Payment Industry Dynamics: A Two-Sided Market Approach

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June 14, 2006

Motivation and Set-Up

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- Producers: each sells a distinct good α in a contestable market. Consumers have generalized Cobb-Douglass preferences. A village allows bids for one merchant of each category. Price coherence yields a two-sided market. Village sunk cost in facilities rules out card-only merchants.

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- We abstract from strategic richness of merchant rivalries.
- Predictions of the model are that larger firms and higher income consumers adopt the innovation soonest. How alternative card providers determine their price structure depends on the relative skewness of the income distribution compared to the firm size distribution.

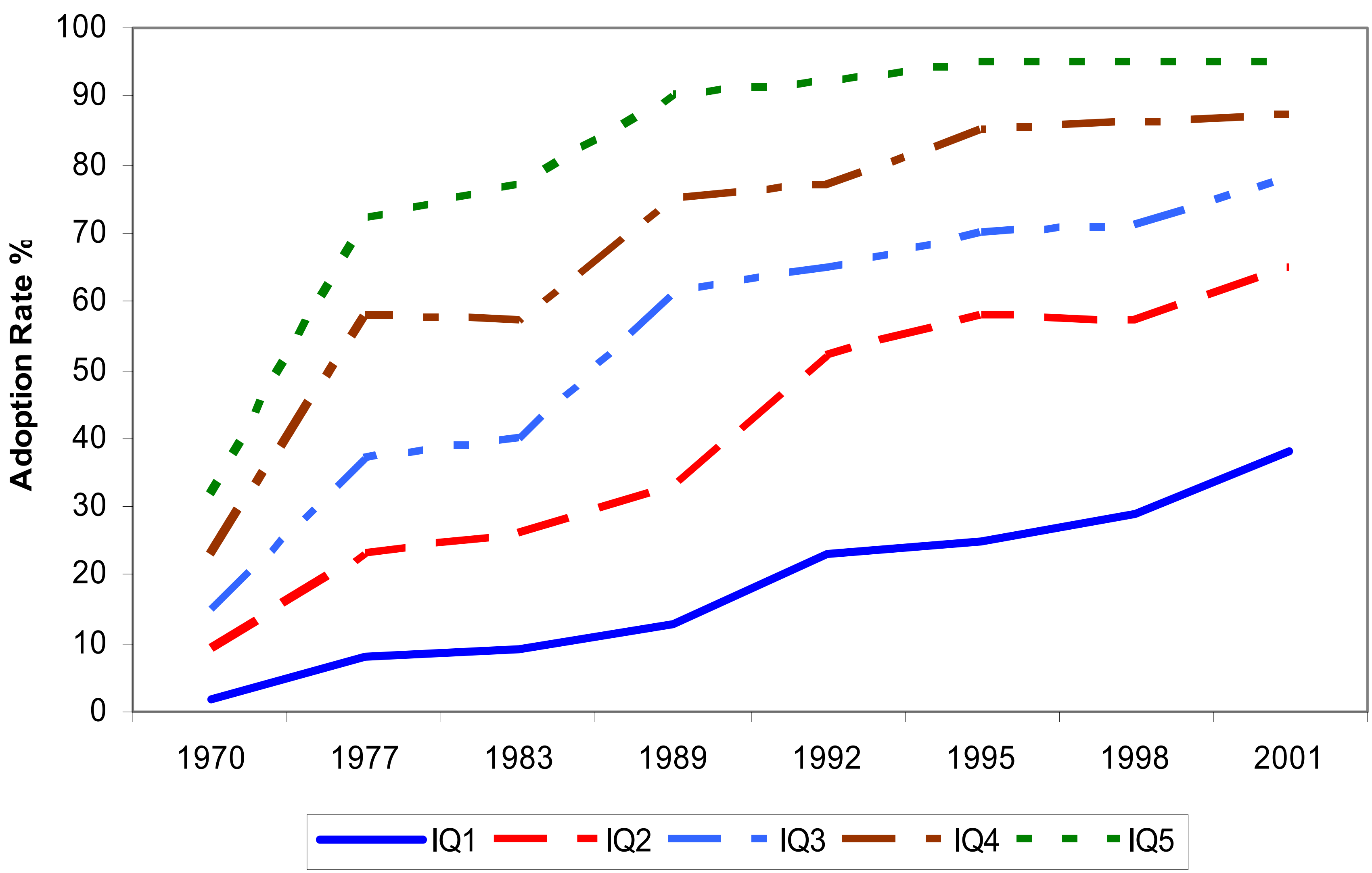

Figure: Household Credit Card Adoption by Income Quintile

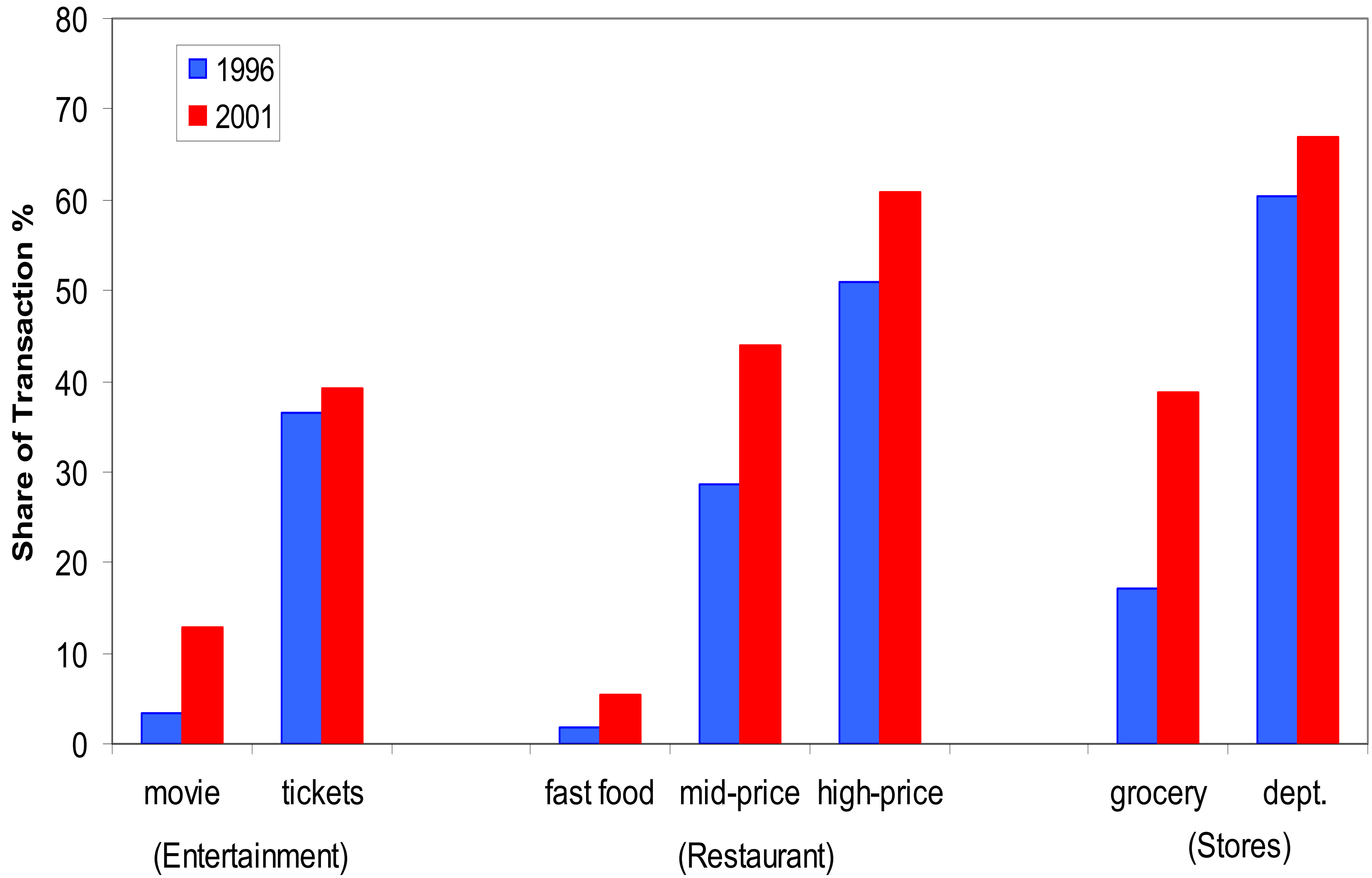

Figure: Payment Card Share of Transaction Volume by Merchant Type

Pre-card Equilibrium

- Merchants: each sells a distinct good α in a contestable market
$$(1-\tau_m)p_\alpha = c_\alpha \Longrightarrow p_\alpha = \frac{c_\alpha}{1-\tau_m}$$
p_α: price of good α; c_α: cost of good α; τ_m: merchant cash cost

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- Consumers: each maximizes utility subject to income I

$$U = Max \int_{\underline{\alpha}}^{\overline{\alpha}} \alpha \ln x_{\alpha,I} \, dG(\alpha)$$

$$s.t. \qquad \int_{\underline{\alpha}}^{\overline{\alpha}} (1+\tau_c) p_\alpha x_{\alpha,I} \, dG(\alpha) = I$$

$x_{\alpha,I}$: consumer I's demand for good α; τ_c: consumer cash cost

- An individual consumer: demand and spending on good α

$$x_{\alpha,I} = \frac{\alpha I}{(1+\tau_c)p_\alpha E(\alpha)}; \qquad p_\alpha x_{\alpha,I} = \frac{\alpha I}{(1+\tau_c)E(\alpha)}$$

- An individual consumer: demand and spending on good α

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- The aggerate market: demand and spending on good α

$$x_\alpha = \frac{\alpha E(I)}{(1+\tau_c)p_\alpha E(\alpha)}; \quad p_\alpha x_\alpha = \frac{\alpha E(I)}{(1+\tau_c)E(\alpha)}$$

$E(I)$: mean of I; $E(\alpha)$: mean of α

Post-card Equilibrium

- Consumers' card adoption:

$$U_0 = \int_{\underline{\alpha}}^{\overline{\alpha}} \alpha \ln \frac{\alpha I}{(1+\tau_c) p_\alpha E(\alpha)} dG(\alpha)$$

$$U_1 = \int_{\underline{\alpha}}^{\alpha_0} \alpha \ln \frac{\alpha (I - k_c)}{(1+\tau_c) p_\alpha E(\alpha)} dG(\alpha) + \int_{\alpha_0}^{\overline{\alpha}} \alpha \ln \frac{\alpha (I - k_c)}{(1+f_c) p_\alpha E(\alpha)} dG(\alpha$$

which implies that the card adoption requires

$$E(\alpha) \ln \frac{I}{(I - k_c)} < E_{\alpha > \alpha_0}(\alpha) \ln \frac{(1+\tau_c)}{(1+f_c)}$$

where

$$E_{\alpha > \alpha_0}(\alpha) \equiv \int_{\alpha_0}^{\overline{\alpha}} \alpha \, dG(\alpha); \qquad f_c\text{: comsumer card fee}$$

It implies a threshold consumer income I_0 for adopting card

$$I > I_0 = \frac{k_c}{1 - \left(\frac{1+f_c}{1+\tau_c}\right)^{E_{\alpha>\alpha_0}(\alpha)/E(\alpha)}}$$

$$\text{where} \qquad \tau_c > f_c$$

More intuitively, a first-order Taylor expansion suggests

$$\underbrace{(\tau_c - f_c)}_{\text{cost saving}} \quad \underbrace{\frac{(I - k_c)E_{\alpha>\alpha_0}(\alpha)}{E(\alpha)(1+f_c)}}_{\text{card transactions}} \quad > \underbrace{k_c}_{\text{adoption cost}}$$

- Merchants' card adoption:

$$p_{\alpha,d} x_{\alpha,d}^{card} = \frac{\alpha [E_{I > I_0}(I - k_c)]}{E(\alpha)(1 + f_c)}; \quad p_{\alpha,d} x_{\alpha,d}^{cash} = \frac{\alpha [E_{I < I_0}(I)]}{E(\alpha)(1 + \tau_c)}$$

Contestability imposes a zero profit condition

$$(1 - f_m) p_{\alpha,d} x_{\alpha,d}^{card} + (1 - \tau_m) p_{\alpha,d} x_{\alpha,d}^{cash} = c_\alpha x_{\alpha,d}^{card} + c_\alpha x_{\alpha,d}^{cash} + k_m$$

$$p_{\alpha,c} = \frac{c_\alpha}{1 - \tau_m}$$

Card adoption requires

$$p_{\alpha,d} < p_{\alpha,c}$$

It implies a threshold merchant size α_0 for accepting card

$$\alpha > \alpha_0 = \frac{E(\alpha)k_m(1+f_c)}{[E_{I>I_0}(I-k_c)](\tau_m - f_m)}$$

wich suggests that merchants' card adoption requires

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$$\underbrace{(\tau_m - f_m)}_{\text{cost saving}} \quad \underbrace{\frac{\alpha[E_{I>I_0}(I-k_c)]}{E(\alpha)(1+f_c)}}_{\text{card transaction}} \quad > \underbrace{k_m}_{\text{adoption cost}}$$

- Competitive Network without Interchange Fee:

$$\frac{E_{\alpha>\alpha_0}(\alpha)E_{I>I_0}(I-k_c)}{E(\alpha)(1+d_c)}$$

$$s.t.\quad I_0 = \frac{k_c}{1-(\frac{1+d_c}{1+\tau_c})^{E_{\alpha>\alpha_0}(\alpha)/E(\alpha)}}$$

$$\alpha_0 = \frac{E(\alpha)k_m(1+d_c)}{[E_{I>I_0}(I-k_c)](\tau_m-d_m)}$$

$$f_m = d_m \quad \text{and} \quad f_c = d_c$$

where d_m (d_c) denotes merchant (consumer) card service cost.

- Competitive Network with Interchange Fee:

$$\underset{f_c, f_m}{Max} \quad \{ \frac{E_{\alpha > \alpha_0}(\alpha) E_{I > I_0}(I - k_c)}{E(\alpha)(1 + f_c)} \}$$

$$s.t. \quad \alpha_0 = \frac{E(\alpha) k_m (1 + f_c)}{[E_{I > I_0}(I - k_c)](\tau_m - f_m)}$$

$$I_0 \quad = \quad \frac{k_c}{1 - (\frac{1+f_c}{1+\tau_c})^{E_{\alpha > \alpha_0}(\alpha)/E(\alpha)}}$$

$$d_m + d_c = f_c + f_m$$

- Monopoly Network:

$$\underset{f_c, f_m}{Max} \ \{\frac{E_{\alpha>\alpha_0}(\alpha)E_{I>I_0}(I-k_c)}{E(\alpha)(1+f_c)}(f_c+f_m-d_m-d_c)\}$$

$$s.t. \ \ \alpha_0 = \frac{E(\alpha)k_m(1+f_c)}{[E_{I>I_0}(I-k_c)](\tau_m - f_m)}$$

$$I_0 = \frac{k_c}{1-(\frac{1+f_c}{1+\tau_c})^{E_{\alpha>\alpha_0}(\alpha)/E(\alpha)}}$$

- Social Planner:

$$\underset{f_c, f_m}{Max} \quad \{\frac{E_{\alpha>\alpha_0}(\alpha)E_{I>I_0}(I)}{E(\alpha)(1+\tau_c)}(\tau_c+\tau_m)-(1-G(\alpha_0))k_m$$

$$-\frac{E_{\alpha>\alpha_0}(\alpha)E_{I>I_0}(I-k_c)}{E(\alpha)(1+f_c)}(d_m+d_c)-(1-F(I_0))k_c\}$$

$$s.t. \quad \alpha_0=\frac{E(\alpha)k_m(1+f_c)}{[E_{I>I_0}(I-k_c)](\tau_m-f_m)}$$

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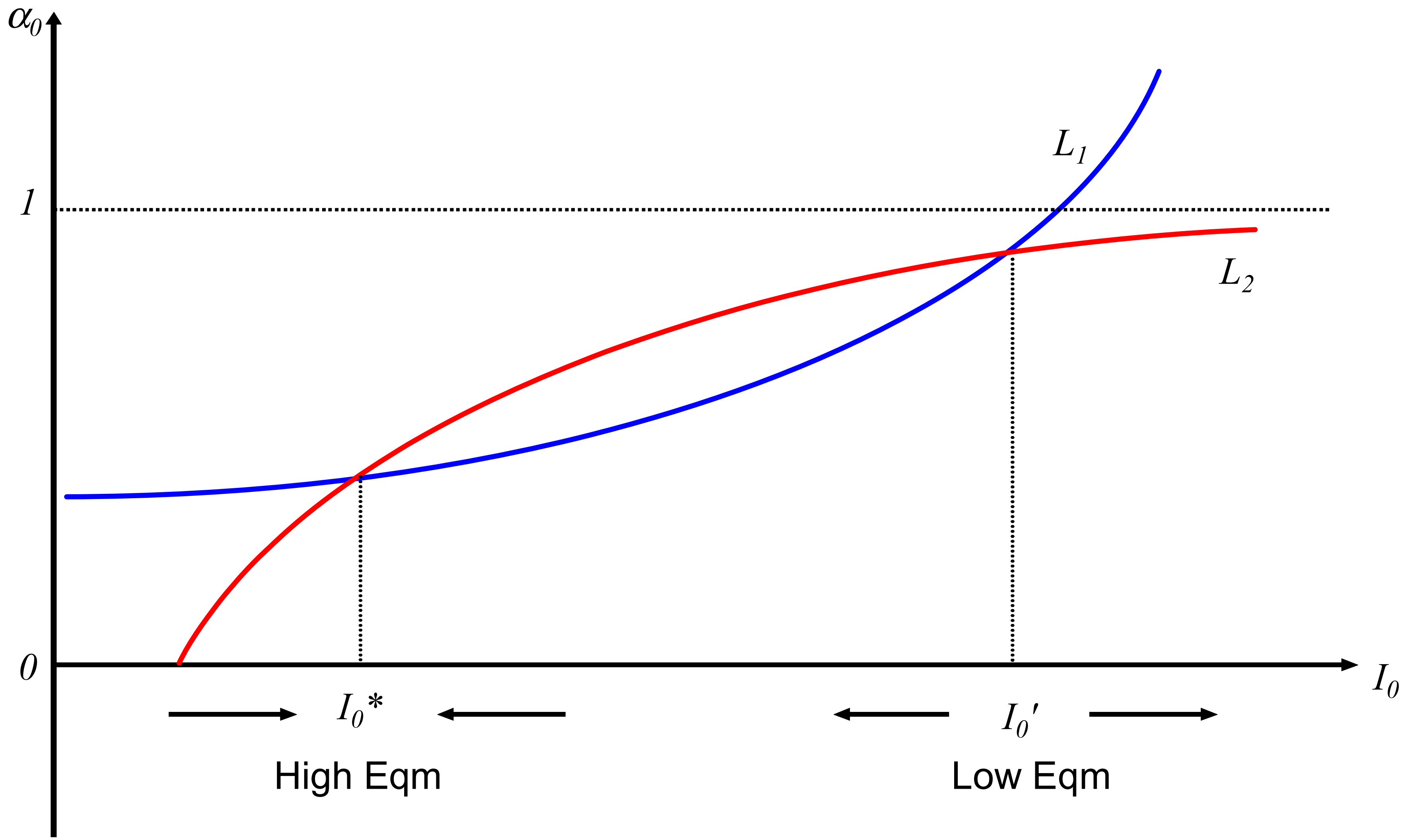
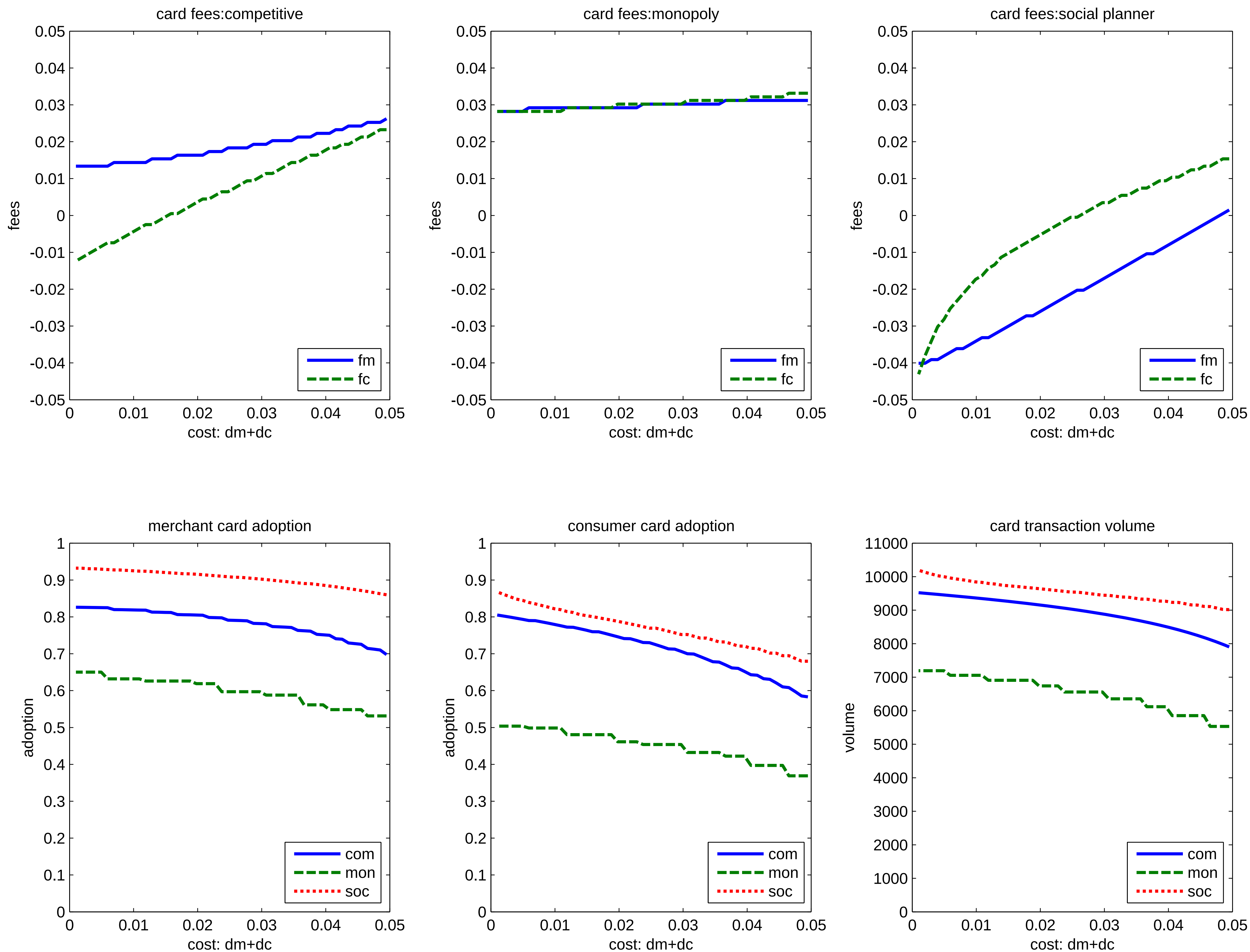
- With an interchange fee, only the sum of the payment card cost $d_m + d_c$ matters;
- An interchange fee improves the cost allocation and helps achieve higher card adoption and usage for the competitive network;
- A monopoly card network maximizes the card revenue instead of transaction volume, so it prefers lower card usage than the competitive network;
- The cost saving of using card relative to cash, i.e. $(\tau_c + \tau_m)$ relative to $(d_m + d_c)$, and the card adoption costs (k_c, k_m) are only in the social planner's calculation but not in (any of) the card network's objectives.

Short-run Industry Dynamics

$$\alpha_0 = \frac{E(\alpha)k_m(1+f_c)}{[E_{I>I_0}(I-k_c)](\tau_m - f_m)} \text{ (L1)}; \quad I_0 = \frac{k_c}{1-\left(\frac{1+f_c}{1+\tau_c}\right)^{E_{\alpha>\alpha_0}(\alpha)/E(\alpha)}} \text{ (L2)}$$





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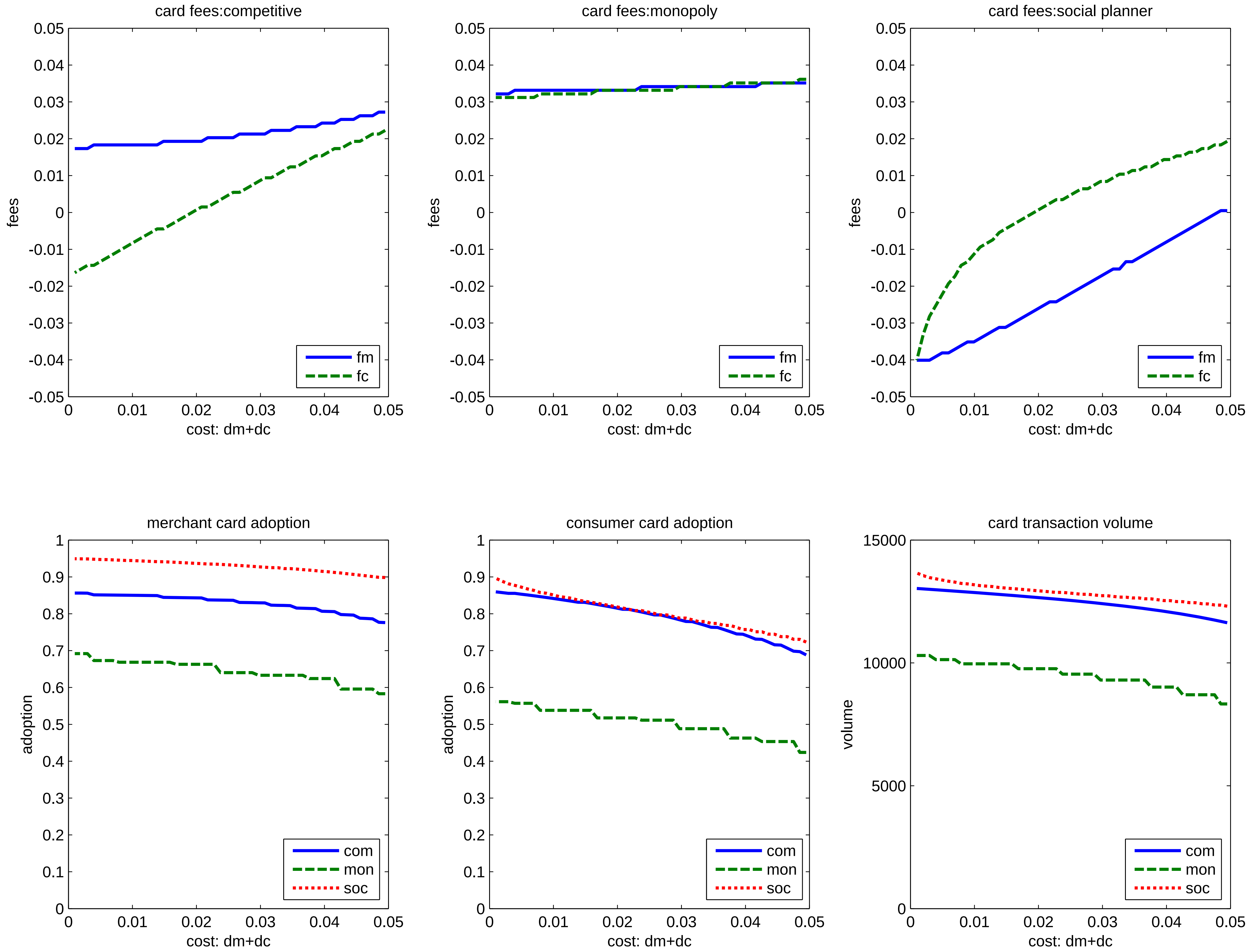

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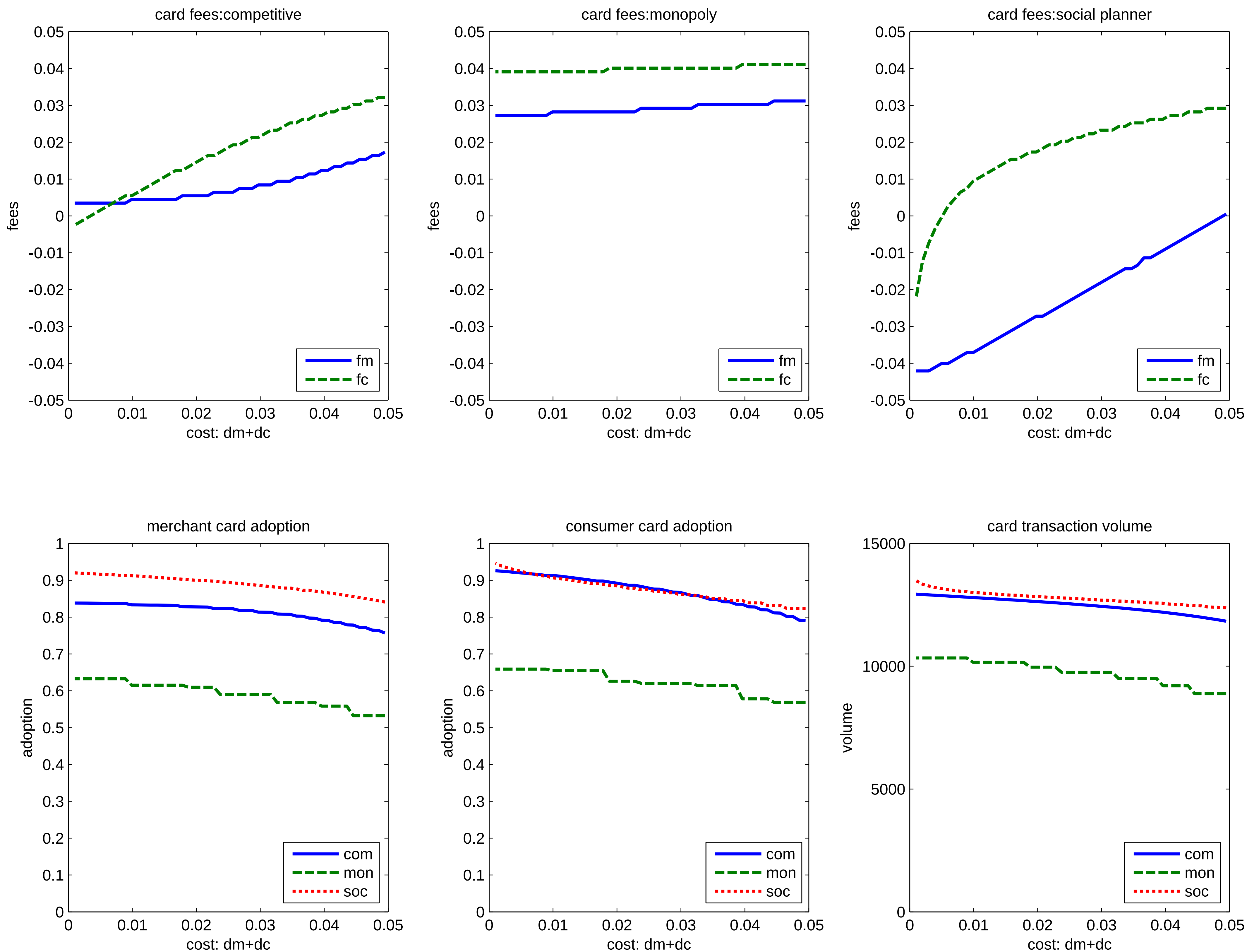

Lamda=0.000075, Km=200, Kc=50, Tm=0.05, Tc=0.05,

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- As consumer incomes rise relative to card service costs, consumer fees tend to be decreased relative to merchant fees.
- The fee allocation is influenced by the adoption cost k_m and k_c so that the party having a higher card adoption cost tends to bear a lower card service fee.

Determination of Price Structure: Competition v. Monopoly

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- If the distribution of income is more skewed at that part of the distribution, then the second fee change increases transactions by a larger amount.

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- Social optimum characterization similar to Farrell (2006).

Determination of Price Structure: Long-run declines in costs of providing card services or growth in consumer income

- Consider long-run technological improvements that lower the total cost of provision of card services, $d_m + d_c$, relative to income. All three market structures choose decreasing fees f_m and f_c, typically decreasing the consumers' fees more rapidly than merchants' fees. Why?

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- Once again, in our model, the distribution of income is more skewed (to the lower tail) than the distribution of merchant sizes. With the distribution of income more skewed, decreasing the consumers' price by more results in a deeper penetration of consumer card adoption, and larger increases in card usage than would decreasing merchant prices.

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- Why have interchange fees on credit cards risen in the U.S. over time? Three possible reasons: the more skewed distribution of income, increasing monopoly power of the card industry, and income growth of consumers, all would predict higher merchant interchange fees.