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

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Motivation

- Credit and debit cards become prominent form of payments
  - 38% US consumer expenditure
  - 75% households own credit cards; 6.3 cards per household
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  - Worldwide: EU, UK, Australia, Spain, Netherlands and etc
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- Legal battles and regulations against the credit card networks
  - 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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- 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?
The Literature

- Two-sided market theories
  - Fundamental externalities in card payment systems
  - Asymmetric pricing on the two-sides
  - Interchange fee: is it too high?
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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
A New Approach

- Starting point: *mature vs. emerging card markets.*
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An equilibrium industry model:
- 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;
- 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 $p_e$:

$$p_a = \frac{k}{1 - \tau_{m,a}}; \quad p_e = \max\left(\frac{k}{1 - \tau_{m,e} - S}, p_a\right).$$
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- A cash store charges $p_a$, while a card store charges $p_e$:
  \[ p_a = \frac{k}{1 - \tau_{m,a}}; \quad p_e = \max\left(\frac{k}{1 - \tau_{m,e} - S}, p_a\right). \]
- 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
  \[ 1 - \tau_{m,e} > S. \]
Consumers:

- Two types: *cash* consumers vs. *card* consumers.
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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 \geq (1 + \tau_{c,e} - R) \ p_e \iff \frac{1 + \tau_{c,a}}{1 - \tau_{m,a}} \geq \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.
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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 $TD$:

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

- The acquiring market is competitive, where each acquirer receives a discount rate $S$ from merchants and pays an interchange rate $I$ to card issuers.
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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 issuers, i.e., $S = I$. 
Issuers:

- The issuing market is competitive, where each issuer receives an interchange rate $I$ from acquirers and pays a reward rate $R$ to consumers.
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- Issuers are heterogeneous in their operational efficiency $\alpha$, which is distributed with pdf $g(\alpha)$ over the population.
- Issuers pay the card network a processing fee $T$ per dollar of transaction and a share of their profits.
Issuers (continued):

- Issuer $\alpha$’s profit $\pi_\alpha$ (before sharing with the network):

$$\pi_\alpha = \text{Max} \left( \frac{(I - R - T)}{V_\alpha} \right) V_\alpha - \frac{V_\beta}{V_\alpha} \alpha - K \Rightarrow$$

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

- Free entry condition requires that the marginal issuer $\alpha^*$ breaks even, hence

\[
\pi_{\alpha^*} = 0 \implies \frac{\beta - 1}{\beta} \left(\frac{\alpha^*}{\beta}\right)^{\frac{1}{\beta - 1}} (I - R - T)^{\frac{\beta}{\beta - 1}} = K.
\]
Issuers (continued):

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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

$$TV = \int_{\alpha^*}^{\infty} V_\alpha g(\alpha) d\alpha = \int_{\alpha^*}^{\infty} \left[ \left( \frac{I - R - T}{\beta} \right)^{\frac{1}{\beta - 1}} \right] g(\alpha) d\alpha.$$
Each period, a card network incurs a variable cost $T$ per dollar of transaction to provide the service.
Network:

- Each period, a card network incurs a variable cost $T$ per dollar of transaction to provide the service.
- In return, the network charges its member issuers a processing fee $T$ to cover the variable costs and shares with their profits.
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- Each period, a card network incurs a variable cost $T$ per dollar of transaction to provide the service.
- In return, the network charges its member issuers a processing fee $T$ to cover the variable costs and shares with their profits.
- 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

\[
\begin{align*}
\text{Max} \quad & \Omega^m = \int_{\alpha^*}^{\infty} \pi_\alpha g(\alpha) d\alpha \\
\text{s.t.} \quad & \pi_\alpha = \left(\frac{\beta - 1}{\beta}\right)\left(\frac{\alpha}{\beta}\right)^{\frac{1}{\beta - 1}}(I - R - T)^{\frac{1}{\beta - 1}} - K, \quad \text{(Profit of Issuer } \alpha) \\
\alpha^* = & \beta K^{\beta - 1}\left(\frac{\beta}{\beta - 1}\right)^{\beta - 1}(I - R - T)^{-\beta}, \quad \text{(Marginal Issuer } \alpha^*) \\
N = & \int_{\alpha^*}^{\infty} g(\alpha) d\alpha, \quad \text{(Number of Issuers)} \\
1 + & \tau_{c,a} \geq 1 + \tau_{c,e} - R \\frac{1}{1 - \tau_{m,a} - I}, \quad \text{(API Constraint)} \\
1 - & \tau_{m,e} > I \geq \tau_{m,a} - \tau_{m,e}, \quad \text{(Pricing Constraint)} \\
TV = & \int_{\alpha^*}^{\infty} V_\alpha g(\alpha) d\alpha = \int_{\alpha^*}^{\infty} \left[\left(\frac{I - R - T}{\beta}\right)\alpha\right]^{\frac{1}{\beta - 1}} g(\alpha) d\alpha, \quad \text{(Total Card Supply)} \\
TD = & \frac{k}{1 - \tau_{m,e} - I}D\left(\frac{k}{1 - \tau_{m,e} - I}(1 + \tau_{c,e} - R)\right), \quad \text{(Total Card Demand)} \\
TV = & TD. \quad \text{(CMC Condition)}
\end{align*}
\]

Monopoly Network:

- Assume \( \alpha \) follows a Pareto distribution so that
  
  \[ g(\alpha) = \gamma L^\gamma / (\alpha^{\gamma+1}) \]

  where \( \gamma > 1 \) and \( \beta \gamma > 1 + \gamma \).
Monopoly Network:

- Assume $\alpha$ follows a Pareto distribution so that $g(\alpha) = \gamma L^\gamma / (\alpha^{\gamma+1})$, where $\gamma > 1$ and $\beta \gamma > 1 + \gamma$.
- Consumer demand function: $D = \eta p_r^{-\epsilon}$; and pricing constraint $1 - \tau_{m,e} > I \geq \tau_{m,a} - \tau_{m,e}$ is not binding.
Monopoly Network:

- Assume $\alpha$ follows a Pareto distribution so that $g(\alpha) = \gamma L^\gamma / (\alpha^{\gamma+1})$, where $\gamma > 1$ and $\beta \gamma > 1 + \gamma$.
- Consumer demand function: $D = \eta p^{1-\epsilon}$; and pricing constraint $1 - \tau_{m,e} > l \geq \tau_{m,a} - \tau_{m,e}$ is not binding.
- The monopoly maximization problem can be rewritten as

  $$\max_{\Omega^m} \Omega^m = A(l - R - T)^{\beta \gamma}$$  \hspace{1cm} \text{(Network Profit)}

  $$\text{s.t. } B(l - R - T)^{\beta \gamma - 1} = (1 - \tau_{m,e} - l)^{\epsilon - 1}(1 + \tau_{c,e} - R)^{-\epsilon}$$  \hspace{1cm} \text{(CMC)}

  $$\frac{1 + \tau_{c,a}}{1 - \tau_{m,a}} \geq \frac{1 + \tau_{c,e} - R}{1 - \tau_{m,e} - l}.$$  \hspace{1cm} \text{(API)}

$A, B$ are functions of parameters.
Monopoly Network (Continued):

- Denote the net card price $Z = I - R$. 
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- Denote the net card price $Z = I - R$.
- Rewrite the monopoly maximization problem:

$$\max_{\Omega} \Omega^m = A(Z - T)^{\beta\gamma} \quad \text{(Network Profit)}$$

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

$$\frac{1 + \tau_{c,a}}{1 - \tau_{m,a}} \geq \frac{1 + \tau_{c,e} + Z - I}{1 - \tau_{m,e} - I}. \quad \text{(API)}$$
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Rewrite the monopoly maximization problem:

$$\max_{l} \Omega^m = A(Z - T)^{\beta\gamma}$$ (Network Profit)

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

$$\frac{1 + \tau_{c,a}}{1 - \tau_{m,a}} \geq \frac{1 + \tau_{c,e} + Z - I}{1 - \tau_{m,e} - I}.$$ (API)

Two scenarios:

- elastic demand ($\epsilon > 1$) and inelastic demand ($\epsilon \leq 1$).
Monopoly Network (Continued):

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

\[
\frac{1 + \tau_{c,e} + Z - I}{1 - \tau_{m,e} - I} = \frac{\varepsilon}{\varepsilon - 1},
\]

(FOC)

\[
B(Z - T)^{\beta\gamma^{-1}} = (1 - \tau_{m,e} - I)^{\varepsilon^{-1}}(1 + \tau_{c,e} + Z - I)^{-\varepsilon}.
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Monopoly Network (Continued):

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  \]
  \[
  \] (FOC)

- Less elastic ($\frac{1+\tau_{c,a}}{\tau_{c,a}+\tau_{m,a}} > \varepsilon > 1$) or inelastic ($\varepsilon \leq 1$) demand:
  \[
  \frac{1 + \tau_{c,a}}{1 - \tau_{m,a}} = \frac{1 + \tau_{c,e} + Z - I}{1 - \tau_{m,e} - I},
  \]
  \[
  B(Z - T)^{\beta\gamma^{-1}} = (1 - \tau_{m,e} - I)^{\varepsilon^{-1}}(1 + \tau_{c,e} + Z - I)^{-\varepsilon}.
  \]
  \[
  \] (CMC)
Monopoly Interchange Pricing: Elastic Demand

Case (1)

Case (2)
Monopoly Interchange Pricing: Inelastic Demand

Case (3)

CMC Equation ($\epsilon \leq 1$)

API Constraint

$Z^m$ $\tau_{m,a} - \tau_{m,e}$ $I^m$ $1 - \tau_{m,e}$

Case (4)

API Constraint

CMC Equation ($\epsilon \leq 1$)

$Z^m$ $\tau_{m,a} - \tau_{m,e}$ $I^m$ $1 - \tau_{m,e}$
Endogenous Variables

\[ R = I - Z; \]

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

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

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

\[ p_e = \frac{k}{1 - \tau_{m,e}}; \]

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

\[ D = \eta p_r^{-\varepsilon}; \]

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

\[ B = \frac{L^\gamma \beta^{-\gamma} k^{\varepsilon - 1}}{\eta} \left( \frac{\beta_\gamma - \gamma}{\beta^\gamma - \gamma - 1} \right) \left( \frac{K \beta}{\beta - 1} \right)^{1 + \gamma - \beta \gamma}. \]
### Equilibrium Industry Dynamics under a Monopoly Network

<table>
<thead>
<tr>
<th>I</th>
<th>R</th>
<th>Z</th>
<th>$\pi_\alpha$</th>
<th>$V_\alpha$</th>
<th>N</th>
<th>$\Omega$</th>
<th>TV</th>
<th>$P_e$</th>
<th>$P_r$</th>
<th>D</th>
</tr>
</thead>
<tbody>
<tr>
<td>Interchange fee</td>
<td>Consumer reward</td>
<td>Net card price</td>
<td>Issuer $\alpha$ profit</td>
<td>Issuer $\alpha$ volume</td>
<td>Number of issuers</td>
<td>Network profit</td>
<td>Network volume</td>
<td>Retail price</td>
<td>After-reward price</td>
<td>Card user’s consumption</td>
</tr>
</tbody>
</table>

| $\tau_{m,e}$ | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | 0 | 0 |
| merchant card cost | | | | | | | | | | |

| $\tau_{c,e}$ | | | | | | | | | | |
| --- | --- | --- | --- | --- | --- | --- | --- | --- | 0 | 0 |
| consumer card cost | | | | | | | | | | |

| T | | | | | | | | | | |
| network card cost | | | | | | | | | | |

| K | | | | | | | | | | |
| issuer entry cost | | | | | | | | | | |

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Equilibrium Industry Dynamics under a Monopoly Network (continued)

<table>
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<th>Z Net card price</th>
<th>( \pi_a ) Issuer ( a ) profit</th>
<th>( V_a ) Issuer ( a ) volume</th>
<th>N Number of issuers</th>
<th>( \Omega ) Network profit</th>
<th>TV Network volume</th>
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\[ \epsilon \geq \frac{1+\tau_{c,a}}{\tau_{c,a} + \tau_{m,e}} > 1 \]

\[ \frac{1+\tau_{c,a}}{\tau_{c,a} + \tau_{m,e}} > \epsilon \geq 0 \]

\( \tau_{m,a} \) merchand cash cost

\( \tau_{c,a} \) consumer cash cost

\( \epsilon \geq \frac{1+\tau_{c,a}}{\tau_{c,a} + \tau_{m,e}} > 1 \)
Monopoly Network: What do we learn?

- Why have interchange fees been increasing?
  - Interchange fees increase as card payments become more efficient or the issuers’ mkt becomes more competitive.
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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.
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- Why can’t merchants refuse cards?
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- Why are interchange fees lower for low-fraud transactions?
  - Different API (alternative payment instrument) constraints that card networks face in different environments.
Duopoly Networks

- Each network’s objective:

\[ U_i = \sum_{t=0}^{\infty} \delta^t \Omega^i (l_{it}, l_{jt}). \]
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- Bertrand Competition:

Minimum Interchange Fee: \( l = \tau_{m,a} - \tau_{m,e} \)
Duopoly Networks

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- Bertrand Competition:

Minimum Interchange Fee: \( I = \tau_{m,a} - \tau_{m,e} \)

- Tacit Collusion:

Trigger Strategy \( \implies \) Monopoly Interchange Fee
Top Eight Credit Card Issuers in 2004

<table>
<thead>
<tr>
<th>ISSUERS</th>
<th>VISA</th>
<th>MASTER CARD</th>
</tr>
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<tbody>
<tr>
<td></td>
<td>Rank</td>
<td># Cards (M)</td>
</tr>
<tr>
<td>JP Morgan Chase</td>
<td>2</td>
<td>48.1</td>
</tr>
<tr>
<td>Citigroup</td>
<td>3</td>
<td>28.9</td>
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<tr>
<td>MBNA</td>
<td>5</td>
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<td>Bank of America</td>
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<td>Capital One</td>
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<td>26.9</td>
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<td>HSBC</td>
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<td>10.3</td>
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<td>Providen</td>
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<td>10.1</td>
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<td>Wells Fargo</td>
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Visa and MasterCard Comparison 2004

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<th></th>
<th>Visa</th>
<th>MasterCard</th>
<th>Total</th>
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<tbody>
<tr>
<td>Merchants (M)</td>
<td>4.6</td>
<td>4.6</td>
<td>4.6</td>
</tr>
<tr>
<td>Outlets (M)</td>
<td>5.7</td>
<td>5.6</td>
<td>5.7</td>
</tr>
<tr>
<td>Cardholders (M)</td>
<td>96.2</td>
<td>96.3</td>
<td>118.5</td>
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<tr>
<td>Cards (M)</td>
<td>295.3</td>
<td>271.5</td>
<td>566.8</td>
</tr>
<tr>
<td>Accounts (M)</td>
<td>215.5</td>
<td>217.6</td>
<td>433.1</td>
</tr>
<tr>
<td>Active Accts (M)</td>
<td>115.2</td>
<td>120.1</td>
<td>235.3</td>
</tr>
<tr>
<td>Transactions (M)</td>
<td>7,286.8</td>
<td>5,286.2</td>
<td>12,573.0</td>
</tr>
<tr>
<td>Total Volume ($B)</td>
<td>722.2</td>
<td>546.7</td>
<td>1268.9</td>
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<tr>
<td>Outstandings ($B)</td>
<td>302.9</td>
<td>293.7</td>
<td>596.48</td>
</tr>
</tbody>
</table>
Policy and Welfare Analysis

- Price cut: \( I < I^m \).

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

(CMC)

The effects:

<table>
<thead>
<tr>
<th>Z</th>
<th>R</th>
<th>( \pi_\alpha )</th>
<th>( V_\alpha )</th>
<th>N</th>
<th>( \Omega )</th>
<th>TV</th>
<th>( p_e )</th>
<th>( p_r )</th>
<th>D</th>
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<tbody>
<tr>
<td>I</td>
<td>+</td>
<td>±</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>−</td>
</tr>
</tbody>
</table>
Policy and Welfare Analysis

- **Price cut:** $l < l^m$.

  \[
  B(Z - T)^{\beta \gamma^{-1}} = (1 - \tau_{m,e} - l)^{\varepsilon^{-1}}(1 + \tau_{c,e} + Z - l)^{-\varepsilon}.
  \]

  (CMC)

  The effects:

  |   |   |   |   |   |   |   |   |   |   |
  |---|---|---|---|---|---|---|---|---|
  | $I$ | + | ± | + | + | + | + | + | + |

- **Price ceiling:** $l^c < l^m$.

  \[
  B(Z - T)^{\beta \gamma^{-1}} = (1 - \tau_{m,e} - l^c)^{\varepsilon^{-1}}(1 + \tau_{c,e} + Z - l^c)^{-\varepsilon}.
  \]

  (CMC)
Interchange Ceiling: Elastic/Inelastic Demand

Case (5)

API Constraint

CMC Equation ($\varepsilon > 1$)

Case (6)

API Constraint

CMC Equation ($\varepsilon \leq 1$)
## Equilibrium Industry Dynamics under a Binding Interchange Ceiling

<table>
<thead>
<tr>
<th></th>
<th>I</th>
<th>R</th>
<th>Z</th>
<th>$\pi_\alpha$</th>
<th>$V_\alpha$</th>
<th>N</th>
<th>$\Omega$</th>
<th>TV</th>
<th>$P_e$</th>
<th>$P_r$</th>
<th>D</th>
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</thead>
<tbody>
<tr>
<td></td>
<td>Interchange fee</td>
<td>Consumer reward</td>
<td>Net card price</td>
<td>Issuer $\alpha$ profit</td>
<td>Issuer $\alpha$ volume</td>
<td>Number of issuers</td>
<td>Network profit</td>
<td>Network volume</td>
<td>Retail price</td>
<td>After-reward price</td>
<td>Card user’s consumption</td>
</tr>
<tr>
<td>$\tau_{c,e}$ consumer card cost</td>
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<td>+</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>0</td>
<td>+</td>
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<tr>
<td>$T$ network card cost</td>
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<td>+</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>0</td>
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<td>$K$ issuer entry cost</td>
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<td>+</td>
<td>±</td>
<td>+</td>
<td>−</td>
<td>+</td>
<td>−</td>
<td>0</td>
<td>+</td>
<td>−</td>
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<tr>
<td>$\tau_{m,a}$ merchand cash cost</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>$\tau_{c,a}$ consumer cash cost</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
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<tr>
<td>$\tau_{m,e}$: merchand card cost</td>
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<tr>
<td>$\varepsilon &gt; 1$</td>
<td>0</td>
<td>+</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>−</td>
<td>+</td>
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<td>$\varepsilon = 1$</td>
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<td>0</td>
<td>+</td>
<td>+</td>
<td>−</td>
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<tr>
<td>$0 &lt; \varepsilon &lt; 1$</td>
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<td>−</td>
<td>+</td>
<td>+</td>
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<td>+</td>
<td>+</td>
<td>+</td>
<td>+</td>
<td>−</td>
</tr>
</tbody>
</table>
Social Planner’s Problem

\[
\begin{align*}
\text{Max } \Omega^* &= \int_0^{Q^*} D^{-1}(Q) dQ - \frac{k(1 + \tau_{c,e} - R)}{1 - \tau_{m,e} - I} Q^* + \int_{\alpha^*}^{\infty} \pi_\alpha g(\alpha) d\alpha \quad \text{(Social Surplus)} \\
\text{s.t. } Q^* &= D\left(\frac{k}{1 - \tau_{m,e} - I}(1 + \tau_{c,e} - R)\right), \quad \text{(Demand of Goods)} \\
\pi_\alpha &= \left(\frac{\beta - 1}{\beta}\right)\left(\frac{\alpha^*}{\beta}\right)^{1-\tau}\pi(1 - R - T)^{\frac{\beta}{\beta - 1}} - K, \quad \text{(Profit of Issuer } \alpha \text{)} \\
\alpha^* &= \beta K^{\beta - 1}\left(\frac{\beta - 1}{\beta}\right)^{1-\tau}(1 - R - T)^{-\beta}, \quad \text{(Marginal Issuer } \alpha^* \text{)} \\
N &= \int_{\alpha^*}^{\infty} g(\alpha) d\alpha, \quad \text{(Number of Issuers)} \\
1 + \tau_{c,a} &\geq \frac{1 + \tau_{c,e} - R}{1 - \tau_{m,a} - I}, \quad \text{(API Constraint)} \\
1 - \tau_{m,e} &> I \geq \tau_{m,a} - \tau_{m,e}, \quad \text{(Pricing Constraint)} \\
TV &= \int_{\alpha^*}^{\infty} V_\alpha g(\alpha) d\alpha = \int_{\alpha^*}^{\infty} [(1 - R - T)]^{\frac{1}{\beta}} g(\alpha) d\alpha, \quad \text{(Total Card Supply)} \\
TD &= \frac{k}{1 - \tau_{m,e} - I} D\left(\frac{k}{1 - \tau_{m,e} - I}(1 + \tau_{c,e} - R)\right), \quad \text{(Total Card Demand)} \\
TV &= TD. \quad \text{(CMC Condition)}
\end{align*}
\]
Social Planner’s Problem

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

- Assume $\alpha$ follows a Pareto distribution so that $g(\alpha) = \gamma L^{\gamma}/(\alpha^{\gamma+1})$, where $\gamma > 1$ and $\beta \gamma > 1 + \gamma$.
- Consumer demand: $D = \eta p^{-\varepsilon}$; pricing constraint $1 - \tau_{m,e} > I \geq \tau_{m,a} - \tau_{m,e}$ is not binding.
Social Planner’s Problem

- Assume \( \alpha \) 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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  \[ 1 - \tau_{m,e} > I \geq \tau_{m,a} - \tau_{m,e} \] is not binding.

- For \( \varepsilon > 1 \), the social planner’s problem can be rewritten as

\[
\max_I \Omega^s = A(Z - T)^{\beta \gamma} + \frac{\eta}{\varepsilon - 1} p_r^{1-\varepsilon} \quad \text{(Social Surplus)}
\]

s.t. \( B(Z - T)^{\beta \gamma - 1} = (1 - \tau_{m,e} - I)^{\varepsilon - 1}(1 + \tau_{c,e} + Z - I)^{-\varepsilon}, \)  
\( \frac{1 + \tau_{c,a}}{1 - \tau_{m,a}} \geq \frac{1 + \tau_{c,e} + Z - I}{1 - \tau_{m,e} - I}. \)  
\( \text{(CMC)} \)  
\( \text{(API)} \)
Social Planner’s Problem

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

\[
\max_I \Omega^s = A(Z - T)^{\beta \gamma} + \frac{\eta}{\varepsilon - 1} p_r^{1-\varepsilon} \quad \text{(Social Surplus)}
\]

s.t. 
\[
B(Z - T)^{\beta \gamma - 1} = (1 - \tau_{m,e} - I)^{\varepsilon - 1}(1 + \tau_{c,e} + Z - I)^{-\varepsilon},
\]

\[
\frac{1 + \tau_{c,a}}{1 - \tau_{m,a}} \geq \frac{1 + \tau_{c,e} + Z - I}{1 - \tau_{m,e} - I}.
\]

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

- The analysis provides some justification for government interventions on interchange pricing.
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- The analysis provides some justification for government interventions on interchange pricing.
- However, several additional issues may complicate the results.
  - Exogenous vs. endogenous technology progress.
  - Market costs vs. social costs of payment instruments.
  - Competitive vs. monopolistic merchant markets.
  - Unintended consequences.
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- However, several additional issues may complicate the results.
  - Exogenous vs. endogenous technology progress.
  - Market costs vs. social costs of payment instruments.
  - Competitive vs. monopolistic merchant markets.
  - 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?