Access Pricing and Entry in the Postal Sector^{*}

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Abstract

Postal markets are open to competitor for a long time. But, with a few exceptions, the competitors of the incumbent postal operator are currently active on the upstream segments of the market -preparation, collection, outward sorting and transport of mail products. With the further steps planed in the liberalization process, there are new opportunities to extend competition to the downstream segments of the market -the delivery of mails. In the future, two business model will be possible for the new postal operators: (1) access: where the firm perform the upstream operations and uses the incumbent's delivery network and (2) bypass where the competing firm controls the entire supply chain and delivers mails with its own delivery network. These two options have a different impact on both the welfare and the profit of the historical operator. In particular, bypass raises severe concerns for the financing of the universal service obligations.

The choice between access and bypass depends on the entrant's delivery cost relative to the cost of buying access to the incumbent operator (the access price). In this paper, we derive optimal -welfare maximizing- stamp and access prices for the incumbent operator when

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these prices have an impact on the delivery method chosen by the entrant. We show how prices should be re-balanced when the entry method is considered as endogenous i.e. affected by the incumbent's prices.

1 Introduction

This paper concentrates on the ongoing liberalization process of the postal sector in the European Union. It particularly focuses on the entry of new postal operators on the downstream segments of the postal market (the delivery of mails).

Competition in the postal sector raises a major concern for the financing of the universal service obligations (USO) imposed to the incumbent operators. USO includes the requirement to serve all customers (universality/ubiquity), the imposition of a geographically uniform tariff for a bundle of products, obligations in term of service quality (frequency of delivery, accessibility of contact points) and constraints on prices. It is commonly accepted that universal service obligations are associated with large fixed costs for the universal service provider (USP).¹

For the moment, the universal service obligations are (partially) financed by monopoly profits in the reserved areas. As these reserved areas will disappear, so will the associated monopoly profits (or at least part of them). And, in this case, the future of USO is no longer guaranteed and the financing of the USO is then a major concern for both the regulator (or the State) and the USP. What is the extent of this problem will obviously depend on the scope of the USO and the importance of competition on the postal markets.

Maintaining the USO in a competitive market is then a source of tension. To overcome this potential problem, there are proposal to limit the scope of the USO and/or to limit competition to the upstream segments of the market.² Moreover, the welfare impact of entry of competitors on the postal markets is not clear-cut. For example, Crew and Kleindorfer (2005) estimate that the impact on welfare of allowing downstream bypass is negative.

This paper particularly concentrates on the impact of the incumbent's pricing behavior on the entry of the competitors on the postal market. A

¹Cazals et al. (1997), Cremer et al. (1997).

²references

potential competitor of the incumbent postal operator has different entry strategies: it can either deliver its mails using the existing delivery network of the incumbent operator (downstream access) or it can deliver its mails using its own delivery network (downstream bypass). If the competitor chooses downstream access, it performs itself all the upstream operations (collection, sorting, transport) and uses the incumbent's delivery network for which it pays an access price. If the competitor chooses downstream bypass, it performs itself all the upstream and downstream operations.

In Sweden, City Mail chooses the downstream bypass option and delivers mails with its own delivery network. But, City Mail has a limited geographical coverage. In the UK, UK-Mail (and many others) offers E2E mail services but the mails collected by UK-Mails are ultimately delivered by the incumbent operator, Royal Mail (downstream access).

This paper builds up on the literature on efficient access pricing in the postal sector (De Donder (2004), Billette de Villemeur et al. (2005), Laffont and Tirole (1994, 2000)). In the efficient access pricing approach, the incumbent's stamp and access prices are derived by maximizing the total welfare while guaranteeing a non-negative profit for the firms. If USO obligations are imposed (or if there are fixed costs in the delivery activity), the access price paid by the entrant to the incumbent operator is equal to the incumbent's marginal cost of delivery plus a mark-up. This mark-up aims at covering part of the fixed costs associated with the incumbent's USO. It can be decomposed into a 'Ramsey term' and a 'displacement term'. For each product, including access, the Ramsey term is inversely related to the product's price elasticity. Products for which the demand is highly sensitive to prices are charged a lower mark-up than those who are relatively less price sensitive. The displacement term is the product of the incumbent's margin on its E2E products and the displacement ratio who measures the substituability between the incumbent's and the entrant's products. If the entrant attracts a large fraction of the incumbent's consumers (the displacement ratio is high),

competition creates serious concerns for the USO financing. Therefore, the regulator will set a high access charge to levy a large contribution to the USO financing from the entrant. Conversely, if the entrant offers innovative products and attract few consumers from the incumbent but rather attracts new consumers, its contribution to the USO financing will be lower.

All these papers consider as given the entrant's delivery method -access or bypass. In this paper, we consider this choice as endogenous. The choice of one of these strategies depends (1) on the entrant's technology and in particular its delivery costs and (2) on the incumbent's products and access prices. Our objective in this paper is to derive efficient stamp and access prices when the entrant's delivery method is affected by those prices.

Overview of the results.

In this paper, we start by deriving the efficient access and stamp prices in the case where the entrant buys access to the incumbent's delivery network and in the case in which it bypass and builds up its own delivery network. We start our analysis by considering that the incumbent's stamp prices depend on the delivery region (non-uniform tariff). In the case of downstream access, the access price is equal to delivery cost plus a Ramsey term plus a displacement term. Under bypass, there are two modifications in prices: (1) the tariff is a rebalanced and the incumbent is relatively more aggressive on the urban market where it faces competition. (2) Because the USP looses access receipts, there is an overall increase of all its prices to cover the fixed costs associated with the USO.

Then, we compute the efficient technological choice for delivering the mails of the entrant. The welfare maximizing choice of a delivery method is to access if the entrant's *marginal* cost of delivery is higher than the incumbent's *marginal* cost. We show that the efficient prices induce too much bypass from a welfare point of view. In other words, if the entrant is free to choose its delivery technology, there exists a range of parameters where access is efficient but the firm chooses bypass.

We then modify the access and retail prices in order to induce the efficient amount of bypass by the entrant. For that, access price should decrease and we show how access and retail prices should be modified to take into account the technological choice of the entrant.

When a uniform tariff is imposed on the USP, the incumbent postal operator has less freedom to set prices and it therefore has an impact on the entry strategy of the competitor. As urban mail price increases, the entrant is able to capture a larger fraction of the urban mail demand with a given price. In other words, the displacement ratio is higher. As a consequence, the efficient access price increases which makes bypass more attractive for the entrant. Then, inducing the efficient choice of access requires more distortion in the prices than in the case of non-uniform tariff. This means that the cost in term of welfare of having an efficient delivery method is higher.

In this paper, we show how efficient prices should be set when the type of entry is considered as endogenous. We derive the modifications in the pricing scheme that should be applied in this case to countervail the incentives of the entrant to bypass and builds up its own delivery network.

By doing that, we consider two different cases. In the first, the regulator and the USP knows the entrant's delivery technology. They can therefore perfectly anticipate the entrant's choice of a delivery method. In the second case, the regulator and the USP only have a knowledge of the prior distribution of the entrant's delivery costs. This uncertainty on cost translates into an uncertainty on the choice of a delivery method. In this case, the probability of entry with bypass is endogenous and it depends on the access and stamp prices.³ We show that the probability of bypass is positive when the cost is unknown. It therefore means that the choice of a delivery method could be ex-post inefficient.

Our approach differs from the Efficient Component Pricing Rule (ECPR)

³This part of the paper is closely related to Dam and Gautier (2006) who develop super-elasticities formulas that applies when the entry on the market is endogenous.

who also takes the market structure as endogenous. In the ECPR approach (Armstrong (2001) for example), it is efficient to have one producer serving the entire market segment. The ECPR pricing rule is then designed to select the most efficient producer. By setting the access price equals to the incumbent's opportunity cost i.e. its retail price minus its cost, the ECPR gives right signals to the entrants. They enter the market only if they are more efficient than the incumbent operator. In our approach, the prices are not designed to select the most efficient producer but to maximize the welfare taking into account that the regulator does not control the choice of the delivery method by the entrant.⁴

The contribution of this paper is paper to analyze the impact of pricing on the entry strategy of the competitor i.e. how prices should be adapted to take into account their impact on the entry behavior of the competitors. By doing so, we neglect other issues as, for example, the reform of the USO. Clearly, relaxing some of the USO constraints is another possible way to overcome the problem of USO financing in a competitive market (see Crew and Kleindorfer 2005).

2 Model

There are two postal operators on the market: an incumbent postal operator -we call it firm 1- and an entrant -firm 2-. By assumption, USO are imposed to firm 1 only and the regulatory regime is an asymmetric one: firm 1 is fully regulated while firm 2 is not. However, we will assume that firm 2 behaves competitively.

Mails are delivered in two delivery zones: a high density region (urban) and a low density region (rural). Delivery costs depend on the population density and differ in the two regions.

 $^{^4\}mathrm{It}$ is only in few circumstances that the ECPR and efficient prices coincides. See for example Laffont and Tirole, 2000, Armstrong, Doyle and Vickers, 1996

Each postal operator offers end-to-end (E2E) mails to consumers. Firm 1 delivers mails to both regions. This ubiquity constraint is part of the USO imposed to the incumbent. Firm 2 serves only the most profitable, urban, region. In the sequel, we use indices i = 1, 2 to refer to firms and exponents k = u, r to refer to the delivery zone. The mail products of the two firms are differentiated. For example, the incumbent operator offers J+1 E2E mails to the customers while the entrant offers mail services with a lower frequency of delivery. Customers view the two products as imperfect substitutes.

There are two types of costs associated with the production of E2E mails: an upstream and a downstream (delivery) costs. We represent by c_i , the unit cost of all the upstream operations (collection, sorting, transport,....) for firm i = 1, 2. This upstream cost is independent of the delivery region. Because of the universal service obligations imposed to firm 1, the two firms have a different cost structure for their delivery activities. For the universal service provider, delivery costs are mainly fixed costs. We denote this fixed cost by F. In addition, there is a unit cost of d_1^u (resp. d_1^r) per mail delivered in the urban (resp. rural) area. Delivery costs are higher in the rural region: $d_1^r > d_1^u$. Firm 2 has a more flexible cost structure with no fixed cost and only variable costs. For the entrant, the unit cost of delivering one mail in the urban region is d_2^u . The entrant can avoid this delivery cost by buying access to the delivery network of firm 1. In this case, it pays a per-unit access charge denoted by α^u to firm 1 and firm 1 supports the delivery cost d_1^u .

The net surplus of a representative consumer who sends x_i^k mails to zone k with the incumbent (i = 1) and x_2^u mails to the urban zone with the entrant is:

$$U(x_1^u, x_1^r, x_2^u) - p_1^u x_1^u - p_1^r x_1^r - p_2^u x_2^u$$

where the p_i^k are the prices charged by firm *i* for their E2E mails delivered in zone *k*.

The maximization of this surplus function gives the demand for each type of mail x_i^k . We will make the following assumptions on the demand functions:

1. $\frac{\partial x_1^u}{\partial p_1^r} \le 0$ and $\frac{\partial x_1^r}{\partial p_1^u} \le 0$ 2. $\frac{\partial x_2^u}{\partial p_1^r} = 0$ and $\frac{\partial x_1^r}{\partial p_2^u} = 0$

Part 1 means that consumers give a positive value to the ubiquity of the service offered by the USP. Urban and rural mails offered by firm 1 are thus complements. In addition, the demand functions satisfies the standard following properties: $\frac{\partial x_i^k}{\partial p_i^k} < 0$, $\frac{\partial x_i^u}{\partial p_j^u} > 0$ and $\left|\frac{\partial x_i^u}{\partial p_i^u}\right| \geq \frac{\partial x_i^u}{\partial p_j^u}$.

In the sequel, we use elasticities in the pricing formulas. These elasticities are defines as follow:

Definition 2.1

- 1. The direct price elasticity (in absolute value) of a product sold by firm i in region k is: $\eta_i^k = -\frac{dx_i^k}{dp_i^k} \frac{p_i^k}{x_i^k}$.
- 2. The cross price elasticity of a product sold by firm *i* on the urban market is, for i, j = 1, 2: $\eta_i^{uu} = \frac{dx_i^u}{dp_i^u} \frac{p_j^u}{x_i^u}$.
- 3. The intra-brand price elasticities for firm 1 are: $\eta_1^{ur} = \frac{dx_1^u}{dp_1^r} \frac{p_1^r}{x_1^u}$ and $\eta_1^{ru} = \frac{dx_1^r}{dp_1^u} \frac{p_1^u}{x_1^r}$.

Consistent with our assumptions, we have positive cross price elasticities and negative intra-brand price elasticities.

The total welfare is the sum of the consumer's and producers' surplus:

$$W = U(x_1^u, x_1^r, x_2^u) - (c_1 + d_1^u)x_1^u - (c_1 + d_1^r)x_1^r - (c_2 + \theta d_1^u + (1 - \theta)d_2^u)x_2^u - F \quad (2.1)$$

where θ is a dummy variable that has a value of one if firm 2 chooses to buy access to deliver its mails and equals to zero if it chooses bypass. The aim of the regulator is to set the stamp prices p_1^u , p_1^r and the access price α^u in order to maximize the total welfare W. We will consider sequentially two cases. In the first one, the stamp price for mails to the urban and the rural area can be different. In the second one, a geographically uniform tariff is imposed: $p_1^u = p_1 = p_1^r$.

Firm 2 behaves as a competitive fringe. The competitive fringe assumption means that its product is sold at marginal cost. Since this cost depends on the delivery method, the stamp price charged by firm 2 is for its urban mail is:

$$p_2^u = c_2 + \alpha^u$$
 if firm 2 chooses access,
 $p_2^u = c_2 + d_2^u$ if firm 2 chooses bypass.

With this marginal cost pricing rule, the profit of firm 2 is in any case equals to zero. We therefore assume that firm 2 chooses the delivery technology with the lowest cost, that is access if $\alpha^u \leq d_2^u$ and bypass otherwise.

3 Non-uniform pricing.

In this section, we derive the welfare maximizing prices when the regulator can set a different stamp prices for mails delivered in the urban and the rural regions.

3.1 Access

Suppose that firm 2 uses firm 1 delivery network for which it pays an access fee of α^u per mail distributed. If firm 2 chooses access, the welfare is:

$$W^{a} = U(x_{1}^{u}, x_{1}^{r}, x_{2}^{u}) - (c_{1} + d_{1}^{u})x_{1}^{u} - (c_{1} + d_{1}^{r})x_{1}^{r} - (c_{2} + d_{1}^{u})x_{2}^{u} - F$$

The regulator selects the prices that maximize the welfare and that guarantee to firm 1 a non-negative profit i.e. firm 1 is able to cover its costs (including the fixed cost of the USO) with its receipts from E2E mails and from access. This zero profit constraint is:

$$\Pi_1^a = (p_1^u - c_1 - d_1^u)x_1^u + (p_1^r - c_1 - d_1^r)x_1^r + (\alpha^u - d_1^u)x_2^u - F \ge 0$$
(3.2)

Firm 2 sells its mail product at marginal cost and charge a price equals to:

$$p_2^u = c_2 + \alpha^u \Rightarrow \Pi_2 = 0 \tag{3.3}$$

The regulator's objective is to find the stamp prices for the incumbent and the access price that maximize the welfare subject to the constraint (3.2). We denote by λ the Lagrange multiplier of the zero profit constraint for firm 1. (3.3) implies that the derivative of the demand x_i^k with respect to α^u is equal to the derivative of x_i^k with respect to p_2^u . The first order conditions to this problem read as follow:

$$(1+\lambda)\left((p_1^u - c_1 - d_1^u)\frac{\partial x_1^u}{\partial p_1^u} + (p_1^r - c_1 - d_1^r)\frac{\partial x_1^r}{\partial p_1^u} + (\alpha^u - d_1^r)\frac{\partial x_2^u}{\partial p_1^u}\right) + \lambda x_1^u = 0$$
(3.4)

$$(1+\lambda)\left((p_1^u - c_1 - d_1^u)\frac{\partial x_1^u}{\partial p_1^r} + (p_1^r - c_1 - d_1^r)\frac{\partial x_1^r}{\partial p_1^r}\right) + \lambda x_1^r = 0$$
(3.5)

$$(1+\lambda)\left(\left(p_1^u - c_1 - d_1^u\right)\frac{\partial x_1^u}{\partial p_2^u} + \left(\alpha^u - d_1^r\right)\frac{\partial x_2^u}{\partial p_2^u}\right) + \lambda x_2^u = 0$$
(3.6)

This type of first order conditions are standard in efficient access pricing problems (see for example De Donder, 2004). Rearranging the terms in the first order conditions, we can express the prices as the sum of three terms: price = marginal cost + a Ramsey term + a displacement term. That is:

$$\alpha^{u} = d_{1}^{u} + \frac{\lambda}{1+\lambda} \frac{p_{2}^{u}}{\eta_{2}^{u}} + (p_{1}^{u} - c_{1} - d_{1}^{u})\sigma^{u}$$
(3.7)

where η_2^u is the price elasticity of urban mail of firm 2 (in absolute value) and $\sigma^u \in [0, 1]$ is the displacement ratio: $\sigma^u = -\frac{dx_1^u/dp_2^u}{dx_2^u/dp_2^u}$.

Similarly, the stamp prices for the incumbent's mails are:

$$p_1^u = c_1 + d_1^u + \frac{\lambda}{1+\lambda} \frac{p_1^u}{\eta_1^u} + \tilde{\sigma}^u (\alpha^u - d_1^u) + \sigma^{ur} (p_1^r - c_1 - d_1^r), \qquad (3.8)$$

$$p_1^r = c_1 + d_1^r + \frac{\lambda}{1+\lambda} \frac{p_1^r}{\eta_1^r} + \sigma^{ru} (p_1^u - c_1 - d_1^u), \qquad (3.9)$$

where η_1^k is the price elasticity of mails sent to region k by firm 1 and $\tilde{\sigma}^u \in [0,1] = -\frac{dx_2^u/dp_1^u}{dx_1^u/dp_1^u}$, $\sigma^{ur} \in [-1,0] = -\frac{dx_1^r/dp_1^u}{dx_1^u/dp_1^u}$ and $\sigma^{ru} \in [-1,0] = -\frac{dx_1^u/dp_1^r}{dx_1^r/dp_1^r}$. Solving this system, the efficient prices can be expressed as:

$$L_{1}^{u} \equiv \frac{p_{1}^{u} - c_{1} - d_{1}^{u}}{p_{1}^{u}} = \frac{\lambda}{1+\lambda} \left(\frac{1}{\hat{\eta}_{1}^{u}} + \gamma_{1}^{u}\right), \qquad (3.10)$$

where $\hat{\eta}_1^u = \frac{\eta_1^r \eta_1^u - \eta_1^{ru} \eta_1^{ur}}{\eta_1^r + \eta_1^{ru}}$ and $\gamma_1^u > 0$. Similarly,

$$L_{1}^{r} \equiv \frac{p_{1}^{r} - c_{1} - d_{1}^{r}}{p_{1}^{r}} = \frac{\lambda}{1 + \lambda} \left(\frac{1}{\hat{\eta}_{1}^{r}} + \gamma_{1}^{r}\right), \qquad (3.11)$$

where $\hat{\eta}_1^r = \frac{\eta_1^r \eta_1^u - \eta_1^{ru} \eta_1^{ur}}{\eta_1^u + \eta_1^{ur}}$ and $\gamma_1^r < 0$. For convenience, the technical analysis is relegated to the appendix.

To start the discussion of these optimal prices, it is convenient to recall that, in the absence of competition, the optimal stamp price in region k would be set at a level such that $\frac{p_1^k - c_1 - d_1^k}{p_1^k} = \frac{\lambda}{1+\lambda} \frac{1}{\hat{\eta}_1^k}$. In other words, the optimal prices for a monopolist are inversely related to the so-called super-elasticities of its products.⁵ Because urban and rural mails are complements, we have $\hat{\eta}_1^k > \eta_1^k$.

How prices are modified when there is a competitor that buys access? There are two main modifications. First, if entry is not neutral with respect to the incumbent's profit i.e. if the access receipts less than compensate the lost receipts from the customers, there is an overall increase in prices. This change is captured by an increase in the value of the Lagrange multiplier λ . Second, the tariff is rebalanced. This change is captured by the ' γ ' terms in the above expressions. This ' γ ' term is positive on the urban market and negative in the rural market. The displacement ratios explain these modifications in the prices.

 $^{^5\}mathrm{Laffont}$ and Tirole, 2000.

In the sequel, we denote by p_1^{ka} and α^* , the optimal prices that the regulator applies if the entrant buys access.

3.2 Bypass

Now suppose that firm 2 bypass the incumbent's delivery network. The regulator selects the prices p_1^k in order to maximize:

$$W^{b} = U(x_{1}^{u}, x_{1}^{r}, x_{2}^{u}) - (c_{1} + d_{1}^{u})x_{1}^{u} - (c_{1} + d_{1}^{r})x_{1}^{r} - (c_{2} + d_{2}^{u})x_{2}^{u} - F$$

subject to:

$$\Pi_1^b = (p_1^u - c_1 - d_1^u)x_1^u + (p_1^r - c_1 - d_1^r)x_1^r - F \ge 0$$
(3.12)

Firm 2 sell its mail product at marginal price which gives in the case of bypass:

$$p_2^u = c_2 + d_2^u \Rightarrow \Pi_2 = 0 \tag{3.13}$$

In the case of bypass, there is (by definition) no access receipts and therefore the value of α^u is not meaningful in this case. The first order conditions can be expressed as:

$$p_1^u = c_1 + d_1^u + \frac{\lambda}{1+\lambda} \frac{p_1^u}{\eta_1^u} + \sigma^{ur} (p_1^r - c_1 - d_1^r), \qquad (3.14)$$

$$p_1^r = c_1 + d_1^r + \frac{\lambda}{1+\lambda} \frac{p_1^r}{\eta_1^r} + \sigma^{ru} (p_1^u - c_1 - d_1^u).$$
(3.15)

If we compare prices under bypass with those that are applied under access, there are two main differences: (1) the prices are re-balanced: urban mail for which firm 1 faces competition is relatively cheaper in the case of bypass than in the case of access. Comparing (3.8) and (3.14), the positive displacement term has disappear in the case of bypass. (2) There is an overall increase in stamp prices. Since firm 1 does not collect any access receipts, the financial burden of the USO is supported by the mark-up on its product only. As a consequence, prices should be increase (i.e. λ increases).

Solving the system, the prices can be inversely related to the superelasticity of the products:

$$L_1^k \equiv \frac{p_1^k - c_1 - d_1^k}{p_1^k} = \frac{\lambda}{1 + \lambda} \frac{1}{\hat{\eta}_1^k}$$
(3.16)

Under bypass, the price structure is similar to the monopoly prices but the overall level of prices is higher since the firm faces a stronger financial constraint. In other words, the firm should raise its prices to compensate the lost receipts on the urban market due to the presence of the competitor.

In the sequel, we denote the prices under bypass as p_1^{kb} .

3.3 Access vs. Bypass

Suppose for a while that the regulator can control the delivery method chosen by the entrant. We then compare the welfare under bypass and access, W^a and W^b . The idea is to derive the welfare maximizing delivery method. We establish that:

PROPOSITION 3.1 It exists a cutt-off point for the delivery cost on the urban market such that: (1) $d^* < d_1^u$ and (2) $W^a \ge W^b$ for all $d_2^u \ge d^*$.

PROOF We first show that $W^a \ge W^b$ for any $d_2^u \ge d_1^u$ (with strict inequality if $d_2^u > d_1^u$). The reasoning is the following. One could easily replicate the bypass prices in a model with access, by setting $\alpha^u = d_2^u$, $p_1^{ua} = p_1^{ub}$, $p_1^{ra} = p_1^{rb}$. Let us call $\overline{W^a}$ the welfare you would get by doing that. As long as $d_2^u \ge d_1^u$, $\overline{W^a} \ge W^b$. Furthermore, as $\alpha \ge d_1^u$, $\overline{\Pi_1^a} = \Pi_1^b + (\alpha - d_1^u)x_2 \ge \Pi_1^b = 0$. So the choice $\alpha = d_2^u$, $p_1^{ua} = p_1^{ub}$, $p_1^{ra} = p_1^{rb}$ is a feasible choice for the regulator. By a revealed preference argument, we thus have: $W^a \ge \overline{W^a} \ge W^b$. Suppose $d_2^u = d_1^u$. We can still show $W^a > W^b$. The argument is that the optimal choice of α must involve $\alpha^* > d_1^u$ (see the equation characterizing the optimal choice of α). Intuitively, the regulator prefers that the incumbent make a positive profit on the market where prices are not distorted, rather than raise prices to make sure that the profit constraint is satisfied.

As W^a and W^b are continuous functions of d_2 and d_1^u , this shows that there exists $\varepsilon > 0$ such that $W^a \ge W^b$ for all $d_1^u \ge d_2 - \varepsilon$

This proposition means that as long as the entrant's marginal cost of delivery is higher than the incumbent's marginal cost of delivery in the urban area, access is the efficient (welfare maximizing) delivery method. The reasoning behind this result is the following: under access, the regulator can replicate the prices that applies under bypass: $p_1^{ra} = p_1^{rb}, p_1^{ua} = p_1^{ub}$ and $p_2^{ua} = p_2^{ub}$ if $\alpha = d_2^u$. With these prices, the welfare levels under access (we call it \overline{W}^a) is the same than under bypass. But, if the access price is above the marginal cost of delivery, the incumbent has a positive profit. Hence, the regulator can adapt the prices under access to lower the incumbent's profit and pass the welfare gains to consumers.

If the two firms have identical delivery costs, the regulator still prefers access to bypass, since it raises money to finance the USO with access but not with bypass. By continuity of the welfare functions, this must hold also for $d_1^u \ge d_2^u - \varepsilon$.

We have assumed that the two firms have a different cost structure for their delivery activity. Because of the USO, the incumbent's delivery technology is associated with fixed costs, in addition to the marginal costs (which are specific to the delivery region). Of course, the relative importance of the fixed costs depends on the scope of the USO and limiting the scope of the USO would lead to a change in the incumbent's cost structure: lower fixed costs and higher variable costs. The entrant has only variable costs for its delivery activity. A key point in proposition 3.1 is that the efficient delivery technology is determined by comparing the *marginal* costs. Since the USO must be financed anyway, as long as the entrant contributes to its financing access is preferred to bypass.

A couple of remarks should be made. First, a key assumption for the result of proposition 3.1 is that the quality of the entrant's product is independent of the delivery technology chosen. The two firms sell different products but the entrant sells the same product with the two delivery methods. In other words, it is assumed that the entrant cannot increase its product quality by controlling the whole supply chain. Of course, if it was not the case the welfare under bypass would be higher and the parameter space under which bypass is efficient would increase. Second, we take as granted that the USO is financed by the USP's profits and the access receipts. We then neglect other financing methods envisaged in the postal sector like a compensation fund. A possibility that is explicitly provided in French postal law (but not yet used). Third, we implicitly assume that upstream competition is welfare enhancing. This is in fact the case if the entrant's product is sufficiently differentiated and/or the upstream cost c_2 is not too big compared to c_1 .

We now turn to the key issue of the paper. In fact, the choice of the delivery method is not in the hand of the regulator as we assumed in proposition 3.1 but left to the firm. And firm 2 chooses access whenever $\alpha^* \leq d_2^u$. Consequently, for all the values of $d_2^u \in [d^*, \alpha^*]$, the firm chooses bypass while access is socially preferred. This impact of prices on the delivery method should be incorporated in the design of the optimal prices. In the next subsection, we then derive a constrained access solution where the regulator induces the efficient technological choice by the entrant.

3.4 Constrained access

In the constrained access case, the regulator maximizes the welfare W^a under the additional constraint that $\alpha^u \leq d_2^u$. This constraint aims at inducing an efficient technological choice by firm 2. When this constraint binds, the efficient stamp prices for the incumbent operator are:

$$\frac{p_1^u - c_1 - d_1^u}{p_1^u} = \frac{\lambda}{1 + \lambda} \frac{1}{\hat{\eta}_1^u} + (d_2^u - d_1^u)\gamma_1^{\prime u}$$
(3.17)

$$\frac{p_1^r - c_1 - d_1^r}{p_1^r} = \frac{\lambda}{1 + \lambda} \frac{1}{\hat{\eta}_1^r} + (d_2^u - d_1^u)\gamma_1^{\prime r}, \qquad (3.18)$$

with $\gamma_1^{\prime u} > 0$ and $\gamma_1^{\prime r} < 0$.

The structure of price under constrained access is similar to the structure under access. The main difference is that the ' γ ' terms are weighted by the difference in the marginal costs of delivery.

With constrained access, the welfare level attained is $\overline{W^a}$. We can show that:

PROPOSITION 3.2 When the regulator takes into account the impact of the access price on the entrant's delivery method, the efficient delivery method is access for $d_1^u \leq d_2^u$ and bypass for $d_1^u \geq d_2^u$.

PROOF The proof is a follow. (1) For $d_1^u \leq d_2^u$, $\overline{W^a} \geq W^b$: this part is obvious (see the proof of 3.1).

(2) For $d_1^u \ge d_2^u$, $\overline{W^a} \le W^b$

Suppose that $d_2^u \leq d_1^u$. We will show that $W^b \geq W^a$ (with strict inequality if $d_2 < d_1^u$), so that the regulator prefers bypass to access. Consider the optimal choice of prices under access, and let $p_1^{ub} = p_1^{ua}$, $p_1^{rb} = p_1^{ra}$. Notice that $p_2 = d_2 + c_2 = c_2 + \alpha$ both under bypass and access. Let $\overline{W^b}$ be the welfare value of bypass under these prices. Because $d_2 \leq d_1^u$, $W^a \leq \overline{W^b}$. Now, notice that $\overline{\Pi_1^b} = \Pi_1^a + (d_1^u - d_2)x_2 \geq \Pi_1^a = 0$, so these prices are feasible in the case of bypass. Again, by a revealed preference argument, we have: $W^b \geq \overline{W^b} \geq W^a$.

Notice that, if $d_2^u = d_1^u$, then $\overline{W^a} = W^b$. In fact, if $d_2^u = d_1^u$, the optimal choices of p_1^u and p_1^r are the same under access and bypass, because the two

problems faced by the regulator are exactly identical. \blacksquare

This shows that the regulator will always promote bypass if $d_2^u \leq d_1^u$ and access if $d_2 \geq d_1^u$. This is the "technically efficient" solution, but it is not welfare maximizing. If he could, the regulator would like to favor access for some values such that $d_2^u \leq d_1^u$. On the other hand, the regulator will never want to favor bypass for some values such that $d_2^u \geq d_1^u$. So there might be excess bypass, but there will never be excess access.

This important proposition means that first, by modifying the prices, the regulator is able to induce an efficient technological choice by the entrant. This efficient choice is based on the comparison of the *marginal* costs of delivery. Access is efficient if the incumbent has a lower marginal cost, bypass is efficient if the entrant has a lower marginal cost. This efficient choice once the impact of prices on the technical choice of the entrant is taken into account does correspond to the welfare maximizing choice. Second, there is cost in term of welfare of inducing an efficient choice of the delivery method. This cost can be measured by the positive difference between W^a and $\overline{W^a}$.

This result is central to our paper. It shows that the regulator can implement the efficient level of competition; upstream only in the case of access or upstream and downstream in the case of bypass. And this can be done by manipulating the regulated prices. It is then of prime importance for the regulator to take into account the impact that prices have on the choice of a delivery method.

We now analyze the case in which the regulator is unaware of the true cost of the entrant d_2^u but it has only a prior knowledge of the distribution of this cost. This uncertainty on the cost implies that for a triple (p_1^u, p_1^r, α^u) , the regulator does not know whether the entrant chooses access or bypass. The uncertainty on the cost translates into an uncertainty on the choice of a delivery method. In this case, the regulated prices influence the probability that the entrant chooses a delivery method rather than the other. Before analyzing this point, we briefly describe the case in which a uniform tariff is imposed to the incumbent.

3.5 Uniform tariff

In the postal sector, a geographically uniform tariff is often imposed as part of the universal service obligations. When a unique stamp price p_1 is applied for urban and rural mails, urban mails are relatively more expensive while rural mails are relatively less expensive: $p_1^u \leq p_1 \leq p_1^r$. What are the consequence of the uniform tariff on the access vs bypass decision of the entrant

A higher urban price means that with a given price p_2^u , the entrant is able to capture a larger fraction of the incumbent's customers. As a consequence, the USP has lower receipts from its urban mail. To compensate, the entrant should contribute more to the USO financing. That is the access price must increase. If we take the first order condition of the maximization of W^a , when a uniform tariff is imposed (3.6) must be replaced by:

$$\alpha^{u} = d_{1}^{u} + \frac{\lambda}{1+\lambda} \frac{p_{2}^{u}}{\eta_{2}^{u}} + \underbrace{(p_{1} - c_{1} - d_{1}^{u})\sigma^{u}}_{\text{higher displacement ratio}}$$
(3.19)

In this expression, it is clear that the displacement term is higher when a uniform tariff is imposed. And therefore, the optimal access price α^* increases when the firm cannot price discriminate between its rural and its urban mail.

But, since firm 2 chooses to bypass whenever $d_2^u \leq \alpha^*$, an increase in the access price implies that the set of parameter under which the entrant has incentives to bypass is larger. In other words, it means that if the regulator wants to implement an efficient technological choice by the entrant, the constrained access solution applies for a larger set of parameters under a uniform tariff. This is represented in the figure 1

By using the same argument as before, we can show that the welfare maximizing technological choice (access vs bypass) is not affected by the imposition of a uniform tariff. Bypass dominates for $d_2^u < d_1^u$ and access



Figure 1: Efficient access vs bypass choice in the uniform and the non-uniform tariff case

dominates otherwise.

The uniform tariff is by itself a source of decrease in the welfare. But, when the entry mode is taken as endogenous, to have an efficient technological choice, the constrained access should be applied for a larger set of parameters. Then, there is an additional welfare loss associated with a geographically uniform tariff: whenever the entrant's delivery cost lies in $[d_1^u, \alpha^*]$, the welfare is $\overline{W^a}$ which is lower than the welfare with unconstrained access W^a .

4 Unknown cost

In this section we made the assumption that the regulator and the USP are unaware of the entrant's delivery $\cot d_2^u$. This uncertainty on the technology of the entrant translates into an uncertainty on the choice of the delivery method. Since the USP's prices affect the technological choice of the entrant, the uncertainty on the technology should be incorporated into the efficient USP prices.

We consider the following problem: the entrant knows its delivery $\cot d_2^u$ while the USP and the regulator have only a knowledge of the distribution of this cost. We assume that d_2^u is distributed according to a continuous density g(.) over the interval $[\underline{d}_2^u, \overline{d}_2^u]$ and $g(d_2^u) > 0$ for all d_2^u in the considered interval. The regulator designs the access and the incumbent's stamp prices without knowing the true value of d_2^u . These prices cannot be made contingent on the realized value of d_2^u . In other words, the regulator cannot solve a mechanism design problem where it asks firm 2 to reveal its cost and offers a menu of prices contingent on the revealed value of the marginal cost. Instead, we assume that the regulator is bound to use flat stamp and access prices. This could be viewed as an application of the 'no-discrimination' principle impose by the European directives regarding the organization of the postal sector.

Knowing the access price decided by the regulator, firm 2 decides to bypass the incumbent's network if $d_2^u \in [\underline{d}_2^u, \alpha^u]$ and to buy access otherwise. The regulator then solves the following problem:

$$\max_{p_1^u, p_1^r, \alpha^u} \hat{W} = \int_{d_2^u = \underline{d}_2^u}^{d_2^u = \alpha^u} W^b g(d_2^u) dd_2^u + \int_{d_2^u = \alpha^u}^{d_2^u = \overline{d}_2^u} W^a g(d_2^u) dd_2^u$$

subject to the zero profit constraint for firm 1:

$$\Pi_{1} = \int_{d_{2}^{u}=\alpha^{u}}^{d_{2}^{u}=\alpha^{u}} \left((p_{1}^{u}-c_{1}-d_{1}^{u})x_{1}^{u} + (p_{1}^{r}-c_{1}-d_{1}^{r})x_{1}^{r} \right) g(d_{2}^{u}) dd_{2}^{u}$$
$$+ \int_{d_{2}^{u}=\alpha^{u}}^{d_{2}^{u}=\overline{d}_{2}^{u}} \left((p_{1}^{u}-c_{1}-d_{1}^{u})x_{1}^{u} + (p_{1}^{r}-c_{1}-d_{1}^{r})x_{1}^{r} + (\alpha^{u}-d_{1}^{u})x_{2}^{u} \right) g(d_{2}^{u}) dd_{2}^{u} - F \ge 0$$

 \hat{W} is the expected welfare when the entrant's cost is unknown. It is composed of two terms: the first term is the expected welfare under bypass (the entrant's cost is in $[\underline{d}_2^u, \alpha^u]$); the second term is the welfare under access (the entrant's cost is in $[\alpha^u, \overline{d}_2^u]$). Similarly, the profit of firm 1 is the sum of the expected profit under access and the expected profit under bypass.

The key issue in this problem is that the access price α^u determines the probabilities of access and bypass. In particular, for any $\alpha^u \in [\underline{d}_2^u, \overline{d}_2^u]$, there is a probability $G(\alpha^u)$ that firm 2 builds up its own delivery network and a probability $1 - G(\alpha^u)$ that it uses the incumbent's network, where G(.) is the distribution function associated with g(.): $G(x) \int_{\underline{d}_2^u = \underline{d}_2^u}^x g(d_2^u) dd_2^u$. s Clearly

the access price determines the type of entry strategy.

We are in answering two questions: first, suppose that access is always the preferred delivery method. This is the case if the entrant's cost is always above the marginal delivery cost of the incumbent: $\underline{d}_2^u \ge d_1^u$. To induce this efficient technological choice, the regulator must set $\alpha^* = \underline{d}_2^u$. But then, given that the access price is the same for all 'types' of firm, firm 2 pays a lower access price compared to the known cost case. Second, suppose that there are cost parameters for which bypass is efficient: $\le \underline{d}_2^u \le d_1^u \le \overline{d}_2^u$. In this case, if the regulator chooses to promote an efficient technological choice, it does not raise any fund from the entrant: $\alpha^u = d_1^u$.

In both cases, the regulator faces a trade-off between promoting the efficient delivery technology which requires a low access price and raising funds from the entrant to finance the cost of the USO (a higher access charge). Our preliminary result shows that there are circumstances in which, the regulator induces 'too much' bypass to increase the financial contribution of firm 2 in the case of access.⁶ Allowing for inefficient bypass is a way to increase the expected financial contribution of the entrant to the USO. Under asymmetric information, the regulator trades-off the contribution of the entrant to the USO financing and the efficient delivery method.

This section must be completed!

5 Concluding remarks

Most of the papers on optimal pricing in the postal sector consider as given the market structure and the delivery method of the entrant(s). In this paper, we integrate a new dimension and analyze the impact of the incumbent's pricing on the technological choice of the entrant. For the moment, the contribution is mainly methodological and it shows how prices should be modified to take into account the entrant's choice.

 $^{^{6}}$ see Gautier and Mitra (2003) for a related analysis.

We show that under symmetric information about the entrant's cost (meaning symmetric information about the delivery method of the entrant), the regulator can induce an efficient technological choice. But, (1) this choice is not always welfare maximizing and (2) for that, the prices should be modified to take into account that the choice of a delivery method is left to the competing firm. It implies that access price should be sometimes lowered (and therefore the access receipts are lower) to induce the firm to choose access when it is socially preferred.

Under asymmetric information, the regulator (and the USP) should take into account that an efficient technological choice is associated with the lowest possible access receipts. Therefore, the regulator is likely to accommodate of a positive probability of bypass to increase the contribution of the entrant to the USO.

Finally, we show that access prices are lowered in some circumstances compared to their optimal level. In the analysis, we neglect an important dimension: access is not only sold to competitors but also to clients. If the access price is the same for the clients and the competitors, inducing an efficient technological choice could be costly in term of lost receipts from the clients and the regulator could, in this case, allow inefficient bypass. Integrating this dimension in the analysis is clearly important for a future research.

A Derivation of the optimal prices

Let us define the following $2x^2$ matrix A and the column vector b:

$$A = \begin{pmatrix} -x_1^u \eta_1^u & x_1^r \frac{p_1^r}{p_1^u} \eta_1^{ru} \\ x_1^u \frac{p_1^u}{p_1^r} \eta_1^{ur} & -x_1^r \eta_1^r \end{pmatrix}, \ b = \begin{pmatrix} -\frac{\lambda}{1+\lambda} x_1^u \\ -\frac{\lambda}{1+\lambda} x_1^r \end{pmatrix}$$

From these matrices, we define the $2x^2$ matrix B_i as the matrix A where its i^{th} column is replaced by the vector b.

The solutions of the equation system

$$A\left(\begin{array}{c}X_1\\X_2\end{array}\right) = b$$

are:

$$X_{1} = \frac{det|B_{1}|}{det|A|} = \frac{\lambda}{1+\lambda} \frac{\eta_{1}^{r} + \eta_{1}^{ru}}{\eta_{1}^{r} \eta_{1}^{u} - \eta_{1}^{ru} \eta_{1}^{ur}} = \frac{\lambda}{1+\lambda} \frac{1}{\hat{\eta}_{1}^{u}}$$
(A.20)

$$X_2 = \frac{det|B_2|}{det|A|} = \frac{\lambda}{1+\lambda} \frac{\eta_1^u + \eta_1^{ur}}{\eta_1^r \eta_1^u - \eta_1^{ru} \eta_1^{ur}} = \frac{\lambda}{1+\lambda} \frac{1}{\hat{\eta}_1^r}$$
(A.21)

To derive these expressions, we made the hypothesis that $dx_1^u/dp_1^r = dx_1^r/dp_1^u$.

A.1 Access

Under access, the first order conditions of the welfare maximization problem can be expressed as:

$$\begin{pmatrix} & & x_2^u \frac{p_2^u}{p_1^u} \eta_2^{uu} \\ A & & 0 \\ & & & 0 \\ x_1^u \frac{p_1^u}{p_2^u} \eta_1^{uu} & 0 & -x_2^u \eta_2^u \end{pmatrix} \begin{pmatrix} L_1^u \\ L_1^r \\ L_2^u \end{pmatrix} = \begin{pmatrix} -\frac{\lambda}{1+\lambda} x_1^u \\ -\frac{\lambda}{1+\lambda} x_1^r \\ -\frac{\lambda}{1+\lambda} x_2^u \end{pmatrix}$$

The solution can be expressed as:

$$L_1^u = \frac{\lambda}{1+\lambda} \left(\frac{1}{\eta_1^u} + \gamma_1^u \right) \tag{A.22}$$

where $\gamma_1^u = x_1^r \eta_1^r \eta_2^{uu} x_2^u \frac{p_2^u}{p_1^u} \frac{x_2^u + \eta_1^{uu} \frac{p_1^u}{p_2^u} \frac{1}{\eta_1^u}}{\eta_2^u x_2^u det|A| - \eta_2^{uu} \eta_1^{uu} x_1^u x_2^u x_1^r \eta_1^r} > 0.$ Similarly,

$$L_1^r = \frac{\lambda}{1+\lambda} \left(\frac{1}{\eta_1^r} + \gamma_1^r \right) \tag{A.23}$$

where $\gamma_1^r < 0$.

A.2 Bypass

Under bypass, the first order conditions of the welfare maximization problem can be expressed as:

$$A\left(\begin{array}{c}L_1^u\\L_1^r\end{array}\right) = b$$

We immediatly have: $L_1^u = \frac{det|B_1|}{det|A|} = \frac{\lambda}{1+\lambda} \frac{1}{\hat{\eta}_1^u}$ and $L_1^r = \frac{det|B_2|}{det|A|} = \frac{\lambda}{1+\lambda} \frac{1}{\hat{\eta}_1^r}$. Firm 2 sets its price at marginal cost: $p_2^u = c_2 + d_2^u$ and the access price is set at a level that induces bypass: $\alpha^u \ge d_2^u$.

A.3 Constrained access

Under constrained access, we have $\alpha^u = d_2^u$. The rst order conditions of the welfare maximization problem can be expressed as:

$$A\left(\begin{array}{c}L_1^u\\L_1^r\end{array}\right) = b + \left(\begin{array}{c}-(d_2^u - d_1^u)\frac{dx_2^u}{dp_1^u}\\0\end{array}\right)$$

The solution is:

$$L_1^u = \frac{det|B_1|}{det|A|} + (d_2^u - d_1^u) \frac{x_1^r \eta_1^r (dx_2^u / dp_1^u)}{det|A|}$$
(A.24)

$$= \frac{\lambda}{1+\lambda} \frac{1}{\hat{\eta}_{1}^{u}} + (d_{2}^{u} - d_{1}^{u}) \underbrace{\frac{\eta_{1}^{r}(dx_{2}^{u}/dp_{1}^{u})}{x_{1}^{u}(\eta_{1}^{r}\eta_{1}^{u} - \eta_{1}^{ru}\eta_{1}^{ur})}_{+}}_{+}$$
(A.25)

$$L_1^r = \frac{det|B_2|}{det|A|} + (d_2^u - d_1^u) \frac{(p_1^u/p_1^r)\eta_1^{ur} x_1^u (dx_2^u/dp_1^u)}{det|A|}$$
(A.26)

$$= \frac{\lambda}{1+\lambda} \frac{1}{\hat{\eta}_{1}^{r}} + (d_{2}^{u} - d_{1}^{u}) \underbrace{\frac{\eta_{1}^{ru}(dx_{2}^{u}/dp_{1}^{u})}{x_{1}^{r}(\eta_{1}^{r}\eta_{1}^{u} - \eta_{1}^{ru}\eta_{1}^{ur})}_{-}}_{-}$$
(A.27)

References

- Armstrong, M. (2001), Access Pricing, Bypass and Universal Service, American Economic Review, Papers and Proceedings, 91: 297-301.
- [2] Armstrong, M., C. Doyle and J. Vickers (1996), The Access Pricing Problem: A Synthesis, *Journal of Industrial Economics* 44 (2): 131-150.
- [3] Billette de Villemeur, E., Cremer, H. Roy, B. and J. Toledano (2005), Worksharing, Access and Bypass: the Structure of Prices in the Postal Sector, paper presented at the 13th CRRI conference on Postal and Delivery Economics.
- [4] Cazals, C. M. de Rycke, J.P. Florens and S. Rouzaud (1997) Scales Economies and Natural Monopolies in the Postal Delivery in Managing Changes in the Postal and Delivery Industries, M. Crew and P. Kleindorfer (eds), Kluwer Academic Press.
- [5] Cremer, H. M. De Rycke and A. Grimaud (1997), Costs and Benefits of Universal Service Obligations in the Postal Sector. *in Managing Changes in the Postal and Delivery Industries*, M. Crew and P. Kleindorfer (eds), Kluwer Academic Press.
- [6] Crew, M. and P. Kleindorfer (2005) Welfare Effects of Entry and Strategies for Maintaining the USO, in Progress Toward the Liberalization of the Postal and Delivery Sector, M. Crew and P. Kleindorfer (eds), Springer.
- [7] Dam, K. and A. Gautier (2006), Efficient Access Pricing and Endogenous Market Structure, miméo CORE, Louvain-la-Neuve.
- [8] De Donder, P. (2004), Access Pricing in the Postal Sector, miméo IDEI, Toulouse.

- [9] Gautier, A. and M. Mitra (2003), Regulation of an Open Access Essential Facility, CORE Discussion Paper Number 2003/84.
- [10] Laffont J. J. and J. Tirole (1994) Access Pricing and Competition, European Economic Review 38, 1673-1710.
- [11] Laffont J. J. and J. Tirole (2000) Competition in Telecommunications, MIT Press.