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Price Differentiation and Menu Costs in Credit Card Payments

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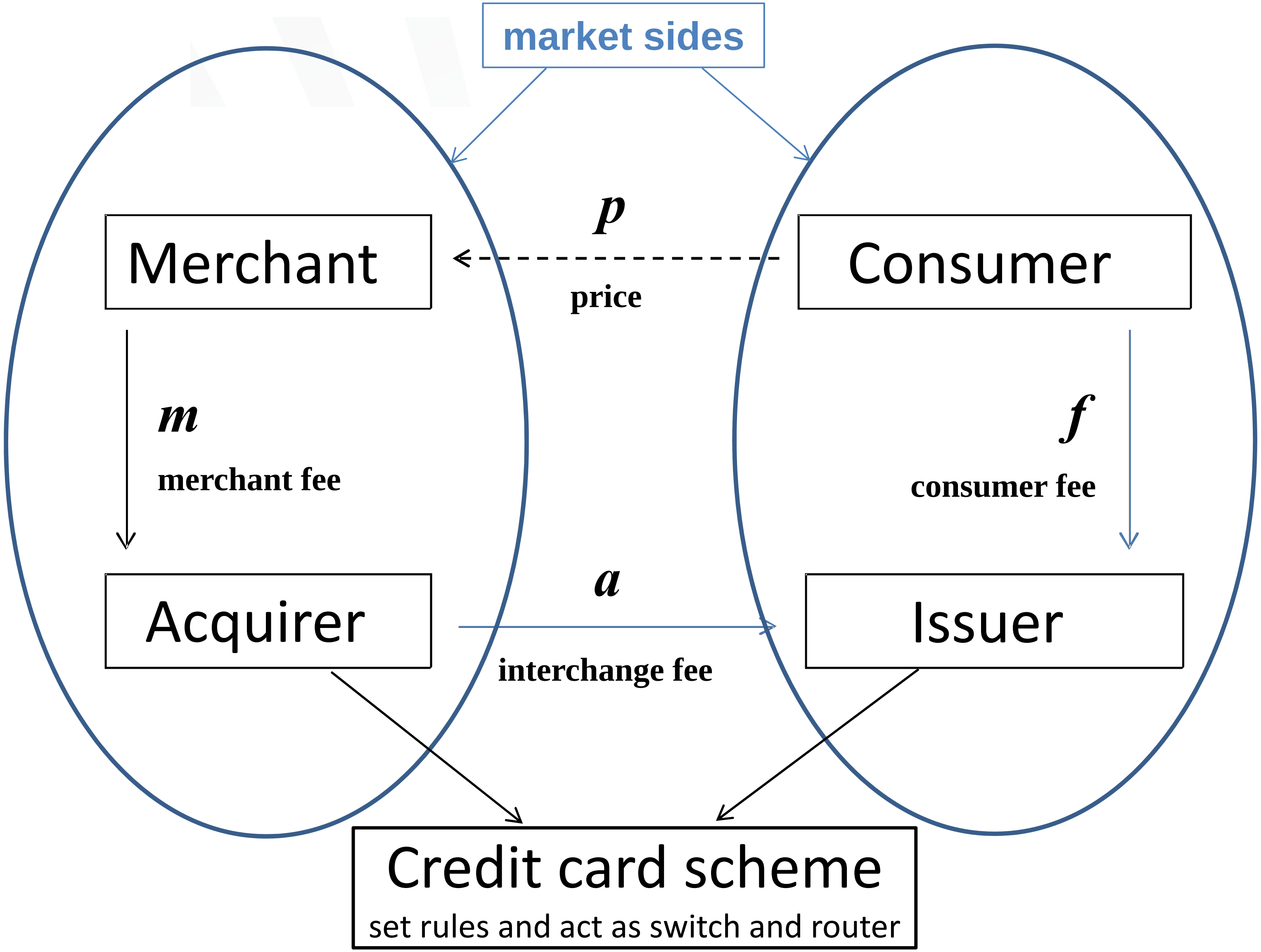
Market structure
(four-party scheme)



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;

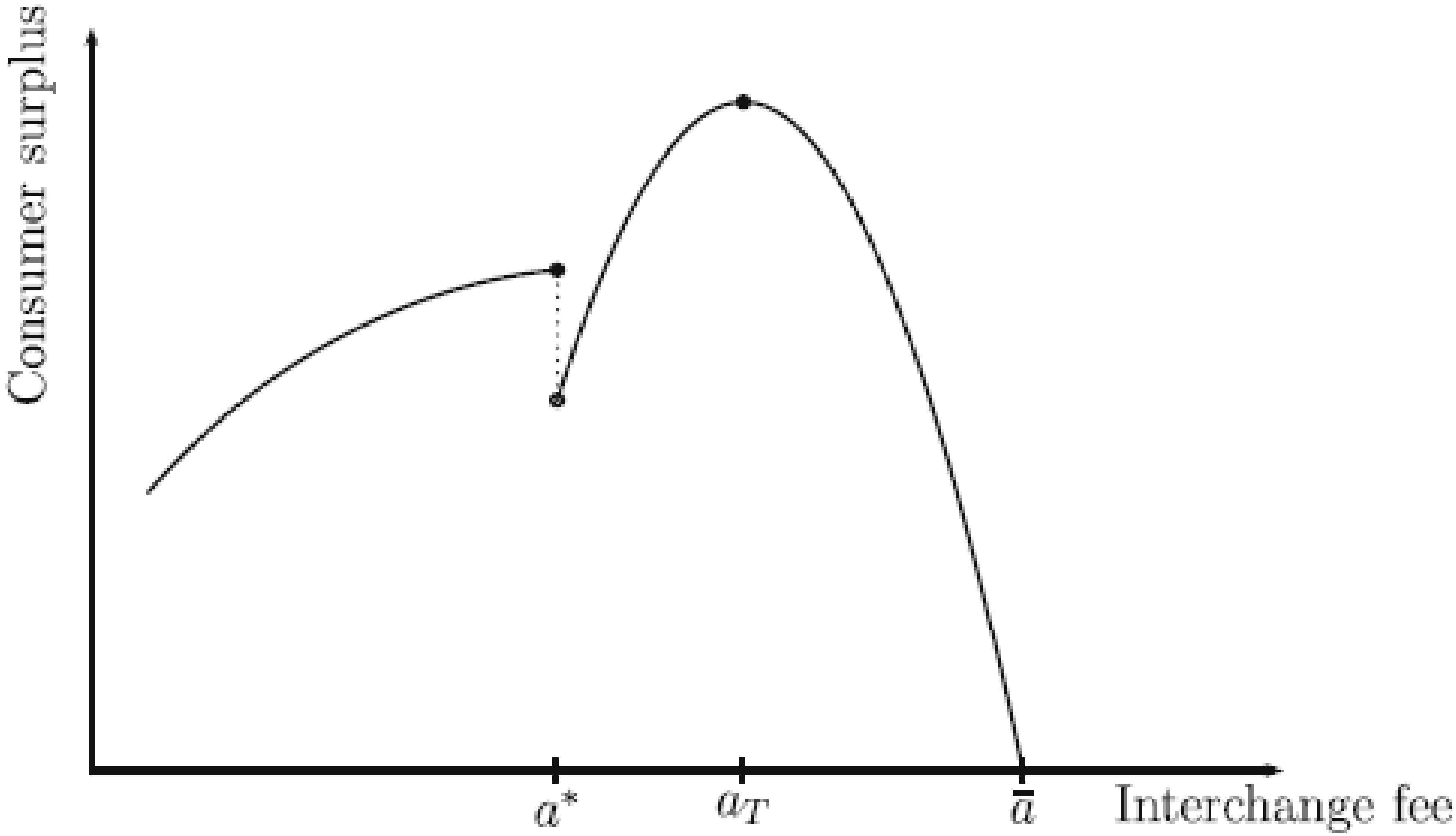
Results under non surcharge rule
Rochet&Wright (JBF 2010)

- 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.

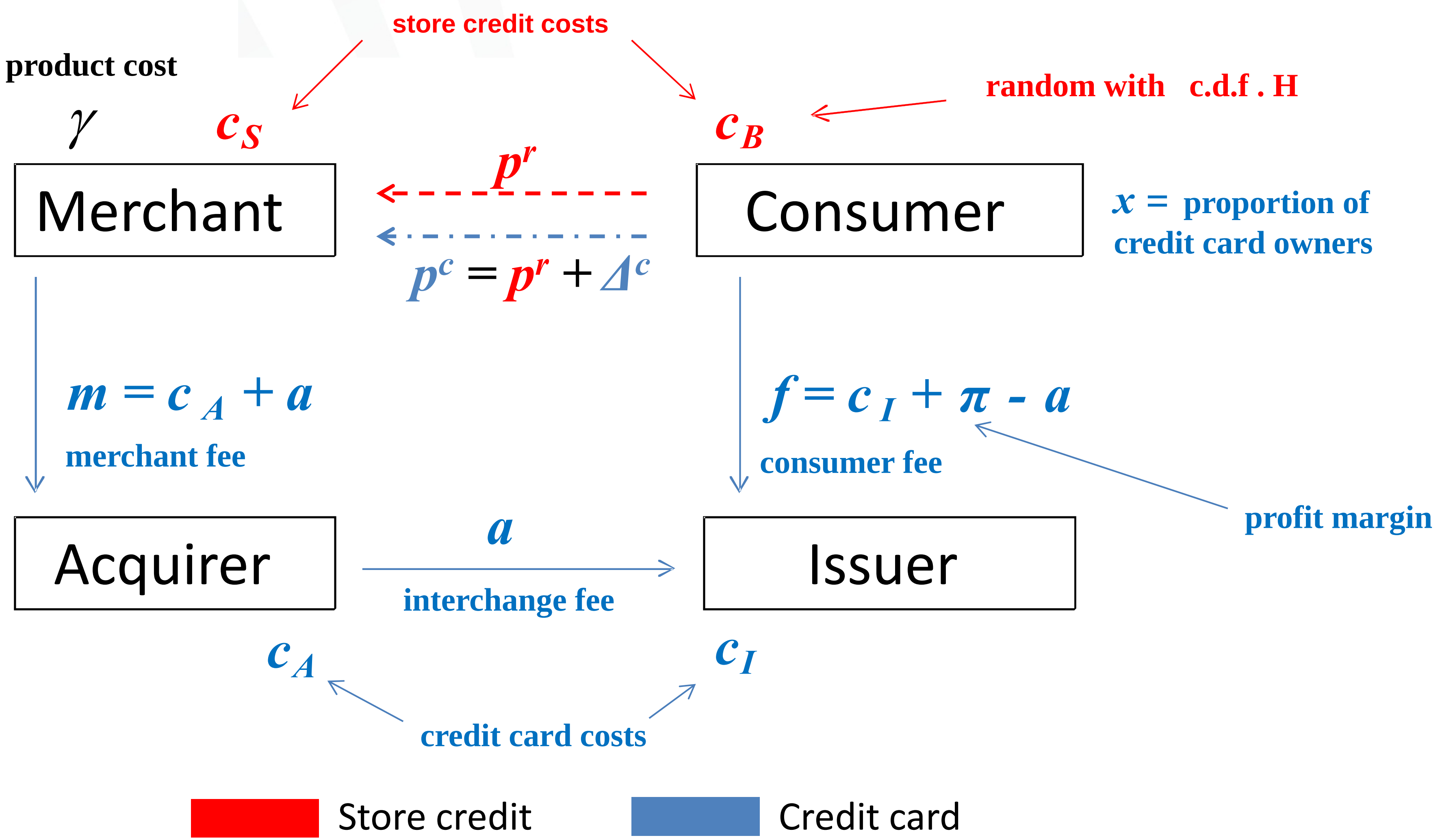
Consumer's welfare under single price equilibrium



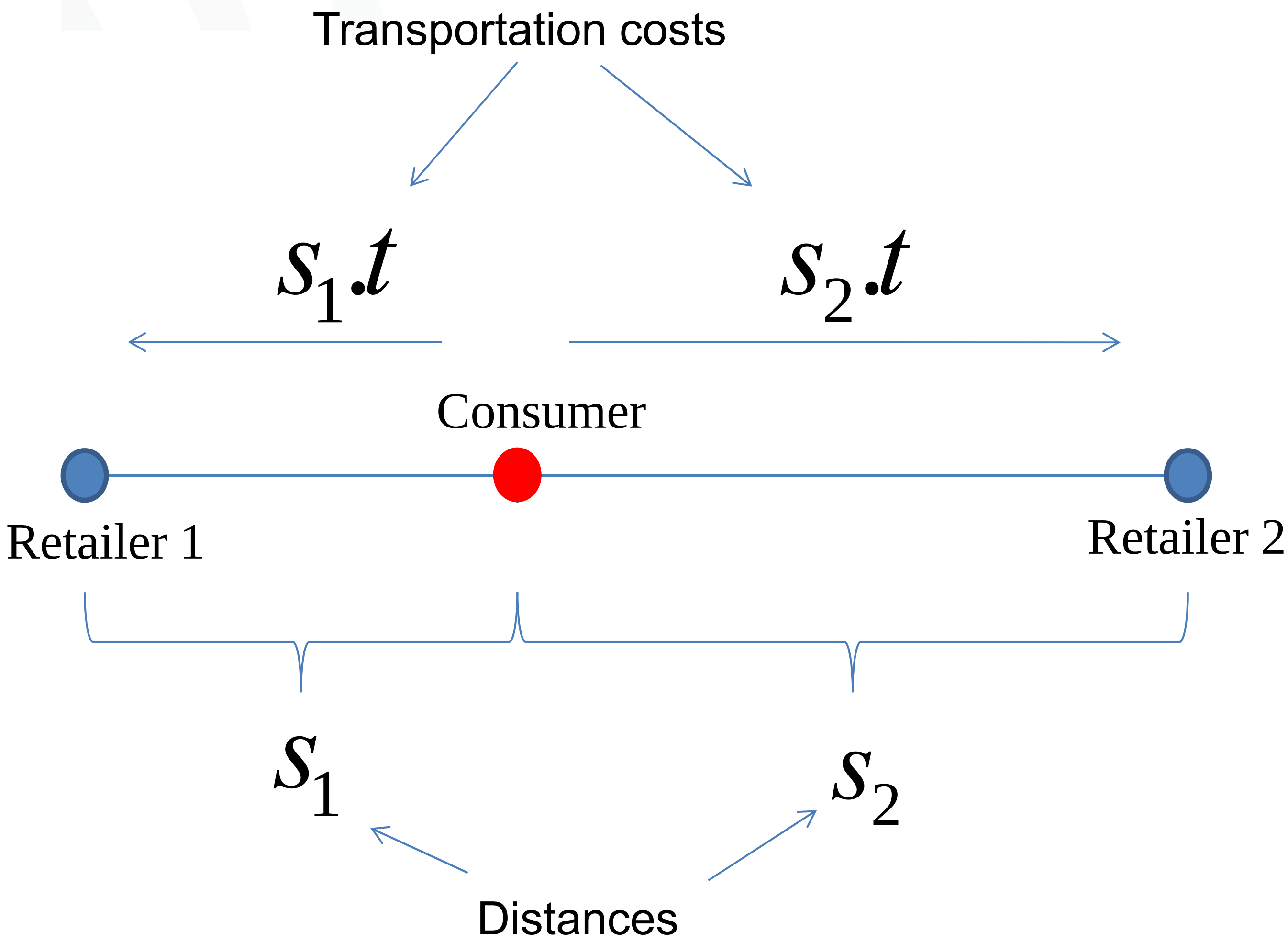
Methodology

- 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;

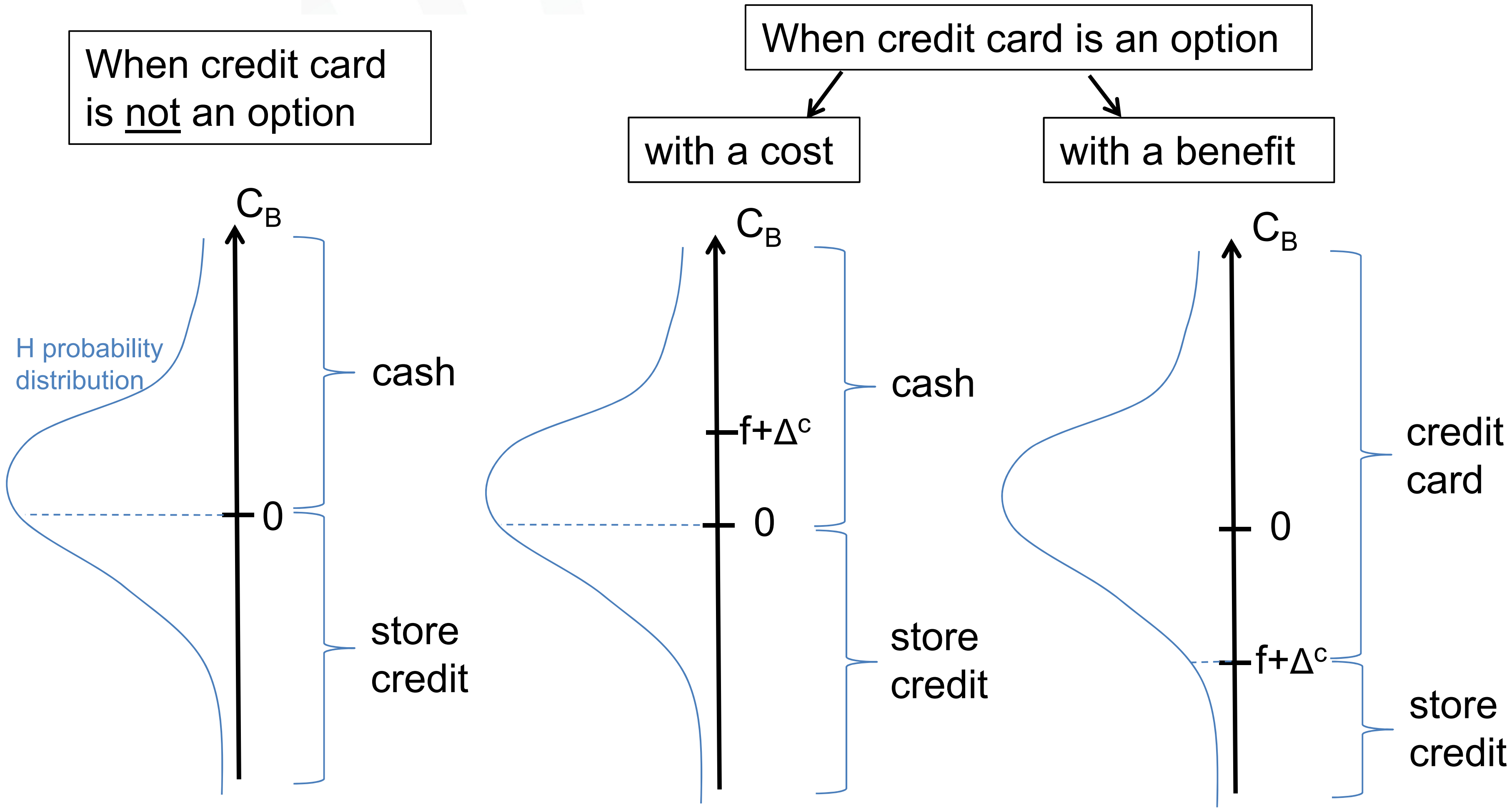
Model structure with price differentiation



Hotelling competition with transportation costs



Store credit random cost faced by consumers (<u>ordinary purchases</u>)



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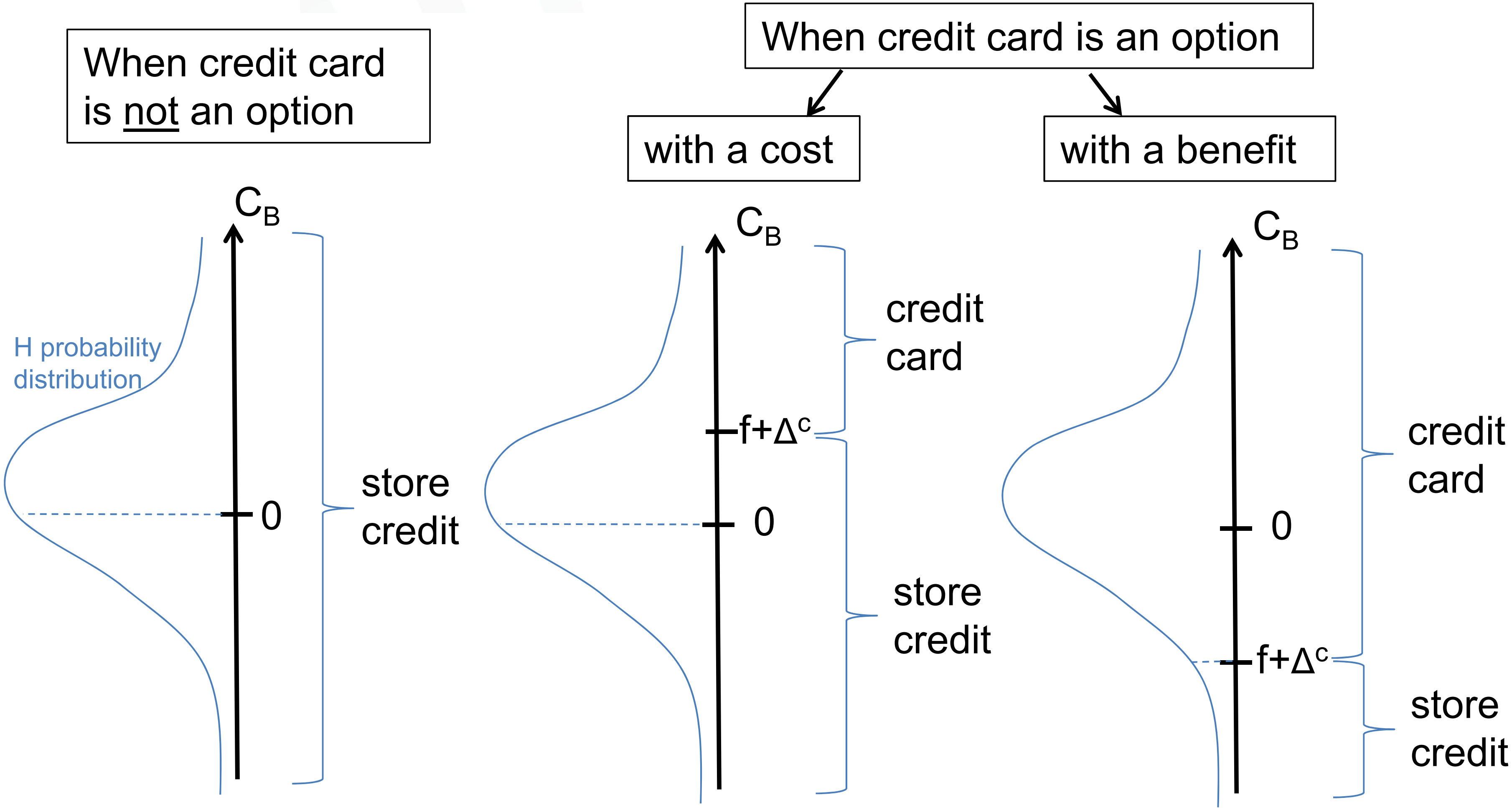


Indicators of acceptance

- Does the consumer use of credit cards instead of cash at the retailers $\boldsymbol{i}$?

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

- Does the retailer $\boldsymbol{i}$ adhere to the credit card system?

$$L_i^r = \begin{cases} 1 & \text{if adhere system} \\ 0 & \text{otherwise} \end{cases}$$

Consumer's expected utility

$$U_i = u_0 + \theta . u_1 - (1+\theta).p_i^r \underbrace{- \int_{\underline{c_B}}^{0} c_B . dH(c_B) - \theta . E(c_B)}_{\text{Cost of the store credit transactions (if } x=0\text{)}} + \underbrace{x . L_i^r . \overline{S}(a, \Delta_i^c)}_{\text{Benefit from credit card transactions}}$$

Utility of an ordinary purchases.

Utility of extraordinary (credit) purchase with probability θ.

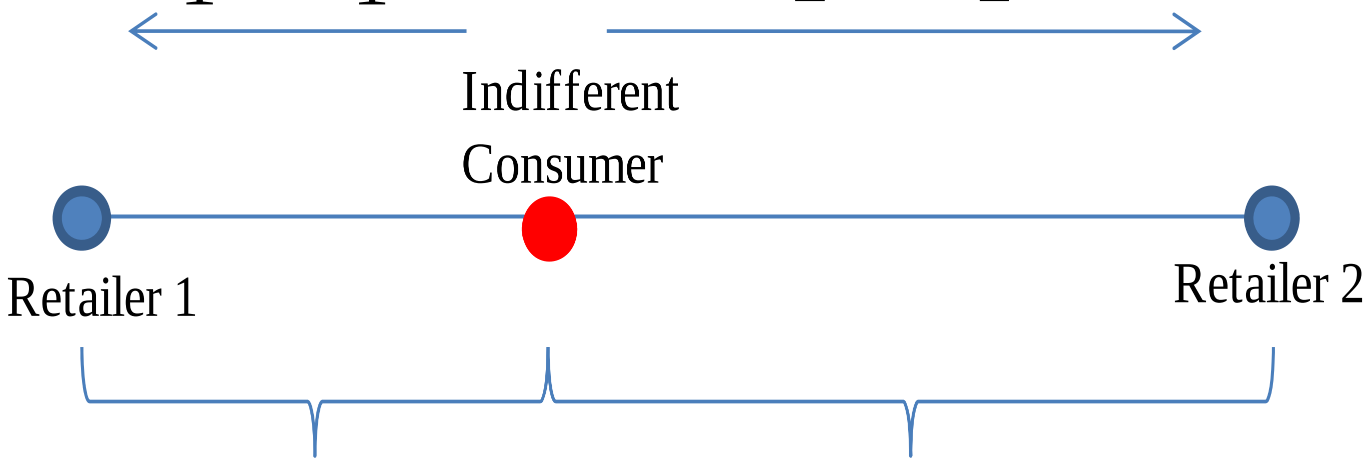
Cost of all purchases

where

$$\overline{S}(a, \Delta_i^c) := (L_i^c + \theta).\underbrace{\left(\int_{f+\Delta_i^c}^{\overline{c_B}} (c_B - f - \Delta_i^c).dH\left(c_B\right) \right)}_{\text{Cost savings from substituting store credit for credit card}} - L_i^c . \int_0^{\overline{c_B}} c_B . dH(c_B)$$

Indifferent consumer and retailers' market shares

$$U_1 - s_1.t \;=\; U_2 - s_2.t$$



$$s_1 \qquad\qquad s_2 = 1 - s_1$$

Retailer's market share

$$\left(U_i - s_i.t\right) - \left(U_j - (1-s_i).t\right) = 0$$

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

$$\boxed{s_i = \frac{1}{2} + \underbrace{(1+\theta).\left(\frac{p_j^r - p_i^r}{2.t}\right) + x.\left(\frac{L_i^r.\overline{S}(a,\Delta_i^c) - L_j^r.\overline{S}(a,\Delta_j^c)}{2.t}\right)}_{\text{zero when in equilibrium}}}$$

Retailer's expected margin

$$M_i = \underbrace{(1+\theta).(p_i^r - \gamma)}_{\substack{\text{Revenue} \\ \text{net of product cost.}}} - \underbrace{(H(0)+\theta).c_S}_{\substack{\text{Cost of store credit} \\ \text{transactions} \\ \text{(if } x=0\text{)}}} - \underbrace{x.L_i^r.\overline{\Gamma}(a,\Delta_i^c)}_{\substack{\text{Cost of credit card} \\ \text{transactions}}}$$

where

$$\overline{\Gamma}(a,\Delta_i^c) := (1+\theta).\left[1-H\left(f+\Delta_i^c\right)\right].\left(\underbrace{m-\Delta_i^c}_{\substack{\text{Cost of credit card} \\ \text{transactions}}} - c_S\right) + \left[1-H(0)\right].c_S$$

Retailers' profits

$$\pi_i = s_i . M_i$$

Equilibrium prices under price differentiation

$$\overline{p}^{r} = \gamma + \left\{ t + \underbrace{\left(H(0)+\theta\right)}_{\text{Use store credit when there is no cardholders.}}.c_S + \boxed{x.\underbrace{\left(1-H(0)\right)}_{\text{Use the credit card instead of cash.}}.c_S} \right\}.\frac{1}{\left(1+\theta\right)}$$

Subsidy to credit card users

$$\overline{p}^{c} = \overline{p}^{r} + \underbrace{m - c_S}_{\substack{\text{retailers avoided cost} \\ \overline{\Delta}^{c}}}$$

Rochet&Wright's single price

$$\overline{p} = \gamma + \left\{ t + \underbrace{\left(H(0) + \theta\right)}_{\text{Use store credit if there is not cardholders.}} . c_S - x . \underbrace{\left(H(0) - H(f)\right)}_{\text{Abandon the store credit to use the credit card.}} . c_S + x . \underbrace{\left(1 - H(f)\right)}_{\text{Use credit cards}} . m \right\} . \frac{1}{1+\theta}$$

Cross subsidies under price differentiation

1) Cash:

$$\bar{p} = \underbrace{\gamma}_{\text{Product cost}} + \underbrace{\frac{t}{1+\theta}}_{\text{Transportation Markup}} + \underbrace{\left(1 - \frac{(1-x).[1-H(0)]}{1+\theta}\right).c_S + \boxed{x.[1-H(f)].(m-c_S)}}_{\text{Subsidy paid}}$$

Eliminated with price differentiation

2) Store credit:

$$\bar{p} = \gamma + \frac{t}{1+\theta} + \underbrace{c_S}_{\text{Store credit cost}} - \underbrace{\frac{(1-x).[1-H(0)]}{1+\theta}.c_S}_{\text{Subsidy received}} + \underbrace{\boxed{x.[1-H(f)].(m-c_S)}}_{\text{Subsidy paid}}$$

3) Credit card:

$$\bar{p} = \gamma + \frac{t}{1+\theta} + \underbrace{m}_{\text{Merchant fee}} - \underbrace{\frac{(1-x).[1-H(0)]}{1+\theta}.c_S}_{\text{Subsidy received}} - \underbrace{\boxed{\{1-x.[1-H(f)]\}.(m-c_S)}}_{\text{Subsidy received}}$$

Mean price under price differentiation

Single price

$$\overline{p} = (1-\alpha_0).\overline{p}^r + \alpha_0 . \overline{p}^c$$

where $\alpha_0 := x.[1-H(f)]$ is the proportion of credit card owners that, <u>under no-surcharge rule</u>, prefer credit cards.

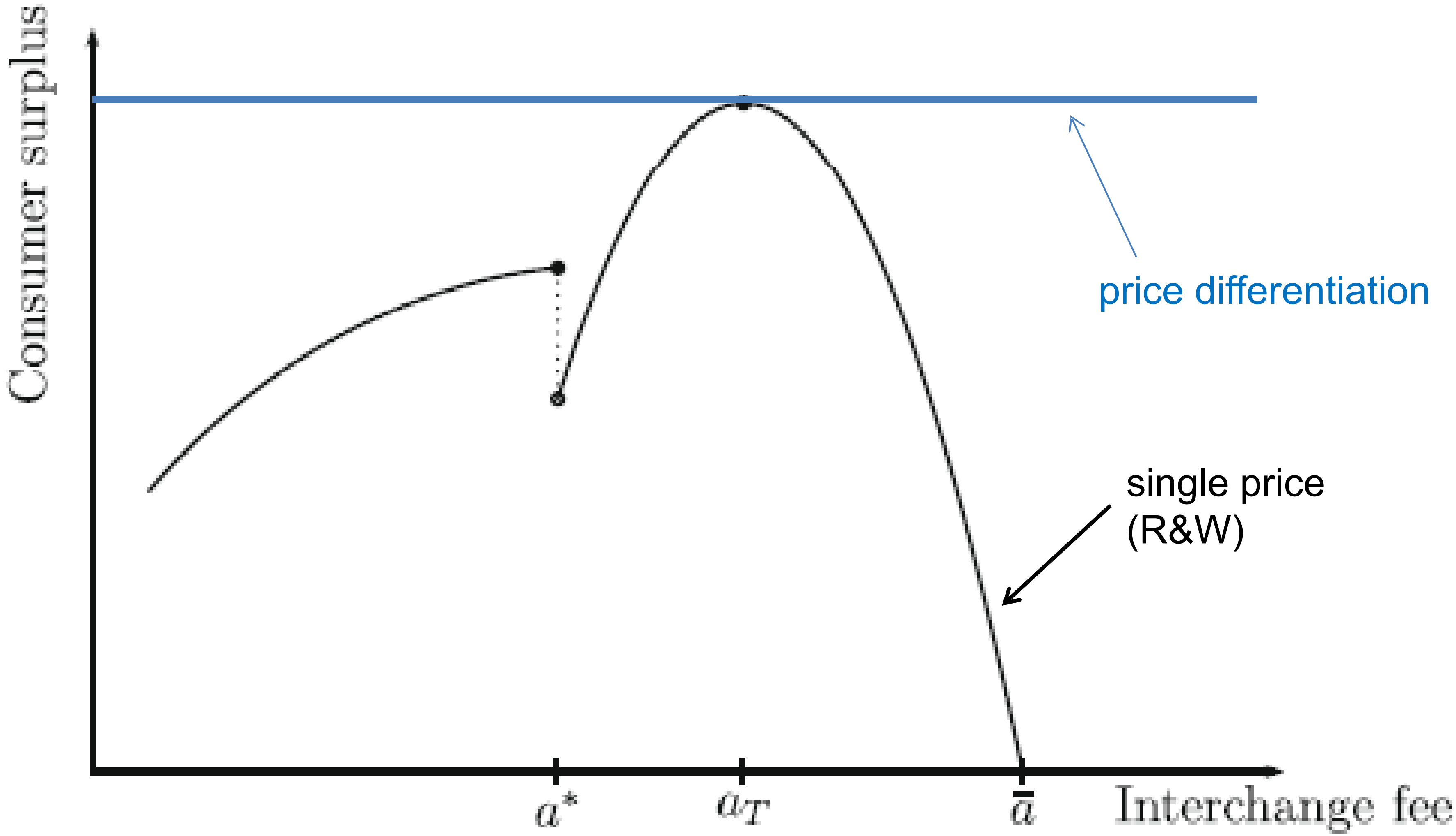
But $\alpha_\Delta = x.[1-H(f+\overline{\Delta}^c)]$ is the proportion of credit card owners that, <u>under price differentiation</u>, prefer credit cards.

Then $\overline{\Delta}^c > 0 \Rightarrow \alpha_0 > \alpha_\Delta$ and $\overline{p}^c > \overline{p}^r$

$$\Downarrow$$

$$\overline{p} > \underbrace{(1-\alpha_\Delta).\overline{p}^r + \alpha_\Delta . \overline{p}^c}_{\text{mean price under price differentiation}}$$

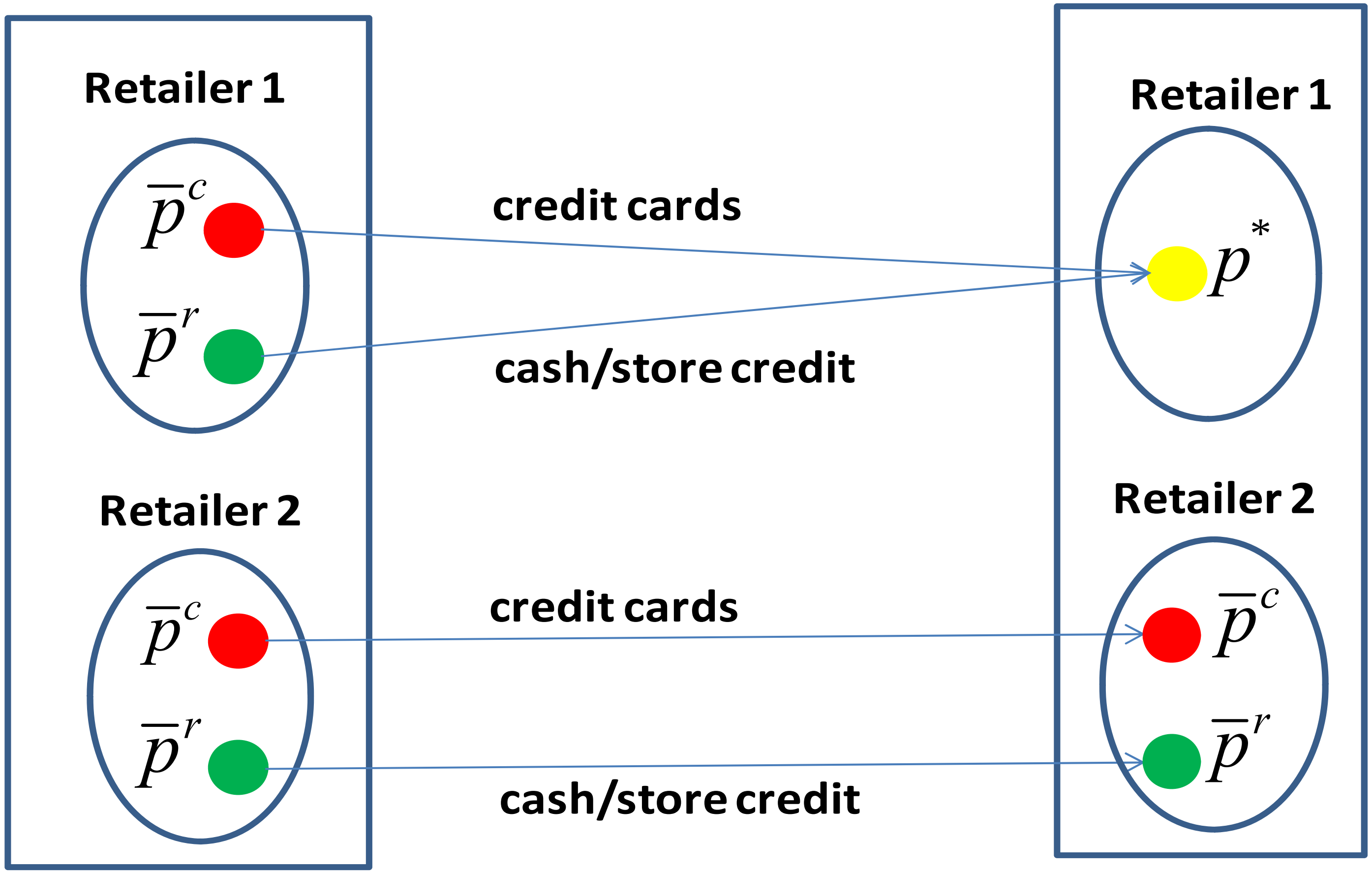
Consumers' welfare under price differentiation



Results under price differentiation

Valli&Maldonado (WP 2013)

- Unilateral movement to unique price strategy:



Retailers' profits under price differentiation

Retailers' profits		Retailer 2: Differential prices	Retailer 2: Single price
Retailer 1	Differential prices	***t/2 ; t/2***	*t/2 + ε/2 ;* ***t/2 – ε.(1–ε/2t)*** ***t/2 + ε.(1+ε/2t)*** *; t/2 – ε/2*
	Single price	***t/2 – ε.(1–ε/2t)*** *; t/2 + ε/2* *t/2 – ε/2 ;* ***t/2 + ε.(1+ε/2t)***	***t/2 ; t/2***

$$\varepsilon(a) := \frac{1}{2}\underbrace{.x.(1+\theta).\int_{-\delta+c_S-c_A-a}^{-\delta}(-\delta-c_B).dH(c_B)}_{\text{welfare gain of consumers and retailers from price differentiation equilibrium compared with the single price equilibrium}}$$

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

Margins with menu costs

$$M_i^{\mu} := (1+\theta).(p_i^r - \gamma) - (H(0)+\theta).c_S - x.L_i^r.\overline{\Gamma}(a,\Delta_i^c) - \underbrace{\mu_i.I(\Delta_i^c)}_{\text{menu cost}}$$

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

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

$$\overline{p}_i^{c,\mu} = \overline{p}_i^{r,\mu} + \overline{\Delta}^c$$

Sufficient conditions: $\mu_1 \geq \mu_2 \qquad t \geq \frac{\mu_1 - \mu_2}{3} \qquad \varepsilon(a) > \frac{\mu_1}{2}$

Retailers' profits under price differentiation with menu costs

Retailers' profits under price differentiation and menu costs		Retailer 2	
		Differential Prices	**Single Price**
Retailer 1	**Differential prices**	$\boldsymbol{t/2\,.(1-\alpha)^2\ ;\ t/2\,.\ (1+\alpha)^2}$	$t/2\ .\ (1-\alpha).(1-\alpha+\beta_2)$; $\boldsymbol{t/2\,.(1+\alpha-\beta_2)^2}$ $\boldsymbol{t/2\,.(1+\beta_1)^2}$; $t/2\ .(1-\beta_1)^2$
	Single price	$\boldsymbol{t/2\,.(1-\alpha-\beta_1)^2}$; $t/2\ .(1+\alpha).(1+\alpha+\beta_1)$ $t/2\ .(1-\beta_2)$; $\boldsymbol{t/2\,.(1+\beta_2)^2}$	$\boldsymbol{t/2\ ;\ t/2}$

$$0<\alpha:=\frac{1}{t}.\left(\frac{\mu_1-\mu_2}{3}\right)<1 \qquad 0<\beta_i(a):=\frac{1}{t}.\left(\varepsilon(a)-\frac{\mu_i}{2}\right)<1$$

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": $\boldsymbol{m - c_S}$);
  - **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 <u>not neutral</u> 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 <u>highest (smallest) menu cost</u> have a <u>smaller (higher) profit</u> than under no-surcharge single price equilibrium;**
  - **<u>Card system</u> has a <u>smaller profit</u>, because the <u>volume of transactions decrease</u>;**
  - **<u>Consumers increase welfare</u> compared with non-surcharge single price equilibrium, despite the menu costs.**

THE END

Thank you!!

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