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

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  - US: 50 pending cases; Credit Card Fair Fee Act 2008
  - Worldwide: EU, UK, Australia, Spain, Netherlands and etc
- The controversy of interchange fees
  - Fees paid to issuers when merchants accept card payments
  - Set by four-party systems: Visa and MasterCard
  - Totals $42 billion or $370 per US household (2007)

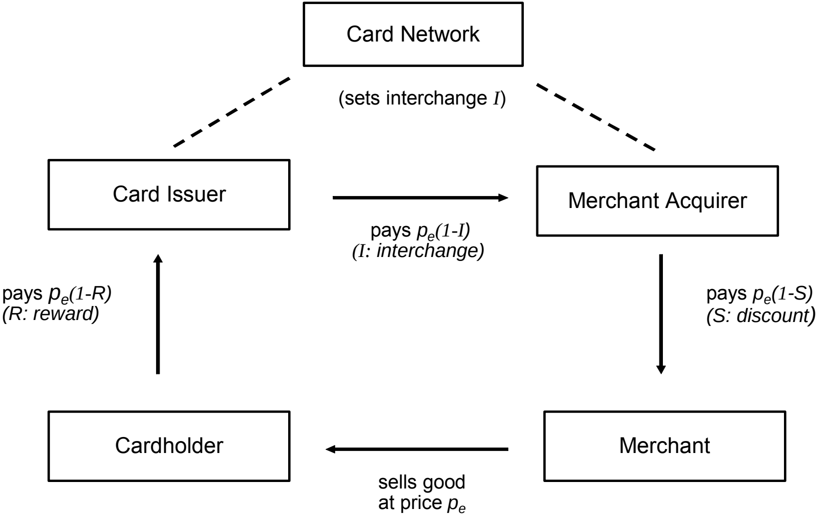


Figure: A Four-Party Credit Card System

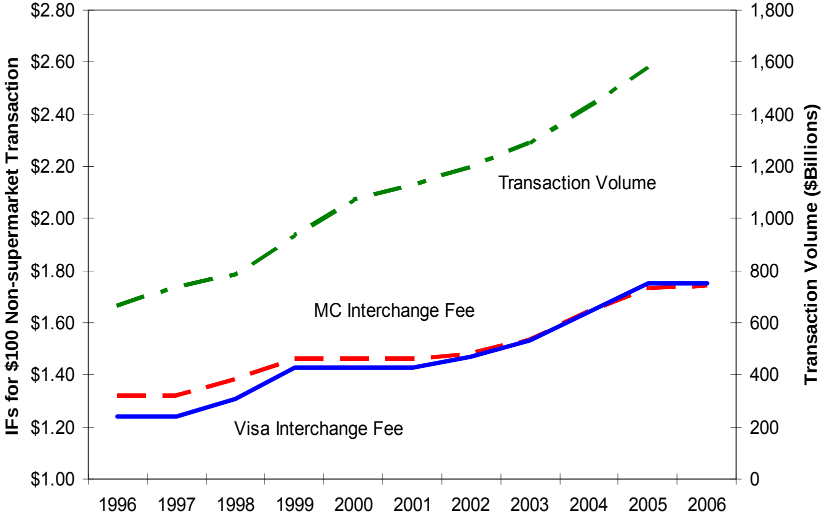
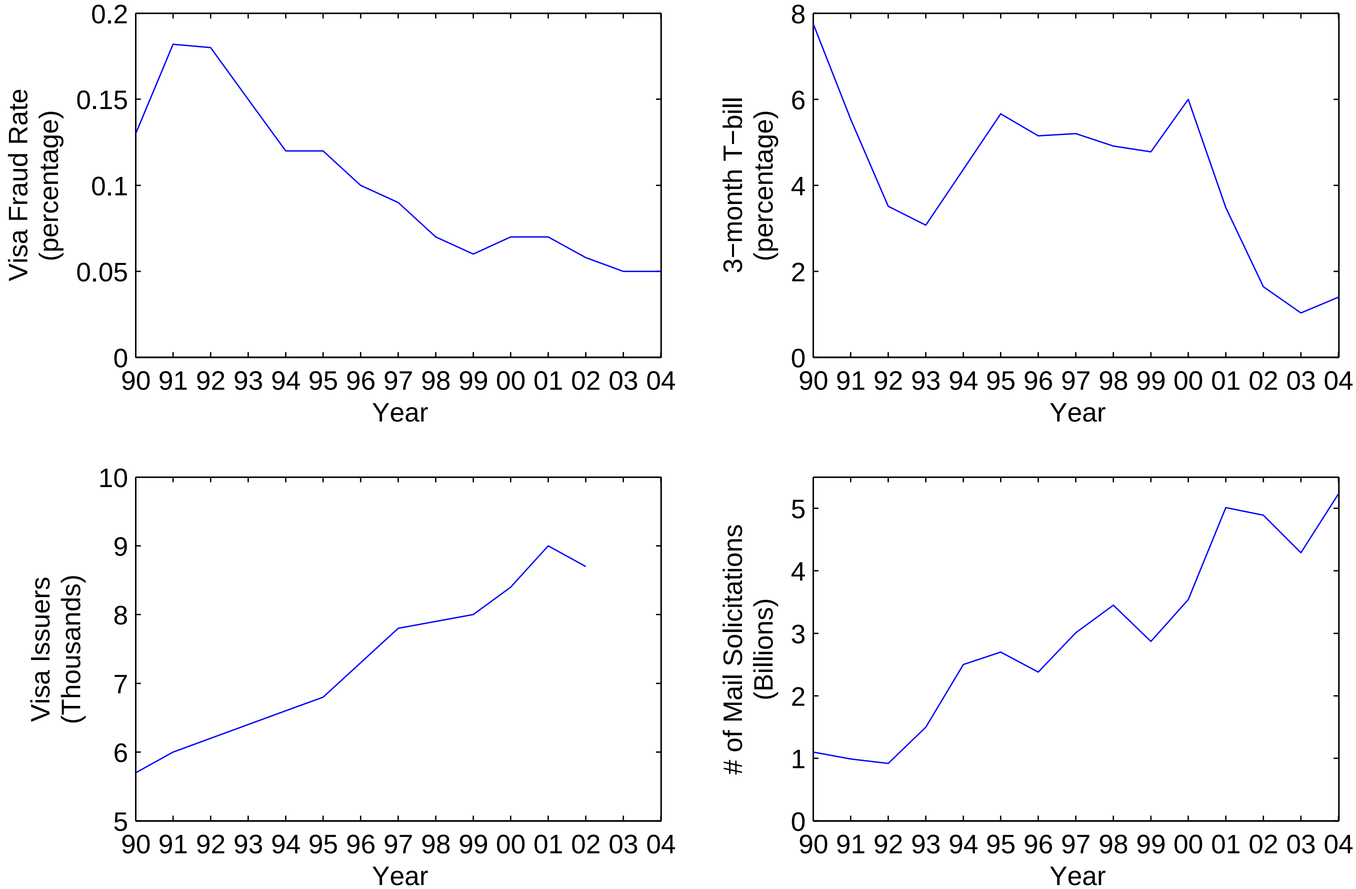


Figure: U.S. Credit Card Interchange Fees and Transaction Volume



Credit Card Industry Trends: Costs and Competition

Puzzles

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- 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?

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  - Asymmetric pricing on the two-sides
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  - Fundamental externalities in card payment systems
  - Asymmetric pricing on the two-sides
  - Interchange fee: is it too high?
- Some limitations
  - Unspecified convenience benefits from card usage
  - Fixed consumer demand invariant to payment choices
  - Imperfect competition among merchants

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  - Competing payment instruments, e.g., cards vs. alternatives;
  - Rational consumers (merchants) always use (accept) lowest-cost payment instruments;
  - Oligopolistic networks set profit-maximizing interchange fees;
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  – Oligopolistic networks set profit-maximizing interchange fees;

  – Competitive issuers join the most profitable network and compete with one another via consumer rewards.
- New findings:

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

  – Consumer reward and card transaction increase with interchange fees, while consumer surplus does not.

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

$$p_a = \frac{k}{1 - \tau_{m,a}}; \;\; p_e = \max\left(\frac{k}{1 - \tau_{m,e} - S}, p_a\right).$$

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

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

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 at 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 at 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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- For simplicity, we normalize $C = 0$ so acquirers play no role in our analysis but pass through merchant discounts as interchange fees to the issuers, i.e., $S = I$.

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

$$\pi_{\alpha^*} = 0 \Longrightarrow \frac{\beta - 1}{\beta}\left(\frac{\alpha^*}{\beta}\right)^{\frac{1}{\beta-1}}(I - R - T)^{\frac{\beta}{\beta-1}} = K.$$

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- 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 sets the interchange fee I to maximize the total profits of its member issuers:

$$\Omega = \int_{\alpha^*}^{\infty} \pi_\alpha g(\alpha) d\alpha.$$

Monopoly Network's Problem

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

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

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

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

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

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

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

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

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

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

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

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

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

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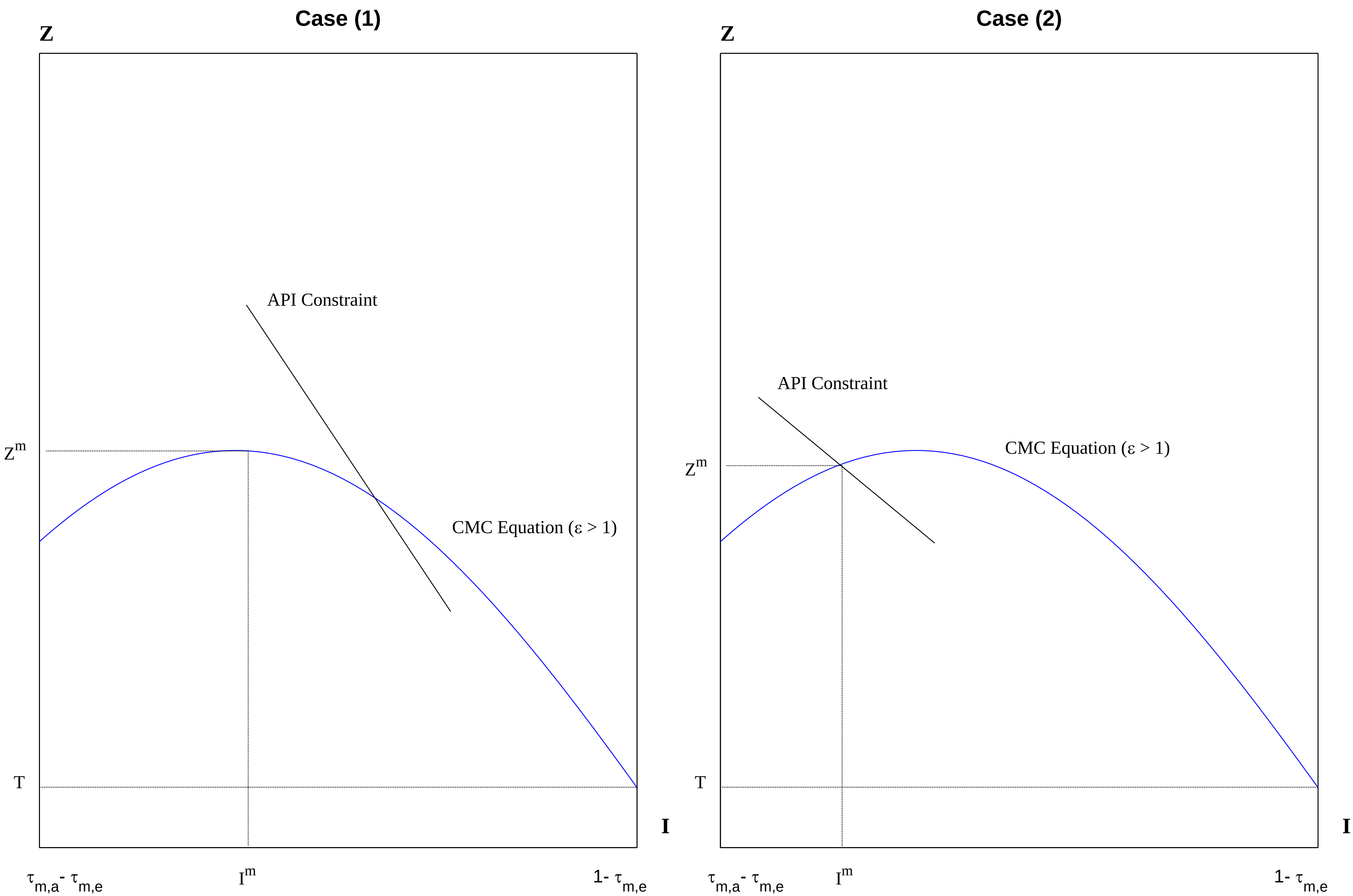
- Less elastic ($\frac{1+\tau_{c,a}}{\tau_{c,a}+\tau_{m,a}} > \varepsilon > 1$) or inelastic ($\varepsilon \leq 1$) demand :

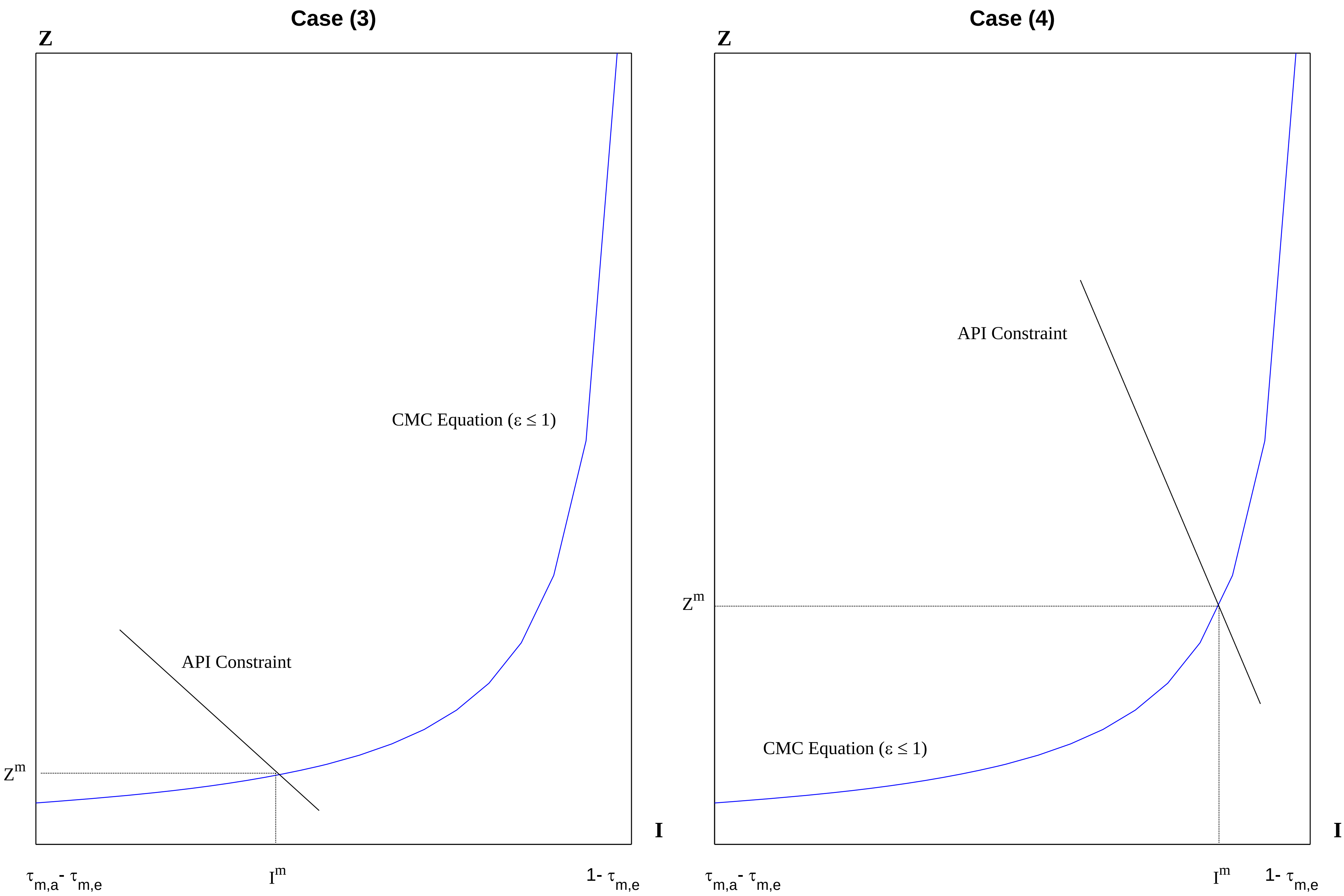
$$\frac{1+\tau_{c,a}}{1-\tau_{m,a}} = \frac{1+\tau_{c,e}+Z-I}{1-\tau_{m,e}-I}, \tag{API}$$

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

Monopoly Interchange Pricing: Elastic Demand



Monopoly Interchange Pricing: Inelastic Demand



Endogenous Variables

$$R = I - Z;$$

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

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

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

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

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

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

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

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

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

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

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

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)

	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
					$\varepsilon \geq (1+\tau_{c,a})/(\tau_{c,a}+\tau_{m,e}) > 1$						
$\tau_{m,a}$ 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?

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- Why can't merchants refuse cards?
  – As card payment becomes more efficient, card networks can charge higher interchange fees but keep cards a competitive payment service to merchants.
- Why are interchange fees lower for low-fraud transactions?
  – Different API (alternative payment instrument) constraints that card networks face in different environments.

Duopoly Networks

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- Tacit Collusion:

$$\text{Trigger Strategy} \implies \text{Monopoly Interchange Fee}$$

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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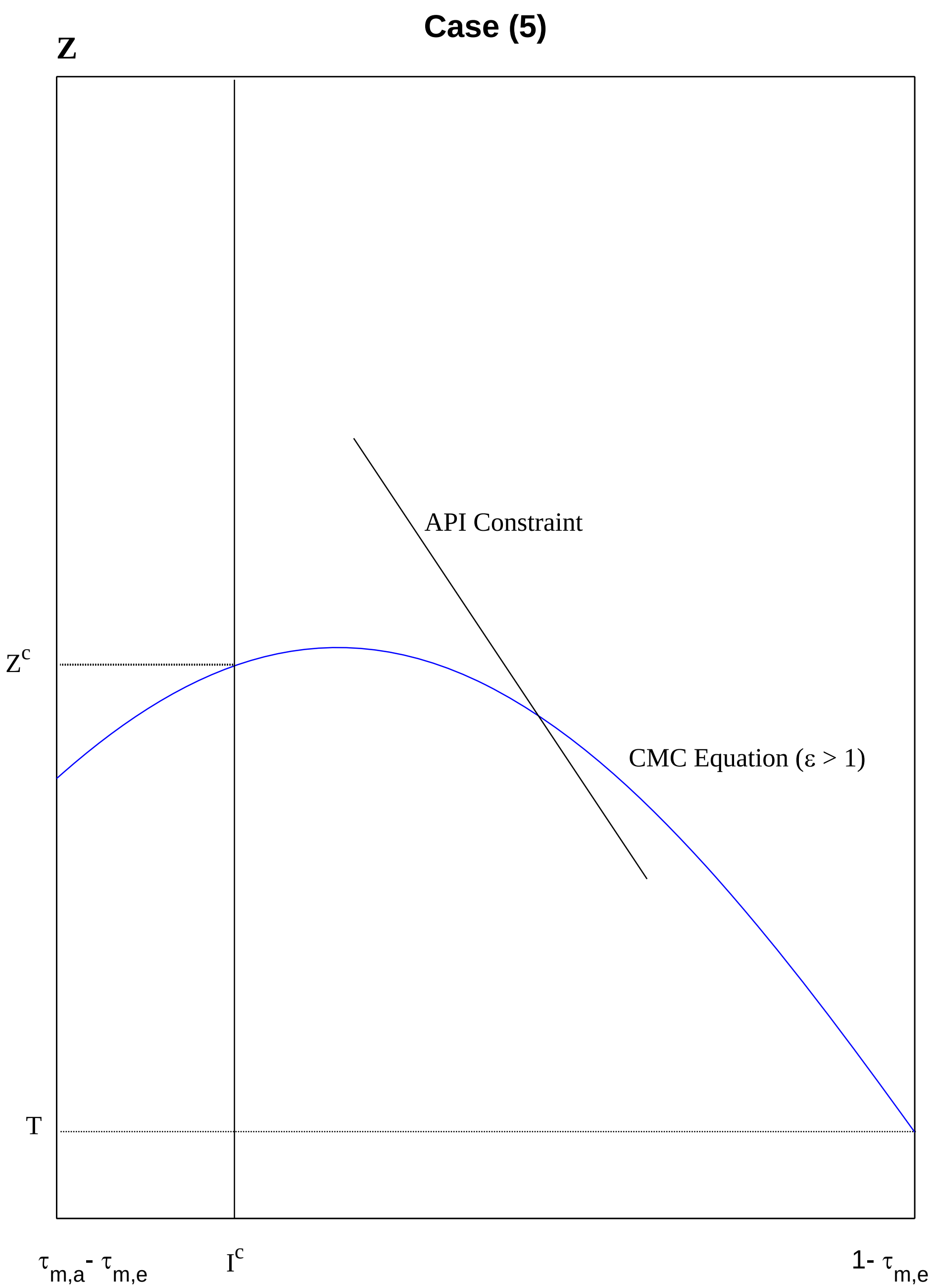
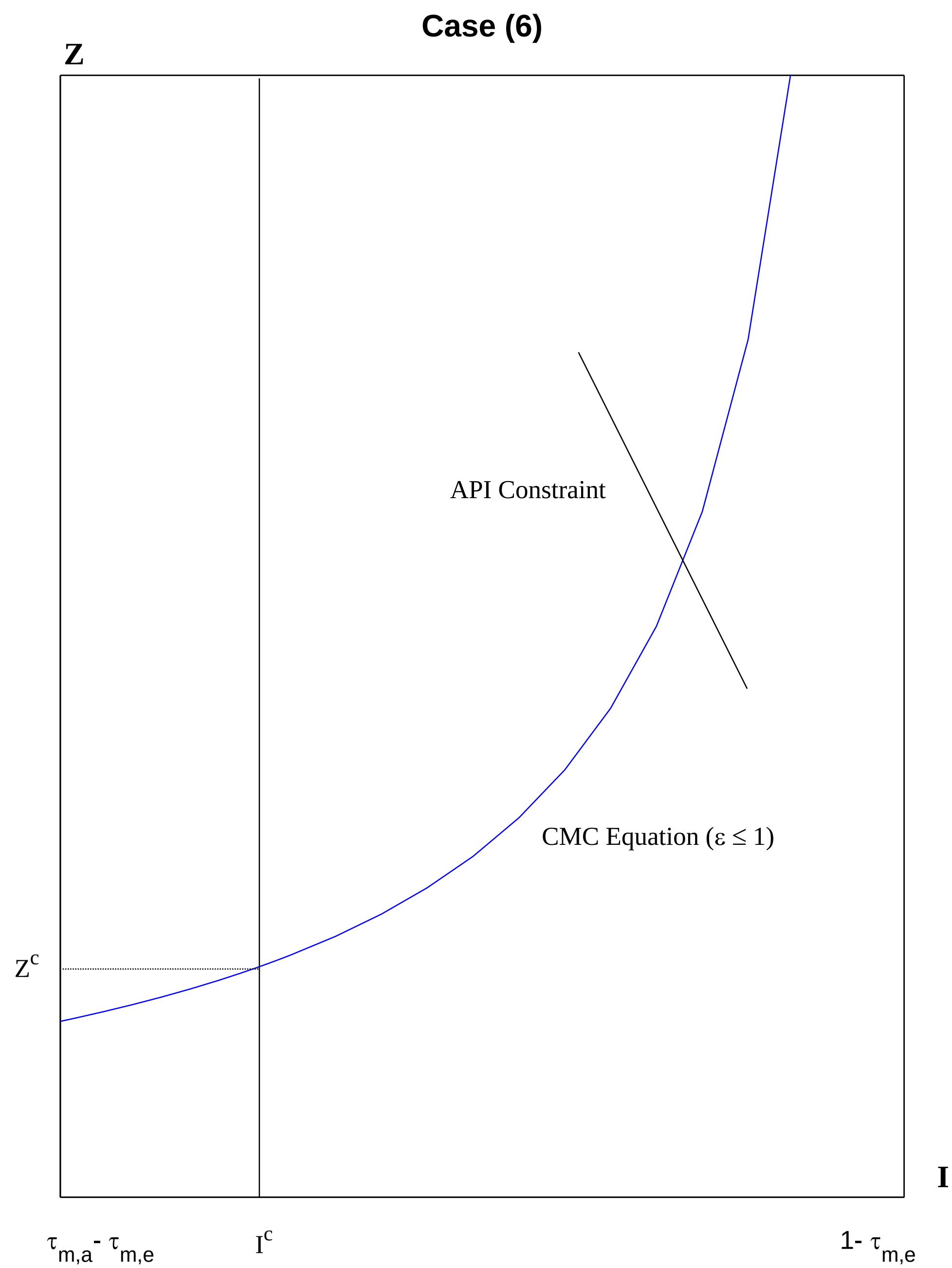
I	$+$	$\pm$	$+$	$+$	$+$	$+$	$+$	$+$	$+$	$-$

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

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

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

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

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

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

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

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

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

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

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

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

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

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- For $\varepsilon > 1$, the social planner's problem can be rewritten as

$$\underset{I}{Max} \quad \Omega^s = A(Z - T)^{\beta\gamma} + \frac{\eta}{\varepsilon - 1} p_r^{1-\varepsilon} \qquad \text{(Social Surplus)}$$

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

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

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  - Unintended consequences.
- The role of merchants.

Takeaway from this paper

- Do card networks have market power?
- Do rising consumer rewards increase consumer welfare?
- Do rising interchange fees hurt merchants?
- What should government do in this market?