Market Structure and Credit Card Pricing: What Drives the Interchange?

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  - Worldwide: EU, UK, Australia, Spain, Netherlands and etc.
- The controversy of interchange fees.
  - The fees merchant-acquiring banks pay to card-issuing banks for transactions between merchants and cardholders.
  - Set by four-party systems: Visa and MasterCard.
  - Totals $30 billion or $270 per US household (2005).

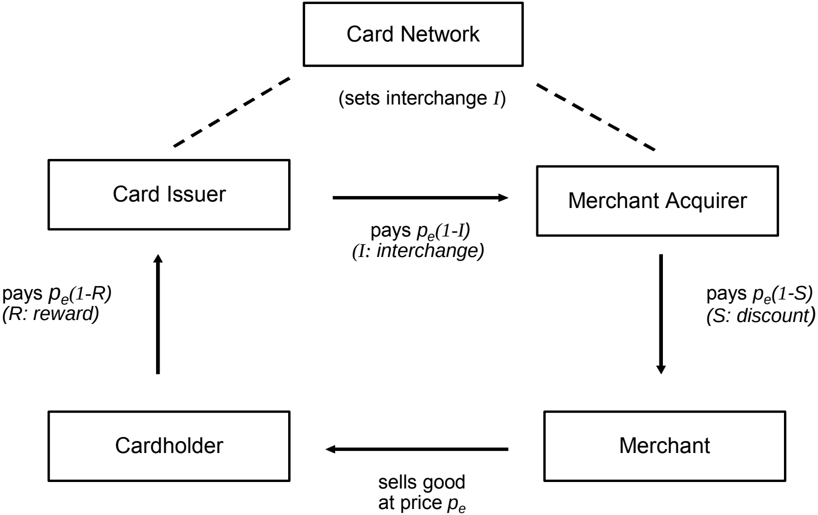


Figure: A Four-Party Credit Card System

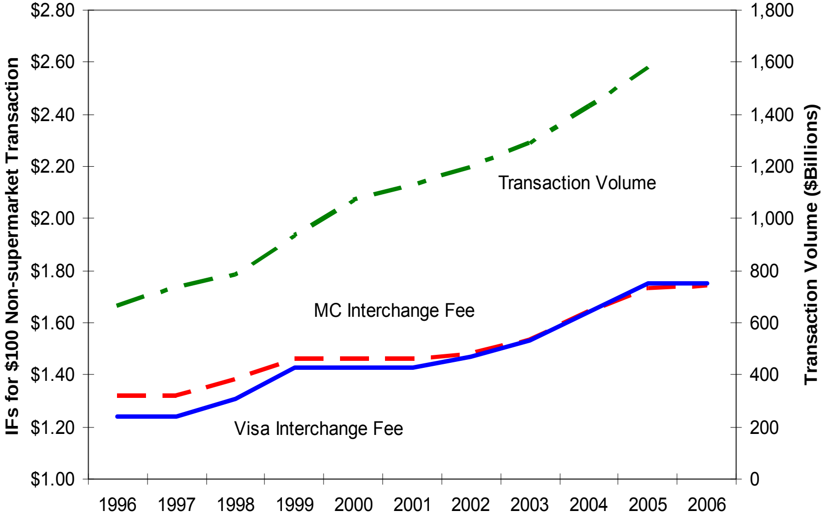
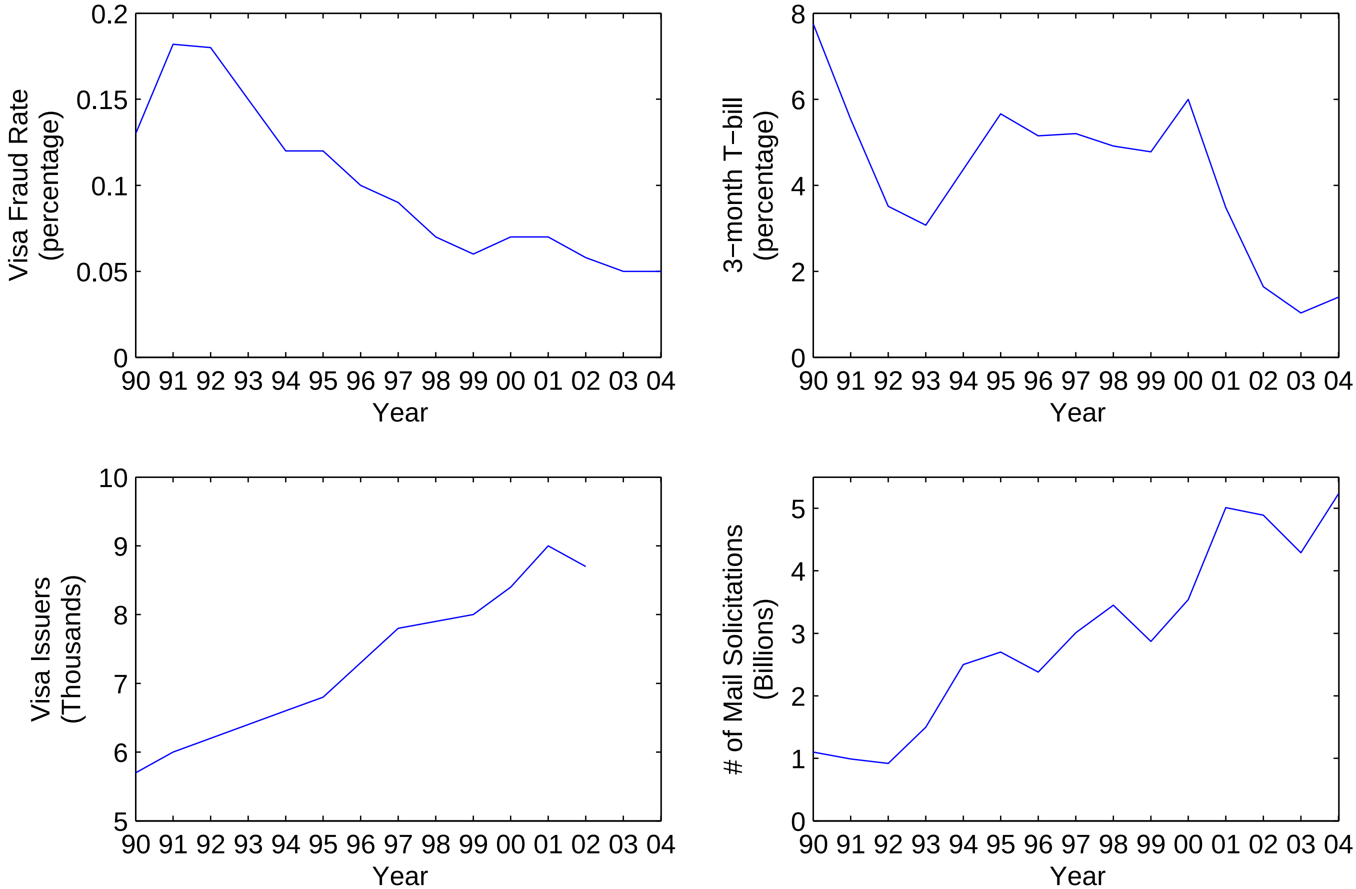


Figure: U.S. Credit Card Interchange Fees and Transaction Volume



Credit Card Industry Trends: Costs and Competition

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- Given the rising interchange fees, why can't merchants refuse accepting cards? Why has card transaction volume been growing rapidly?
- What are the causes and consequences of the increasing consumer card reward?
- What can government intervention do in the credit card industry? Is there a socially optimal card pricing?

Literature

- *For interchange:*
  – Schmalensee (2002), Rochet and Tirole (2002), Wright (2004): Interchange fees increase the value of two-sided payment systems by shifting costs between issuers (consumers) and acquirers (merchants). The profit and welfare maximizing fee likely coincide.

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- *Against interchange:*
  – Carlton and Frankel (1995), Katz (2001), Frankel (2006): Although the collective determination of interchange fees help reducing costly bargaining between individual issuers and acquirers, there are potential anti-competitive effects.

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  – Competing payment instruments, e.g., cards vs. alternatives;

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  – Oligopolistic card networks that set profit-maximizing interchange fees;

  – Competitive card issuers that join the most profitable network and compete with one another via consumer rewards.

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- New findings:

  – Collusive card networks demand higher interchange fees as card payment become more efficient;

  – At equilibrium, consumer reward and card transaction volume also increase, while consumer surplus does not.

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- A cash store charges p_a, while a card store charges p_e:

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- The condition $p_a \le p_e$ ensures card stores do not incur losses in case someone use cash there, so that

$$S \ge \tau_{m,a} - \tau_{m,e};$$

Moreover, a meaningful pricing requires

$$1 - \tau_{m,e} > S.$$

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- Using cash costs consumers $\tau_{c,a}$ per dollar, while using card costs $\tau_{c,e}$ but receives a reward R from issuers. Therefore, card consumers do not shop cash stores if and only if

$$(1+\tau_{c,a})p_a \geqslant (1+\tau_{c,e}-R)\ p_e \iff \frac{1+\tau_{c,a}}{1-\tau_{m,a}} \geqslant \frac{1+\tau_{c,e}-R}{1-\tau_{m,e}-S}\ .$$

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- Given $p_a \leq\ p_e$, cash consumers prefer shopping cash stores and card consumers have no incentive to use cash in card stores.
- When making a purchase decision, card consumers face the after-reward price

$$p_r = (1+\tau_{c,e}-R)p_e = \frac{(1+\tau_{c,e}-R)k}{1-\tau_{m,e}-S},$$

and have the total demand for card transaction volume TD:

$$TD = p_e D(p_r) = \frac{k}{1-\tau_{m,e}-S} D[\frac{(1+\tau_{c,e}-R)k}{1-\tau_{m,e}-S}].$$

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- Acquiring incurs a constant cost C for each dollar of transaction.
- For simplicity, we normalize $C = 0$ so acquirers play no role in our analysis but pass through merchant discounts as interchange fees to the merchants, i.e., $S = I$.

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- Issuers pay the card network a processing fee T per dollar of transaction and a share c of their profits.

Issuers (continued):

- Issuer α's profit π_α (before sharing with the network):

$$\pi_\alpha = \underset{V_\alpha}{Max}(I - R - T)V_\alpha - \frac{V_\alpha^\beta}{\alpha} - K =>$$

$$V_\alpha = \left(\frac{\alpha(I - R - T)}{\beta}\right)^{\frac{1}{\beta-1}}; \;\; \pi_\alpha = \frac{\beta - 1}{\beta}\left(\frac{\alpha}{\beta}\right)^{\frac{1}{\beta-1}}(I - R - T)^{\frac{\beta}{\beta-1}} - K.$$

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- Free entry condition requires that the marginal issuer α^* breaks even, hence

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- Therefore, the total number of issuers is

$$N = \int_{\alpha^*}^{\infty} g(\alpha)d\alpha$$

and the total supply of card transaction volume is

$$TV = \int_{\alpha^*}^{\infty} V_\alpha g(\alpha)d\alpha = \int_{\alpha^*}^{\infty} [(\frac{I - R - T}{\beta})\alpha]^{\frac{1}{\beta-1}} g(\alpha)d\alpha.$$

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- As a result, the card network would like to set the interchange fee I to maximize its profit

$$\Omega = c \int_{\alpha^*}^{\infty} \pi_\alpha g(\alpha) d\alpha - E,$$

which also maximizes the total profits of its member issuers.

Monopoly Network's Problem

$$\underset{I}{Max} \quad \Omega^m = c\int_{\alpha^*}^{\infty} \pi_\alpha g(\alpha) d\alpha - E \qquad \text{(Card Network Profit)}$$

$$s.t. \qquad \pi_\alpha = (\frac{\beta-1}{\beta})(\frac{\alpha}{\beta})^{\frac{1}{\beta-1}}(I-R-T)^{\frac{\beta}{\beta-1}} - K, \qquad \text{(Profit of Issuer } \alpha\text{)}$$

$$\alpha^* = \beta K^{\beta-1}(\frac{\beta}{\beta-1})^{\beta-1}(I-R-T)^{-\beta}, \qquad \text{(Marginal Issuer } \alpha^*\text{)}$$

$$N = \int_{\alpha^*}^{\infty} g(\alpha) d\alpha, \qquad \text{(Number of Issuers)}$$

$$\frac{1+\tau_{c,a}}{1-\tau_{m,a}} \geqslant \frac{1+\tau_{c,e}-R}{1-\tau_{m,e}-I}, \qquad \text{(API Constraint)}$$

$$1-\tau_{m,e} > I \geq \tau_{m,a} - \tau_{m,e}, \qquad \text{(Pricing Constraint)}$$

$$TV = \int_{\alpha^*}^{\infty} V_\alpha g(\alpha) d\alpha = \int_{\alpha^*}^{\infty} [(\frac{I-R-T}{\beta})\alpha]^{\frac{1}{\beta-1}} g(\alpha) d\alpha, \qquad \text{(Total Card Supply)}$$

$$TD = \frac{k}{1-\tau_{m,e}-I} D(\frac{k}{1-\tau_{m,e}-I}(1+\tau_{c,e}-R)), \qquad \text{(Total Card Demand)}$$

$$TV = TD. \qquad \text{(CMC Condition)}$$

API: Alternative Payment Instruments; CMC: Card Market Clearing.

Monopoly network:

- Assume α follows a Pareto distribution so that $g(\alpha) = \gamma L^{\gamma}/(\alpha^{\gamma+1})$, where $\gamma > 1$ and $\beta\gamma > 1 + \gamma$.

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- The monopoly maximization problem can be rewritten as

$$\underset{I}{Max} \;\; \Omega^m = A(I - R - T)^{\beta\gamma} - E \qquad \text{(Network Profit)}$$

$$s.t. \;\; B(I - R - T)^{\beta\gamma - 1} = (1 - \tau_{m,e} - I)^{\varepsilon - 1}(1 + \tau_{c,e} - R)^{-\varepsilon}, \qquad \text{(CMC)}$$

$$\frac{1 + \tau_{c,a}}{1 - \tau_{m,a}} \geqslant \frac{1 + \tau_{c,e} - R}{1 - \tau_{m,e} - I}. \qquad \text{(API)}$$

A, B are functions of parameters.

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- Two scenarios:
  – elastic demand ($\varepsilon > 1$) and inelastic demand ($\varepsilon \leq 1$).

Monopoly network (Continued):

- Elastic demand ($\varepsilon \geqslant \frac{1+\tau_{c,a}}{\tau_{c,a}+\tau_{m,a}} > 1$):

$$\frac{1+\tau_{c,e}+Z-I}{1-\tau_{m,e}-I} = \frac{\varepsilon}{\varepsilon-1}, \tag{FOC}$$

$$B(Z-T)^{\beta\gamma-1} = (1-\tau_{m,e}-I)^{\varepsilon-1}(1+\tau_{c,e}+Z-I)^{-\varepsilon}. \tag{CMC}$$

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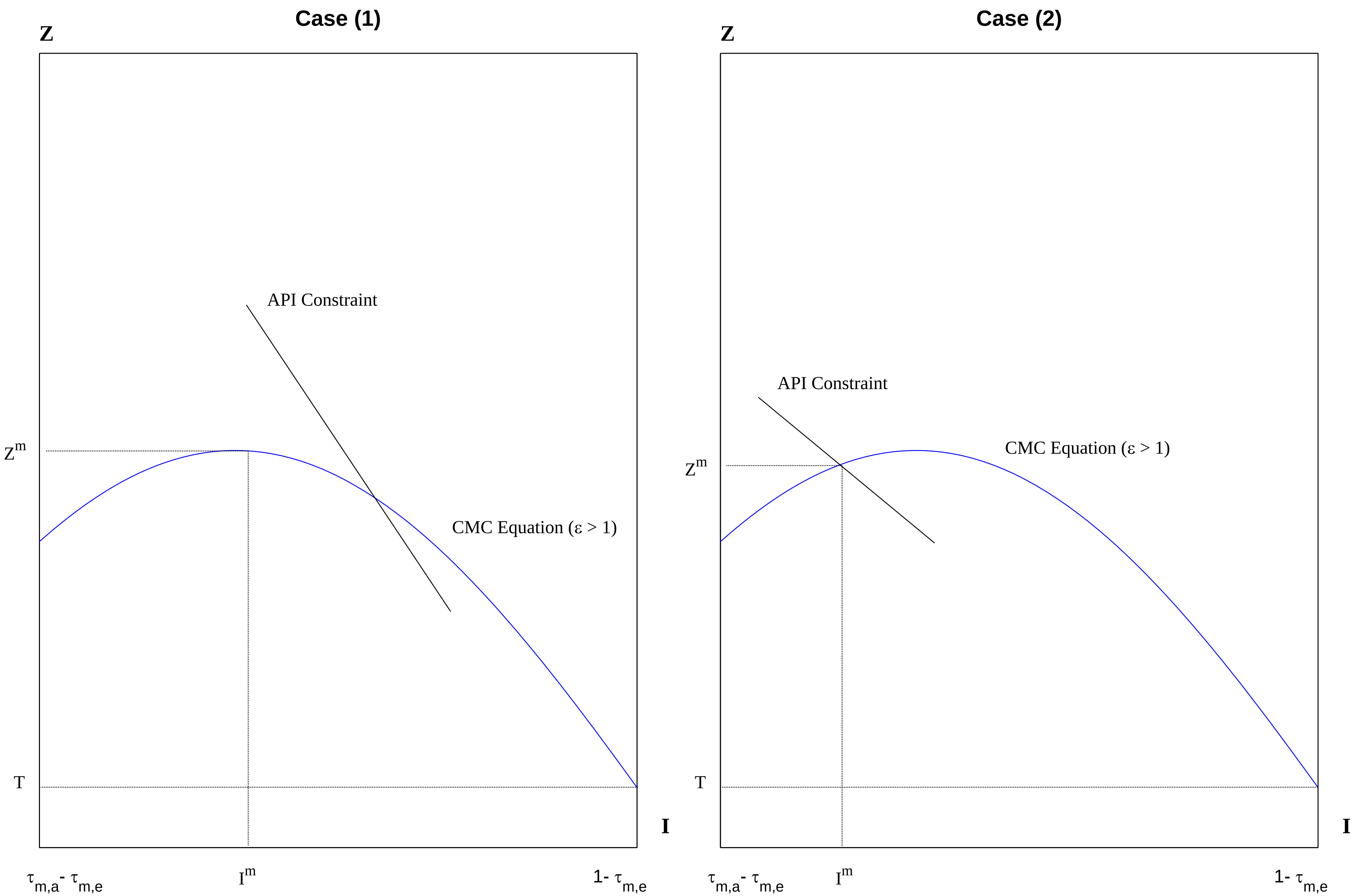
- Elastic $\left(\frac{1+\tau_{c,a}}{\tau_{c,a}+\tau_{m,a}} > \varepsilon > 1\right)$ or inelastic $(\varepsilon \leq 1)$ demand :

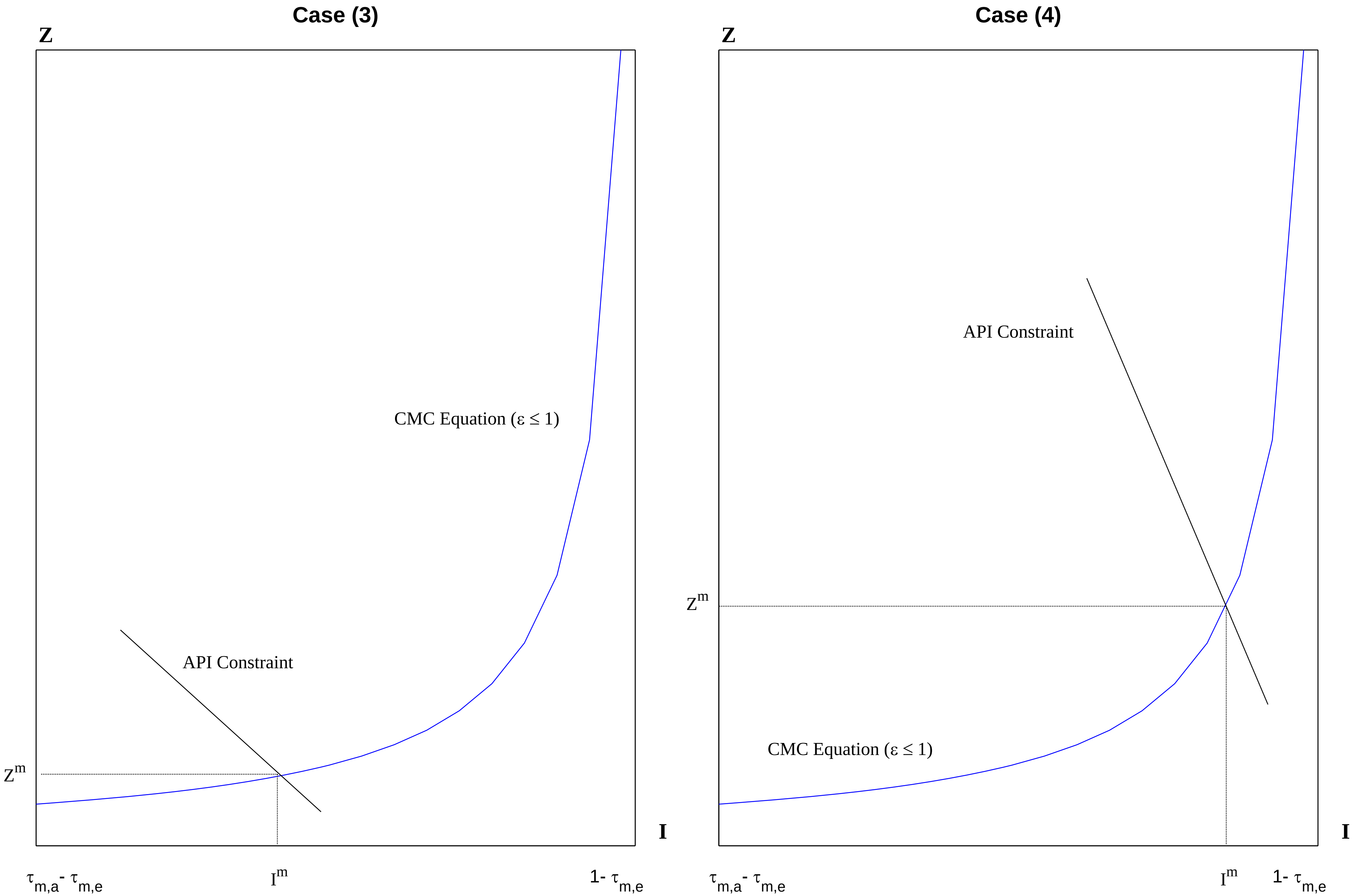
$$\frac{1+\tau_{c,a}}{1-\tau_{m,a}} = \frac{1+\tau_{c,e}+Z-I}{1-\tau_{m,e}-I}, \tag{API}$$

$$B(Z-T)^{\beta\gamma-1} = (1-\tau_{m,e}-I)^{\varepsilon-1}(1+\tau_{c,e}+Z-I)^{-\varepsilon}. \tag{CMC}$$

Monopoly Interchange Pricing: Elastic Demand



Monopoly Interchange Pricing: Inelastic Demand



Endogenous Industry Variables

$$R = I - Z;$$

$$\pi_\alpha = \left(\frac{\beta-1}{\beta}\right)\left(\frac{\alpha}{\beta}\right)^{\frac{1}{\beta-1}}(Z-T)^{\frac{\beta}{\beta-1}} - K;$$

$$V_\alpha = \left(\frac{\alpha}{\beta}(Z-T)\right)^{\frac{1}{\beta-1}};$$

$$\alpha^* = \beta\left(\frac{\beta K}{\beta-1}\right)^{\beta-1}(Z-T)^{-\beta};$$

$$N = \int_{\alpha^*}^{\infty} g(\alpha)d\alpha = \left(\frac{L}{\alpha^*}\right)^{\gamma};$$

$$\Omega^m = A(Z-T)^{\beta\gamma} - E;$$

$$TV = B(Z-T)^{\beta\gamma-1}k^{1-\varepsilon};$$

$$p_e = \frac{k}{1-\tau_{m,e}-I};$$

$$p_r = \frac{(1+\tau_{c,e}+Z-I)}{(1-\tau_{m,e}-I)}k;$$

$$D = \eta p_r^{-\varepsilon};$$

$$A = \left(\frac{K\beta}{\beta-1}\right)^{(1-\beta)\gamma}\frac{cKL^{\gamma}\beta^{-\gamma}}{\beta\gamma-\gamma-1};$$

$$B = \frac{L^{\gamma}\beta^{-\gamma}k^{\varepsilon-1}}{\eta}\left(\frac{\beta\gamma-\gamma}{\beta\gamma-\gamma-1}\right)\left(\frac{K\beta}{\beta-1}\right)^{1+\gamma-\beta\gamma}.$$

Equilibrium Industry Dynamics under a Monopoly Network

	I Interchange fee	**R** Consumer reward	**Z** Net card price	**π_α** Issuer α profit	**V_α** Issuer α volume	**N** Number of issuers	**Ω** Network profit	**TV** Network volume	**P_e** Retail price	**P_r** After-reward price	**D** Card user's consumption
$\tau_{m,e}$ merchant card cost	–	–	–	–	–	–	–	–	–	0	0
$\tau_{c,e}$ consumer card cost	–	±	–	–	–	–	–	–	–	0	0
T network card cost	–	–	+	–	–	–	–	–	–	0	0
K issuer entry cost	–	–	+	±	+	–	+	–	–	0	0

Equilibrium Industry Dynamics under a Monopoly Network (continued)

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					$\varepsilon \geq (1+\tau_{c,a})/(\tau_{c,a}+\tau_{m,e}) > 1$						
$\tau_{m,a}$ merchand cash cost	0	0	0	0	0	0	0	0	0	0	0
$\tau_{c,a}$ consumer cash cost	0	0	0	0	0	0	0	0	0	0	0
					$(1+\tau_{c,a})/(\tau_{c,a}+\tau_{m,e}) > \varepsilon \geq 0$						
$\tau_{m,a}$ merchand cash cost	+	±	+	+	+	+	+	+	+	+	−
$\tau_{c,a}$ consumer cash cost	+	±	+	+	+	+	+	+	+	+	−

Monopoly Network: What do we learn?

- Why have interchange fees been increasing?
  – Under a monopoly card network, equilibrium interchange fees increase as card payments become more efficient (a lower $\tau_{m,e}$, $\tau_{c,e}$ or T) or the issuers' mkt becomes more competitive (a lower K). Technology change and enhanced competition drive up consumer reward and card transaction volume, but not consumer welfare.

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- Why can't merchants refuse cards?
  – As card payment becomes increasingly more efficient than alternatives, card networks can afford charging higher interchange fees but still keep cards a competitive payment service to merchants.
- Why are interchange lower for lower-fraud transactions?
  – Although it seems to contradict the fact that interchange fees increase as fraud costs decrease over time, the answer lies on the different API (alternative payment instrument) constraints that card networks face in different environments.

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- A useful theoretical result:

  – Proposition: Anything else being equal, a lower interchange fee results a lower after-reward price: $\partial p_r / \partial I > 0$.

Duopoly Networks (Continued)

- Each network's objective:

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- The payoffs (i, j) for the stage game:

i

	Payoffs	collude	defect
j	collude	$\frac{\Omega^m - E}{2}, \frac{\Omega^m - E}{2}$	$\Omega^m, -E$
	defect	$-E, \Omega^m$	$0, 0$

Duopoly Networks (Continued)

- Consider the following symmetric strategies, also known as Forgiving Trigger (FT):

1. Phase A: set interchange fee at the monopoly level I^m and switch to Phase B;
2. Phase B: set interchange fee at I^m unless some player has deviated from I^m in the previous period, in which case switch to Phase C and set $\tau = 0$;
3. Phase C: if $\tau \leq n$, set $\tau = \tau + 1$ and charge the interchange fee at the punishment level I^p that $\Omega^i(I^p, I^p) = 0$, otherwise switch to Phase A.

Duopoly Networks (Continued)

- One-shot deviation property

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- As the length of punishment increases, the lower bound on δ decreases, and as $n\rightarrow\infty$, the bound converges to $(\Omega^m(I^m)+E)/(2\Omega^m(I^m))$. which is the harshest punishment, also known as Grim Trigger (GT).

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- The assumption of infinite horizon is crucial. It is known that collusion cannot be sustained even for a long but finite horizon due to backward induction. However, this requires no more than that at each period there is a probability θ in $(0, 1)$ that the market survives.
- An infinitely repeated game may have multiple equilibriums, as suggested by Folk Theorems. Naturally, we assume the two networks coordinate on a Pareto-optimal equilibrium, that is the monopoly outcome. In addition, we choose a symmetric equilibrium given the symmetric nature of the game.

Top Eight Credit Card Issuers in 2004

	Visa		MasterCard	
Issuers	Rank	# Cards (M)	Rank	# Cards (M)
JP Morgan Chase	2	48.1	2	39.9
Citigroup	3	28.9	1	75.1
MBNA	5	24.4	3	32.3
Bank of America	1	58.1	8	3.1
Capital One	4	26.9	4	26.7
HSBC	7	10.3	5	24.4
Providen	8	10.1	11	2.5
Wells Fargo	10	7.1	9	2.8

Visa and MasterCard Comparison 2004

	VISA	MASTERCARD	TOTAL
Merchants(M)	4.6	4.6	4.6
Outlets(M)	5.7	5.6	5.7
Cardholders(M)	96.2	96.3	118.5
Cards(M)	295.3	271.5	566.8
Accounts(M)	215.5	217.6	433.1
Active Accts (M)	115.2	120.1	235.3
Transactions (M)	7,286.8	5286.2	12573.0
Total Volume ($B)	722.2	546.7	1268.9
Outstandings ($B)	302.9	293.7	596.48

Policy and Welfare Analysis

- Price cut $I < I^m$.

$$B(Z - T)^{\beta\gamma - 1} = (1 - \tau_{m,e} - I)^{\varepsilon - 1}(1 + \tau_{c,e} + Z - I)^{-\varepsilon}. \quad \text{(CMC)}$$

The effects:

	Z	R	π_α	V_α	N	Ω	TV	p_e	p_r	D
I	$+$	$\pm$	$+$	$+$	$+$	$+$	$+$	$+$	$+$	$-$

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- Price ceiling $I^c < I^m$.

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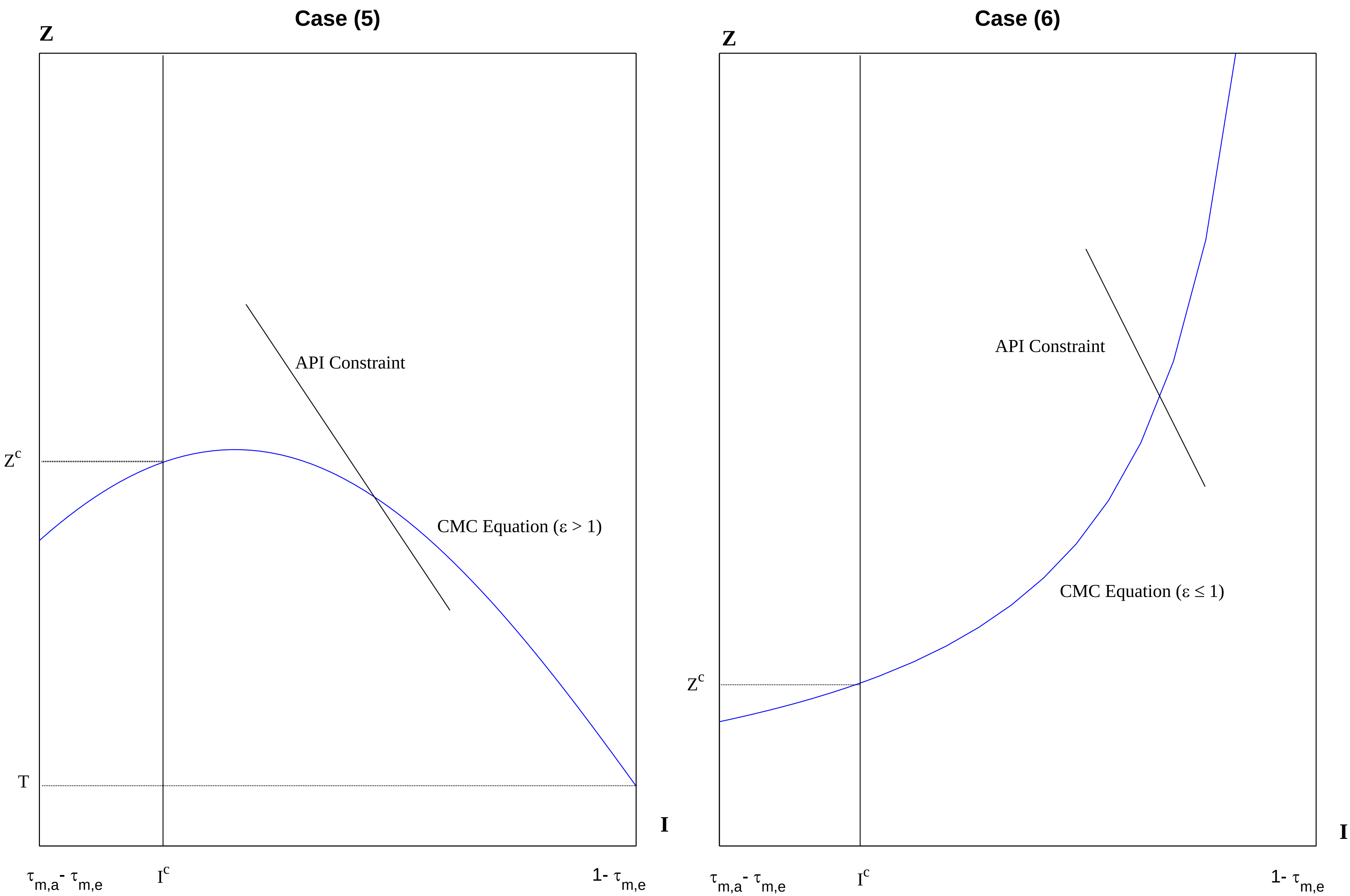
Interchange Ceiling: Elastic/Inelastic Demand



Equilibrium Industry Dynamics under a Binding Interchange Ceiling

	I Interchange fee	R Consumer reward	Z Net card price	π_α Issuer α profit	V_α Issuer α volume	N Number of issuers	Ω Network profit	TV Network volume	P_e Retail price	P_r After-reward price	D Card user's consumption
$\tau_{c,e}$ consumer card cost	0	+	–	–	–	–	–	–	0	+	–
T network card cost	0	–	+	–	–	–	–	–	0	+	–
K issuer entry cost	0	–	+	$\pm$	+	–	+	–	0	+	–
$\tau_{m,a}$ merchand cash cost	0	0	0	0	0	0	0	0	0	0	0
$\tau_{c,a}$ consumer cash cost	0	0	0	0	0	0	0	0	0	0	0
$\tau_{m,e}$: merchand card cost											
$\varepsilon > 1$	0	+	–	–	–	–	–	–	+	+	–
$\varepsilon = 1$	0	0	0	0	0	0	0	0	+	+	–
$0 < \varepsilon < 1$	0	–	+	+	+	+	+	+	+	+	–

Social Planner's Problem

$$\underset{I}{Max}\ \Omega^s = \int_{\alpha^*}^{\infty} \pi_\alpha g(\alpha) d\alpha + \int_0^{Q^*} D^{-1}(Q)dQ - \frac{k(1+\tau_{c,e}-R)}{1-\tau_{m,e}-I}Q^* - E \qquad \text{(Social Surplus)}$$

$$s.t. \qquad \pi_\alpha = (\frac{\beta-1}{\beta})(\frac{\alpha}{\beta})^{\frac{1}{\beta-1}}(I-R-T)^{\frac{\beta}{\beta-1}} - K, \qquad \text{(Profit of Issuer } \alpha)$$

$$\alpha^* = \beta K^{\beta-1}(\frac{\beta}{\beta-1})^{\beta-1}(I-R-T)^{-\beta}, \qquad \text{(Marginal Issuer } \alpha^*)$$

$$Q^* = D(\frac{k}{1-\tau_{m,e}-I}(1+\tau_{c,e}-R)) \qquad \text{(Demand of Goods)}$$

$$N = \int_{\alpha^*}^{\infty} g(\alpha) d\alpha, \qquad \text{(Number of Issuers)}$$

$$\frac{1+\tau_{c,a}}{1-\tau_{m,a}} \geqslant \frac{1+\tau_{c,e}-R}{1-\tau_{m,e}-I}, \qquad \text{(API Constraint)}$$

$$1-\tau_{m,e} > I \geq \tau_{m,a} - \tau_{m,e}, \qquad \text{(Pricing Constraint)}$$

$$TV = \int_{\alpha^*}^{\infty} V_\alpha g(\alpha) d\alpha = \int_{\alpha^*}^{\infty} [(\frac{I-R-T}{\beta})\alpha]^{\frac{1}{\beta-1}} g(\alpha) d\alpha, \qquad \text{(Total Card Supply)}$$

$$TD = \frac{k}{1-\tau_{m,e}-I} D(\frac{k}{1-\tau_{m,e}-I}(1+\tau_{c,e}-R)), \qquad \text{(Total Card Demand)}$$

$$TV = TD, \qquad \text{(CMC Condition)}$$

$$c\int_{\alpha^*}^{\infty} \pi_\alpha g(\alpha) d\alpha - E \geqslant 0. \qquad \text{(Ramsey Constraint)}$$

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- Consequently, $I^s \leq I^m$. (Similar proofs for $\varepsilon \leq 1$).

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