Digital currency policy economics

Part 2: The industrial organization of payment markets and fintech entry

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A payment

Alice -> $8 -> Bob the baker
Illustrative cryptographic payment authorization flow

Figure 2.

Device-Centric POS Transaction Flow

Figure 3.

In-App Device-Centric Wallet Transaction Flow with Tokenization

Source: Federal Reserve Bank of Boston.
Disruptable bank-based payment system revenues

Ratio of payment revenues to GDP: North America 2.1% versus EMEA: 1.6%

A monopolistic payment service market

Alice_1

Alice_2

Alice_3

\ldots

Alice_n

Bob_1

Bob_2

Bob_3

\ldots

Bob_m

payment service provider
Two-sided markets with network effects: monopoly case

- Unit masses of Alice type and Bob type agents.

- Type-\textit{i} utility \( u_i(q_j; v_i, \gamma_i) = v_i + \gamma_i q_j \), with \textit{iid} preference coefficients \( (v_i, \gamma_i) \in \mathbb{R}_+^2 \).

- Given a type-\textit{i} total fee of \( P_i = p_i + f_i q_j \), the fraction of type-\textit{i} agents joining the platform is
  \[ q_i = D(P_i, q_j) \equiv \mathbb{P}\{(v_i, \gamma_i) : v_i + \gamma_i q_j \geq P_i\} \].

- With onboarding cost \( c_i \) and transaction cost \( \sigma \), the profit of the platform is
  \[ \max_{P_1, P_2} \sum_{i=1}^{2} (P_i - c_i) q_i - \sigma q_i q_j \].

Solving the monopoly case

- The elasticity of demand of type $i$ is

$$\epsilon_i(P_i; q_j) = -\frac{\partial D_i(P_i; q_j)}{\partial P_i} \frac{P_i}{D_i(P_i; q_j)}.$$ 

- Under mild conditions, the optimal total fee is

$$P_i = c_i + q_j(\sigma - \tilde{\gamma}_j(P_1, P_2)) + \frac{P_j}{\epsilon_i(P_i, q_j)},$$

where

$$\tilde{\gamma}_j(P_1, P_2) = \mathbb{E}(\gamma_j \mid v_j + \gamma_j q_i = P_j).$$

is the expected interaction benefit experienced by type-$j$ marginal agents.
Compare with the welfare maximizing fees

Total welfare is

\[
\sum_i \mathbb{E} \left[ (v_i + \gamma_i q_j - c_i)1_{v_i + \gamma_i q_j \geq P_i} \right] - \sigma q_i q_j.
\]

The welfare-maximal total fee is

\[
\bar{P}_i = c_i + \bar{q}_j (\sigma - \bar{\gamma}_j(\bar{P}_i, \bar{P}_j)),
\]

where

\[
\bar{\gamma}_j(\bar{P}_1, \bar{P}_2) = \mathbb{E} (\gamma_j | v_j + \gamma_j \bar{q}_i \geq \bar{P}_j)
\]

is the expected interaction benefit experienced by all participating type-\(j\) agents.

The average-less-marginal participant interaction benefit

\[
\bar{\gamma}_j(\bar{P}_1, \bar{P}_2) - \bar{\gamma}_j(P_1, P_2)
\]

is the Spence (1981) distortion.
A duopoly of payment service provision

\[ \text{PSP}_a \]

\[ \text{PSP}_b \]

Alice_1

Alice_2

Alice_3

\ldots

Alice_n

Bob_1

Bob_2

Bob_3

\ldots

Bob_n
Some strategic effects

1. The incumbent PSP\textsubscript{a} prices to protect; the entrant PSP\textsubscript{b} prices to conquer (Caillaud and Jullien 2001, 2003).

2. The incumbent PSP\textsubscript{a} can monopolize even if PSP\textsubscript{b} is equally efficient, having the same $c_1$, $c_2$, and $\sigma$.

3. Divide and conquer, by which PSP\textsubscript{b} subsidizes Alice to gain entry, works unless PSP\textsubscript{a} does the same.

4. Introductory pricing: subsidize initial customers, then increase prices, as explained for one-sided markets by Farrell and Saloner (1986), Katz and Shapiro (1986, 1992).
A duopoly of PSPs with multi-homing
Some strategic effects with multi-homing

1. When agents can multi-home, it is easier to convince them to try an entrant platform.

2. Example: Bob can join entrant PSP\(_b\) without losing access to Alice at PSP\(_a\).

3. But this does not remove customers from PSP\(_a\), so does not necessarily make firm PSP\(_a\) less attractive.

4. PSP\(_a\) keeps its incumbency advantage under multi-homing but with a reduced profit.

5. Example: With \(v_i = 0\), PSP\(_a\) can price each side at \(c_1 + c_2\) and make a profit of \(c_1 + c_2\).
Bank payment rails
Two-ledger payment system
A CBDC payment

PSP_A

message

central bank ledger

PSP_B

message

A's account

$8

B's account
Interoperability of CBDC apps is crucial for competition.

Is this CBDC payment feasible?
Open-banking rules may force banks to compete

- The EU’s Second Payment Services Directive (PSD2):
  - Third-party payment providers now have direct access to the customer’s payment account information if they have the customer’s consent.

  - TPPs can use banks’ infrastructure to facilitate payment initiation and account information services.

  - Consent is also subject to General Data Protection Regulation (GDPR), introducing potential rule conflicts.

  - Similar new rules in India, China, Brazil, Australia, …

- Forbes (2018): *With open APIs, many of the long-standing barriers to switching providers will dissipate. Big banks face the prospect that many of their customers may seek out the convenience of digital aggregators, taking their accounts, and the profit pools they represent, with them.*
Pix adoption has been rapid

![Graph showing transactions per capita over years after launch for various countries including Brazil, Chile, Denmark, Australia, UK, Singapore, India, Sweden, Mexico, and Nigeria.](chart)

Merchant costs for cards and Pix

Fast payments with competition from non-bank PSPs

- Special bank settlement agent
- Alias database
- Fast Payments System
- Non-bank PSP
- Payment initiator
- Alice
- Bob
Imagining the future digital-asset economy

Adapted from Araujo (2022)