# Annex 6

## Pricing and Welfare Implications of Alternative Approaches to Setting Price Controls in the Postal Sector

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## 1. INTRODUCTION

Within the postal sector, price controls are being developed and set to limit the scope for a universal service provider (USP) to increase prices and to provide incentives for improvements in cost efficiency (Correia da Silva et al, 2004). The provision of universal postal service, including setting geographically uniform prices within a country or member state, is an overriding requirement for the development of any policy decision in the postal sector, including that of setting of a price control. Further, some countries have moved away from a monopoly provision of postal service to one that is open, to varying degrees, to competition. The optimal structure for price controls within the economics literature is that of a global price cap (GPC) (see Billette de Villemeur et al (2003) and the references mentioned there), where all goods provided by the regulated firm are included in the computation of the price cap. This familiar result arises under conditions where a regulator is assumed to seek to maximise welfare while a regulated business maximises its profit and leads to optimal prices that are based on a mark-up on marginal costs. While GPC is the optimal structure for a price control also in the presence of competition, regulators have looked at alternative structures and approaches, at least in part as a means of facilitating or promoting competition. For example, some have considered removing services that are deemed to be competitive from the coverage of the control (Dudley et al, 2005).

Our paper examines the implications of a regulator adopting alternative cost allocation and pricing rules for setting a price control in the postal sector and its focus is on this aspect of a price control rather than other areas such as the promotion of reductions in the level of underlying costs. A major issue

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[*] The analysis contained in this paper reflects the views of the authors and may not necessarily be those of Royal Mail Group.

with regard to cost allocation rules is the presence of significant fixed costs associated with the retention of geographic reach and provision of universal service (Cazals et al, 2005). This provides considerable scope for the potential allocation of fixed, network costs between products and means for trying to recover these and other costs through final postal prices charged by the USP. However, in a situation where a postal market is open or is in the process of being liberalised, this scope has the potential of being substantially curtailed by loss of mail volumes to competitors thereby limiting the ability of the USP to recover its fixed, network costs and remain financially viable. Through its consideration of alternative cost allocation and pricing rules, this paper aims to provide insights into the implications of potential regulatory decisions relating to the setting of a price control. Amongst other things, this highlights the need for consistency in cost allocation and pricing rules over time and the merits of the rules consistent with GPC that maximise economic welfare.

Our analytical model concentrates on the prices of a USP in the postal sector that are sufficient to recover network costs under conditions of entry. The ability to recover such costs is a central requirement of an effectively set price control. In the model the USP offers two products: a single piece product and a business mail product, the latter being treated as a bulk mail product requiring presortation of mail by the mailer[1]. This facilitates consideration of cost allocation rules consistent with a GPC (or "a single basket") structure for the control, alongside alternative cost allocation rules and two basket, non-GPC structures for the control. Although we do not consider the issue of the uniformity (geographical averaging) of tariffs explicitly in our analysis we note that single piece mail at a uniform tariff is used by most households and that its availability and price are of particular interest to regulators and policy makers.

We pay particular attention to two cost allocation rules which allow the USP to at least break-even overall which here implies that each product covers both its marginal cost and also share between them, through an allocation, the network cost incurred by the USP[2]. The first cost allocation rule results in the minimum price for the single piece product at which the

[1] These can be thought of also as two groups of products. The defining difference between the USP's two products in our model is that entry is assumed to occur in the market for business mail but not for single piece mail. In order to restrict the model to just two goods we simplify and equate business mail with bulk mail. In practice, of course, some business mail does not require worksharing and it would be possible to develop a model which distinguishes between bulk mail and other types of business mail. However, the main insights from our model can be gained from the two good version developed in the paper.

[2] Throughout this paper the term break-even is used to mean that the USP achieves a normal rate of accounting profit and so is able to be financially viable on a continuing basis.

USP breaks even overall.[3] The second rule results in the prices under GPC which not only allow the USP to break-even but also at the same time to maximise economic welfare. These rules together identify a range for the price of the single piece product within which the USP breaks even and economic welfare increases as the single piece product price rises towards its welfare maximising value. For prices below this range the USP does not break-even while for prices above this range the welfare maximising price is exceeded and there is a decline in welfare. Other cost allocation rules can then be applied to see if the resulting prices lie within this range. For example, we consider one other rule, equiproportional mark-ups (EPMU, see Sherman(1993)), which while neither welfare-maximising nor necessarily consistent with financial viability for the USP may be an option considered by regulators for the recovery of fixed, network costs.

The paper proceeds as follows. Our model is set out further in section 2. In section 3, we calibrate it with parameter values consistent with key characteristics of the postal sector outlined above and in section 4 we report results from our model calibrated with these values and test sensitivities. Section 5 draws out implications from our analysis for cost allocation rules, pricing and price control structures in a liberalised postal market.

## 2. MODEL

The model has three goods. The USP offers two goods (a single piece good labelled 1 and a business mail product which is assumed to be a bulk mail good labelled 2) with demands independent from each other. Note, however, that there is an effective floor to the single piece price which is the price of the bulk mail product plus the worksharing cost incurred by the sender in presortation and presentation of its mail to the USP. At any price below this it would be cheaper for the bulk mailer to use the single piece product so that all bulk mail would switch to the single piece product. Goods 1 and 2 can be thought of also as two baskets of goods rather than just as single goods. The consumer surplus derived from good 1 is given by $u(x_1)$. There is a global network (fixed) cost $F$ which the USP incurs to meet its obligation for the provision of universal service and constant marginal costs $c_1$ and $c_2$[4]. Entrants in the form of a competitive fringe provide a good, labelled 3, that is an imperfect substitute for good 2. The utility derived from those substitutes is given by $v(x_2, x_3)$. Good 3 is produced at a constant

[3] A similar focus on the minimum uniform stamp price is developed by Panzar (2005).

[4] Fixed costs attributable to one particular good play no role in the analysis although the model could be extended to consider such a case.

marginal cost $c_3$, with no fixed cost[5]. The price of good *i* is denoted by $p_i$ and its demand function by $x_i(.)$. To simplify notation, we often do not write the argument(s) of the demand functions.

In terms of setting the price control and recovery of the network cost, we consider three possible pricing and allocation rules for the USP[6]: a global price cap (GPC), minimising the price of good 1 while breaking even overall and an equiproportional mark-up solution (EPMU). We first define the optimal second best prices and show that they can be decentralised using a global price cap where weights and average price have been suitably chosen. We then describe the other two pricing rules.

The second-best optimal prices are obtained when the regulator maximizes total welfare (the sum of consumer surplus and operators' profits) subject to the USP breaking even. Denoting by λ the Lagrange multiplier of the USP profit constraint, the regulator solves the problem:

$$\max_{p_1,p_2} u(x_1)+v(x_2,x_3)-p_1x_1-p_2x_2-p_3x_3$$
$$+(1+\lambda)((p_1-c_1)x_1+(p_2-c_2)x_2-F)$$

whose first-order conditions are

$$-x_i+(1+\lambda)(x_i+(p_i-c_i)\frac{\partial x_i}{\partial p_i})=0$$

which give the usual Ramsey prices

$$\frac{p_i-c_i}{p_i}=\frac{\lambda}{1+\lambda}\frac{1}{\varepsilon_i}$$

where $\varepsilon_i$ is the demand own-price elasticity. Note that, as long as good 3 is provided at marginal cost, the formulas above are not affected by this good. In other words, we will get the same formulas for the monopoly situation and for the case where the USP faces competition. The numerical values will of course be different, because the demand for good 2 will be more elastic when it competes with a substitute. Note also that we cannot exclude from

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5 Entrants are assumed to have no requirement to offer universal service. However, we assume in section 3 that the marginal cost of entrants' good 3 is higher than that of the USP's good 2 to allow for other costs entrants may incur in offering postal service.

6 The analysis of welfare-optimal (and other) cost allocation procedures was pioneered by Braeutigam(1980).

the outset that, if competition is strong enough, the maximization program of the USP has no solution, i.e. there is no combination of USP prices that allows it to break-even.

The regulator can decentralize these Ramsey prices by using a global price cap formula. We assume that the USP chooses its prices in order to maximise its profit

$$(p_1 - c_1)x_1 + (p_2 - c_2)x_2 - F$$

subject to the price-cap

$$p_1 n_1 + p_2 n_2 \leq p^{\circ}$$

where $n_i$ is a weight and $p°$ the average price and both are set by the regulator. The first-order conditions are

$$x_i + (p_i - c_i)\frac{\partial x_i}{\partial p_i} = \mu n_i$$

where $\mu$ is the Lagrange multiplier of the price cap constraint. One can see that the regulator can decentralize the Ramsey prices by setting weights equal to (optimal) quantities, $n_i = x_i$, and by setting the average price appropriately. This level is such that the Lagrange multiplier of the constraint at equilibrium is equal to $1/(1+\lambda)$.[7]

Secondly, rather than using a global price cap, the regulator could fix the share of fixed cost $\alpha_i$ that each product has to cover, while the USP is just allowed to break-even, i.e. to post prices such that

$$(p_1 - c_1)x_1 + (p_2 - c_2)x_2 = F$$

with

$$(p_i - c_i)x_i = \alpha_i F \qquad (1)$$

$$\alpha_i \geq 0, \quad \sum_{i=1,2} \alpha_i = 1.$$

The price of good $i=1,2$ is then given by

[7] This of course assumes that there exist prices $p_1$ and $p_2$ that allow the USP to break-even. If not, it is clear that no value of the average price, however large, can decentralise an allocation that does not exist!

$$p_i = c_i + \frac{\alpha_i F}{x_i}.$$

Note that this formulation is implicit, since the demand function $x_i$ in the right hand side of the equation depends on the price $p_i$. It is even possible that this problem does not admit any solution for a given value of $\alpha_i$. For example, setting $\alpha_1$ at zero means that all the network fixed cost should be recovered only by a mark-up on good 2, while good 1 is priced at marginal cost; depending on the calibration of demand and cost functions, the effective minimum for the price of good 1, and the respective sizes of the markets for goods 1 and 2, this may or may not be feasible. For instance, if competition is strong enough on the market for goods 2 and 3, even the profit-maximizing price for good 2 may not generate enough profit to fund the fixed cost $F$. In the rest of the paper, we consider solutions with the minimum value of $\alpha_1$ since this yields the lowest price of good 1, $p_1$, that is compatible with the USP breaking even. A minimum value of $\alpha_1$ of zero means that the totality of the fixed cost is funded by profit made on selling good 2. This does not imply that the USP posts the profit-maximising price of good 2, since we do not allow the USP to make a profit on good 2 greater than the amount of the fixed cost.[8] On the other hand, a strictly positive minimum value of $\alpha_1$ implies that the USP posts the profit-maximising price for good 2 but that the maximum profit earned by selling that good is not high enough to fund the fixed cost.

Thirdly, the regulator could impose that each product's price exhibits the same proportional mark-up over marginal cost, while allowing the USP to break-even (see Sherman(1993)). Formally, the USP posts prices with a mark-up, *k,* such that

$$(p_1 - c_1)x_1 + (p_2 - c_2)x_2 = F$$

with

$$\frac{p_i - c_i}{c_i} = k$$

which is equivalent to

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[8] Nor do we allow a negative value of $\alpha_1$ which would entail a cross-subsidy from good 2 to good 1 or a value of $\alpha_1$ below that consistent with the effective floor for the price of good 1 given by the price of the bulk mail product, good 2, plus the worksharing cost incurred by a bulk mailer.

$$k = \frac{F}{c_1 x_1(c_1(1+k)) + c_2 x_2(c_2(1+k), c_3)}.$$

Observe that there is no guarantee that such a value of $k$ exists. If demand conditions (including the existence of competition for a subset only of the goods provided by the USP, as in this model) vary a lot between goods, break-even may require very different mark-ups over the different goods and a requirement of equiproportional mark-ups may prevent the USP from breaking even. The existence of an EPMU solution can only be assessed numerically after the model is calibrated.

Before going to the calibration of the model, we compare the three procedures presented above in terms of the share of fixed cost recovered by good 1 (the parameter $\alpha_1$ in equation (1)). The second procedure gives us the minimum value of $\alpha_1$, and hence for $p_1$, compatible with the USP breaking even. The value of $\alpha_1$ obtained from the optimal price cap is always greater than this value, since the second-best optimal prices require a positive mark-up for all goods in our setting with a network fixed cost. These two procedures then determine a range of potential values of $\alpha_1$ compatible with the USP breaking even. Observe that increasing the value of $\alpha_1$ above its second-best value (i.e. raising the price of good 1 above its second-best value) would only generate a decrease in total welfare in the economy. We can also associate a value of $\alpha_1$ to the EPMU solution. If the EPMU solution is feasible (i.e. allows the USP to break-even), then this value of $\alpha_1$ is by definition above the minimum $\alpha_1$ computed above. On the other hand, it is not possible to say in general whether this value of $\alpha_1$ will be above or below the one corresponding to the second-best optimal prices. To answer this question, we first have to calibrate the model to which we now turn.

## 3. CALIBRATION

To calibrate the model, we start from the hypothetical situation where the USP does not face any entrants. We assume that the USP posts a price of 0.50€ for good 1, a single piece product, and of 0.40€ for good 2, a bulk mail product used by business. Quantities sold at those prices are, respectively, 2 billion and 8 billion items. We assume that the direct price elasticities of these two goods are, respectively, -0.2 and -0.4. A number of studies have estimated direct price elasticities for mail yielding values which are low and of about this order of magnitude (see Florens et al (2002), Nankervis et al (2002), USPS (2000)). Finally, we calibrate linear demands based on these quantities, prices and elasticities.

We need further information to calibrate the demand function for good 2 once good 3 is available from entrants. We use two types of information: the extent of entry for different price configurations and the substitutability between goods 2 and 3 for consumers. As for the extent of entry, we assume a significant level of brand loyalty to the USP and inertia in switching to competitor products.[9] In the main cases of section 4 entrants would capture 10% of the total market for goods 2 and 3 if the price of good 3 were set at the same level as the USP, and 50% of the market if entrants were to offer a 20% price discount over the USP. In section 4 also we study the sensitivity of our results to these assumptions and develop the case where, in the early phases of entry, the entrants' market shares are, respectively, 5% and 20% for an equal price and a 20% price discount.

The final element needed to calibrate demand for goods 2 and 3 is related to the substitution between those two goods. We measure it using the displacement ratio, whose formula is

$$\sigma = -\frac{\partial x_2 / \partial p_3}{\partial x_3 / \partial p_3}.$$

We fix the value of this ratio at 0.75, which means that three quarters of the quantities sold by entrants are effectively displaced from the USP, while one quarter represents additional volumes sold in the sector. We study the sensitivity of our result to this parameter by setting it at 0.9.

The marginal costs for the two goods offered by the USP are 0.30€ and 0.24€. The difference reflects higher sortation and collection costs of single piece mail. The worksharing cost of senders of bulk mail need not be the same as this difference but is likely to be of a similar order depending on the effectiveness of mailers in preparing and presenting mail in the this way. Accordingly, we assume for simplicity that the worksharing cost incurred by a bulk mailer is 0.06€ and that the effective minimum for the price of good 1 is the price of good 2 plus 0.06€. If the price of good 1 fell below this bulk mailers would find it cheaper not to incur the cost of worksharing and instead send all mail as single piece.[10] The fixed cost is 1.68 bn€ such that at these prices, volumes and marginal costs the USP breaks even under monopoly (including a normal rate of profit and equals 40% of revenue of 4.2 bn€). Two values are considered for the marginal cost of good 3, 0.32€

[9] There is limited evidence available on switching propensities. However, the calibration values used here are likely to be conservative and understate prospective switching.

[10] Clearly such a case could be modelled but is of little practical interest here where two separate goods are assumed to be offered by the USP. In practice, business mail includes also mail which is not presorted and here the effective minimum price for such mail is that for single piece and indeed may be the single piece product itself. As noted earlier the model could be extended to allow two business mail products, one requiring presortation and a second one of a higher price with no sortation requirement.

and 0.40€, and results reported for each to test the variation of our results to this parameter. As noted above, entrants do not have an obligation to offer universal service. While they do not face a fixed, network cost for this the marginal costs assumed are above those of the USP to reflect additional costs they may incur in offering a postal service.[11]

## 4. RESULTS

### Monopoly Case

We commence our analysis by evaluating the position of the USP under monopoly and the prices, volumes and welfare under the three pricing or cost allocation rules set out in section 2. The numerical results from applying the calibration values set out in section 3 are shown in table 1. In the first column we report the output for the EPMU cost allocation rule which, in the monopoly case, allows the USP to break-even and was used to calibrate the model. Applying the calibration values set out in section 2, welfare is equal to 6.5bn€. The average price required by the USP under monopoly, given this cost allocation and pricing rule, is 0.42€. The share of the fixed costs of universal service provision collected from good 1 ($\alpha_1$ using section 2's notation) is 23.8%, and so that raised from product 2 ($\alpha_2$) is 76.2%.

Having calibrated the model for the EPMU case, the remaining columns in table 1 show the results of two further cost allocation rules under monopoly. These cases identify the range, as set out in section 2, of the minimum price for good 1 at which the USP breaks even at or above the price of good 2 plus worksharing cost for a sender of bulk mail (0.469€ in column 2) and the price for good 1 at which welfare is maximised subject to the USP breaking even (0.609€ in column 3). For the first of these, shown in the second column of the table, the USP breaks even with the good 1 price set at its effective floor of the price of good 2 plus the worksharing cost to a sender of bulk mail and a smaller share of the fixed cost is recovered from good 1, at 20.3%, than in the EPMU case. Given the price elasticities in the model, this results in slightly lower volumes in total from the two products so that the fixed cost is shared among a smaller number of items. The average price is marginally higher at 0.421€ and welfare lower relative to the values for these variables in the EPMU case.

For the welfare maximising prices achievable through a GPC, in the third column of the table, the mark-up on the product with the lower (absolute) price elasticity is higher than the mark-up on the product with the higher (absolute) price elasticity. Compared with prices under EPMU, the

[11] A marginal cost of 0.32€ relative to 0.40€ reflects a lower cost and hence a situation where entrants are relatively more efficient. The marginal cost for the USP is lower still at 0.24€ though the USP also recovers the network cost of universal service provision.

price of good 1 is higher and that for good 2 lower. Overall volumes rise and the minimum average price required for the USP to break-even and recover the fixed cost of universal service is lower at 0.417€. The allocation of fixed costs which maximises welfare and produces a lower overall level of USP prices leads to a greater share of the fixed cost being recovered from the lower elasticity product, good 1, at 35.1% rather than 23.8% under EPMU.

These results illustrate some points about the cost allocation rules that apply not only under monopoly but also more generally to the cases involving entry considered below. For prices of good 1 below that at the GPC outcome, three related points are evident from increasing the price of good 1, single piece mail, compared with good 2, bulk mail. First, with good 1 having a lower (absolute) price elasticity than good 2, the combined demand for the two products is increased which implies that there are more items of mail to share the fixed cost of universal service provision; secondly, the combined average price of the two products declines; and, thirdly, total welfare increases. Of the three rules, therefore, the cost allocation consistent with GPC produces the highest level of demand and total use of the network, the lowest average price and, as shown in section 2, the highest level of welfare. The alternatives to the rule consistent with GPC result in lower total volume, higher average prices and lower welfare. Nevertheless, in this instance, under monopoly the volume and welfare impacts of different price sets are quite small as are those on average price. In addition, the EPMU cost allocation rule results in prices that lie within the range between the minimum break-even price and welfare maximising price. The inference from this is that, under monopoly, there is a broad range of prices that are close to welfare maximising and include EPMU, which may also partly explain why a USP in moving from a monopoly to a competitive market may begin with prices that are far from welfare maximising prices.

**Table 1: Prices, Volumes and Welfare Under Alternative Price and Cost Allocation Rules: Monopoly Case**[1]

| | EPMU | Lowest Price of Good 1 for Overall Break-Even | GPC |
|---|---|---|---|
| Prices,€ : | | | |
| - USP Good 1 | 0.500 | 0.469 | 0.609 |
| - USP Good 2 | 0.400 | 0.409 | 0.373 |
| Volumes, bn items | | | |
| - USP Good 1 | 2.000 | 2.025 | 1.913 |
| - USP Good 2 | 8.000 | 7.930 | 8.219 |
| - USP Total | 10.000 | 9.955 | 10.132 |
| Profit, €m | 0 | 0 | 0 |
| Welfare, €bn | 6.500 | 6.493 | 6.510 |
| Average Price, € | 0.420 | 0.421 | 0.417 |
| Share of Fixed Cost Recovered by Good 1, % | 23.8 | 20.3 | 35.1 |

[1] Calibration values as follows: Marginal costs (USP good 1, 0.30€; USP good 2, 0.24€); fixed cost (1.68bn€ including normal rate of profit); price elasticities (USP good 1, -0.2; USP good 2, -0.4); relationship between prices (price of good 1 ≥ price of good 2 + 0.06€).

## Entry: Central Case for Calibration of Demand for Goods 2 and 3

Unless entry represents completely new mail, it implies a decline in demand for the products of the USP. In our model we consider this through the effect on the demand for the USP's good 2, with which the entrants' product competes, with the demand function for the USP's good 1 remaining unchanged. If the prices of both products remain unchanged, reduced demand for good 2 due to entry results in a loss of contribution for each item of good 2 displaced by the entrants' product. A financial loss results and the initial set of prices and allocation of the network cost between the two products is no longer sufficient to allow break-even. In this subsection we apply our model to consider the implications of entry for our central case in calibrating demand as set out in section 3.[12] We do this for two alternative prices set by entrants to evaluate the effect of different degrees of entry. First, entrants' costs are assumed to be such that their price equals the initial price for the USP's product 2 (0.40€); this results in a limited amount of entry. Secondly, the entrants' price is 20% below this initial price; entry is then more extensive. Results for both entrant prices are reported in table 2.

In the first case, results of which are reported in the first three columns of table 2, entrants charge a price of 0.40€. The lowest price for good 1

[12] First, entrants capture 10% of the total market for goods 2 and 3 if their price were the same as that of the USP and 50% if they offered a discount of 20% over the USP; and, secondly, a displacement ratio, σ, of 0.75.

consistent with break-even after taking account of entry and losses of volume for the USP's good 2 is 0.54€. This is above the price of good 1 under monopoly which if unchanged at 0.50€ would result in the USP making a loss. Although the USP breaks even at the new equilibrium prices, the average price of its two products is higher than before entry (at 0.453€ compared with 0.42€) and welfare lower. While entry has led to overall market volumes growing slightly (by about 2%), those handled by the USP have fallen. The arrival of entrants decreases the quantity of good 2 sold by the USP at the monopoly price. This induces the USP to increase both its prices to make up for the lost revenue, which increases its average price and further decreases the quantities it sells. On the other hand, only one quarter of the entrants' volumes constitute an addition to the total market volume, and entrants offer good 3 at the same price as that of good 2 under monopoly (0.40€). This means that the consumers gain little from the availability of this new good, while they suffer from the increase in the prices of goods 1 and 2. Table 2 shows that the net effect of entry on the consumer surplus (and on total welfare) is negative, since total welfare is lower than under monopoly.

The second column reports the GPC solution. Compared with the previous column, the USP decreases its price for the more elastic good 2 and increases its price for the less elastic good 1. Given the high price of good 3, no entry occurs and the result obtained is the same as in the last column of table 1. The average price is again lower than that with the minimum price of good 1 and total welfare is higher. For this case of low entry, the range of prices identified by the outcomes associated with the minimum break-even price of good 1 and the GPC price has narrowed from 0.469€ to 0.609€ (in table 1) to 0.54€ to 0.609€ (in table 2). Nevertheless, this range includes EPMU which requires the USP to set prices at 0.541€ for good 1 and 0.433€ for good 2. Both prices are higher than before entry because, clearly it is the total volume of the USP's two products after entry that is relevant. Average price across the two products is higher (at 0.459€ compared with 0.42€ pre-entry) and welfare lower than under monopoly.

**Table 2: Prices, Volumes and Welfare Under Alternative Price and Cost Allocation Rules: Entry Under Central Case for Calibration of Demand for Goods 2 and 3[1]**

| | Entrants' Price Compared With The Initial Price of USP's Good 2 | | | | | |
|---|---|---|---|---|---|---|
| | Same | | | 20% Less | | |
| | Lowest Price of Good 1[2] | GPC | EPMU | Lowest Price of Good 1[2] | GPC | EPMU |
| Prices,€ : | | | | | | |
| - USP Good 1 | 0.540 | 0.609 | 0.541 | 0.847 | 0.996 | 0.524 |
| - USP Good 2 | 0.427 | 0.373 | 0.433 | 0.386 | 0.316 | 0.419 |
| - Entrants (Good 3) | 0.400 | 0.400 | 0.400 | 0.320 | 0.320 | 0.320 |
| Volumes, bn items | | | | | | |
| - USP Good 1 | 1.968 | 1.913 | 1.967 | 1.722 | 1.603 | 1.981 |
| - USP Good 2 | 6.442 | 8.219 | 6.266 | 5.036 | 7.476 | 3.910 |
| - Entrants (Good 3) | 1.785 | 0 | 1.965 | 4.097 | 1.600 | 5.248 |
| - Total USP | 8.410 | 10.132 | 8.233 | 6.758 | 9.079 | 5.891 |
| - Total Market | 10.195 | 10.132 | 10.198 | 10.855 | 10.679 | 11.139 |
| USP Profit, €bn | 0 | 0 | 0 | 0 | 0 | -0.535 |
| Welfare, €bn | 6.238 | 6.510 | 6.204 | 6.142 | 6.339 | 5.897[3] |
| Average Price, € | 0.453 | 0.417 | 0.459 | 0.503 | 0.436 | 0.572[4] |
| Share of USP Fixed Cost Recovered by Good 1, % | 28.1 | 35.1 | 28.2 | 56.1 | 66.4 | 26.4 |

[1] Calibration values as follows: Marginal costs (USP good 1, 0.30€; USP good 2, 0.24€); fixed cost (1.68bn€ including normal rate of profit); price elasticities (USP good 1, -0.2; USP good 2, -0.4); displacement ratio (σ=0.75); extent of entry (10% of total market for goods 2 and 3 at entrant price equal to USP; 50% at price discount of 20% to USP); relationship between prices (price of good 1≥ price of good 2 + 0.06€).

[2] Lowest price of Good 1 for USP to breakeven overall across both products.

[3] Using cost of public funds at 0.3.

[4] Including coverage of financial deficit at cost of public funds of 0.3.

In the second case, shown in the final three columns of table 2, entrants' prices are assumed to be 0.32€ so encouraging higher entry. As a result, the lowest price of good 1 which satisfies break-even is much higher at 0.847€ (in column 4) compared with 0.54€ (in column 1) while the price of good 2 at 0.386€ (in column 4) is below 0.427€ (in column1). Again, although market volumes increase, in this case by about 4%, those using the USP's network fall significantly. The average price of the USP products increases from 0.453€ to 0.503€ and welfare falls. The GPC price for good 1 is higher at 0.996€ and for good 2 somewhat lower at 0.316€. Entrants retain a significant share of overall volumes but, with the USP's total volume closer to that before entry, both the average price and welfare level improve towards their levels before entry. Given the high level of entry, no EPMU allocation allows the USP to break-even. The last column of table 2 reports the loss minimizing EPMU allocation, where the USP loss is 0.535bn€ and the contribution per item of good 1 to the fixed cost is 0.244€ while that from good 2 is 0.179€. In comparison, the minimum contribution on the USP's good 1 implied by the lowest price of good 1 to allow break-even is 0.547€ and that for good 2 is 0.146€. To facilitate comparison of the total welfare implications, it is assumed that outside funds are available at a cost of 0.3.[13] The average price of the USP's two products inclusive of this funding is 0.572€, well above that under the two other cost allocation rules. Consequently, in this case the EPMU cost allocation leads to the position of the USP being unsustainable or this loss is funded in some other way[14].

Figure 1 summarises some of these results and shows the relationship between the price of good 1 and economic welfare for the three cases of monopoly and entry at prices of 0.32€ and 0.40€. The unbroken part of each curve is the range from either the effective minimum of the price of good 1 given by the price of good 2 plus a bulk mail sender's worksharing cost (in the case of monopoly) or the minimum price of good 1 for the USP to break-even overall (in the two cases for entry) up to the GPC welfare-maximising price. The broken lines indicate the values of welfare which are below the sustainable price for good 1. The curves for the entry cases are much steeper than under monopoly indicating that welfare is much more sensitive to the price of the USP's good 1 where there is entry. This is due in turn to the impact of entry on the demand for the USP's good 2. The EPMU prices are recorded at the bottom of figure 1 and vary much less than the minimum

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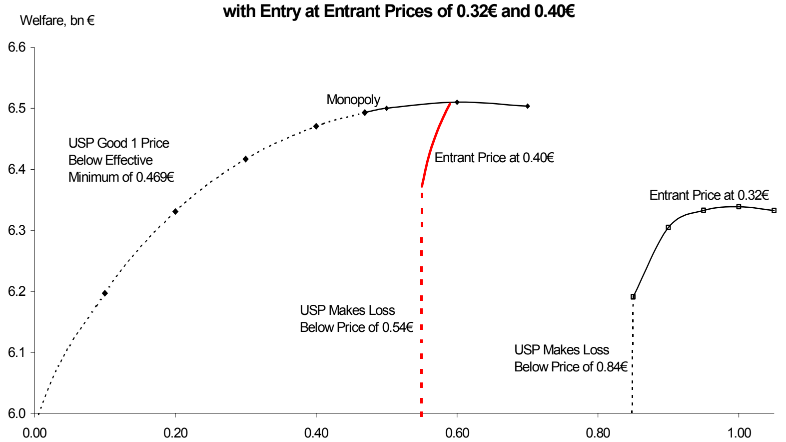
[13] Raising taxes generates distortions in the economy as soon as the government cannot use lump-sum taxes. Most estimates of the size of these distortions, called the cost of public funds, in developed countries belong to the range of 0.2 to 0.3. This means that, to raise 10 (million) euros, the government has to decrease the surplus of the agents who pay these taxes by the equivalent of 12 to 13 (million) euros.

[14] Other possibilities for funding such a deficit are not considered here but include changes to the service specification, taxes on entrants and a universal service or compensation fund (see De Donder et al (2002) for review). Where the USP is considered by its regulator to be less than fully efficient, price controls contain assumptions regarding the rate at which underlying costs should be reduced which would either increase contribution directly or allow lower prices leading to less entry and higher volumes. Implicitly the calibration values take account of this improvement which under incentive regulation may be overachieved. However, to the extent that a deficit would arise after such cost reductions then EPMU as a cost allocation rule would be inconsistent with financial viability.

prices of good 1 to allow the USP to break-even overall and hence respond only in a very limited way to the impact of entry. Figure 1 also highlights the impact of lower entrant prices and hence higher entry on welfare. As the extent of entry increases, welfare reaches its maximum at a higher price of good 1 and a lower level of welfare. A similar effect is apparent in the lowest price of good 1 to allow the USP to break-even overall such that the greater the degree of entry, the higher the accompanying level of this price and the lower the associated level of welfare.

**Figure 1: Price of USP Good 1 and Welfare under Monopoly and with Entry at Entrant Prices of 0.32€ and 0.40€**




EPMU prices: Monopoly (0.50€); Entrant price at 0.40€ (0.54€); Entrant price at 0.32€ (0.524€)

### Entry: Sensitivities on the Main Parameter Values

It is informative to understand the sensitivity of the results to the parameter values in the model. This can be achieved by changing one element of the calibration and comparing results from this with the original case. We report three comparative static analyses of this type in this subsection. First, the extent of entry in newly liberalised postal markets may be less than in a fully developed market. We examine this effect of a lower propensity of customers to switch in the near term by assuming 5% switch at equal prices (against 10% in the base) and that 20% switch at a 20% price discount (against 50% in the base). Secondly, one of the key parameters in the model is the extent to which traffic carried by entrants is new. In the base case, we assume that one in four items is new and three in four items displace those of the USP ($\sigma$=0.75). As a sensitivity, we evaluate a case where only one in ten items carried by entrants is new traffic ($\sigma$=0.9). The results from these sensitivities are reported in table 3. After this we consider a third sensitivity relating to the structure of demand in the central case, reported separately in table 4.

For lower initial entry, the comparison in table 3 is with the first three columns in table 2 where the entrants' price is the same as the initial price of the USP's good 2 (0.40€). With a lower propensity for the USP's good 2 traffic to switch to entrants, more of the network cost could be recovered under this cost allocation rule from good 2. The lowest price of good 1 is lower than in the case in table 2 and at its effective minimum of the price of good 2 plus the worksharing cost of 0.06€ for a sender of bulk mail. In addition, the GPC outcome remains close to that in the table 2 case. The EPMU cost allocation rule lies within this range and results in a smaller loss of good 2 volume allowing lower prices and higher welfare compared with the case in table 2. We conclude that with lower entry the range of cost allocations between lowest good 1 price and GPC is widened with the higher retention of volume helping to lower the average level of USP prices and raise welfare. Nevertheless, the EPMU rule remains with a lower welfare level than GPC.

**Table 3: Prices, Volumes and Welfare Under Alternative Price and Cost Allocation Rules: Sensitivities Compared with Central Case for Calibration of Demand for Goods 2 and 3[1]**

| | Lower Entry[2] | | | Higher Displacement[3] | | |
|---|---|---|---|---|---|---|
| | Lowest Price Good 1[4] | GPC | EPMU | Lowest Price of Good 1[4] | GPC | EPMU |
| Prices,€ : | | | | | | |
| - USP Good 1 | 0.479 | 0.636 | 0.508 | 0.867 | 1.008 | 0.496 |
| - USP Good 2 | 0.419 | 0.366 | 0.407 | 0.370 | 0.308 | 0.397 |
| - Entrants | 0.400 | 0.400 | 0.400 | 0.320 | 0.320 | 0.320 |
| Volumes, bn items | | | | | | |
| - USP Good 1 | 2.017 | 1.891 | 1.993 | 1.707 | 1.594 | 2.003 |
| - USP Good 2 | 7.376 | 8.270 | 7.581 | 5.501 | 8.117 | 4.347 |
| - Entrants | 0.631 | 0 | 0.487 | 3.047 | 0.688 | 4.087 |
| - Total USP | 9.393 | 10.161 | 9.574 | 7.208 | 9.711 | 6.350 |
| - Total Market | 10.024 | 10.161 | 10.061 | 10.255 | 10.399 | 10.437 |
| USP Profit, €bn | 0 | 0 | 0 | 0 | 0 | -0.606 |
| Welfare, €bn | 6.405 | 6.509 | 6.436 | 6.177 | 6.363 | 5.943[5] |
| Average Price, € | 0.432 | 0.417 | 0.428 | 0.488 | 0.423 | 0.552[6] |
| Share of USP Fixed Cost Recovered by Good 1, % | 21.5 | 37.9 | 24.7 | 57.6 | 67.2 | 23.4 |

[1] Calibration values as follows: Marginal costs (USP good 1, 0.30€; USP good 2, 0.24€); fixed cost (1.68bn€ including normal rate of profit); Price elasticities (USP good 1, -0.2; USP good 2, -0.4); relationship between prices (price of good 1≥ price of good 2 + 0.06€).

[2] Same as first case in table 2 (entrants' price, 0.40€, and displacement ratio, σ=0.75) but assumes entry equal to 5% of total market for goods 2 and 3 prices (10% in base) and 20% at a price discount of 20% (50% in base).

[3] Same as second case in table 2 (entrants' price, 0.32€; extent of entry (10% of total market for goods 2 and 3 at entrant price equal to USP; 50% at price discount of 20% to USP)) but assumes displacement ratio of σ=0.9 (σ=0.75 in base) or that 9 in 10 items carried by the entrants are displaced from the USP's good 2 and 1 in 10 items is new traffic.

[4] Lowest price of good 1 for USP to break-even.

[5] Using cost of public funds at 0.3.

[6] Including coverage of financial deficit at cost of public funds of 0.3.

The second case in table 3 is compared with the case in the final three columns in table 2 with both assuming that the entrants' price is 0.32€. The only difference between the two cases then is that, against the original displacement ratio of σ=0.75, the corresponding parameter value is σ=0.9.

This higher displacement means that the demand for good 2 is more elastic, and the USP reacts by decreasing the price for this product both in columns 4 and 5 (compared to table 2). The price of good 1 increases so that the USP breaks even. Faced with a lower price for good 2, the quantities sold by entrants decrease in both cases, and so does total quantity in the market. The impact on consumer surplus is a priori indeterminate: a higher displacement ratio means that goods 2 and 3 are closer substitutes so that consumers gain less from the introduction of product 3 in the market. On the other hand, consumers gain from the lower price for good 2 and lose from the higher price for product 1. With our simulations, the lower price for good 2 overrides the other effects and total welfare increases slightly. As for the EPMU cost allocation, increasing the displacement ratio does not enable the USP to break-even anymore than it did in table 2. On the contrary, the minimum loss attained under EPMU increases compared with table 2. This minimum loss is attained with lower prices than previously, both for goods 1 and 2. The net effect on welfare of a higher displacement ratio is composed of the positive impact of lower prices for goods 1 and 2 and of the negative impact of a higher USP loss and a less differentiated good 3. With our calibration, the net impact is slightly positive.

In table 4 we consider a third sensitivity. The structure of demand in the central case assumes that 80% of the USP's initial market is effectively open to entry either as presorted bulk mail or other types of business mail and that 20% of the market is not a realistic prospect for entry. For the sensitivity we assume that 90% of the USP's initial volume would face competition and hence a single piece share of only 10%.[15] All other parameter values are unchanged.[16] The first three columns of table 4 report results under monopoly. The pattern of results across the three pricing rules is very similar to those reported in table 1 for the central case. The EPMU rule is within the range of the two other rules and applying that rule leads to a price for good 1 such that it funds 12% of the network cost compared with 10% in the case of the lowest price of good 1 consistent with break-even overall and 19.2% in the case of the GPC. Welfare overall is lower (for example, in the case of EPMU 5.750bn€ compared with 6.500bn€ in the central case) as there is less of good 1 where consumer surplus is higher but again the differences in welfare between the three pricing rules are very small.

The two remaining columns in table 4 show the impact of entry for the case where entrants' prices are 20% less than the initial prices of the USP's

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[15] Single piece volumes have been declining in a number of countries in recent years. While 10% may be less than the share of consumer single piece and small business mailings in many countries currently, as e-substitution continues these segments of the market are likely to represent a declining share of future total mail volumes.

[16] The fixed cost and normal rate of profit implied by these parameters is slightly lower at 1.66bn€ compared with 1.68bn € in the central case.

good 2. The central case reported in table 2 produced a set of prices of the USP's two goods where break-even was feasible over a range of prices (for the USP's good 1 from 0.847€ to 0.996€). However, in the sensitivity, good 1 represents only 10% of the initial demand and table 4 shows that there is no pair of prices available to the USP which it can set to allow it to break-even overall. Instead we report the pair of prices which minimises the financial loss incurred by the USP. This sum is –0.081m€ and requires a significant increase in the price of the USP's good 1 to its profit-maximising level of 1.65€ and hence in the overall average price to 0.514€ compared with the prices under monopoly. As the best outcome is one of minimising continuing financial losses, this case is consistent with a "graveyard spiral" unless an alternative means of funding is available to cover this deficit (Crew and Kleindorfer, 2000). As might be expected from the central case in table 2, the EPMU pricing rule produces a significantly worse financial outcome and a higher average price than that under the pair of prices for the USP's two goods which minimises financial losses.

**Table 4: Prices, Volumes and Welfare Under Alternative Price and Cost Allocation Rules: Sensitivity of Single Piece Mail at 10% of USP Base Volume[1]**

| | Monopoly | | | Competition with Entrants' Price 20% Less Than USP's | |
|---|---|---|---|---|---|
| | Lowest Price of Good 1[2] | GPC | EPMU | Loss Minimising Pair of USP Prices | EPMU |
| Prices,€ : | | | | | |
| - USP Good 1 | 0.464 | 0.637 | 0.500 | 1.650 | 0.502 |
| - USP Good 2 | 0.404 | 0.385 | 0.400 | 0.386 | 0.401 |
| - Entrants (Good 3) | - | - | - | 0.320 | 0.320 |
| Volumes, bn items | | | | | |
| - USP Good 1 | 1.014 | 0.945 | 1.000 | 0.540 | 0.999 |
| - USP Good 2 | 8.960 | 9.138 | 9.000 | 5.665 | 5.091 |
| - Entrants (Good 3) | - | - | - | 4.609 | 5.196 |
| - Total USP | 9.974 | 10.083 | 10.000 | 6.205 | 6.090 |
| - Total Market | 9.974 | 10.083 | 10.000 | 10.814 | 11.286 |
| USP Profit, €bn | 0 | 0 | 0 | -0.081 | -0.617 [3] |
| Welfare, €bn | 5.746 | 5.756 | 5.750 | 5.083 | 5.190 |
| Average Price, € | 0.4101 | 0.408 | 0.410 | 0.514 | 0.549 [4] |
| Share of USP Fixed Cost Recovered by Good 1, % | 10.0 | 19.2 | 12.0 | 44.5 | 12.3 |

[1] Compared with 20% of base volume in central case. Other calibration values as follows: Marginal costs (USP good 1, 0.30€; USP good 2, 0.24€); fixed cost (1.66bn€ including normal rate of profit); price elasticities (USP good 1, -0.2; USP good 2, -0.4); displacement ratio (σ=0.75); extent of entry (10% of total market for goods 2 and 3 at entrant price equal to USP; 50% at price discount of 20% to USP); relationship between prices (price of good 1 ? price of good 2 + 0.06€).

[2] Lowest price of good 1 for USP to breakeven overall across both products.

[3] Using cost of public funds at 0.3.

[4] Including coverage of financial deficit at cost of public funds of 0.3.

## 5. IMPLICATIONS FOR PRICE SETTING AND STRUCTURE OF PRICE CONTROLS

In this final section we outline briefly the main implications from our model and numerical analysis for the setting of price controls in liberalised postal markets. In setting of prices and recovery through these of variable costs and the network or fixed cost of universal service provision, we have paid particular attention to the price of the product where entry is least likely (single piece mail or “good 1” in our model). Even though its price may not be affected by entry through a direct impact on its volume, it will be affected by entry to other segments of the market and the impact of this on the USP’s total volume of mail. In this analysis we have concentrated on the range of prices for good 1 defined by the minimum price for that product to allow break-even for the USP and the welfare-maximising GPC price (which is always higher than this minimum since it calls for a positive mark-up on all goods). A price for good 1 in this range enables the USP to break-even and to enhance economic welfare by raising the price of good 1 and lowering that of the other product with a higher (absolute) price elasticity (bulk mail or “good 2” in our model). Of course, it may be the case that competition is so extensive, either because of the effect of entry on the demand for the USP’s good 2 or the small size of the market for good 1 where entry is assumed not to occur, that no prices allow the USP to break-even.

Clearly the relevant volumes for the setting of prices and recovery of the network cost are those inclusive of the impact of entry. Entry reduces the mail volumes of the USP and so requires a different set of prices to achieve break-even. The higher the level of entry, the lower the volume of the USP to recover network costs and hence the higher the average price across products required by the USP to break-even. The increase in the average price due to entry also reduces the total level of economic welfare (having included the increase in welfare arising from the new products offered by entrants). If there is little entry, cost allocation rules such as EPMU result in prices that are likely to be within the range identified by the minimum price required for good 1 to allow break-even and the welfare–maximising GPC price. However, if entry is more extensive, cost allocation rules of this kind are increasingly likely to fall outside of this range and the cost allocation rule would need to be closer to that of the welfare-maximising GPC prices to enable the USP to break-even overall. At the limit, it may be that even complete price flexibility is insufficient to allow break-even and we consider a result of this type in the paper.

We find the following implications from our model for the setting of price controls. In terms of the overall level of prices required by the USP, our model shows clearly that this depends on the cost allocation rule. The level is lowest under GPC where welfare is also maximised and higher under alternative cost allocation rules (e.g. “lowest price of good 1” and EPMU). Consequently, in addition to assumptions made by a regulator relating to improvements in underlying cost levels of the USP, the overall level of prices set for a price control is contingent also on the cost allocation rule the USP is able to adopt for its pricing.[17]

Our model has incorporated two products for the USP although these can also be viewed as representing two groups of products. This facilitates consideration as to whether a single control or basket should apply as under GPC or whether the two products should be placed and controlled in two separate baskets. If the two products are price controlled separately, then this requires a division of the fixed, network cost between the two baskets. This cost allocation rule not only affects the degree of price rebalancing between baskets but also the average level of allowed prices, the overall level of welfare and the financial viability of the USP. The greater is the degree of competition, the more likely it is that any cost allocation rule, such as EPMU, will lie outside the range of prices at which the USP breaks even.

Where, as in our model, the fixed cost is common to both products, the interdependence of prices between the price controls on the two products is a key building block of the overall price control. This interdependence between different groups of products is unavoidable, particularly where entry is likely to be significant, as the overall requirement is for the two products jointly to recover the fixed cost. This requirement may be inadequately addressed by arbitrary cost allocation rules, like EPMU, if the degree of competition assumed in setting the price control is understated since in such cases the USP may be loss-making and ultimately unsustainable. Thus, cost allocation rules that are consistent with GPC and price control structures that facilitate the rebalancing of prices may be necessary to enable the USP to remain financially viable in the presence of competition provided a price solution exists.

We add two final comments. As noted in our introduction the focus of our paper has been on cost allocation and pricing rules within price controls rather than other areas such as promotion of reductions in underlying costs. To the extent that entry has a stimulating effect on service quality and/or the underlying cost level of the USP there are benefits which would need to be weighed with the areas covered by our paper. Secondly, in practice, there is uncertainty about the extent to which accounting costs should be treated as fixed or variable and, particularly, about the future volumes of USPs in a liberalised market. These informational considerations also suggest the benefits of allowing flexibility in terms of the setting of prices and facilitating this in the structure of a price control. To the extent that this is not allowed for and products are controlled separately, then it would be

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[17] There may be some interaction between cost efficiency and the structure of prices. For example, the lower the level of the USP's costs, the lower its prices can be and hence the less entry will occur. This would widen the range of prices identified by the lowest price of good 1 to allow overall break-even and the GPC solutions and hence the range of cost allocation rules consistent with break-even.

necessary for the regulatory framework to set higher allowed prices to accommodate the pricing rules implicit or explicit in the separate controls. That framework should include also the employment of tests and explicit means to underpin continuing financial viability where this becomes at risk.

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