The Economics of Two-Sided Payment Card Markets: Pricing, Adoption and Usage

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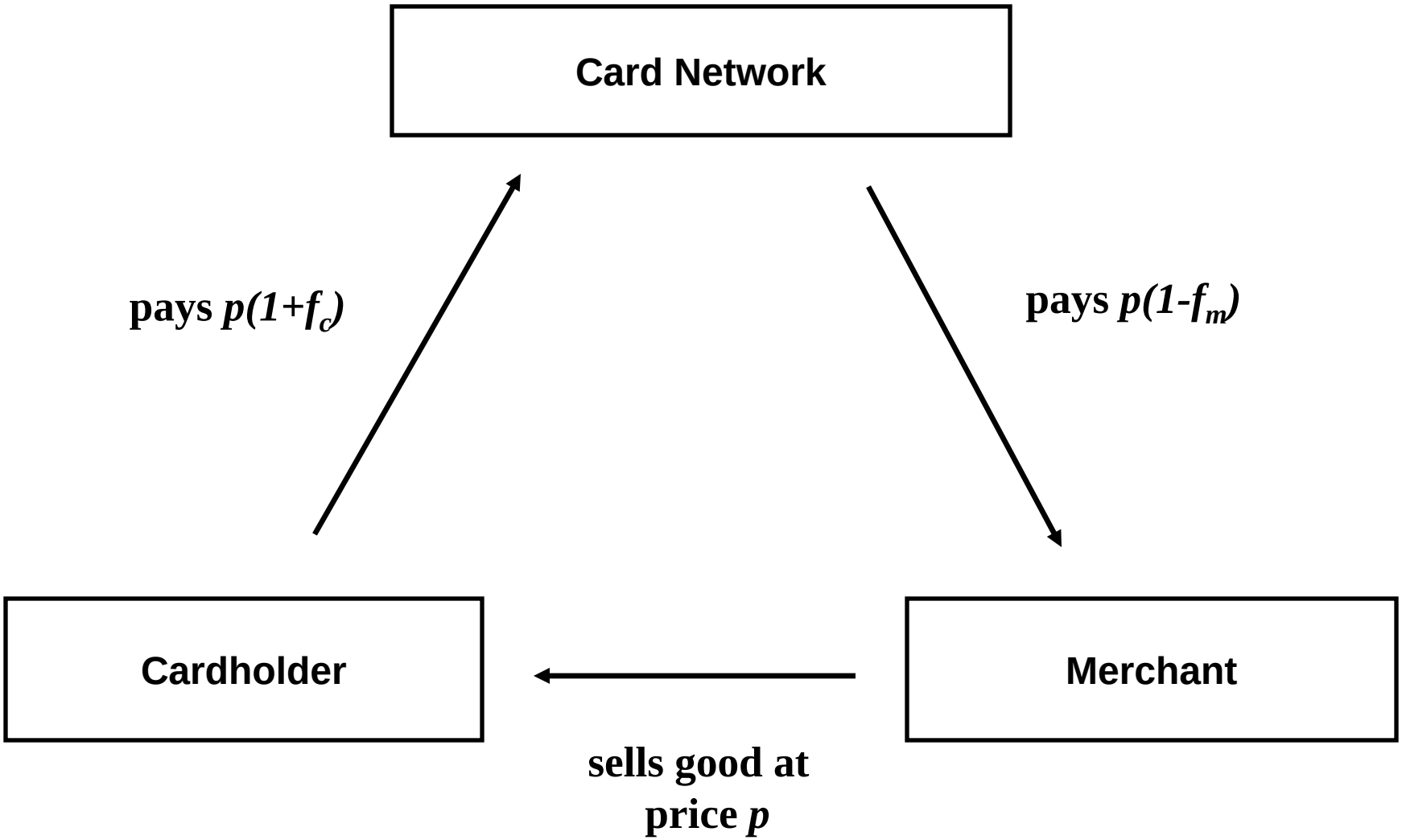
The Economics of Payment Card Markets

- Controversy on interchange fees
  - Increasing adoption and usage of payment cards
  - Rising credit card interchange fees
  - Ongoing legal and regulatory actions
- Two-sided market literature
  - Fundamental externality in card payment system
  - Asymmetric pricing on the two-sides
  - Interchange fee: is it too high?

Card Payment System: An Illustration



The Existing Two-sided Market Theories: Weak Micro-foundations

- Unspecified convenience benefits from the card usage
- Fixed consumer demand for goods invariant to payment choices
- Imperfect competition among merchants

A New Two-sided Market Analysis

- Monetary benefits from the payment card usage
- Varying consumer demand for goods subject to payment choices
- Contestable market for merchants

Supporting Evidence and New Findings

- The card adoption patterns of consumers and merchants
- Three types of merchants who accept cash, card or both
- Rising interchange fees at falling card costs
- The "two-sided market" effect and the "inflation" effect

Basic Elements of the Model

- Consumers
  - Cobb-Douglass preference, heterogenous income
- Merchants
  - contestable market, heterogenous size
- Card technology
  - high fixed cost of adoption, low variable cost of usage
- Card service provider
  - the monopoly network who maximizes profit
  - the social planner who maximizes consumer surplus
  - the policy maker who sets an interchange fee ceiling

Pre-card Market Equilibrium

- A competitive merchant selling good α sets the cash price $p_{\alpha,c}$:

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

- A consumer with income I purchases x_α units of good α:

$$U = Max \int_{\underline{\alpha}}^{\overline{\alpha}} \alpha \ln x_\alpha dG(\alpha) \quad s.t. \quad \int_{\underline{\alpha}}^{\overline{\alpha}} (1+\tau_c)p_{\alpha,c}x_{\alpha,I}dG(\alpha) = I$$

- A consumer I's demand and spending on good α:

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

- Total market demand and spending on good α:

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

Introducing the Payment Card

- The payment card service is provided by a monopoly network
- Merchants and consumers are each charged a fee f_m and f_c
- Card service costs for merchants and consumers are d_m and d_c
- Merchants and consumers pay an adoption cost k_m and k_c

Card Adoption and Usage

- Merchants' choice
  - Large merchants ($\alpha \geq \alpha_1$) accept cards and charge price $p_{\alpha,d} \leq p_{\alpha,c}$

$$\alpha_1 = \frac{E(\alpha)k_m}{[E_{I>I_0}(I-k_c)](\frac{1-f_m}{1+f_c} - \frac{1-\tau_m}{1+f_c})}$$

  - Intermediate merchants ($\alpha_0 \leq \alpha < \alpha_1$) specialize. They either accept cards and charge $p_{\alpha,d}$, where $\frac{1+\tau_c}{1+f_c} p_{\alpha,c} \geq p_{\alpha,d} > p_{\alpha,c}$, or they do not accept cards and charge $p_{\alpha,c}$

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

  - Small merchants ($\alpha < \alpha_0$) do not accept cards and charge $p_{\alpha,c}$

Card Adoption and Usage

- Consumers' choice
  - A consumer with income I compares utility between adopting card (V_d) or not (V_c)

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

$$V_c = \int_{\underline{\alpha}}^{\alpha_1} \alpha \ln \frac{\alpha I}{(1+\tau_c)p_{\alpha,c}E(\alpha)} dG(\alpha) + \int_{\alpha_1}^{\overline{\alpha}} \alpha \ln \frac{\alpha I}{(1+\tau_c)p_{\alpha,d}E(\alpha)} dG(\alpha)$$

  - The threshold income level I_0 for card adoption

$$I \geq I_0 = \frac{\left(\frac{1+\tau_c}{1+f_c}\right)^{E_{\alpha>\alpha_0}(\alpha)/E(\alpha)} k_c}{\left(\frac{1+\tau_c}{1+f_c}\right)^{E_{\alpha>\alpha_0}(\alpha)/E(\alpha)} - \exp\left(\int_{\alpha_0}^{\alpha_1} \alpha \ln\left(\frac{p_{\alpha,d}}{p_{\alpha,c}}\right) dG(\alpha)/E(\alpha)\right)}$$

Monopoly Network vs. Social Planner

- The monopoly network maximizes network profit subject to merchants and consumers' card adoption

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

- The social planner maximizes consumer surplus subject to merchants and consumers' card adoption

$$\underset{f_c, f_m}{Max} \quad \int_{\underline{I}}^{\bar{I}} (U_{I,d} - U_{I,c}) dF(I)$$

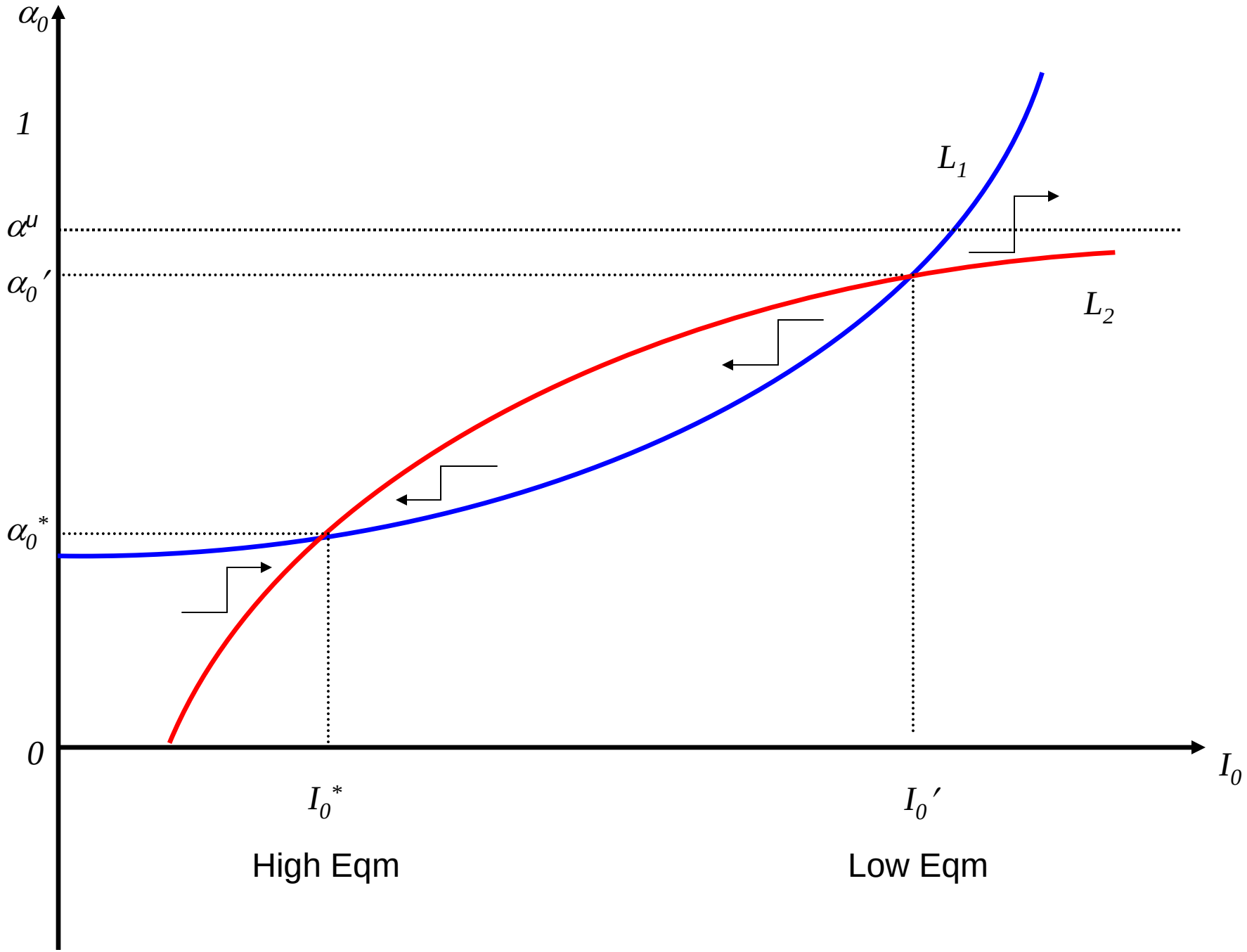
Short-run (Transitional) Dynamics

- Two-sided market interactions

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

$$I_0 = \frac{\left(\frac{1+\tau_c}{1+f_c}\right)^{E_{\alpha>\alpha_0}(\alpha)/E(\alpha)}k_c}{\left(\frac{1+\tau_c}{1+f_c}\right)^{\frac{E_{\alpha>\alpha_0}(\alpha)}{E(\alpha)}} - \exp\left(\int_{\alpha_0}^{\alpha_1}\frac{\alpha}{E(\alpha)}\ln\left(\frac{(1-\tau_m)\alpha}{(1-f_m)\alpha-(1+f_c)\alpha_0\left(\frac{1-f_m}{1+f_c}-\frac{1-\tau_m}{1+\tau_c}\right)}\right)dG(\alpha)\right)}$$

- Assume $\alpha \in [0,1]$ is uniformly distributed, and $I \in [0,\infty)$ is exponentially distributed.


α_0
1
α^u
α_0'
α_0^*
0
L_1
L_2
I_0
I_0^*
I_0'
High Eqm
Low Eqm

Long-run Dynamics

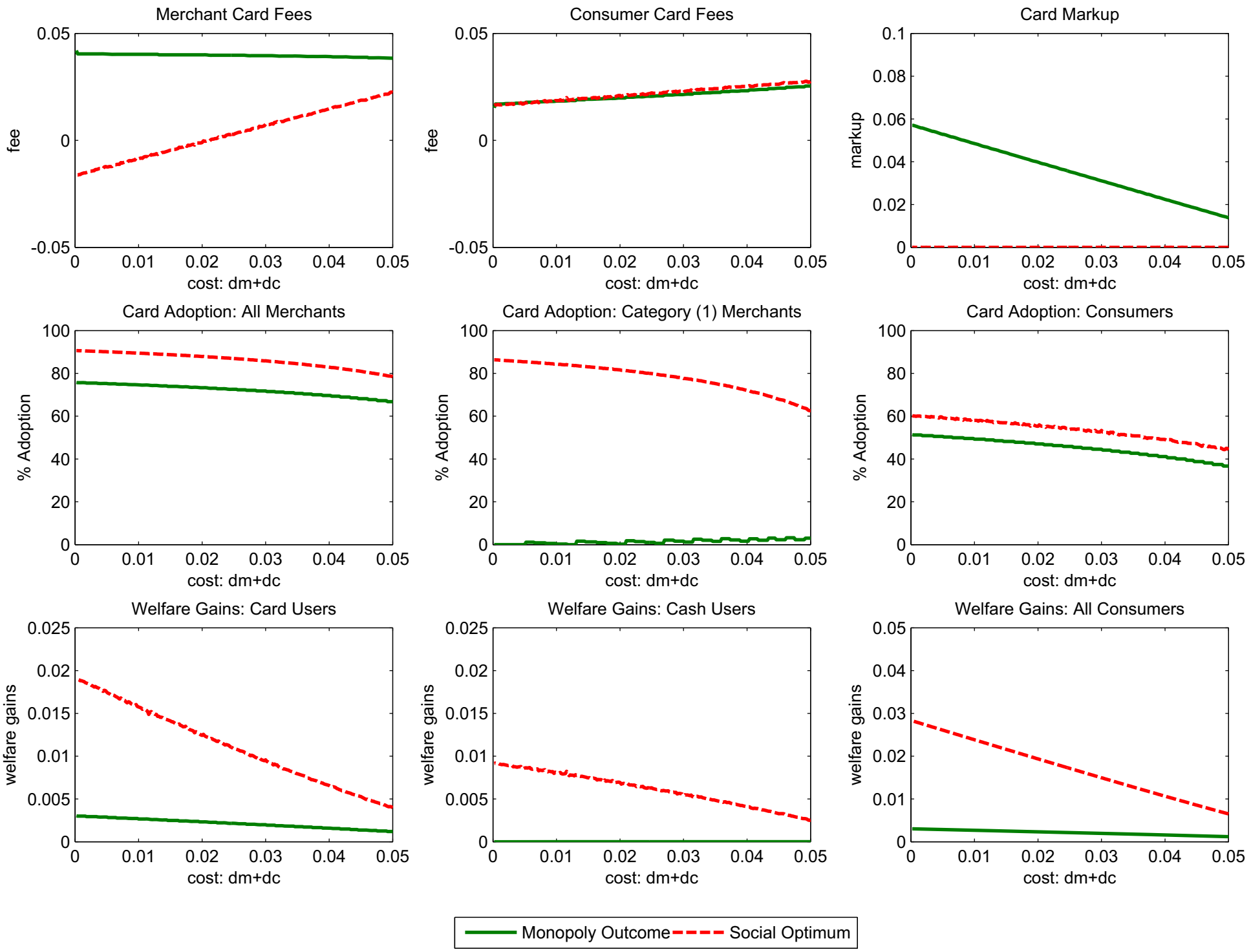
- Long-run dynamics are characterized by the time path of the high-adoption equilibrium
- Driving forces:
  - Declining card usage costs $d_m + d_c$
  - Declining card adoption costs k_c and k_m
  - Rising consumer income $E(I)$

Simulation Parameterization

- Under the monopoly network
- Under the social planner
- Under the policy of interchange ceiling ($f_m \leq 0.03$)

	k_m	k_c	$E(I)$	τ_m	τ_c	$d_m + d_c$
Case 1	160	160	10,000	0.05	0.05	(0, 0.05)
Case 2	120	200	10,000	0.05	0.05	(0, 0.05)
Case 3	128	128	10,000	0.05	0.05	(0, 0.05)
Case 4	160	160	12,500	0.05	0.05	(0, 0.05)

Figure A5: Monopoly Outcome vs. Social Optimum (Case 1)



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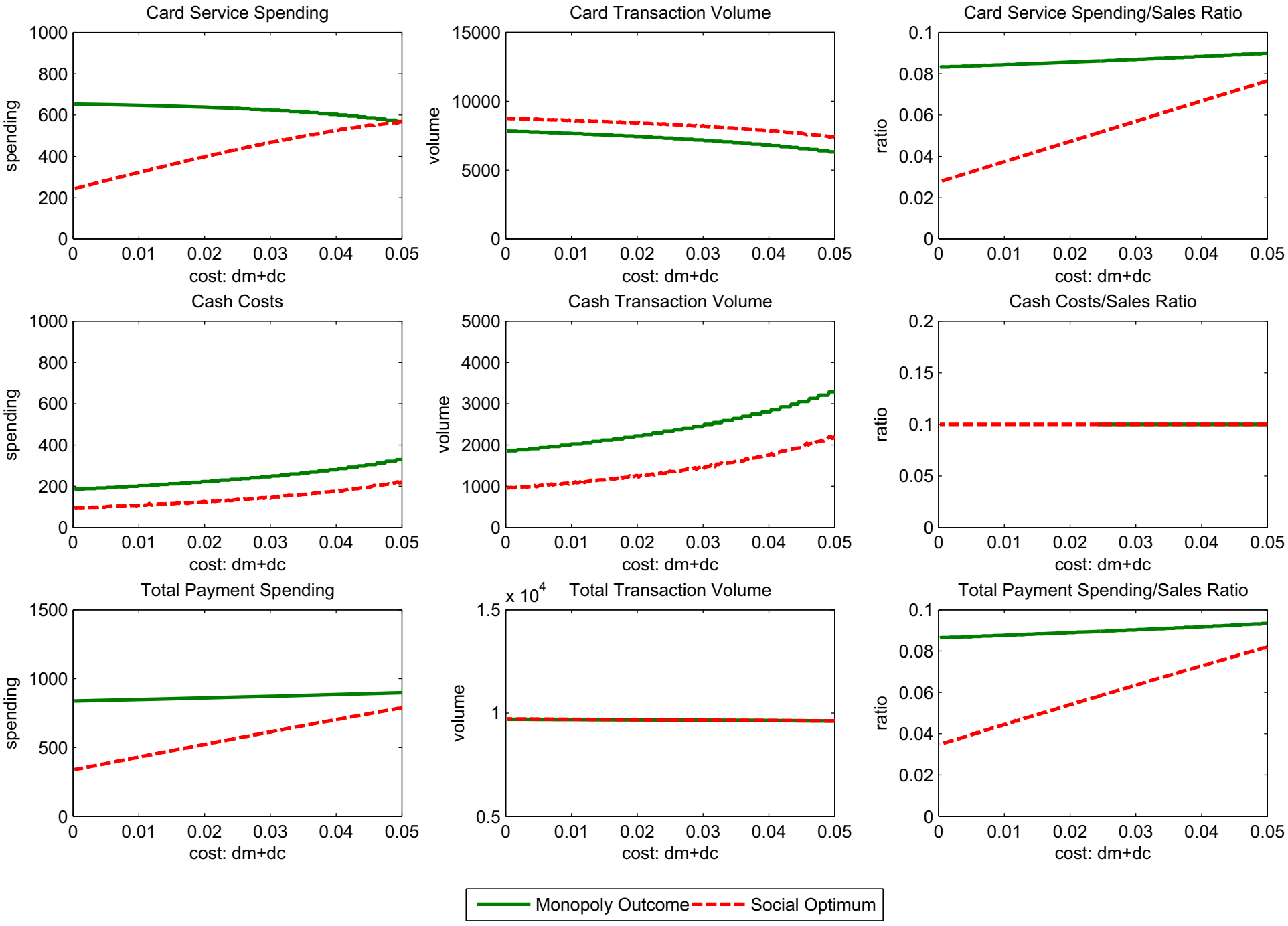
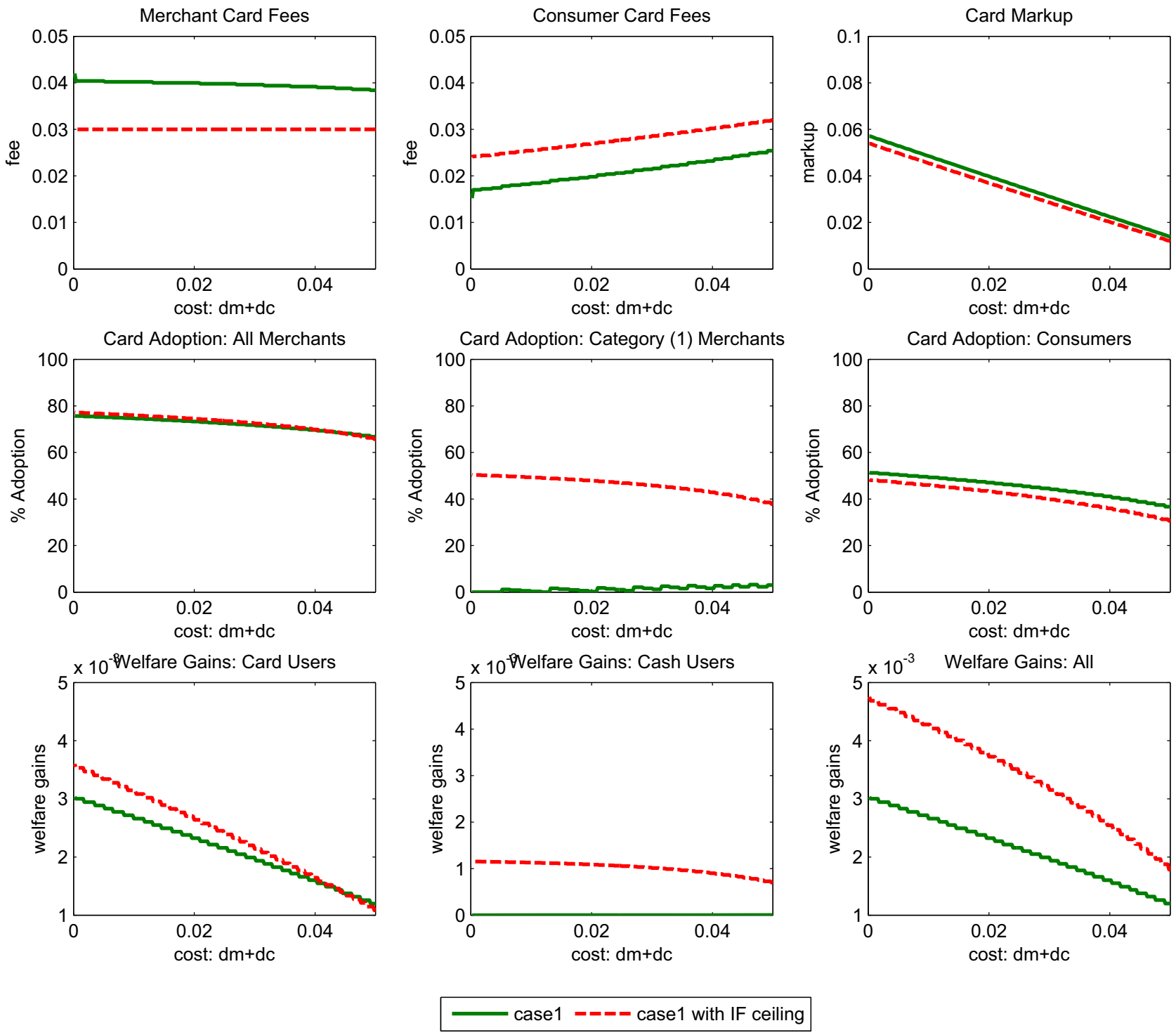


Figure A6: Monopoly Outcome with and without An Interchange Fee Ceiling (Case 1)



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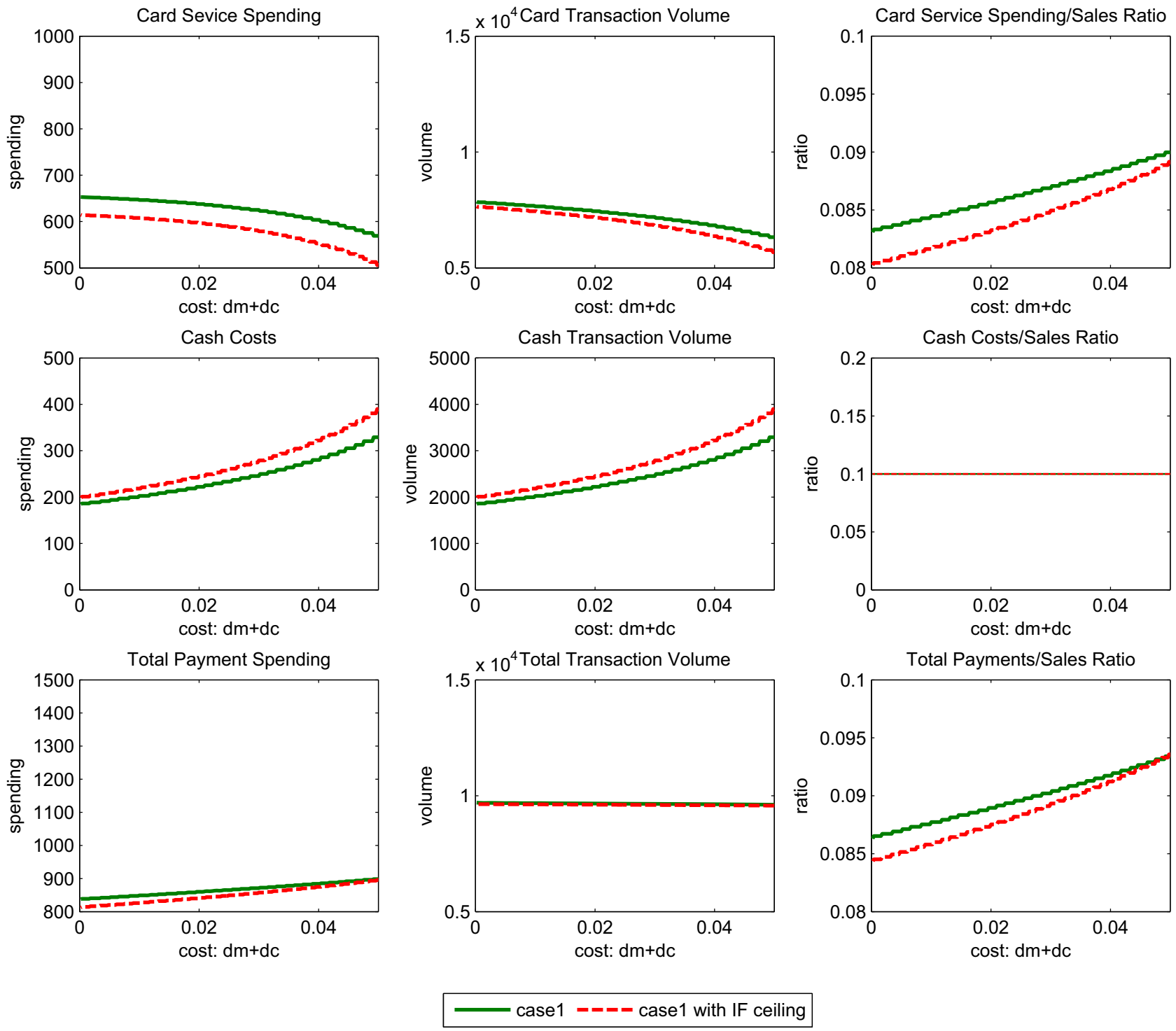

The Findings

- Monopoly outcome is very different from social optimum
  - The card network maximizes the profit
    - it cares only about the card users but not the cash users
    - lowering card fees to consumers help inflate the value of card transactions, so the network prefers high interchange fees
  - The social planner maximizes the consumer surplus
    - it cares about both card users and cash users
    - lowering card fees to merchants help increase consumers' real purchase, so the social planner prefers low interchange fees
- Imposing an interchange ceiling may improve consumer welfare

Conclusion

- The paper provides a new theory for two-sided payment card markets with better micro-foundations
  - Monetary benefits from the payment card usage
  - Consumer demand is affected by payment choices
  - Contestable markets for merchants
- The paper derives card adoption and usage patterns that are consistent with empirical evidence
  - Rich consumers and large merchant adopt payment cards early on
  - Three types of merchants who accept cash, card or both
- The paper offers new insights on payment card pricing
  - The decline of card service costs is consistent with increasing interchange fees
  - The card network has the incentive to inflate the nominal value of card transactions
  - Imposing an interchange ceiling may improve consumer welfare