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Optimal Access and Uniform Retail Pricing in the Postal Sector

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Paper prepared for the

Third Conference on *"Regulation, Competition and Universal Service in the Postal Sector"*

Toulouse (France), November 13-14, 2003

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1. INTRODUCTION

One approach considered by policy-makers and regulators as part of the process of opening up postal markets has been to encourage access by entrants to the postal facilities of the universal service provider (USP). In this paper we build on previous work on access pricing set out in De Donder et al (2003).[1] We focus again on identifying pricing rules for access to a USP's delivery network where the rules are optimal or welfare-maximising and so of the type of a regulator charged with regulating access would wish to set. The USP is required to offer access at these prices while at the same time providing universal postal service at a uniform tariff and continuing to break-even (including a normal rate of return on capital).

The main difference with De Donder et al (2003) is that we endogeneize the USP uniform retail price that was previously exogenously fixed. Our main objective here is to assess whether the results obtained earlier are robust to the introduction of this new instrument. The main results are the following ones:

- Optimal access charges are given by a second best ECPR rule, modified to take account of both the proportion of mail displaced from the USP to the entrant (as opposed to newly generated by the entrant) and of the necessity for the USP to raise money to cover its fixed costs.
- The optimal access charge is affected directly by the optimal uniform retail price.
- If bypass is not available to entrants, all consumers benefit from entry while the USP manages to use both the access charges and retail price in an optimal way to cover its fixed costs and break even.
- If optimal access charges are higher than the entrant's delivery cost, the entrant would prefer bypass to access to the USP delivery network. In our simulations we examine the likeliest case for entrant bypass; namely that it occurs on the urban area but entrants prefer to deliver by use of access to the USP's network in rural areas. This case of urban bypass and rural access does not allow the USP to break even anymore.
- The optimal uniform retail price is generally not the same as the break-even uniform price under monopoly prior to entry. The paper uses simulations to show that in some cases the uniform retail price is lower and in others it is higher than under monopoly. The optimal uniform

[1] Other recent papers on access pricing issues in the postal sector include those by Crew and Kleindorfer (2002), De Donder et al (2002b) and Panzar (2002).

retail price tends to be lower where entry is only through access to the USP's delivery network and higher when entry can also be through bypass.

- The effect on total welfare of urban bypass coupled with rural access depends on specific circumstances. In the calibration model, we find that welfare will tend to increase the greater the underlying attractiveness of entrants' services and the more the traffic they carry is newly generated. At the same time total welfare is lower where bypass is possible than in the case where only access but not bypass is available to entrants and also, in most cases, than under monopoly.

The structure of the paper is as follows. Section 2 briefly sets out the basic model and section 3 derives the optimal access charges and USP retail price from the model. The elements of the model have been reduced to a minimum in order to try to identify policy insights into potentially a highly complex problem. To aid this, section 4 reports some illustrative numerical results based on a calibration reported in De Donder et al (2002a). Section 5 concludes by highlighting the main insights from the development of the model previously set out in De Donder et al (2003).

2. THE MODEL

There are two postal operators: the universal service provider (USP) and an entrant which acts as a competitive fringe. The USP offers a single product (average mail) which can be sent to the rural or to the urban area. The USP has to serve both markets at a uniform price. The entrant is not subject to a uniform service obligation and chooses which market (urban and/or rural) to serve and at which price. One representative consumer sends letters to both areas (or markets). We assume that the two markets are independent (the prices on one area do not affect the number of letters sent to the other area) and that the services offered by the two operators are (imperfect) substitutes on any given market, so that an increase in one operator's price in one market increases the quantity sold by the other operator on the same market.

The USP delivers its letters on both markets while the entrant can choose whether to deliver itself or to ask access to the USP's delivery network. The entrant will deliver itself if its delivery cost is (strictly) lower than the access charge. Moreover, if the access charge is higher than the full retail price of the USP, the entrant will always prefer remailing its letters through the USP rather than asking for access. We study the optimal access charges and USP retail price given these constraints.

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We now introduce the notation used in the paper. We denote by an upperscript *I* variables pertaining to the USP and by *E* to the entrant. We use the lowerscript *U* for the urban market and *R* for the rural market. We denote by q_j^i the demand for mail addressed to operator $i \in \{I, E\}$ for delivery in area $j \in \{U, R\}$. The universal service obligation translates into a global fixed cost for the USP, which is denoted by *F*. The USP uniform retail price is denoted by *p*. We separate the postal activity into two segments: one for collection-sorting-transportation and a second for delivery. Both operators are active on the first segment. Their (constant) marginal cost is $c^i, i \in \{I, E\}$ respectively. Operator *i's* constant marginal cost of delivery to area *j* is denoted by $d_j^{\,i}, i \in \{I, E\}, j \in \{U, R\}$. The entrant does not face a fixed cost but has a higher marginal delivery cost than the USP on both markets.[2] The USP charges a constant unit access price of a_j for each letter that the entrant asks the USP to deliver to area $j \in \{U, R\}$[3]. z_j^E measures the number of letters effectively delivered by the entrant in area $j \in \{U, R\}$, so that $q_j^E - z_j^E$ gives the amount of access to area $j \in \{U, R\}$ sold by the USP to the entrant.

The USP's profit is given by

$$\begin{aligned}\Pi^I &= \left(p - c^I\right)\left(q_U^I + q_R^I\right) - d_U^I q_U^I - d_R^I q_R^I - F \\ &+ \left(a_U - d_U^I\right)\left(q_U^E - z_U^E\right) + \left(a_R - d_R^I\right)\left(q_R^E - z_R^E\right),\end{aligned}$$

where the first line gives the profit made on the letters addressed to the USP and the second line is the profit made on selling access. Entrant's profit is given by

$$\begin{aligned}\Pi^E &= \left(p_U^E - c^E\right)q_U^E + \left(p_R^E - c^E\right)q_R^E - d_U^E z_U^E - d_R^E z_R^E \\ &- a_U\left(q_U^E - z_U^E\right) - a_R\left(q_R^E - z_R^E\right),\end{aligned}$$

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2 This can be due to the fact that the entrant has a different technology than the incumbent. Moreover, the marginal costs used here are long run marginal costs, which include many things which one may consider as 'fixed costs' from an accounting perspective.

3 It would be straightforward to include also an explicit acceptance or metering charge incurred by the USP in providing access, as in Crew and Kleindorfer(2002). Such a charge enters the results below in the expected way and has been excluded from the discussion here to simplify the model.

with $0 \leq z_j^E \leq q_j^E, j \in \{U, R\}$ and $a_j \leq p, j \in \{U, R\}$. Maximisation of entrant's profit gives that

$$z_j^E = \begin{cases} 0 \; if \, d_j^E \geq a_j \\ q_j^E \; if \, d_j^E < a_j \end{cases},$$

that is, that the entrant delivers itself only if it is strictly cheaper to do so rather than to ask access. We assume that the entrant acts as a competitive fringe i.e. that any positive profit made by the entrant would attract new competitors until prices are driven down to average (and marginal) costs. In other words, the entrant uses marginal cost pricing and we have $p_j^E = c^E + \min(d_j^E, a_j)$.

Total welfare *W* is the sum of postal operators' profits and consumer surpluses. We look for the optimal access charges and USP retail price, i.e. access charges a_U, a_R and price p that simultaneously maximise total welfare *W* under the constraint that the USP profit is non-negative ($\Pi^I \geq 0$) and that $a_j \leq p, j \in \{U, R\}$.

3. OPTIMAL ACCESS CHARGES AND USP RETAIL PRICE

To find the optimal access charges and USP retail price, we differentiate total welfare with respect to these three prices. Note first that the access charge does not play any role when it is greater than the entrant's delivery cost, in which case the entrant bypasses the USP's network and delivers the mail itself. We thus concentrate on the case where $a_j \leq d_j^E$. We also make the assumption (reflected in our calibration results) that the optimal access charge is less than the USP retail price in both markets: $a_j \leq p, j \in \{U, R\}$. In this case, $z_j^E = 0, p_j^E = c^E + a_j^E$ and the first-order condition for the optimal value of a_j is given by

$$(1+\lambda)\left\{(p - c^I - d_j^I)\frac{\partial q_j^I}{\partial p_j^E} + (a_j - d_j^I)\frac{\partial q_j^E}{\partial p_j^E} + q_j^E\right\} - q_j^E = 0,$$

where λ is the Lagrange multiplier associated with the USP's budget constraint.

Similarly, the optimal value of the USP retail price is obtained from the following first order condition

$$q_U^I + q_R^I + (1+\lambda)\left\{(p - c^I - d_U^I)\frac{\partial q_U^I}{\partial p} + (a_U - d_U^I)\frac{\partial q_U^E}{\partial p}\right.$$
$$\left. + (p - c^I - d_R^I)\frac{\partial q_R^I}{\partial p} + (a_R - d_R^I)\frac{\partial q_R^E}{\partial p}\right\} = 0.$$

In order to get a better understanding of the meaning of these equations, we first assume that $\lambda = 0$, i.e. that the USP's profit constraint is not binding (because of the absence of fixed costs or of the availability of an external non-distortionary funding source). We then obtain

$$(p - c^I - d_j^I)\frac{\partial q_j^I}{\partial p_j^E} + (a_j - d_j^I)\frac{\partial q_j^E}{\partial p_j^E} = 0 \qquad (1)$$

for the optimum access charge in area j={U,R} and

$$(p - c^I - d_U^I)\frac{\partial q_U^I}{\partial p} + (a_U - d_U^I)\frac{\partial q_U^E}{\partial p} + (p - c^I - d_R^I)\frac{\partial q_R^I}{\partial p} + (a_R - d_R^I)\frac{\partial q_R^E}{\partial p} = 0, \qquad (2)$$

for the optimum retail price.

We first discuss the optimal access charge as given by equation (1). With the competitive fringe assumption, increasing the access charge to area *j* results in an increase by the same amount of the entrant's price in that area. This increase in turn affects both the entrant's and the USP's quantity on that market. To obtain the impact on welfare, one has to multiply the effects on quantities by the difference between price and marginal cost of the good supplied. The USP supplies two goods: a final good (the letter it delivers to area *j*) and an intermediate good (access to area *j* for the entrant). The reason why the final good sold by entrant does not enter into the formula is because it is, by definition of a competitive fringe, sold at marginal cost.

A first consequence of formula (1) is that first best access pricing ($a_j = d_j^I$) is only called for when the letter price is set at its first best level $p = c^I + d_j^I$. Unfortunately, the uniform pricing constraint prevents this from happening simultaneously on the urban and rural markets when

$d_U^I \neq d_R^I$. If the letter price is not set at its first-best level, the access price formula can be rewritten as

$$a_j = d_j^I + \left(p - c^I - d_j^I\right)\sigma_j \qquad (1')$$

where $\sigma_j = -\dfrac{\partial q_j^I / \partial p_j^E}{\partial q_j^E / \partial p_j^E}$ is the displacement ratio which measures the substitutability between USP's and entrant's products on market j, i.e. by how much the USP's demand decreases when the entrant supplies one more unit of retail service in this market. Multiplying this displacement ratio by the difference between the letter price and its marginal cost, one obtains the USP's lost profit on the retail market caused by providing access. This is thus an ECPR formula, which compensates the USP for the opportunity cost in terms of foregone profit (and hence contribution towards the network cost of providing universal service) of any traffic lost to the entrant (see Armstrong, 2002).[4]

We now turn to equation (2) which determines the optimal value of the retail price p. There are four markets where p affects quantities: two final good markets (the selling of USP letters to the urban and the rural areas) and two intermediate good markets (providing access to urban and rural areas for the entrant). On each market, the impact of p on welfare is the product of the effect of p on quantities sold by the difference between price and marginal costs. Here also, we see that, because of the uniformity of the USP price, it is impossible that both access charges be equal to marginal cost when $d_U^I \neq d_R^I$

We now look at the simultaneous determination of access charges and retail price. Using (1') in (2), we reformulate the expression for the optimal p as

$$\left(p - c^I - d_U^I\right)\left(\frac{\partial q_U^I}{\partial p} + \frac{\partial q_U^E}{\partial p}\sigma_U\right) + \left(p - c^I - d_R^I\right)\left(\frac{\partial q_R^I}{\partial p} + \frac{\partial q_R^E}{\partial p}\sigma_R\right) = 0. \quad (2')$$

[4] One can also show that the part of the access charge that is above the marginal cost of giving access is equal to the second-best output tax on the entrant. The intuition for this tax is the following: if the USP's letter price is above marginal cost, the quantity produced is too low from a social welfare viewpoint. To raise this quantity, the welfare maximiser's only available instrument is the access charge paid by the entrant. Increasing this charge results in an increase in the entrant's letter price, which in turn increases the number of letters sold by the USP in the same market, since entrant's and USP's letters are substitutes in any given market.

In words, to obtain (2') we have used the relationship between access prices and retail prices to express the optimal retail price as a function of its impact on the two final good markets. The effect of p on the quantity sold in each area is the sum of two effects: the usual direct effect of price on quantity, $\partial q_j^I / \partial p$, and an indirect effect through the quantity of the entrant. This second effect is the product of the effect of p on the entrant's quantity in the rural market, $\partial q_j^E / \partial p$, by the displacement ratio σ_j. If we denote by

$$\frac{dq_j^I}{dp} = \frac{\partial q_j^I}{\partial p} + \frac{\partial q_J^E}{\partial p} \sigma_j$$

the **total** derivative of q_j^I with respect to p, we obtain the following formula for the optimal value of p

$$p = \left(c^I + d_U^I\right) \frac{dq_U^I / dp}{d(q_U^I + q_R^I)/dp} + \left(c^I + d_R^I\right) \frac{dq_R^I / dp}{d(q_U^I + q_R^I)/dp}. \quad (3)$$

Equation (3) shows that the USP retail price is a weighted average of marginal costs in the urban and rural markets. The weights used are equal to the share of variation of quantity in one delivery area (when the letter price is changed) in the total variation in both areas. It is worth noting that weights are proportional to **variation** of quantities when the price changes, and not to the **absolute value** of quantities in the areas: it is not the size of the market that matters, but its sensitivity to variations in the letter price (the size of the market still plays a role in that weights are proportional to the derivatives of quantities, and not to elasticities).

Observe that $\left| dq_j^I / dp \right| < \left| \partial q_j^I / \partial p \right|$ and thus that the optimal letter price formula puts **less** weight on area j when the entrant needs access to this market. The reason for this surprising result is the following. Increasing the USP letter price has two effects on the area j welfare, and they play in opposite directions. The first, direct, effect is to decrease the number of USP letters. The second effect is to increase the quantity of access demanded by the entrant. To link these variations in quantities to variations in welfare, note that the access charge formula implies that the rural access charge is larger than social cost if and only if the USP letter price is greater than total marginal cost for rural delivery. This implies that the two effects of increasing p on rural welfare go in opposite directions, or put differently that the second effect partly compensates the first. With a second effect partly compensating the first, the difference between letter price and rural marginal cost is less costly for social welfare, and the optimal USP letter price puts less weight on rural marginal cost.

We now turn to the case where $\lambda > 0$, i.e. where the USP profit constraint is binding at the optimum. The access pricing formula can be restated as

$$a_j = d_j^I + \left(p - c^I - d_j^I\right)\sigma_j + \frac{\lambda}{1+\lambda}\frac{p_j^E}{\varepsilon_j^E} \tag{4}$$

where ε_j^E is the (absolute value) of the direct price elasticity of the demand for entrant's letters addressed to area *j*. Formula (4) builds on (1') and adds the usual Ramsey term as a mark-up, which is inversely proportional to the demand direct price elasticity. The intuition for this last term is that it is less costly in terms of welfare to raise prices on markets where the demand is less sensitive to price, i.e. where demand direct price elasticity is lower.

The formula for the optimum USP retail price is more complicated and given by the following FOC

$$\begin{aligned}&\left(p - c^I - d_U^I + \frac{\lambda}{1+\lambda}\frac{p}{\hat{\varepsilon}_U^I}\right)\frac{dq_U^I}{dp} + \left(p - c^I - d_R^I + \frac{\lambda}{1+\lambda}\frac{p}{\hat{\varepsilon}_R^I}\right)\frac{dq_R^I}{dp}\\ &+ \frac{\lambda}{1+\lambda}\left(\frac{p_R^E}{\varepsilon_R^E}\frac{\partial q_R^E}{\partial p} + \frac{p_U^E}{\varepsilon_U^E}\frac{\partial q_U^E}{\partial p}\right) = 0.\end{aligned} \tag{5}$$

m Equation (5) is constituted of three additive terms. The first two terms are similar: each is composed of the product of the derivative of USP's quantity by *p* and of a price term. This price term is equal to *p* minus marginal cost in market *j*, augmented by a Ramsey term. One peculiarity of this expression is the use of the **total** derivative of q_j^I with respect to *p* in both the weight and in the computation of the elasticity $\hat{\varepsilon}_j^I = -(dq_j^I / dp)(p / q_j^I)$. As explained above, this is due to the fact that *p* affects q_j^I directly but also indirectly through its effect on q_j^E.

The third term in the expression has the form of a Ramsey markup, with on each market a weight proportional to the derivative of the entrant's quantity by the USP's letter price. Observe also the absence of any marginal cost in this third term. The intuition for this formula goes as follows. When setting the optimal value of p, the USP takes into account its effect on its own final good markets (including the indirect effect through modifications in the entrant's quantity), but also on the entrant's final good markets, because the USP makes profit on these market by selling access to the entrant. As usual, the distortion (and thus the need to keep p as close to marginal cost as possible) is inversely proportional to the elasticity of demand.

Finally, our framework allows us to look for the optimal uniform access charge, in the case where the access charge cannot (for regulatory or practical reasons) be differentiated according to the final destination of the entrant's mail. In this case, we know from De Donder et al.(2003) that the optimal uniform access charge is a weighted average of the optimum differentiated access charges obtained above. The weight used for each market corresponds to the share of the variation of entrant's quantities in this market when the entrant's price increases in the total variation of entrant's quantities (in both markets) when the entrant's prices in both markets are increased.

More precisely, introducing the new notation

$$\alpha = \frac{\partial q_U^E / \partial p_U^E}{\left(\partial q_U^E / \partial p_U^E\right) + \left(\partial q_R^E / \partial p_R^E\right)},$$

we obtain after simplification that the optimum uniform access charge is given by

$$a = \alpha\left(d_U^I + \left(p - c^I - d_U^I\right)\sigma_U\right) + (1-\alpha)\left(d_R^I + \left(p - c^I - d_R^I\right)\sigma_R\right). \qquad (6)$$

in the case where λ=0, and by

$$a = \alpha\left(d_U^I + \left(p - c^I - d_U^I\right)\sigma_U + \frac{\lambda}{1+\lambda}\frac{p_U^E}{\varepsilon_U^E}\right) + (1-\alpha)\left(d_R^I + \left(p - c^I - d_R^I\right)\sigma_R + \frac{\lambda}{1+\lambda}\frac{p_R^E}{\varepsilon_R^E}\right). \qquad (7)$$

if λ>0.

The expression for p is very complicated but basically boils down to a weighted sum of the marginal cost, augmented by a Ramsey term if $\lambda>0$, in both areas of delivery.

The analytical results obtained in this section assume that the optimal access charge is lower than the entrant's delivery cost. If this is not the case, the entrant does not ask for access and the precise value of the access charge is irrelevant. For instance, it may happen that this uniform access charge is greater than the entrant's delivery cost on one market, say the urban market. In this case, the entrant will not request access to the urban submarket and the optimal uniform access charge is computed with only the rural submarket in mind. In other terms, the uniform access charge will be given by the optimal rural access charge as computed in equations (1) and (2). The same access charge will be offered on both markets but the entrant will use its own delivery capability on the urban market rather than the USP's network.

The analytical approach developed here is based on first order conditions for optimality and does not allow the assessment of whether a constraint on an access charge is binding or not at the optimum nor the comparison of levels, particularly welfare levels, in the different cases. In order to get a better understanding of these elements, we make use of numerical simulations in the rest of this paper. We explain our calibration assumptions and give the results obtained in section 4.

4. RESULTS

Calibration and Reporting of Results

Calibration data for the demand side are obtained from De Donder et al (2002a). More precisely, we take linear demands that we calibrate to obtain that the total quantity sold by the USP under monopoly at an assumed current price p of 0.35€ is 8 900 millions items for urban delivery and 1 100 millions items for rural delivery. Both demand functions exhibit a direct price elasticity of –0.376 (obtained by averaging the elasticities on the households' and firms' markets in De Donder et al (2002a)) on both markets at the 0.35€ price. Regarding the costs, we assume that the collection plus transportation and sorting cost is c^I =0.1€ for the USP and c^E =0.13€ for the entrant. The delivery cost is d_U^I =0.07€ for the USP and d_U^E =0.12€ for the entrant on the urban market and, respectively, d_R^I=0.16€ and d_R^E =0.35€ on the rural market. The USP's fixed cost F is 1 701 millions €. The reader can easily check that the letter business of the USP just covers its costs (including the fixed cost) at the 0.35€ price before opening of the market to competition.[5]

Results from the model using these calibration values are reported in Tables 1, 2 and 3. The column headed "monopoly" gives the results before the opening of the market to competition. Its main interest is in the value of the consumer surplus in the urban and rural areas[6], which will be used as benchmark values. The remaining columns of Tables 1 and 3 report results from the model which highlight sensitivities relating to the extent and nature of entry and reflect the higher level of uncertainty relating to the value of these parameters. Two blocks of results are shown. Columns two and three are results for cases where the entrant would take a 10% share of each market if it were to post a price of 0.35€, the same as the uniform tariff set by the USP. The second block reports results for a value of 23.8% and so one where the underlying attractiveness of the entrant's service is, for whatever reason, appreciably more than the first block.[7] The second dimension highlighted in the results is the displacement ratio, σ. This is set at two values: σ=0.5 which implies that for every two items carried by the entrant, one is displaced from the USP and one is newly generated by the entrant's service and σ= 0.75 where for every four items carried by the entrant, three are displaced from the USP and only one is new.[8]

Optimal Access Charges and Uniform Retail Price when Bypass is not Allowed

We first analyse the optimal differentiated access charges when the entrant does not have the availability to bypass the USP's delivery network. The main consequence of this assumption is to lift the constraint that the optimum access charge has to be lower than the entrant's delivery cost. In the case where λ =0, the optimal retail price p is given by equation (3) while

[5] Note that for ease of presentation the "fixed cost" includes a normal rate of return on capital or accounting profit so that the USP breaks even after allowing for this return (see De Donder et al, 2002a).

[6] More precisely, it is the welfare that the representative consumer gets from sending letters to, respectively, urban and rural addressees.

[7] The value of 23.8% is taken from De Donder et al (2002a) and is the value obtained there where the market share for business senders is 25% and that of residential senders is 15%. The alternative value assumes that the combined figure is only 10%.

[8] We assume the same displacement ratio and market share in both the urban and rural areas.

Table 1: Optimal Access Charges and Retail Price – No bypass allowed

		Monopoly	Entrant's Market Share If It Set Prices at 0.35€			
			10%		23.8%[1]	
			σ = 0.5	σ = 0.75	σ = 0.5	σ = 0.75
Access Charges, €:	Urban	-	0.178	0.213	0.189	0.219
	Rural	-	0.217	0.232	0.228	0.238
Entrant's Prices, €:	Urban	-	0.308	0.343	0.319	0.349
	Rural	-	0.347	0.362	0.359	0.368
USP Retail Price		0.35	0.346	0.349	0.337	0.345
Entrant's Quantities, bn:	Urban	-	1.445	1.050	2.716	2.193
	Rural	-	0.118	0.078	0.275	0.219
USP Quantities[2], bn:	Urban	8.9	8.213	8.123	7.662	7.304
	Rural	1.1	1.045	1.043	0.977	0.941
USP Profit, bn €		0	0	0	0	0
Consumer Surplus, bn €:	Urban	4.142	4.257	4.178	4.544	4.298
	Rural	0.512	0.521	0.514	0.550	0.527
Value of λ			0.217	0.221	0.200	0.214
Total Welfare, bn €[3]		4.654	4.778	4.692	5.094	4.842
Compared with Monopoly, bn €		-	0.124	0.038	0.440	0.170

1. Weighted average of business and residential sender mail as calculated in De Donder et al (2002a).
2. Additionally, the USP delivers all of the entrant's mail so that the USP's delivered volumes are higher in all cases than its monopoly quantities.
3. Sum of consumer surplus and (1+ λ) USP profit.

optimal charges are given by equation (1'). Comparing the optimal pricing strategy under no bypass with the pre-liberalisation one, we obtain that both types of consumers (urban and rural) have a much higher consumer surplus after entry. The entrant breaks even, by definition of a competitive fringe. On the other hand, the USP makes a huge loss after entry. The reason for this loss is the following. With $\lambda = 0$, we are in a first best setting, where the retail price p equals marginal cost (except for the fact it cannot differ in the urban and rural markets, so it is an average of marginal costs). Moreover, the ECPR-like formula for access charges perfectly compensates the incumbent for any end-to-end profit foregone due to access being provided. The USP then covers exactly its variable costs and its loss equals its fixed costs.[9]

[9] This contrasts with De Donder et al (2003) where $\lambda=0$ allows the USP to break even. In that paper, the USP retail price p is held exogenously at the monopoly break-even price (0.35€) even after entry. Since the optimal access charge formula compensates the USP for the profit lost due to providing access, the USP still breaks even after liberalisation.

The USP loss when λ=0 indicates that the USP profit constraint is binding at the optimum. We report in Table 1 the results obtained when the USP just breaks even and the value of λ (the Lagrange multiplier of this constraint is obtained endogenously when solving the regulator's maximisation program. We first comment on the case where the market share of the entrant at a price equal to the USP equals 10% and where σ equals 0.5, before looking at the impact of modifying σ and the market share assumption. The endogenous value of λ is quite low at 0.217, showing that it is not very costly in terms of aggregate welfare to require the USP to break-even in this case. This low value of λ feeds (through equations (4) and (5)) into relatively low values for *p* (0.346€) as well as the urban (0.178€) and the rural (0.217€) access charges. Observe that the value of the retail price is even lower than its monopoly level! This is due to the fact that the USP makes some profit on selling access to its competitors and so can decrease its final price while still breaking even. It is worth noting also that even though the USP's end-to-end volume declines the total volume of mail it delivers (of this type and delivery of the entrant's product) rises compared with the monopoly base case.

With a lower USP retail price and access to the goods sold by the entrant, both categories of consumers benefit from the opening of the market to competition. Such a move then constitutes a Pareto improvement (with respect to the monopoly situation) since some actors are strictly better off (consumers) while no one is worse off (postal operators break-even).

We now compare the results shown in the four columns of Table 1 to assess the impact of a higher displacement ratio σ and/or a higher entrant's market share. First note that, in all cases, the value of λ is low, the USP retail price is lower than its monopoly level and the USP's delivered volumes rise compared with the monopoly level. All consumers benefit from the opening of the market to competition which introduces a wider range of choice and leads to a more intensive use of the USP's delivery network. All these results are thus robust to the modifications of parameter values shown in Table 1.

As for the impact of the entrant's market share, we see that a higher share leads to a small decrease in λ, and to small decreases in the USP retail price and access charges which in turn increase consumer welfare. These results may seem surprising at first sight and deserve an explanation. Increasing the entrant's market share means increasing the desirability of the entrant's product and increasing the total size of the postal market. The small decrease in USP retail price is not enough to prevent the USP retail quantities from falling. However, the USP compensates this loss in end-to-end revenues by increasing its revenues from selling access to the entrant, since the entrant's quantities roughly double with a higher market share and so increases the total volume of mail delivered by the USP jointly from its own end-to-end service and delivery of the entrant's product. The increase in the consumers' surplus thus has two sources: the higher desirability of the entrant's product associated with its higher market share and the (slightly) lower prices for both the USP and the entrant's goods.

A lower displacement ratio has the same (qualitative) effects than an increase in the entrant's market share: a lower value of σ means that a higher proportion of the entrant's volumes corresponds to a generation of postal volume and not simply replacement of USP's by entrant's volume. The same mechanisms as above then explain why higher volumes tend to lower prices and increase consumers' welfare.

To summarise, when bypass is not a possibility, setting the USP retail price and access charges at their optimal levels leads to increases in consumers' welfare while allowing the USP to break-even. A higher entrant's market share and lower displacement ratio raise the total volume of mail delivered by the USP, decrease prices and increase welfare.

This appealing result incorporates within it the possibility for the USP to post access charges differentiated according to the delivery area. Such a differentiation may be technically cumbersome, legally prohibited or more simply may entail significant transaction costs for the USP. We now look at the consequences of imposing uniformity for the access charges as well as for the USP retail price in the case where bypass is not available to entrants[10]. Table 2 focuses on the no bypass case with σ=0.5 and the entrant's market share at 23.8% and an endogenous value of λ. It compares the welfare maximising results obtained when the access charges may be differentiated according to the area (second column of figures) and where a uniform access charge must be posted (third column). The optimum value of the uniform access charge is given by equation (7). It is very close to the optimum urban access charge, since the weight put on this value (the parameter α in equation (7)) is equal to 0.89. We know from theory that imposing another constraint (uniformity of access charge) will make it more costly to raise money to cover the USP fixed costs. However, we see in Table 2 that the value of λ is barely affected by the uniformity constraint, and such is the case also for the USP retail price. The reason is that the rural market is sufficiently small not to matter much in these results. We also know from Section 3 that imposing the access charge to be uniform will increase the entrant's urban price and decrease the entrant's rural price. Since the USP price barely moves, this translates into a lower urban consumers' surplus and a higher rural consumers' surplus. Note that even with a uniform access charge (and USP retail price), all consumers have a

[10] This case is similar to that in the US under "dropshipment" discounts (Cohen et al, 2002).

higher welfare than under monopoly. Moreover, the net effect on total welfare compared with the case of differentiated access charges is only very slightly negative and this result is prior to the cost of a differentiation of access prices geographically.

Table 2: Optimal Uniform Access Charges and Retail Price – No Bypass

			Access Charges	
		Monopoly	Differentiated	Uniform
Access Charges, €:	Urban	-	0.189	0.194
	Rural	-	0.228	0.194
Entrant's Prices, €:	Urban	-	0.319	0.324
	Rural	-	0.359	0.324
USP Retail Price		0.35	0.337	0.337
Entrant's Quantities[1], bn:	Urban	-	2.716	2.662
	Rural	-	0.275	0.329
USP Quantities, bn:	Urban	8.9	7.662	7.689
	Rural	1.1	0.977	0.950
USP Profit, bn €		0	0	0
Consumer Surplus, bn €:	Urban	4.142	4.544	4.532
	Rural	0.512	0.550	0.560
Value of λ			0.200	0.201
Total Welfare, bn €[2]		4.654	5.094	5.093
Compared with Monopoly, bn €		-	0.440	0.439

1. Additionally, the USP delivers all of the entrant's mail so that the USP's delivered volumes are higher in all cases than in monopoly quantities.
2. Sum of consumer surplus and $(1+\lambda)$ USP profit.

To summarise, the results obtained with differentiated access charges are robust to the introduction of a uniform access pricing constraint. In particular, the welfare gain from geographical de-averaging of the access price in this case is minimal for the parameters chosen. We obtain the same conclusion for the other cases of σ and market shares reported in Table 1.

Optimal Access Charges and Uniform Retail Price with Bypass in Urban Area

Unfortunately, these welfare-enhancing results do not carry through to the situation where bypass is available to the entrant. In all four cases reported in Table 1 as well as in Table 2, the urban access charge is higher than the entrant's delivery cost in the urban area (which is set at 0.12 €). Faced with this access charge, the entrant will deliver itself on the urban area. However, the entrant still asks for access to the rural area given that the rural access charge is in all cases lower than its rural delivery cost (set at 0.35€). The rural access charge is also lower than the USP retail price, so that the entrant is not tempted to reinject its rural mail through the USP's end-to-end network.

In Table 3, we provide results where the entrant bypasses the USP delivery network in the urban area and uses it in the rural area.[11] As for table 1, we first discuss the results for the low entrant's market share, low displacement ratio case before analysing the comparative static results with respect to these parameters.

In stark contrast to De Donder et al.(2003), fixing simultaneously the rural access charge and the USP retail price makes it possible for this case for the USP to break even. On the other hand, the welfare cost for society of requiring the USP to break even is quite high, as shown by the high value of λ (0.511) at equilibrium. This value is much higher than the cost of public funds in developed countries, often put in the range of 0.2 to 0.3. This indicates that, from a solely welfarist viewpoint, the level of welfare would be higher if the USP were to run a deficit and to finance it via transfers from the State general budget. The reason why λ is so high, especially compared with the corresponding no bypass situation, is simply that the USP cannot earn money by providing access to the urban area so resulting in a decline in the volumes it handles through its delivery network. This leads to the USP needing to raise its prices for both its final retail good and rural access. It turns out that the USP retail price (0.383€) and the entrant's rural price (0.374€) are both greater than the USP pre-liberalisation price (0.35€). Both types of consumers suffer from these higher prices and end up with less surplus than under monopoly! Such a scenario constitutes a Pareto worsening move away from monopoly, since some groups are worse off (consumers) while no group is better off (the postal operators just break even). Such results illustrate the very significant impact potentially of allowing entrant bypass since adding this possibility turns a Pareto improvement into a Pareto worsening move![12]

[11] We assume that the USP is prevented by legal or regulatory constraints from "undercutting" the entrant's urban delivery cost and so that urban bypass cannot be prevented. We then maintain the urban access charge at their Table 1 level, without any loss of generality.

[12] It is important to note that bypass is in itself socially inefficient in our setting since the entrant's delivery cost is higher than the USP's. A socially efficient bypass is a necessary but not sufficient condition for bypass to be welfare improving.

Table 3: Optimal Access Charges and Retail Price – Bypass Allowed
Case where Entrant Chooses Bypass in Urban Area and Access in Rural Area

		Monopoly	Entrant's Market Share If It Sets Prices at 0.35€			
			10%		23.8% [1]	
			σ = 0.5	σ = 0.75	σ = 0.5	σ = 0.75
Access Charges, €:	Urban [2]	-	0.178	0.213	0.189	0.219
	Rural [3]	-	0.244	0.304	0.302	0.318
Entrant's Prices, €:	Urban	-	0.250	0.250	0.250	0.250
	Rural	-	0.374	0.434	0.432	0.448
USP Retail Price		0.35	0.383	0.429	0.415	0.407
Entrant's Quantities, bn:	Urban	-	2.419	4.392	4.096	5.374
	Rural	-	0.104	0.046	0.220	0.129
USP Quantities, bn:	Urban	8.9	7.379	4.851	6.227	4.323
	Rural	1.1	1.009	0.972	0.913	0.936
USP Profit, bn € [4]		0	0	-0.274	0	-0.518
Consumer Surplus, bn €:	Urban	4.142	4.087	3.911	4.239	4.310
	Rural	0.512	0.480	0.429	0.458	0.454
Value of λ			0.511	Infinite	0.841	Infinite
Total Welfare, bn € [5]		4.654	4.567	Undefined [6]	4.697	Undefined [7]
Compared with Monopoly, bn € [8]		-	-0.087	-0.670	0.042	-0.563

1. Weighted average of business and residential sender mail as calculated in De Donder et al (2002a)
2. Optimal charge is greater than entrant's delivery cost per item of 0.12€ so entrant uses own delivery capability.
3. The rural access charge is the optimal uniform access charge given entrants deliver by their own network in the urban area.
4. Note that if the USP had set an access charge between the entrant's delivery cost per item of 0.12€ and its own delivery cost of 0.07€ it would have been able to reduce its financial loss.
5. Sum of consumer surplus and (1+ λ) USP profit.
6. Undefined because λ is infinite. If, in this case, the loss-minimising profit of –0.274bn€ were to be funded by some distortionary means, such as taxation, at a value of λ=0.3 then total welfare would be 3.984 bn€.
7. See footnote 6. Total welfare of 4.091 bn€ if the loss minimising profit of –0.518 bn€ were funded at a value of λ=0.3.
8. Cases where break-even is not possible expressed against case where remaining loss is funded at λ=0.3 (see footnotes 6, 7).

The impact of bypass is even more visible when the value of the displacement ratio is higher at 0.75 because in such a case there are no values of the rural access charge and the USP retail price that enable the USP to break-even. The reason is straightforward: when the entrant mostly displaces volume from the USP, it prevents the USP from earning revenues on these volumes, except by selling access to the rural area, which is a small market compared to the urban one, and there is a significant fall in the total number of items the USP delivers through its delivery network. For a high enough value of the displacement ratio, breaking even is then not possible for the USP.

In the case where σ=0.75, Table 3 reports the USP loss minimising solution, which formally corresponds to the case where λ is set at plus infinity in the regulator's optimisation program. In such a case, all prices are higher than when σ=0.5, and surpluses are lower for both urban and rural consumers. It is difficult to give a value for total society's welfare, since the value of λ is infinite. Observe nevertheless that the sum of USP loss and consumers' surpluses is lower than under monopoly, since all three actors are worse off. But taking a simple sum overestimates total welfare, since it implies that there is no welfare cost in transferring money to cover the USP loss. A more reasonable assumption is that this loss would have to be funded by some form of distortionary means such as taxation. Using a value of 0.3 for the welfare cost associated with this transfer, we report results on this basis in Table 3 and obtain that total welfare is lower than the monopoly level by 670 millions € in the (σ=0.75, 10% entrant's market share) case and by 563 millions € in the (σ=0.75, 23.8% entrant's market share) case.

As for the impact of a higher entrant's market share, we obtain that although it increases all prices, it increases consumers' surpluses in both the urban and rural (except when σ=0.5) areas. The reason for this result is that increasing the entrant's market share means that consumers derive more utility from the good provided by the entrant. This effect is stronger than the negative effect of higher prices (except for rural consumers when σ=0.5).

As a consequence, the only case where total welfare is (very slightly) higher than under monopoly is when the displacement rate is low and the entrant's market share high. Even in this case, there is no Pareto improvement, since rural consumers are worse off. For the three other cases, both types of consumers are worse off.

5. EXTENSIONS TO THE MODEL AND CONCLUSIONS

The purpose of our paper has been to gain insights for the formulation of rules in the setting of optimal or welfare-maximising access charges to the delivery network of a universal service provider (USP). The USP provides universal postal service at a uniform tariff. Our analytical model allows for the possibility of bypass by entrants and this has significant impacts which we have illustrated through numerical results from calibrations of the model. However, the conclusions we draw from our results are preliminary. A number of the extensions to the model are desirable. These include incorporating the possibility of direct access by private customers to the USP's network as required by the 2002 EU Postal Directive[13] and the case

[13] Official Journal, L176/21, 2002. Article 12. The full text reads:
"whenever universal service providers apply special tariffs, for example for services for business, bulk mailers or consolidators of mail from different customers, they shall apply the principles of transparency and non-discrimination with regard both to the tariffs and to the associated conditions. The tariffs shall take account of the avoided costs, as compared to the standard service covering the complete range of features offered for the clearance, transport, sorting and delivery of individual postal

where the entrant has some degree of market power instead of a competitive fringe which sets a price equal to its marginal cost. These developments were discussed in De Donder et al (2003) and further work on these extensions is in progress.

Our first conclusion is one we drew first in De Donder et al (2003) but which is reaffirmed and expanded by the more general model we have presented in the current paper. This is that optimal access charges follow the efficient component pricing rule (ECPR) [14] but modified to take account of at least two main factors which are both related to the effects of entry. The first of these is a reduction below this price to take account of the displacement ratio. More specifically, this reduction is directly related to the extent to which entrants' traffic is newly generated rather than displacing the USP's existing traffic. However, a second modification is an increase in the access charge which depends on the size of the financial loss the USP incurs following entry. This loss will arise if entry through bypass takes place in other parts of the USP's network. Which of these two opposing effects would be larger and hence whether the optimal access charge is above or below ECPR depends on a number of factors and, in particular, on the extent of entry through bypass. The current paper has extended the previous results to allow for the uniform retail price of the USP to be set optimally as well and has shown how this also impacts on optimal access charges.

This leads to a second important conclusion which again both reaffirms and expands that set out in De Donder et al (2003). The optimal access charge as developed through models of this type might be above the cost of entrants using their own networks to deliver mail. The resulting entry through bypass will lead to a financial loss by the USP and, even where some form of funding can be found to cover this deficit, the effect on total welfare of access depends on specific circumstances. In the calibration model, we explore this through the use of a range of parameter values and find that welfare will tend to increase the greater the underlying attractiveness of entrants' services and the more the traffic they carry is newly generated. Conversely, if entrants' services would take a small share

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items and, together with the associated conditions, shall apply equally both as between different third parties and as between third parties and universal service providers supplying equivalent services. Any such tariffs shall also be available to private customers who post under similar conditions"

[14] To be clear we use the term ECPR where the value of the displacement ratio, σ, is equal to 1. Armstrong (2002) uses the term 'margin rule' for this case and the term ECPR for the more general case where the price is inclusive of σ in the interval 0 to 1.

of the market at an equal price to the USP's and custom gained would be largely through the displacement of the USP's traffic then access would tend to have a negative effect on total welfare. By contrast, we show also that where access is permitted but bypass is not, pricing on the basis of ECPR (adjusted to take account of displacement effects) not only allows the USP to break-even but also that welfare is higher than under monopoly without access.

To these original, preliminary conclusions we now add a third. This is that the optimal uniform retail price tends to be higher in the cases where bypass occurs and the total volume of mail delivered by the USP falls compared with the position under monopoly. However, the optimal uniform retail price is lower where entrants can provide service only through access and the total volume of mail delivered by the USP rises compared with the position under monopoly. Underlying this difference is recovery of the fixed cost of the delivery network - with entrant bypass there are fewer items of mail compared with the monopoly base but with access only there are more items from which to recover the fixed cost. In turn, this difference impacts on the optimal access charges compared with those calculated under the original, uniform retail price under monopoly and tends to increase them where bypass occurs and reduce them where entry is by access only.

Our conclusions from the paper indicate then that optimal access charges are ECPR in form but adjusted for the nature and overall level of entry and the optimal uniform retail tariff. In setting access charges this would require a regulator to allow for the effect of entry and the charges are more complex in the case where entry can be either by access or bypass rather than by access alone. In practice, it is difficult to see how these rules could be made fully operational but they support strongly the position that is held widely in postal economics that where regulators require unbundled access to the USP's network ECPR is the appropriate starting point for the setting of access charges. That position is reflected in article 12 of the 2002 EU Postal Directive. The extent to which that rule might be varied up or down would need to allow explicitly for an assessment of entry into the postal market, a conclusion which is reinforced by the more general model presented in this paper.

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