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 θ (not observable)
  - θ may be correlated with bank size, efficiency, specialization, etc.
  - Assume that payment demand q depends positively on θ
- 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 - θ_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):

$$
\begin{aligned}
(PC_H) \quad &: \qquad v(\theta_H, q_H^*) \geq T_H \\
(PC_L) \quad &: \qquad v(\theta_L, q_L^*) \geq T_L
\end{aligned}
$$

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

$$
\begin{aligned}
(IC_H) \quad &: \qquad v(\theta_H, q_H) - T_H \geq v(\theta_H, q_L) - T_L \\
(IC_L) \quad &: \qquad v(\theta_L, q_L) - T_L \geq v(\theta_L, q_H) - T_H
\end{aligned}
$$

(e.g. θ_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

$$\begin{aligned} T'(q_H) &= v_q(\theta_H, q_H) = c \\ T'(q_L) &= v_q(\theta_L, q_L) = c + \frac{\lambda}{1+\lambda}\frac{f_H}{f_L}(\theta_H - \theta_L) \end{aligned}$$

where λ 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 θ_H-banks' rent (because their incentive constraint is binding)

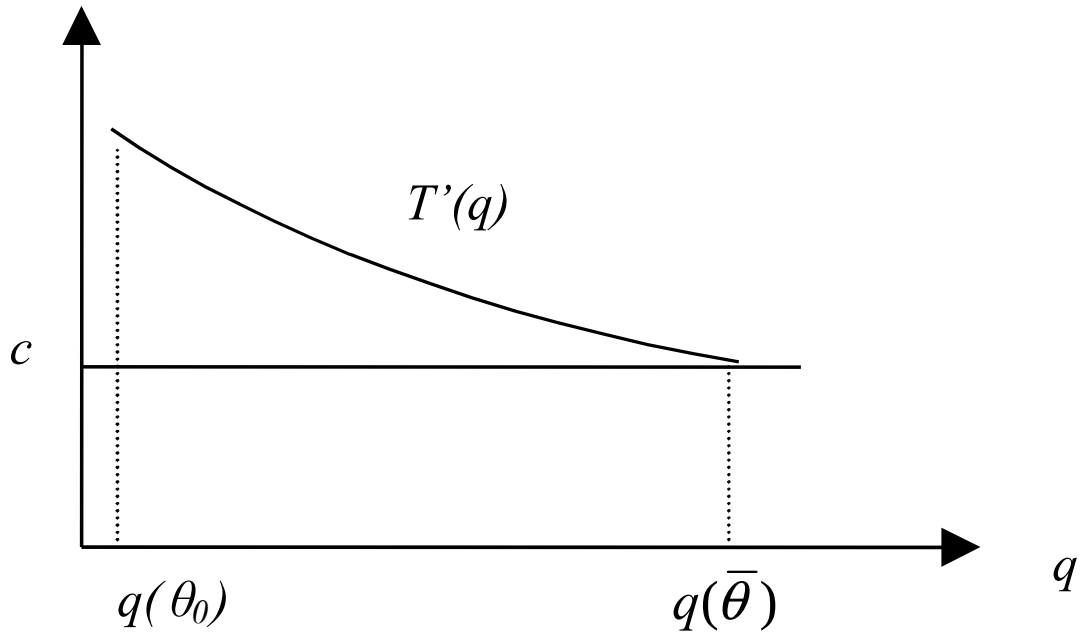

Figure 1: Optimal Pricing in a Public Monopoly with continuous distribution of types

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 θ_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: θ_M-banks participate in public system (and not in private system))
  - incentive compatibility constraints: θ_L-banks prefer (q_L, T_L) over (q_M, T_M) and vice versa
- Assumption: for the θ_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

$$
\begin{aligned}
T'(q_M) &= c - \frac{\lambda}{1+\lambda}\frac{f_L}{f_M}(\theta_M - \theta_L) \\
T'(q_L) &= c.
\end{aligned}
$$

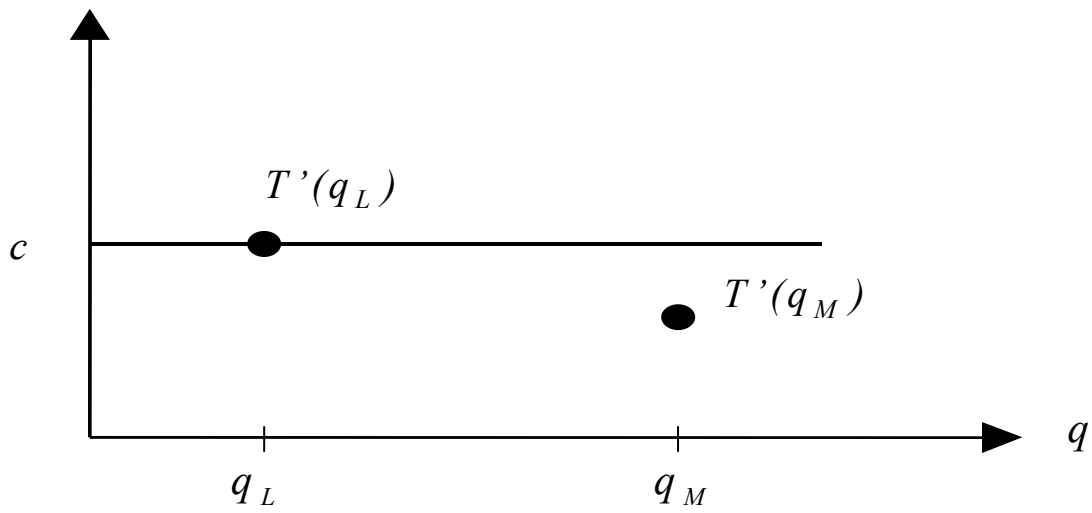

Figure 2: Optimal Pricing in a Duopoly with 2 bank types

- In order to keep θ_M-types in public system, their marginal fee has to be lowered.

- The lower type's price does not need to be distorted because θ_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