Price discrimination in a lifetime value framework: When is CLV maximization an optimal strategy?

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The information revolution is reshaping the way firms interact with their customers…

Customer intelligence

Addressability

The ability to contact consumers individually

Targetability

The ability to predict preferences and purchase behaviors of individual customers

for the purpose of customizing its price or product offer

Consumer’s heterogeneity
- Brand preference
- Switching costs

How?
- Price discriminate? To whom?
- While max ST profits, or CLV?

1 Chen, Narasimhan and Zhang (2001)
Introduction

- “Growing a business can be framed as a matter of getting customers and keeping them so as to grow the value of the base to its fullest potential.”
  Blattberg and Deighton (HBR, 1996)

- “Customer equity is the sum of the lifetime value of all the customers of a firm. Maximizing customer equity will lead to enhanced profits.”
  Rust, Lemon, Zeithaml (MSI, 2001)

- “All firms need to direct attention to customer acquisition because once the customers make a commitment, they want to stay. Therefore the firms should focus on long run revenue stream.”
  Thomas (JMR 2001)
But…. 

- Managers make decisions in firms

  They follow market share data more than CLV
Willingness to pay and price discrimination
Loyalty and CLV

Purchase volume

<table>
<thead>
<tr>
<th>Heavy users</th>
<th>Light-users</th>
</tr>
</thead>
<tbody>
<tr>
<td>Best</td>
<td>Good</td>
</tr>
<tr>
<td>Good</td>
<td>Worst</td>
</tr>
</tbody>
</table>

Loyalty

Switchers

Loyals
Price discrimination models

- Heterogeneity
  - Switching costs (e.g. Narasimhan, 1988; McGahan and Ghemawat, 1994; Chen, Narasimhan and Zhang, 2001)
  - Brand preference (e.g. Hotelling, 1929; Shaffer and Zhang, 1995; Fudenberg and Tirole, 2000)

- Concepts of PD
  - First, Second and Third-degree (Pigou, 1920; Tirole, 1988)
  - Behavior-based (Villas-Boas, 1998; Shaffer and Zhang, 2000)

- Strategic customers and jealousy effects (Villas-Boas, 1998; Chen and Zhang, 2001)
- Asymmetries (Shaffer and Zhang, 2000)
- Imperfect targetability (Chen, Narasimhan and Zhang, 2001)
- Cost of targeting (Shaffer and Zhang, 1995)
- Discrimination in prices, coupons, service
Building a behavior-based price discrimination model that integrates:

- the concept of CLV maximization
- the higher profitability of long-life customers

in order to answer the following two research questions:

- Should the company penalize loyal customers relative to switchers?

- Is it always optimal for a firm to set prices that maximize CLV? If not, when should it maximize ST profits instead?
Model

- 2 periods, homogeneous products, duopoly model
- Customers are **heterogeneous** in their switching costs. Firms know the distribution of switching costs.
- Fixed pool of customers
- Long-life customers may be more (or less) profitable over time
- There is **perfect addressability**, although **not individual targetability**.
- Each company maximizes retention and acquisition
- Offering different prices to different pools of customers, considering:
  - Whether they are current customers or prospects
  - Their switching costs

- **Example**: credit cards
Model

- Consumers are heterogeneous in their SC $\theta_i^h \sim U(0,1)$, $h = \{1,2\}$
- Firms decide at t=0 whether to maximize CLV or ST

<table>
<thead>
<tr>
<th></th>
<th>CLV</th>
<th>ST</th>
</tr>
</thead>
<tbody>
<tr>
<td>First period ($p_{h1}$)</td>
<td>$\pi_{h1}(p_{11}, p_{21}) + \pi_{h2}^*(p_{12}(p_{11}, p_{21}), p_{22}(p_{11}, p_{21}))$</td>
<td>$\pi_{h1}(p_{11}, p_{21})$</td>
</tr>
<tr>
<td>Second period ($p_{h2}$)</td>
<td>$\pi_{h2}(p_{12}(p_{11}, p_{21}^<em>), p_{22}(p_{11}, p_{21}^</em>))$</td>
<td>$\pi_{h2}(p_{12}(p_{11}, p_{21}^<em>), p_{22}(p_{11}, p_{21}^</em>))$</td>
</tr>
</tbody>
</table>

- Pairs of strategies: LVLV, STST, Asymmetry
- At t=1,2 firms offer an acquisition discount $(a)$ and a retention discount $(r)$ to each pool of customers
- Consumers decide to switch or repeat based on their SC $(\theta)$ and the discounts offered, e.g.
  \[ R_h = \Pr(\theta^h \geq a_{3-h} - r^h), \]
- Profits are a function of the number of customers retained and acquired and the discounts offered
  \[ \pi = \pi_R + p_A = R(1-r) + A(1-a) \]
The profitability of long-life customers: *Two models*

We develop and test two models depending on two different effects predicted by the CRM literature, that are included by an exogeneous parameter $\delta$ in the profits equations

**CASE A**

**VOLUME MODEL**

$$\pi = \pi_R + \rho_A = (1+d)R(1-r) + A(1-a)$$

$\delta$: long-life customers are likely to buy more

**CASE B**

**REVENUE MODEL**

$$\pi = \pi_R + \rho_A = R((1+d) - r) + A(1-a)$$

$\delta$: long-life customers are cheaper to serve
Model equations

\[ \theta_i^h \sim U(0,1), \quad h = \{1, 2\} \]

\[ R_h = \Pr(\theta_h \geq a_{3-h} - r_h) = 1 - a_{3-h} + r_h \]

\[ A_h = \Pr(\theta_{3-h} + r_{3-h} \leq a_h) = a_h - r_{3-h} \]

\[ AA_h = a a_h - r a_j \]

\[ RA_h = a_h - r_j + r a_h - a a_j \]

\[ AR_h = a r_h - r r_j + r_j - a_h \]

\[ RR_h = 1 + r r_h - a r_j \]

\[ h = \{1, 2\}, \quad j = 3 - h \]

\[ p_{h1} = (1 + d) R_h (1 - r_h) + A_h (1 - a_h) \]

\[ p_{h2} = (1 + 2d) R R_h (1 - r r_h) + (1 + d) R A_h (1 - r a_h) + A A_h (1 - a a_h) + A R_h (1 - a r_h) \]

\[ p_{h1} = R_h ((1 + d) - r_h) + A_h (1 - a_h) \]

\[ p_{h2} = R R_h ((1 + 2d) - r r_h) + R A_h ((1 + d) - r a_h) + A A_h (1 - a a_h) + A R_h (1 - a r_h) \]
The game

Firm 1

Firm 2

\[t=0\]

\[N_1\]

Choose CLV, ST

\[N_2\]

\[t=1\]

\[R_1 (r_1)\]

\[A_1 (a_1)\]

\[A_2 (a_2)\]

\[R_2 (r_2)\]

Set discounts

\[t=2\]

\[RR_1 (rr_1)\]

\[RA_1 (ra_1)\]

\[AA_1 (aa_1)\]

\[AR_1 (ar_1)\]

\[AR_2 (ar_2)\]

\[AA_2 (aa_2)\]

\[RA_2 (ra_2)\]

\[RR_2 (rr_2)\]

Set discounts

Each of these segments represents a history of purchases.
Firms price discriminate based on past behavior.

Segments’ sizes are in caps letters
Discounts are in parenthesis
Observed switching costs’ distributions

\[
\begin{align*}
\text{t=1} & \\
N_1 & \\
A_2 & \quad R_1 \\
0 & \quad a_2 - r_1 & \quad 1 \\
\text{t=2} & \\
A_1 & \quad R_2 \\
0 & \quad a_1 - r_2 & \quad 1 \\
\end{align*}
\]

Customers of Firm 1

Customers of Firm 2
Results Volume Model

\[ \pi = \pi_R + p_A \left[ (1 + \delta)R (1 - r) + A (1 - a) \right] \]

\( \delta \): long-life customers are likely to buy more

LVLV is PO for \( \delta > 0.112 \), and both LVLV and STST are NE for most values of \( \delta \)

Consumer welfare is higher the lower are the SC of a consumer segment
Results Revenue Model

\[ \pi = \pi_R + p_A = R R \left[ (1 + d) \right]^r - r \right) + A (1 - a) \]

\( \delta \): long-life customers are cheaper to serve

For all positive values of \( \delta \) STST is the PO and for \( \delta > 0.717 \) STST is the unique NE.
For most other values of \( \delta \) both LVLV and STST are NE

When \( \delta \) is sufficiently high, the group of customers with the highest SC get the max possible welfare, and the firm retains all customers for two periods
Conclusions

- Setting prices that max CLV is optimal only under some conditions:
  - The extent to which long-life customers are more (less) profitable than first-time customers
  - Whether this effect if specified as a volume or a revenue effect

- When loyal customers exhibit a sufficiently high revenue effect, the firm should retain all customers and loyal customers get the max possible welfare.
Further Work (Experiment)

- [http://iesedti.com/Equity/Equity.htm](http://iesedti.com/Equity/Equity.htm)
Related work (Villanueva et al. 07)

- Duopoly model
- Each firm owns a customer at the start of period 1
- Reservation utility of customer is 1
- Each customer is a potential switcher with probability $z$
- Switching cost is $\gamma$
- Firms choose two prices in each period - one directed to its own customer and the other to competitor’s customer
- Revenue expansion effect
- Strategic customers
Related work (Villanueva et al. 07), continued

- Always a positive likelihood of customer “churn” in equilibrium, i.e., $p_A > p_B + \gamma$

- Benchmark case - one period model
  - Long term (CLV) same as short term (ST)
  - Lower limit of firm 1’s price is $(1-z)$ and firm 2’s 0
  - Condition for positive likelihood of customer churn is, $(1 - z) > \gamma$
  - There is only mixed strategy equilibrium

\[
\begin{align*}
  &p_B &\quad &p_A \\
  &0 &\quad &1 - z - \gamma &\quad \gamma &\quad 1 - z &\quad 1
\end{align*}
\]
Further Research

- Asymmetries in the size of the players
- Heterogeneity in brand preference
- SC endogenized (e.g. as a function of discounts offered in the past)
- “jealousy” effects or customers behaving “strategically”
- Mix revenue and volume model
- New customers into the market