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

- Merchant pays $p(1-f_m)$
- Card Network pays $p(1+f_c)$
- Cardholder sells good at price $p$
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 $\alpha$ sets the cash price $p_{\alpha,c}$:
  \[(1 - \tau_m)p_{\alpha,c} = c_\alpha \implies p_{\alpha,c} = \frac{c_\alpha}{1 - \tau_m}\]

- A consumer with income $I$ purchases $x_\alpha$ units of good $\alpha$:
  \[U = \text{Max } \int_{\bar{\alpha}}^{\bar{\alpha}} \alpha \ln x_\alpha dG(\alpha) \quad \text{s.t.} \quad \int_{\bar{\alpha}}^{\bar{\alpha}} (1 + \tau_c)p_{\alpha,c}x_\alpha,l dG(\alpha) = I\]

- A consumer $I$’s demand and spending on good $\alpha$:
  \[x_{\alpha,I} = \frac{\alpha I}{(1 + \tau_c)p_{\alpha,c}E(\alpha)}, \quad p_{\alpha,c}x_{\alpha,I} = \frac{\alpha I}{(1 + \tau_c)E(\alpha)}\]

- Total market demand and spending on good $\alpha$:
  \[x_\alpha = \frac{\alpha E(I)}{(1 + \tau_c)p_{\alpha,c}E(\alpha)}, \quad p_{\alpha,c}x_\alpha = \frac{\alpha E(I)}{(1 + \tau_c)E(\alpha)}\]
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 \(k_c\).
Motivation
Model
Industry Dynamics
Simulation Results
Concluding Remarks

Card Adoption and Usage

- Merchants’ choice
  - Large merchants ($\alpha \geq \alpha_1$) accept cards and charge price $p_{\alpha,d} \leq p_{\alpha,c}$
    \[
    \alpha_1 = \frac{E(\alpha)k_m}{[E_{I>0} (I-k_c)] \left( \frac{1-f_m}{1+f_c} - \frac{1-\tau_m}{1+f_c} \right)}
    \]
  - 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 $p_{\alpha,c}$
    \[
    \alpha_0 = \frac{E(\alpha)k_m}{[E_{I>0} (I-k_c)] \left( \frac{1-f_m}{1+f_c} - \frac{1-\tau_m}{1+f_c} \right)}
    \]
  - 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 \( (V_c) \)

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

\[
V_c = \int_{\alpha}^{\alpha_1} \alpha \ln \frac{\alpha I}{(1 + \tau_c)p_{\alpha,c}E(\alpha)} dG(\alpha) + \int_{\alpha_1}^{\bar{\alpha}} \alpha \ln \frac{\alpha I}{(1 + \tau_c)p_{\alpha,d}E(\alpha)} dG(\alpha),
\]

The threshold income level \( I_0 \) for card adoption

\[
I \geq I_0 = \frac{(1 + \tau_c) E_{\alpha > \alpha_0}(\alpha) / E(\alpha) k_c}{(1 + f_c) E_{\alpha > \alpha_0}(\alpha) / E(\alpha) - \exp(\int_{\alpha_0}^{\alpha_1} \alpha \ln(\frac{p_{\alpha,d}}{p_{\alpha,c}}) dG(\alpha) / E(\alpha))}
\]
Monopoly Network vs. Social Planner

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

\[
\max_{f_c,f_m} E_{\alpha > \alpha_0}(\alpha) E_{I > I_0}(I - k_c) \frac{E(\alpha)(1 + f_c)}{E(\alpha)} (f_c + f_m - d_m - d_c)
\]

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

\[
\max_{f_c,f_m} \int_{I}^{\bar{I}} (U_{I,d} - U_{I,c})dF(I)
\]
Short-run (Transitional) Dynamics

- Two-sided market interactions

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

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

- Assume \( \alpha \in [0, 1] \) is uniformly distributed, and \( I \in [0, \infty) \) is exponentially distributed.
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 ($f_m \leq 0.03$)

<table>
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<tr>
<th>Case</th>
<th>$k_m$</th>
<th>$k_c$</th>
<th>$E(I)$</th>
<th>$\tau_m$</th>
<th>$\tau_c$</th>
<th>$d_m + d_c$</th>
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<tbody>
<tr>
<td>Case 1</td>
<td>160</td>
<td>160</td>
<td>10,000</td>
<td>0.05</td>
<td>0.05</td>
<td>(0, 0.05)</td>
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<tr>
<td>Case 2</td>
<td>120</td>
<td>200</td>
<td>10,000</td>
<td>0.05</td>
<td>0.05</td>
<td>(0, 0.05)</td>
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<tr>
<td>Case 3</td>
<td>128</td>
<td>128</td>
<td>10,000</td>
<td>0.05</td>
<td>0.05</td>
<td>(0, 0.05)</td>
</tr>
<tr>
<td>Case 4</td>
<td>160</td>
<td>160</td>
<td>12,500</td>
<td>0.05</td>
<td>0.05</td>
<td>(0, 0.05)</td>
</tr>
</tbody>
</table>
Merchant Card Fees

Consumer Card Fees

Card Markup

Card Adoption: All Merchants

Card Adoption: Category (1) Merchants

Card Adoption: Consumers

Welfare Gains: Card Users

Welfare Gains: Cash Users

Welfare Gains: All Consumers

Monopoly Outcome

Social Optimum
Figure A5: Monopoly Outcome vs. Social Optimum (Case 1)
Figure A6: Monopoly Outcome with and without An Interchange Fee Ceiling (Case 1)
Figure A6: Monopoly Outcome with and without An Interchange Fee Ceiling (Case 1)
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