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Price Differentiation and Menu Costs in Credit Card Payments

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Market structure
(four-party scheme)

- Merchant
- Acquirer
- Consumer
- Issuer

- Merchant fee: $m$
- Interchange fee: $a$
- Consumer fee: $f$
- Price: $p$

Credit card scheme: set rules and act as switch and router
Main reference

• Rochet&Wright (JBF 2010) : “Credit card interchange fees”
  
  – “General tendency for merchants to adhere to the setting of a single price regardless of the form of payment.”
  
  – “Part of the reason for this is the no-surcharge rules adopted by the credit card systems.”
  
  – “If retailers were able and willing to discriminate based on the use of store credit, they maybe able to induce consumers to use credit cards and store credit efficiently.”
  
  – “One important direction for future research: to extend our model to allow retailers to offer different prices when consumers make use of store credit.”
Main aspects of R&W’s approach

• Model the **credit functionality** of a credit card: much of the existing literature treats payment card as debit card;

• Consider the **store credit** as a **competitor** of the credit card (in addition to cash);

• **Cardholders can not internalize retailers’ net avoided costs** from credit card usage (merchant fee minus cost of store credit);

• Model the **excessive usage** of credit cards: increase interchange fee can reduce consumers aggregated welfare;
Results under non surcharge rule
Rochet&Wright (JBF 2010)

• Single price equilibrium;

• Interchange fee is not neutral:
  – It affects card usage (real allocations);
  – There is an endogenous cap:
    • The monopoly card network raise it to increase credit card usage and maximize profit;
    • If sufficiently high, merchants do not adhere to the credit card system;
    • The cap value exceeds the level that maximizes consumer surplus;
Results under non surcharge rule
Rochet&Wright (JBF 2010)

• If regulators only care about consumer surplus:
  – A conservative regulatory approach is to cap interchange fees based on retailers’ net avoided costs from not having to provide credit themselves.
  – This always raises consumer surplus compared to the unregulated outcome, sometimes to the point of maximizing consumer surplus.
Consumer’s welfare under single price equilibrium
Methodology

• Three payment instruments: credit card, store credit and cash;

• Two types of purchases:
  – ordinary purchases (deterministic, using any of the three instruments)
  – extraordinary credit purchases (random, can not use cash);

• Two retailers dispute the market where consumers incur in transportation costs (Hotelling competition);

• Compute:
  – Consumers utilities;
  – Merchants market shares;
  – Merchants margins;
  – Merchants profits (margin x market share);

• Apply first order conditions to obtain equilibrium prices;
Model structure with price differentiation

\[ p^c = p^r + \Delta^c \]

\[ m = c_A + a \]

\[ f = c_I + \pi - a \]

\[ y \]

\[ c_S \]

\[ c_B \]

\[ x = \text{proportion of credit card owners} \]

\[ \text{store credit costs} \]

\[ \text{random with c.d.f. } H \]

\[ \gamma \]

\[ \text{product cost} \]

\[ \text{merchand fee} \]

\[ \text{interchange fee} \]

\[ \text{credit card costs} \]

\[ \text{profit margin} \]

\[ \text{Store credit} \]

\[ \text{Credit card} \]
Hotelling competition with transportation costs

Transportation costs

$S_1 \cdot t$

$S_2 \cdot t$

Consumer

Retailer 1

Retailer 2

Distances

$S_1$

$S_2$
Store credit random cost faced by consumers (ordinary purchases)

When credit card is not an option

When credit card is an option

with a cost

with a benefit

\[ CB \]

\[ 0 \]

\[ \text{cash} \]

\[ \text{store credit} \]

\[ CB \]

\[ 0 \]

\[ f + \Delta^c \]

\[ \text{cash} \]

\[ \text{store credit} \]

\[ CB \]

\[ 0 \]

\[ f + \Delta^c \]

\[ \text{credit card} \]

\[ \text{store credit} \]
Store credit random cost faced by consumers (extraordinary purchases)

When credit card is not an option

When credit card is an option
  with a cost
  with a benefit

\[ C_B \]

\[ \Delta c \]

\[ f \]

\[ H \text{ probability distribution} \]

store credit

credit card

store credit

store credit
Indicators of acceptance

• Does the **consumer** use of credit cards instead of cash at the retailers $i$?

$$L_c^i = \begin{cases} 
1 & \text{if credit card (or } f + \Delta_i^c \leq 0) \\
0 & \text{if cash}
\end{cases}$$

• Does the **retailer** $i$ adhere to the credit card system?

$$L_r^i = \begin{cases} 
1 & \text{if adhere system} \\
0 & \text{otherwise}
\end{cases}$$
Consumer’s expected utility

\[ U_i = u_0 + \theta u_1 - (1 + \theta) p_i^r - \int_{c_B}^{0} c_B . dH(c_B) - \theta . E(c_B) + x . L_i^r . S(a, \Delta^c_i) \]

where

\[ S(a, \Delta^c_i) := (L^c_i + \theta) \left( \int_{f + \Delta^c_i}^{c_B} (c_B - f - \Delta^c_i) . dH(c_B) \right) - L^c_i \int_{0}^{c_B} c_B . dH(c_B) \]

Utility of an ordinary purchases.
Cost of all purchases
Utility of extraordinary (credit) purchase with probability \( \theta \).
Cost of the store credit transactions (if \( x=0 \)).
Benefit from credit card transactions.
Cost savings from substituting store credit for credit card.
Indifferent consumer and retailers’ market shares

\[ U_1 - s_1 t = U_2 - s_2 t \]

\[ s_2 = 1 - s_1 \]
Retailer’s market share

\[(U_i - s_i.t) - (U_j - (1 - s_i).t) = 0\]

\[(1 + \theta) \left( p_j^r - p_i^r \right) + x \left( L_i^r \bar{S}(a, \Delta_i^c) - L_j^r \bar{S}(a, \Delta_j^c) \right) + t - 2.t.s_i = 0\]

\[s_i = \frac{1}{2} + (1 + \theta) \left( \frac{p_j^r - p_i^r}{2.t} \right) + x \left( \frac{L_i^r \bar{S}(a, \Delta_i^c) - L_j^r \bar{S}(a, \Delta_j^c)}{2.t} \right)\]

zero when in equilibrium
Retailer’s expected margin

\[ M_i = \left(1 + \theta\right)(p_i^r - \gamma) - \left(H(0) + \theta\right)c_S - xL_i^r\overline{\Gamma}(a, \Delta_i^c) \]

Revenue net of product cost.  
Cost of store credit transactions (if \( x = 0 \))  
Cost of credit card transactions

where

\[ \overline{\Gamma}(a, \Delta_i^c) := (1 + \theta)\left[1 - H(f + \Delta_i^c)\right]\left(m - \Delta_i^c - c_S\right) + \left[1 - H(0)\right]c_S \]

Cost of credit card transactions
Retailers’ profits

\[ \pi_i = S_i \cdot M_i \]
Equilibrium prices under price differentiation

\[
\overline{p}^r = \gamma + \left\{ t + \left( H(0) + \theta \right) c_s + x(1 - H(0)) c_s \right\} \frac{1}{(1 + \theta)}
\]

Use store credit when there is no cardholders.

Use the credit card instead of cash.

Subsidy to credit card users

\[
\overline{p}^c = \overline{p}^r + m - c_s
\]

Retailers avoided cost

\[
\overline{\Delta}^c
\]
Rochet&Wright’s single price

\[
\bar{p} = \gamma + \left\{ t + (H(0) + \theta)c_s - x(H(0) - H(\bar{f})).c_s + x(1 - H(\bar{f})).m \right\}.\frac{1}{1 + \theta}
\]

- Use store credit if there is not cardholders.
- Abandon the store credit to use the credit card.
- Use credit cards
Cross subsidies under price differentiation

1) Cash:

\[ \bar{p} = \gamma + \frac{t}{1 + \theta} + \left(1 - \frac{(1 - x)[1 - H(0)]}{1 + \theta}\right)c_s + x[1 - H(f)](m - c_s) \]

- Product cost
- Transportation Markup
- Subsidy paid

Eliminated with price differentiation

2) Store credit:

\[ \bar{p} = \gamma + \frac{t}{1 + \theta} + c_s - \frac{(1 - x)[1 - H(0)]}{1 + \theta}c_s + x[1 - H(f)](m - c_s) \]

- Store credit cost
- Subsidy received
- Subsidy paid

3) Credit card:

\[ \bar{p} = \gamma + \frac{t}{1 + \theta} + m - \frac{(1 - x)[1 - H(0)]}{1 + \theta}c_s - \{1 - x[1 - H(f)]\}(m - c_s) \]

- Merchant fee
- Subsidy received
- Subsidy received
Mean price under price differentiation

Single price

\[ \bar{p} = (1 - \alpha_0) \cdot \bar{p}^r + \alpha_0 \cdot \bar{p}^c \]

where \( \alpha_0 := x.\lfloor 1 - H(f) \rfloor \) is the proportion of credit card owners that, under no-surcharge rule, prefer credit cards.

But \( \alpha_\Delta = x.\lfloor 1 - H(f + \bar{\Delta}^c) \rfloor \) is the proportion of credit card owners that, under price differentiation, prefer credit cards.

Then \( \bar{\Delta}^c > 0 \implies \alpha_0 > \alpha_\Delta \) and \( \bar{p}^c > \bar{p}^r \)

\[ \bar{p} > (1 - \alpha_\Delta) \cdot \bar{p}^r + \alpha_\Delta \cdot \bar{p}^c \]

mean price under price differentiation
Consumers’ welfare under price differentiation
Results under price differentiation
Valli&Maldonado (WP 2013)

• Unilateral movement to unique price strategy:

Retailer 1

Retailer 2

Retailer 1

Retailer 2

credit cards

cash/store credit

credit cards

cash/store credit
## Retailers’ profits under price differentiation

<table>
<thead>
<tr>
<th>Retailers’ profits</th>
<th>Retailer 2</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Differential prices</strong></td>
<td><strong>Single price</strong></td>
</tr>
<tr>
<td>Retailer 1</td>
<td></td>
</tr>
<tr>
<td>Differential prices</td>
<td>$t/2 ; t/2$</td>
</tr>
<tr>
<td>Single price</td>
<td>$t/2 - \varepsilon (1-\varepsilon/2t) ; t/2 + \varepsilon/2$</td>
</tr>
</tbody>
</table>

\[
\varepsilon(a) := \frac{1}{2} x (1 + \theta) \int_{a}^{1-\delta-c_{B}-c} (-\delta - c_{B}) \, dH(c_{B})
\]

welfare gain of consumers and retailers from price differentiation equilibrium compared with the single price equilibrium
Margins with menu costs

\[ M_i^\mu := (1 + \theta)(p_i^r - \gamma) - (H(0) + \theta)c_S - x.L_i^r \bar{\Gamma}(a, \Delta_i^c) - \mu_i \cdot I(\Delta_i^c) \]

where \[ I(\Delta_i^c) := \begin{cases} 0 & \text{if } \Delta_i^c = 0 \\ 1 & \text{if } \Delta_i^c \neq 0 \end{cases} \]
Equilibrium prices under price differentiation with menu costs

\[
\bar{p}^{r,\mu}_1 = \bar{p}^r + \frac{1}{1+\theta}\left(\frac{2.\mu_1 + \mu_2}{3}\right) \\
\bar{p}^{r,\mu}_2 = \bar{p}^r + \frac{1}{1+\theta}\left(\frac{\mu_1 + 2.\mu_2}{3}\right)
\]

\[
\bar{p}^{c,\mu}_i = \bar{p}^{r,\mu}_i + \bar{\Delta}^c
\]

Sufficient conditions: \(\mu_1 \geq \mu_2\) \quad \(t \geq \frac{\mu_1 - \mu_2}{3}\) \quad \(\varepsilon(a) > \frac{\mu_1}{2}\)
# Retailers’ profits under price differentiation with menu costs

<table>
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<th>Retailers’ profits under price differentiation and menu costs</th>
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<tbody>
<tr>
<td><strong>Differential Prices</strong></td>
<td><strong>Single Price</strong></td>
</tr>
<tr>
<td>t/2 ((1-\alpha)^2); t/2 ((1+\alpha)^2)</td>
<td>t/2 ((1 - \alpha).(1 - \alpha+\beta_2)); t/2 ((1 + \alpha - \beta_2)^2)</td>
</tr>
<tr>
<td>t/2 ((1-\alpha-\beta_1)^2); t/2 ((1 + \alpha).(1+\alpha+\beta_1))</td>
<td>t/2 ((1+\beta_1)^2); t/2 ((1-\beta_1)^2)</td>
</tr>
<tr>
<td>t/2 ((1-\beta_2)); t/2 ((1+\beta_2)^2)</td>
<td>t/2 ; t/2</td>
</tr>
</tbody>
</table>

0 < \(\alpha := \frac{1}{t} \left( \frac{\mu_1 - \mu_2}{3} \right) \) < 1

0 < \(\beta_i(a) := \frac{1}{t} \left( \varepsilon(a) - \frac{\mu_i}{2} \right) \) < 1
Conclusions

• **Without menu costs:**
  
  – *Single price is not equilibrium*: there are incentives to decide unilaterally to surcharge card transactions;
  
  – *There is equilibrium with differential prices*: the equilibrium surcharge, or spread, is equal to the merchant fee minus the cost of the store credit ("retailer’s net avoided cost": $m - c_s$);
  
  – *The interchange fee becomes neutral*: does not affect card usage;
  
  – *Merchants are indifferent with respect the non-surcharge rule*: same profit with or without differentiation;
  
  – *Consumers obtain maximum welfare*: the welfare under differentiation is equal to the maximum utility under non-surcharge, independently of the interchange rate (neutral) ;
Conclusions

• With menu costs:

  – Interchange fee is **not neutral** anymore:
    • If low: single price equilibrium;
    • If high: differential prices equilibrium;
    • **Endogenous cap**: a high interchange fee can deviate merchants from the single price, limiting the market power of the credit card system (“excessive” usage of credit cards);

  – **Retailer with the highest (smallest) menu cost have a smaller (higher) profit** than under no-surcharge single price equilibrium;

  – **Card system** has a smaller profit, because the **volume of transactions decrease**;

  – **Consumers increase welfare** compared with non-surcharge single price equilibrium, despite the menu costs.
THE END

Thank you!!

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