *but a withdrawal of CRM efforts from firm* B.

[10] Note that the analysis of how attraction efforts of firm B vary with respect to m_B, θ_B, and l_B is parallel to that of §3.1. Specifically, the acquisition efforts increase with the contribution margin for firm B (m_B), exhibit a nonmonotonic relationship with the effectiveness (θ_B), and decrease with the intrinsic preference of the customer towards firm B (l_B).

[11] In Figure 2, for the effects of contribution margin, $m_B = 100$, $\theta_A = \theta_B = 1$, $l_A = l_B = 0.1$, $f_i = 1.1, i = m, \theta, l$. For the effects of retention effectiveness, $m_A = m_B = 100$, $\theta_B = 1$, $l_A = l_B = 0.1$, $f_i = 1.1, i = m, \theta, l$.

Figure 2 Attraction Strategy for Firm B

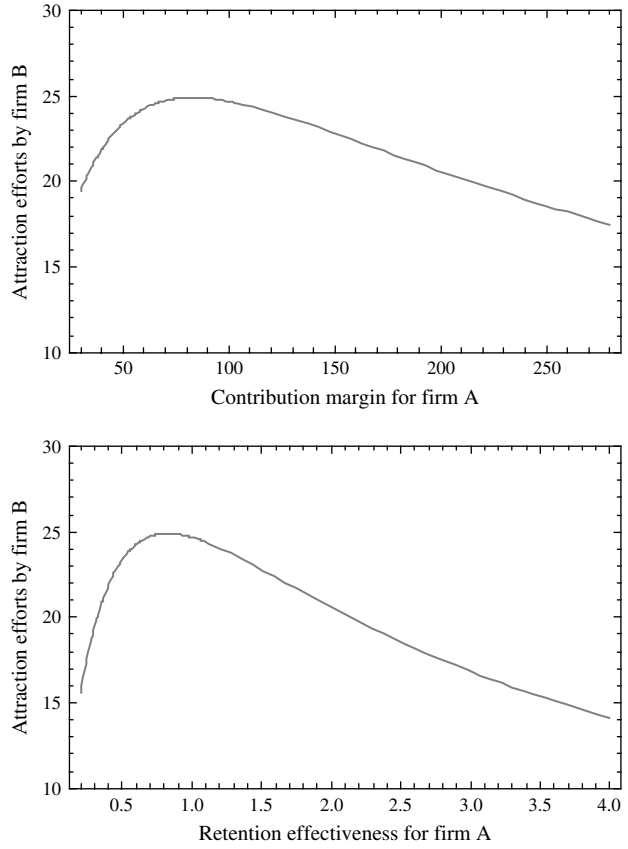
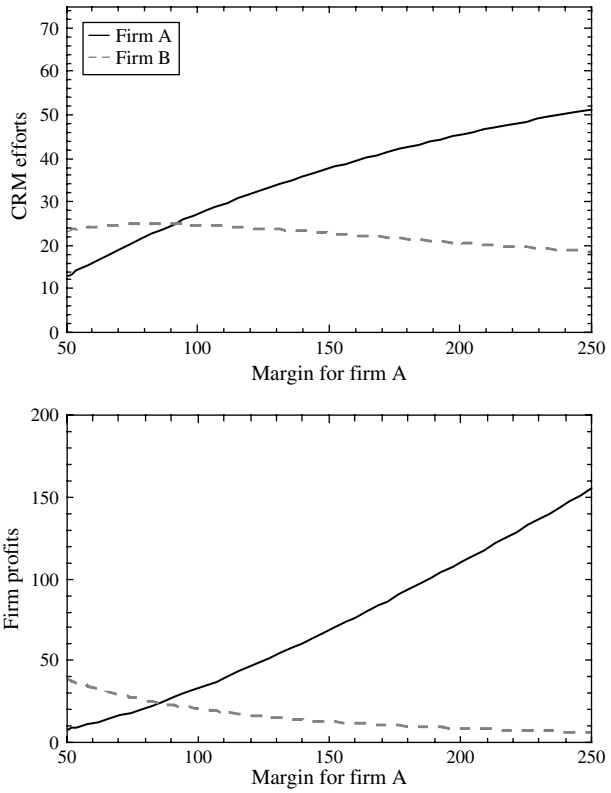


Figure 3 Escalation and Withdrawal as a Function of Firm A Contribution Margin



In all cases, firm A*'s likelihood of retaining the customer increases with* $\widetilde{m}_A$*, whereas the profit for firm* A (B) *increases* (*decreases*) *with* $\widetilde{m}_A$.

Figure 3 plots the equilibrium CRM efforts and profits for both firms as a function of firm A's margin.[12] Consider two customer relationships (h and l) that are otherwise identical except for their firm A margins (let $m_{hA} > m_{lA}$). From Proposition 2, firm A will allocate more resources to h. From Proposition 3, if m_{hA} is sufficiently small, firm B will also devote more resources to h. Both firms fight more fiercely to capture the business of h than l, thus escalating competition for customers that are more profitable for firm A. Interestingly, this competitive escalation harms the profits of firm B, but firm A's higher efforts towards h are rewarded with an improved probability of retaining h, leading to greater profits than from l. In contrast, if m_{hA} is sufficiently large, and customers are very attractive to firm A (i.e., margins are high), firm A still allocates more resources to h, but firm B directs more resources to l, the customer more likely to be persuaded by firm B.

Proposition 5. *In equilibrium*: (1) *When a customer's responsiveness to firm* A*'s retention efforts is small* ($\tilde{\theta}_A < m_B\theta_B/\widetilde{m}_A$)*, an increase in* $\tilde{\theta}_A$ *triggers a joint escalation of CRM efforts from both firms. When a customer's responsiveness is moderate* ($m_B\theta_B/\widetilde{m}_A < \tilde{\theta}_A < \varsigma$)*, an increase in* $\tilde{\theta}_A$ *results in an escalation of CRM efforts from firm* A *and a withdrawal of CRM efforts from firm* B.[13] *When a customer's responsiveness to firm* A *is large* ($\varsigma < \tilde{\theta}_A$)*, an increase in* $\tilde{\theta}_A$ *results in a joint withdrawal of CRM efforts from both firms.* (2) *Retention probability always increases with* $\tilde{\theta}_A$*. If the intrinsic preference towards firm* A *is relatively high* ($\tilde{l}_A > m_B\theta_B/4$)*, profits for firm* A *increase with* $\tilde{\theta}_A$*; otherwise, they exhibit a nonmonotonic behavior* (*first decreasing and then increasing*) *with* $\tilde{\theta}_A$*. Profit for firm* B *decreases with* $\tilde{\theta}_A$.

To understand this result, consider two otherwise identical customers with differing responsiveness to firm A's CRM efforts. When responsiveness of both customers is sufficiently small, both firms invest more in the customer that is more responsive to firm A's retention efforts (see Region 1 in Figure 4).[14] Firm A does so to take advantage of the higher responsiveness of this customer, whereas firm B does so to compensate the stronger efforts from firm A. Due to this increased competition, both firms may earn lower

[12] Here, $m_B = 100$, $\tilde{\theta}_A = \theta_B = 1$, $\tilde{l}_A = l_B = 0.1$, $f_i = 1.1$, $i = m, \theta, l$.

[13] ς is defined in Technical Appendix A, found at http://mktsci.pubs.informs.org.

[14] Here, $\widetilde{m}_A = m_B = 10$, $\theta_B = 2$, $\tilde{l}_A = l_B = 2$, $f_i = 1.1$, $i = m, \theta, l$.

Figure 4 **Escalation and Withdrawal as a Function of Firm A Retention Effectiveness**

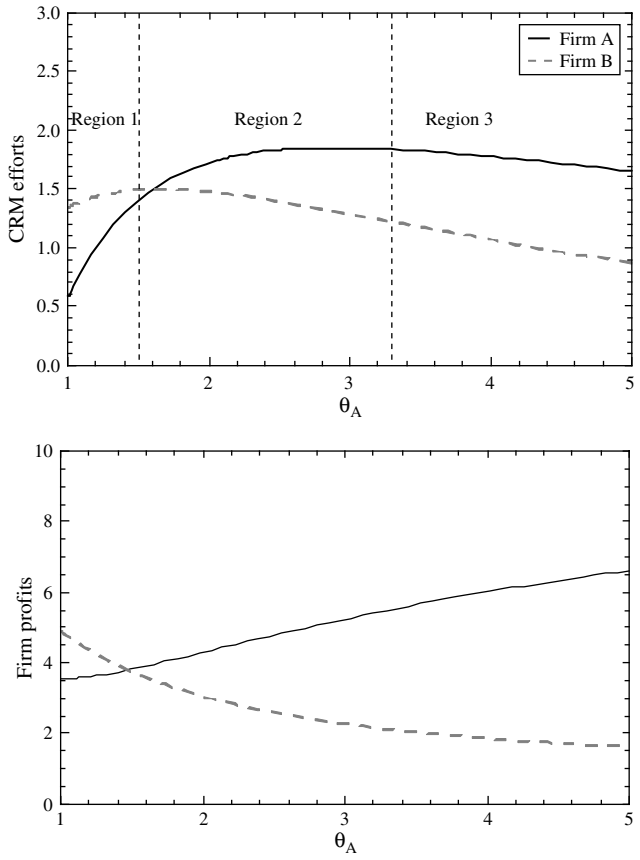
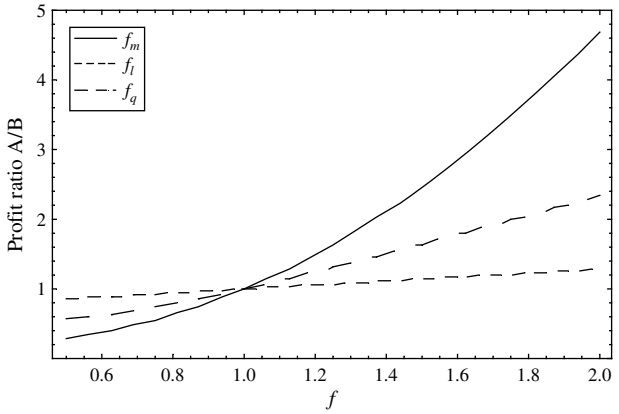


Figure 5 **Firm A's Relative Advantage and Subsequent Profitability**



profits. In contrast, for moderate responsiveness of both customers towards firm A's efforts, firm A continues to devote more resources to the more responsive customer. Firm B, however, adopts a different strategy and allocates more resources to the less-responsive customer, because it is now too costly for firm B to counter the higher spending of firm A on the more responsive customer (Region 2). Further, if the customer's intrinsic preference towards firm A ($\tilde{l}_A$) is sufficiently large, this asymmetry in efforts also translates into asymmetric equilibrium profits. Consequently, firm A spends more and earns more profits from the more responsive customer, whereas firm B's efforts and profits are greater for the less-responsive customer. Finally, when responsiveness is sufficiently large, firm A does not need to spend as much on the more responsive customer to increase the likelihood of retaining this customer, whereas firm B also continues to direct fewer resources to this customer (Region 3). Consequently, both firms allocate fewer resources to the more responsive customer. Firm A obtains greater profits from the more responsive customer, whereas firm B obtains greater profits from the less-responsive customer.

Past research (e.g., Rossi et al. 1996) suggests that a firm stands to benefit from gathering more information about their customers, which improves effectiveness of its marketing efforts (e.g., increasing $\tilde{\theta}_A$). An interesting implication of Proposition 5 is that initiatives to improve effectiveness may, in some instances, negatively affect firm profits. For instance, if $\tilde{\theta}_A$ is sufficiently small, and firm A collects additional information about this customer to increase $\tilde{\theta}_A$, higher retention efforts by firm A will be compensated by higher acquistion efforts from firm B. As implied by Proposition 5, this escalation of marketing resources may harm the profits of firm A. Therefore, although improving the effectiveness of retention initiatives offers some (direct) benefit to the firm, the overall financial consequences may be negative if this enhanced responsiveness leads to a stronger fight with its competitor.

3.4. Customer Development and CRM Investments

An important aspect of our model is the ability to assess the benefits of developing a customer relationship over time. If customer response to both firms is symmetric, there is no advantage to firm A of initially owning the customer (i.e., if $m_A = m_B$, $l_A = l_B$, $\theta_A = \theta_B$, and $f_m = f_l = f_\theta = 1$, then $\pi^*_{2A} = \pi^*_{2B}$). As discussed in §2, this is unlikely, given that a firm can benefit from past customer experiences and enhance its ability to develop its relationship with the customer (Kamakura et al. 2005). To explore how a developed relationship may impact the relative profitability of the two firms, in Figure 5 we plot the ratio of firm A profits to firm B profits against the variation in f_m, f_θ, and f_l.[15]

Note that for $f_i > 1$ ($i = m, \theta$ or l), firm A's profits are higher than firm B's, reflecting the benefits of a developed relationship. Further, note that the relative advantage is the highest for a unit improvement in margin, and lowest for a unit improvement

[15] Here, $m_A = m_B = 10$, $\theta_A = \theta_B = 1$, $l_A = l_B = 1$.

in intrinsic preference.[16] This result is driven by the fact that contribution margin has a direct impact on the profits of the firm, whereas effectiveness works alongside with retention efforts to impact firm profits, and an improvement in the intrinsic preference exhibits decreasing returns in terms of customer utility (see Equation (1)). To better understand how these three benefits impact firms' CRM strategy, in the next section we analyze the firms' first-period decisions.

4. Competitive Dynamics of CRM Investments

In the first period, each firm maximizes its total future discounted profits from a customer relationship (Equations (7) and (8)). Although closed-form solutions for a_{1A}^* and a_{1B}^* are available, the complexity of these expressions hampers a comprehensive analysis of this game. Therefore, we introduce symmetry to study the main features of this equilibrium. Specifically, in the remainder of this section, we assume $\theta_A = \theta_B = \theta$, $m_A = m_B = m$, and $l_A = l_B = l$. Note that although the starting conditions for both firms are the same in period 1, in period 2 the firm that acquires the customer may obtain a competitive advantage over its rival in terms of the loyalty, profitability, and effectiveness of its marketing actions (based on the values of f_l, f_m, and f_θ). We first characterize the Nash equilibrium of this game.[17]

Proposition 6. *When intrinsic preferences towards each firm* (l) *are sufficiently small, i.e.,*

$$l < \min\left\{ \frac{f_m f_\theta m\theta}{(1+f_m f_\theta)^2}, \frac{f_m^2 f_\theta^2 m\theta}{f_l(1+f_m f_\theta)^2}, \frac{\beta f_\theta (f_m^3 f_\theta^2 - 1) + f_\theta m\theta (1+f_m f_\theta)^2}{((4+\beta) f_\theta - \beta f_l)(1+f_m f_\theta)^2} \right\}, \quad (13)$$

then the unique Nash equilibrium for the two-period game corresponds to

$$a_{1A}^* = a_{1B}^* = \frac{(1+f_m f_\theta)^2(-(4+\beta) f_\theta l + \beta f_l l + \beta f_\theta m\theta) + \beta f_\theta m\theta (f_m^3 f_\theta^2 - 1)}{4 f_\theta \theta (1+f_m f_\theta)^2}. \quad (14)$$

Given symmetry, let a_1^* represent equilibrium acquisition efforts in the first period. As argued earlier, after a customer interacts with the firm, the customer may increase spending in the next period, leading to a higher contribution margin during that period. Similarly, a firm may learn about customer preferences from previous interactions and consequently improve its CRM effectiveness. Intuitively, these improvements in profitability (f_m) or effectiveness (f_θ) should be beneficial for the firms as they create opportunities to more efficiently retain the customer and collect higher margins in the future. Interestingly, Proposition 7 shows that this intuition does not always hold in a competitive setting given that the firms may engage in a more aggressive fight in period 1 to acquire the customer in order to enjoy these future benefits.

Proposition 7. *Ceteris paribus, in equilibrium*: (1) *the first-period CRM investment* (a_1^*) *always increases with* f_m *and* f_l. *As long as* $f_\theta > \frac{1}{8}$, a_1^* *increases with* f_θ. (2) *Firm total discounted profit* (π^*) *increases with* f_l *and exhibits a nonmonotonic relationship* (*first decreasing and then increasing*) *with* f_m ($d\pi^*/df_m < 0$ *if and only if* $f_m^2 f_\theta (3 + f_m f_\theta) < 6$) *and* f_θ ($d\pi^*/df_\theta < 0$ *if and only if* $(2m\theta/l) f_m f_\theta^2 (f_m^2 f_\theta - 3)/(1 + f_m f_\theta)^3 < f_l$).

Proposition 7 shows that a higher future margin leads to greater equilibrium acquisition efforts. However, when the increase in this margin is small, greater acquisition efforts lead to lower profits, because gains from increased margin are not sufficient to compensate the negative consequences of increased competition between the firms, as shown in Figure 6.[18] Similarly, a firm can gain more insight into its customers after acquiring them and then use this information to increase the responsiveness of these customers. However, because its competitor also faces similar incentives, this may lead both firms to fight more aggressively to acquire the customer in the first period. Thus, an increase in f_θ may lead to a reduction in profit for the firms, as shown in Figure 7.[19] Finally, an increase in loyalty has the expected effect on efforts and profits, triggering more spending from both competitors in order to attract the customer. In addition, given that a higher loyalty corresponds to a better likelihood of retaining the customer, these benefits outweigh the additional spending required, leading to an increase in equilibrium profits.

5. Conclusions

In this paper, we analyze the strategic CRM decisions by two firms competing to retain or acquire a given customer over two time periods. An explicit consideration of interfirm competition enables us to derive interesting, counterintuitive results, as summarized in the introduction. Our analysis is particularly relevant in settings where customers can switch

[16] This assumes equal costs for the unit improvement along all three parameters. Future research could enhance this discussion with the inclusion of specific cost factors.

[17] In Technical Appendix B, found at http://mktsci.pubs.informs.org, we extend the analysis from this section and present results for equilibrium CRM investments under budget constraints.

[18] Here, $m = 10$, $\theta = 1$, $l = 1$, $f_\theta = 1$, $f_l = 1$, and $\beta = 0.8$.

[19] Here, $m = 10$, $\theta = 1$, $l = 1$, $f_m = 1$, $f_l = 1$, and $\beta = 0.8$.

Figure 6 **Evolution of Customer Profitability, the Initial CRM Efforts, and Firm Profits**

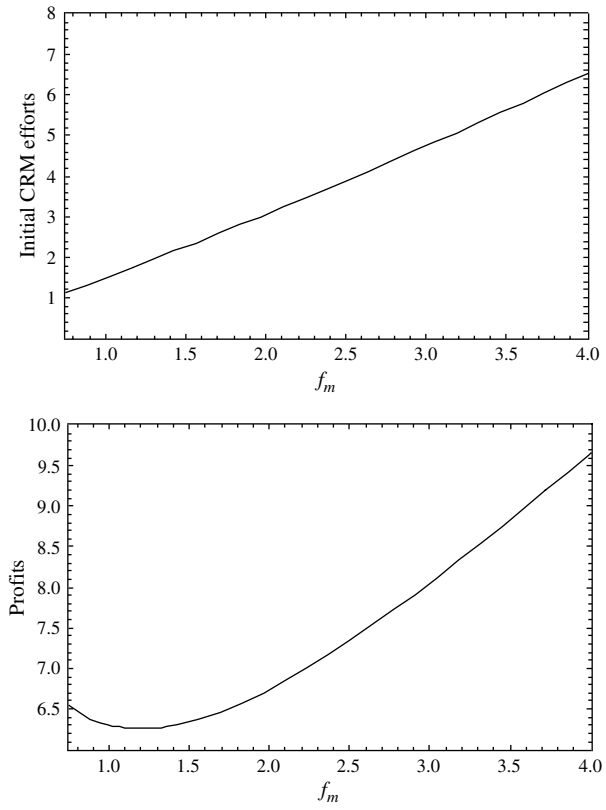
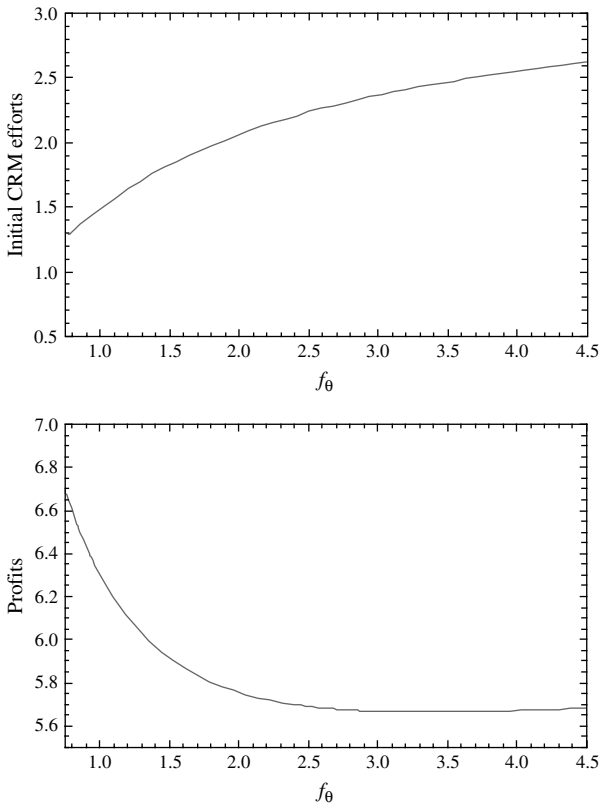


Figure 7 **Customer Relationship Intelligence, Initial CRM Efforts, and Firm Profits**



between firms over time and service is an important component of a firm's offering. This is often the case in industries such as financial services, airlines, Internet services, wireless telecommunications, health care, and tourism. Our framework is applicable to firms using cost accounting principles to determine profitability of each customer. An important feature of our model is firms' ability to decide the right amount of investment for each customer relationship. This level of customization is not uncommon. For example, a financial services firm can decide the service priority it offers each customer accessing its call center. Harrah's, a gaming corporation, can provide different customers with different benefits such as hotel incentives. Equipment manufacturers (e.g., Caterpillar) can make proactive site visits to key customers to verify if supplied equipment is performing as expected.

Some interesting avenues for future research include normative extensions that consider alternative rules of interaction between firms and customers (Shugan 2005b), endogenous firm decisions to improve contribution margin or effectiveness of marketing actions, considerations of information asymmetry (e.g., Villas-Boas and Schmidt-Mohr 1999), and strategic consumer behavior (e.g., Gönül and Shi 1998). Some predictions from our model lend themselves to empirical investigation. For instance, our results suggest that firms may not always have an incentive to collect more information about their customers to improve the effectiveness of their marketing programs. Future empirical research could investigate these predictions across industries. In summary, our paper seeks to fill an important gap in the CRM literature incorporating a competitive dimension to the analysis of CRM initiatives. We hope that this work stimulates further research that expands our knowledge and improves the management of customer relationships.

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References

Anderson, S. P., A. de Palma, J.-F. Thisse. 1992. *Discrete Choice Theory of Product Differentiation*. MIT Press, Cambridge, MA.

Band, W., S. Leaver, M. A. Rogan. 2007. Trends 2007: Customer relationship management. Forrester Research, Cambridge, MA.

Berry, S. 1994. Estimating discrete-choice models of product differentiation. *RAND J. Econom.* **25** 242–262.

Bitran, G., S. Mondschein. 1996. Mailing decisions in the catalog sales industry. *Management Sci.* **42**(9) 1364–1381.

Blattberg, R. C., J. Deighton. 1996. Manage marketing by the customer equity test. *Harvard Bus. Rev.* **74**(4) 136–145.

Bolton, R. N. 1998. A dynamic model of the duration of the customer's relationship with a continuous service provider: The role of satisfaction. *Marketing Sci.* **17**(1) 45–65.

Bolton, R. N., M. B. Myers. 2003. Price-based global market segmentation for services. *J. Marketing* **67**(3) 108–128.

Bolton, R. N., K. N. Lemon, M. D. Bramlett. 2006. The effect of service experiences over time on a supplier's retention of business customers. *Management Sci.* **52**(12) 1811–1823.

Boulding, W., A. Kalra, R. Staelin, V. A. Zeithaml. 1993. A dynamic process model of service quality: From expectations to behavioral intentions. *J. Marketing Res.* **30**(1) 7–27.

Boulding, W., R. Staelin, M. Ehret, W. J. Johnston. 2005. A customer relationship management roadmap: What is known, potential pitfalls, and where to go. *J. Marketing* **69**(4) 155–166.

Chen, Y., C. Narasimhan, Z. J. Zhang. 2001. Individual marketing with imperfect targetability. *Marketing Sci.* **20**(1) 23–41.

Drèze, X., A. Bonfrer. 2008. Moving from customer lifetime value to customer equity. Working paper, The Wharton School, University of Pennsylvania, Philadelphia.

Fruchter, G. E., Z. J. Zhang. 2004. Dynamic targeted promotions. *J. Service Res.* **7**(1) 3–19.

Gönül, F., M. Z. Shi. 1998. Optimal mailing of catalogs: A new methodology using estimable structural dynamic programming models. *Management Sci.* **44**(9) 1249–1262.

Gönül, F., K. Srinivasan. 1996. Estimating the impact of consumer expectations of coupons on purchase behavior: A dynamic structural model. *Marketing Sci.* **15**(3) 262–279.

Guadagni, P., J. Little. 1983. A logit model of brand choice calibrated on scanner data. *Marketing Sci.* **2** 203–238.

Gupta, S., V. Zeithaml. 2006. Customer metrics and their impact on financial performance. *Marketing Sci.* **25**(6) 718–739.

Gupta, S., D. R. Lehmann, J. A. Stuart. 2004. Valuing customers. *J. Marketing* **41**(1) 7–18.

Ho, T.-H., Y.-H. Park, Y.-P. Zhou. 2006. Incorporating satisfaction into customer value analysis: Optimal investment in lifetime value. *Marketing Sci.* **25**(3) 260–277.

Johnson, M. D., F. Selnes. 2004. Customer portfolio management: Toward a dynamic theory of exchange relationships. *J. Marketing* **68**(2) 1–17.

Kamakura, W. A., B. S. Kossar, M. Wedel. 2004. Identifying innovators for the cross-selling of new products. *Management Sci.* **50**(8) 1120–1133.

Kamakura, W. A., C. F. Mela, A. Ansari, A. Bodapati, P. Fader, R. Iyengar, P. Naik, S. A. Neslin, B. Sun, P. C. Verhoef. 2005. Choice models and customer relationship management. *Marketing Lett.* **16**(3–4) 279–291.

Kim, B.-D., M. Shi, K. Srinivasan. 2001. Reward programs and tacit collusion. *Marketing Sci.* **20**(2) 99–120.

Klemperer, P. 1987. The competitiveness of markets with switching costs. *RAND J. Econom.* **18**(1) 138–150.

Kopalle, P. K., S. A. Neslin. 2003. The economic viability of frequency reward programs in a strategic competitive environment. *Rev. Marketing Sci.* **1**(1) 1–39.

Lemon, K. N., T. B. White, R. S. Winer. 2002. Dynamic customer relationship management: Incorporating future considerations into the service retention decision. *J. Marketing* **66**(1) 1–14.

Lewis, M. 2004. The influence of loyalty programs and short-term promotions on customer retention. *J. Marketing Res.* **41**(3) 281–292.

Lewis, M. 2005a. Research note: A dynamic programming approach to customer relationship pricing. *Management Sci.* **51**(6) 986–994.

Lewis, M. 2005b. Incorporating strategic consumer behavior into customer valuation. *J. Marketing* **69**(4) 230–238.

Neslin, S. A., S. Gupta, W. A. Kamakura, J. Lu, C. H. Mason. 2006. Defection detection: Measuring and understanding the predictive accuracy of customer churn models. *J. Marketing Res.* **43**(2) 204–211.

Payne, A., P. Frow. 2005. A strategic framework for customer relationship management. *J. Marketing* **69**(4) 167–176.

Reichheld, F. F., W. E. Sasser. 1990. Zero defections: Quality comes to services. *Harvard Bus. Rev.* **68**(5) 105–111.

Reichheld, F. F., T. Teal. 1996. *The Loyalty Effect*. Harvard Business School Press, Boston.

Reinartz, W., V. Kumar. 2000. On the profitability of long-life customers in a noncontractual setting: An empirical investigation and implications for marketing. *J. Marketing* **64**(4) 17–35.

Reinartz, W., V. Kumar. 2003. The impact of customer relationship characteristics on profitable lifetime duration. *J. Marketing* **67**(1) 77–99.

Rossi, P. E., R. E. McCulloch, G. M. Allenby. 1996. The value of purchase history data in target marketing. *Marketing Sci.* **15**(4) 321–340.

Rust, R. T., T. S. Chung. 2006. Marketing models of service and relationships. *Marketing Sci.* **25**(6) 560–580.

Rust, R. T., P. C. Verhoef. 2005. Optimizing the marketing interventions mix in intermediate-term CRM. *Marketing Sci.* **24**(3) 477–489.

Rust, R. T., A. J. Zahorik. 1993. Customer satisfaction, customer retention, and market share. *J. Retailing* **69**(2) 193–215.

Rust, R. T., K. N. Lemon, V. A. Zeithaml. 2004. Return on marketing: Using customer equity to focus marketing strategy. *J. Marketing* **68**(1) 109–127.

Rust, R. T., A. J. Zahorik, T. L. Keiningham. 1995. Return on quality (ROQ): Making service quality financially accountable. *J. Marketing* **59**(4) 58–70.

Rust, R. T., V. A. Zeithaml, K. N. Lemon. 2000. *Driving Customer Equity*. Free Press, New York.

Schmittlein, D. C., R. A. Peterson. 1994. Customer base analysis. *Marketing Sci.* **13**(1) 41–67.

Schmittlein, D. C., D. G. Morrison, R. Colombo. 1987. Counting your customers: Who are they and what will they do next? *Management Sci.* **33**(1) 1–24.

Seiders, K., G. B. Voss, D. Grewal, A. L. Godfrey. 2005. Do satisfied customers buy more? Examining moderating influences in a retailing context. *J. Marketing* **69**(4) 26–43.

Shaffer, G., Z. J. Zhang. 2002. Competitive one-to-one promotions. *Management Sci.* **48**(9) 1143–1160.

Shin, J., K. Sudhir. 2007. Behavior-based pricing: When to punish or reward current customers? Working paper, Yale School of Management, New Haven, CT.

Shugan, S. M. 2005a. Brand loyalty programs: Are they shams? *Marketing Sci.* **24**(2) 185–193.

Shugan, S. M. 2005b. Marketing and designing transaction games. *Marketing Sci.* **24**(4) 525–530.

Sun, B. 2006. Technology innovation and implications for customer relationship management. *Marketing Sci.* **25**(6) 594–597.

Villanueva, J., P. Bhardwaj, S. Balasubramanian, Y. Chen. 2007. Customer relationship management in competitive environments: The positive implications of a short-term focus. *Quant. Marketing Econom.* **5**(2) 99–129.

Villas-Boas, J. M., U. Schmidt-Mohr. 1999. Oligopoly with asymmetric information: Differentiation in credit markets. *RAND J. Econom.* **30**(3) 375–396.

Zeithaml, V. A., L. L. Berry, A. Parasuraman. 1996. The behavioral consequences of service quality. *J. Marketing* **60**(4) 31–46.