Efficient Pricing of Large-Value Interbank Payment Systems

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1 Introduction

• Aim: develop an efficient pricing framework for a public large-value payment system (LVPS)

• Criterium: cost recovery

• Different market structures
  — monopoly LVPS
  — mixed duopoly

• Microeconomic approach, related to natural monopoly regulation (see Bös 94, Laffont and Tirole 93, Wilson 93)
1.1 Current pricing of European LVPS

• cross-border payments in TARGET (per transaction):
  — EUR 1.75 for first 100 transactions/month, EUR 1.00 for up to 1000 transactions, EUR 0.85 for more

• FEDWIRE (per month):
  — $ 0.30 for first 2500 transactions/month, $ 0.20 up to 80000 transactions, $ 0.10 for more

• Euro1 (CHIPS?):
  — entry fee; annual fee
  — volume-based (degressive) transaction fee
2 Alternative Pricing Schemes

• marginal cost pricing (marginal fee = marginal cost):
  — first best solution, but large economies of scale

• linear tariff (marginal fee = average cost)
  — marginal fee > marginal cost

• fixed tariff (fixed fee)
  — low number of users, network effects
  — low volume-users may use correspondent bank
• Volume-based pricing
  — two-part tariff
    (fixed fee + constant marginal fee)

  — menu of two-part tariffs

  — block tariff
    (non-linear pricing)
3 The Model

• Banks have a demand $q$ for making payments through a LVPS

• Banks differ in types $\theta$ (not observable)
  
  — $\theta$ may be correlated with bank size, efficiency, specialization, etc.
  
  — Assume that payment demand $q$ depends positively on $\theta$

• Tariff charged by LVPS: $T(q)$ (total fee); $T'(q)$ (marginal fee)

• Individual surplus: $v(\theta, q) - T(q)$ ("utility" - fee)

• Social surplus = surplus of all participants (+LVPS’s profits)
4 Optimal Pricing for a Monopoly LVPS

- Assume there are 2 bank types: $\theta_L < \theta_H$

- These occur with frequency $f_L, f_H$, where $f_L + f_H = 1$

- For a given tariff $T(q)$, a type-$\theta_k$ bank chooses payment volume $q_k$ to maximize its surplus.

- Banks’ optimal payment demand:
  \[ v_q(\theta, q_k) = T'(q_k) \] (marginal utility = marginal price)
The (public monopoly) LVPS’ problem

- total transaction volume in the LVPS: \( Q = f_L q_L + f_H q_H \)

- LVPS’s cost function: \( C(Q) = a + cQ \)

- budget balance: \( f_L T(q_L) + f_H T(q_H) \geq C(Q) \).

- Objective: find a tariff structure that maximizes aggregate surplus so that budget balance is achieved.

- For this, the LVPS chooses an optimal fee for each payment volume. Here: \( (q_L, T_L) \) and \( (q_H, T_H) \).
• We need to ensure that banks...

1. choose a positive payment volume (participation constraints):

   \((PC_H) : \quad v(\theta_H, q_H^*) \geq T_H\)
   \((PC_L) : \quad v(\theta_L, q_L^*) \geq T_L\)

2. choose the volume intended for their type (incentive constraints):

   \((IC_H) : \quad v(\theta_H, q_H) - T_H \geq v(\theta_H, q_L) - T_L\)
   \((IC_L) : \quad v(\theta_L, q_L) - T_L \geq v(\theta_L, q_H) - T_H\)

   (e.g. \(\theta_H\)-banks prefer \((q_H, T_H)\) over \((q_L, T_L)\) and vice versa)
Proposition 1: For a monop. LVPS, the optimal marginal prices satisfy

\[
T'(q_H) = v_q(\theta_H, q_H) = c \\
T'(q_L) = v_q(\theta_L, q_L) = c + \frac{\lambda}{1 + \lambda f_L} (\theta_H - \theta_L)
\]

where \(\lambda\) is the Lagrange multiplier of the break-even constraint.
• This implies:
  — The first best solution \( T'(q) = c \) is only obtained for high types
  — Quantity discounts: marginal tariff declines with payment volume

• "First best" solution: \( T'(q) = c \) is not attainable because of
  — budget constraint (fixed cost)
  — incentive constraints (private information)
Interpretation of "second best" solution

- The payment service gives rents to the economy

- This rent is divided between banks and LVPS

- The "harder" the budget constraint, the less rent can the banks obtain

- "optimal distortion" of $q_L$ is a trade-off:
  - a high $q_L$ increases total welfare
  - a high $q_L$ increases $\theta_H$-banks’ rent (because their incentive constraint is binding)
Figure 1: Optimal Pricing in a Public Monopoly with continuous distribution of types
5 Optimal Pricing in a Mixed Duopoly

- Consider now the mixed duopoly problem: public system (TARGET/Fedwire) and private system (e.g. Euro1/CHIPS) co-exist.

- Note: a monopoly might be more cost-effective, but we consider duopoly because of (a) benchmarking; (b) political feasibility.

- Equilibrium concept: Stackelberg equilibrium (first the public LVPS decides about pricing, then the private system reacts).

- Assume there are 3 types of banks: $\theta_L < \theta_M < \theta_H$. 
• Private LVPS cost structure: \( C_1(Q_1) = a_1 + c_1 Q_1 \) where \( a_1 > a \) and \( c_1 < c \).

• This implies that banks with high payment volume participate in private system, those with a low volume in public system.

• Assume: it is efficient that only the highest types \( \theta_H \) participate in the private system.

• The private system operates as a cooperative; maximizes aggregate member surplus under budget balance: \( f_H T_H \geq C_1(Q_1) \)

  —optimal pricing: \( T_1(q) = \frac{a_1}{f_H} + cq \).
Pricing in the Public System

- LVPS chooses tariff to maximize aggregate surplus (of all banks) under the following constraints:
  
  — budget is balanced
  
  — participation constraints (in particular: $\theta_M$-banks participate in public system (and not in private system))
  
  — incentive compatibility constraints: $\theta_L$-banks prefer $(q_L, T_L)$ over $(q_M, T_M)$ and vice versa

- Assumption: for the $\theta_M$-types, the participation constraint is binding (i.e. the tariff has to take into account that they might change to private system, and NOT that they choose volume $q_L$)
Proposition 3: The optimal marginal tariff in the public LVPS is given by

\[ T'(q_M) = c - \frac{\lambda f_L}{1 + \lambda f_M} (\theta_M - \theta_L) \]

\[ T'(q_L) = c. \]

Figure 2: Optimal Pricing in a Duopoly with 2 bank types
• In order to keep $\theta_M$-types in public system, their marginal fee has to be lowered.

• The lower type’s price does not need to be distorted because $\theta_M$-types do not want to choose their $(q_L, T_L)$-bundle.

• In order to achieve cost recovery, fixed fee is needed.

• Pricing scheme viable only if the lower type’s participation constraint is not violated (if $v(\theta_L, q_L) - T(q_L) \geq 0$). Problematic: a high fixed fee $a$. 
6 Concluding Remarks

- We analyzed the pricing structure in large-value payment systems under different market structures: monopoly; mixed duopoly

- Assuming that the objective is to maximize social welfare under a budgetary requirement, we find that a degressive pricing structure is optimal.

- Caveat: in our model, the only difference between public and private system was the cost structure (and the objective function)

- Possible extensions: different payment system characteristics; calibration