

A Welfare and Pricing Analysis of Value Added Taxation in Postal Services*

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1 Introduction

Within the European Union, the application of value added tax in postal services is a matter for the government of the member state. The state is required under the European Directive to ensure the provision of the universal postal service. The incumbent national postal operator provides the universal service provider (USP) as the daily collection and delivery of mail throughout the state which, in most cases, applies through geographically uniform tariffs. As such the incumbent national postal operator has an obligation to provide the universal service that requires it to commit to the provision of a national network. In most countries, the incumbent national postal operator has been a monopolist, owned by the government and exempt from value added tax for the provision of the postal services. In some countries within Europe the postal market has been opened up to competition so that the national postal operator is no longer a monopolist of postal services within the state and in some countries the national postal operator has transferred from public to private ownership. The application of value added tax for postal services in the presence of such change is important in understanding the development of the postal markets in Europe.

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The application of value added tax is of interest because either the postal operator or customer may be VAT exempt or VAT rated. For the postal operator, if it is exempt from charging value added tax (VAT) on postal services it is unable to recover VAT they pay on inputs so these unrecovered tax payments enter their cost base in forming the prices of their postal services. On the other hand, if a postal operator is required to charge VAT on the postal services they offer they are rated for VAT purposes and are able to recover input tax. Similarly for the customer, if it is exempt from value added tax (VAT) on the goods and services it provides to others it is unable to recover the VAT it pays on inputs and, on the other hand, if it is VAT rated and charges VAT on its services then it can recover the VAT charges on its inputs such as postal services it purchases from providers of such services. This means that the tax incidence and prices differ depending on whether the postal operator and customer is VAT exempt or VAT rated.

In this paper we explore some of the issues relating to the application of value added tax under alternative objective functions, initially where the incumbent is a monopolist that is VAT exempt and has some customers that are VAT exempt and other customers that are VAT rated. We then consider the case where the incumbent is a monopolist that is VAT rated and has some customers that are VAT exempt and other customers that are VAT rated. Finally, we consider the cases where an incumbent who is VAT exempt or VAT rated operates in a market that is open to competition in the provision of some upstream services, through entrants accessing the incumbent's downstream services. In addition to the tax incidence and prices, we also consider the welfare implications of these various cases.

In our model the national operator offers two end-to-end (E2E) products: a single piece product and a business mail product. The business mail product is offered to both VAT-rated and VAT exempt customers. The entrant, when introduced, acts as a competitive fringe offering a bulk mail product that is an (imperfect) substitute to the bulk mail offered by the national operator. The national operator also sells access to its delivery areas to this entrant so that the national operator sells an intermediate good as well as the two end-to-end products. While the national operator is either VAT rated or VAT exempt, the entrant is assumed to be VAT rated throughout. As such the model for this paper develops that of De Donder (2006) to explore the issues of value added tax within postal services.

The paper proceeds as follows. Our model is set out further in section 2, first for the monopoly case and then when bulk mail is opened to competition. Section 3 calibrates the model. Section 4 presents, for the monopolist and entrant cases, some numerical results for the second best welfare maximising case and, by contrast, a case with the minimum single piece price that enables the national operator to break

even (Panzar 2004). Section 5 concludes.

2 The model

We first describe the model when the national postal operator (NPO) has monopoly before moving to the case where it faces competition on the bulk mail market.

2.1 Monopoly case

In this section, there is a single NPO (with variables are denoted with the superscript I) that offers both single-piece mail (whose quantity is denoted by x) and bulk mail (whose quantity is denoted by y^I) to a single delivery area. We denote by q the **before-tax** price of single piece mail and by p^I the **before-tax** price of bulk mail. There is a single VAT rate paid on all goods (non-labor inputs and outputs) which is denoted by t . We will consider both the case where the NPO is VAT exempt and where it is VAT rated.

The demand for single-piece mail is assumed to be independent from the demand for bulk mail. All customers of single-piece mail are VAT exempt. In the case where the NPO is also VAT exempt, their demand for single-piece mail is given by $x(q)$. If the NPO is VAT rated, their demand is $x(q(1+t))$. We distinguish two kinds of bulk-mail customers: those who are VAT-rated (denoted with subscript R) and those who are not (subscript NR). VAT exempt buyers care about the after-tax price of the good while the VAT rated ones care about the before-tax price (because they reclaim the VAT they pay on this good, which is an input in their own production function). The postal operator charges the same before-tax price p^I to the two types of customers. The total demand for NPO bulk mail is given by

$$y^I(p^I) = y_R^I(p^I) + y_N^I(p^I(1+t))$$

if the NPO is VAT rated, and by

$$y^I(p^I) = y_R^I(p^I) + y_N^I(p^I)$$

if not.

The NPO faces three kinds of costs: fixed costs, upstream costs and delivery costs. The fixed cost is denoted by F , with a fraction α_F that is non-labor costs, i.e. on which the NPO pays VAT. We denote by c_x (resp., c_y^I) the constant marginal upstream cost for single-piece mail (resp., bulk mail), and we assume that $c_x > c_y^I$. We denote by d^I the constant marginal delivery cost for both single-piece and bulk

mail. Finally, α^I denotes the fraction of the upstream and delivery costs that is non-labor, i.e. on which the NPO pays VAT.

The costs faced by the NPO depend on its VAT status. The NPO pays VAT on its non-labor input whatever its VAT status. If the NPO is VAT exempt, it does not charge VAT to its customers and can not reclaim the VAT paid on inputs. If the NPO is VAT rated, it charges VAT to its customers and reclaims the VAT it has paid on inputs. In the case the NPO is VAT exempt (denoted with a subscript N), its cost of providing x units of single-piece mail and y^I units of bulk mail is denoted by

$$C_N^I(x, y^I) = F(1 + \alpha_F t) + (1 + \alpha^I t) ((c_x + d^I)x + (c_y^I + d^I)y^I)$$

where $\alpha_F t F$ is a fixed amount of VAT paid by the NPO irrespective of its volume of output of postal services while

$$t\alpha^I ((c_x + d^I)x + (c_y^I + d^I)y^I)$$

measures the variable part of VAT the NPO pays.

On the other hand, if the NPO is VAT-rated, it can recoup the VAT paid on inputs, and its cost function is given by

$$C_R^I(x, y^I) = F + (c_x + d^I)x + (c_y^I + d^I)y^I.$$

We obviously have that

$$C_N^I(x, y^I) > C_R^I(x, y^I).$$

The (net of tax) NPO's profit is given by

$$\Pi_N^I(q, p^I) = qx(q) + p^I [y_R^I(p^I) + y_N^I(p^I)] - C_N^I(x(q), y^I(p^I))$$

if the NPO is VAT exempt and

$$\begin{aligned} \Pi_R^I(q, p^I) &= qx(q(1+t)) + p^I [y_R^I(p^I) + y_N^I(p^I(1+t))] \\ &\quad - C_R^I(x(q(1+t)), y_R^I(p^I) + y_N^I(p^I(1+t))) \end{aligned}$$

if it is VAT rated. This illustrates the impact on NPO's profit of changing its VAT status from exempt to rated, while keeping prices constant. On the output side, this move decreases the amount demanded by single-piece buyers (who are all VAT exempt) and by VAT exempt bulk mail customers (the other bulk mail customers are not affected since they reclaim the VAT they pay on inputs). This impact on profit is thus negative. On the input side, the NPO can now reclaim the VAT it

is paying on inputs. This impact on profit is positive. The sign of the net impact is ambiguous and depends on demand elasticities: if the demand by VAT exempt customers were totally inelastic, the first impact would disappear and the net effect would be positive. The larger the demand elasticity of those customers, the lower is $\Pi_R^I(q, p^I) - \Pi_N^I(q, p^I)$.

We first study a Ramsey-type objective for the social planner, who maximizes total welfare in the postal economy subject to the NPO breaking even.¹ Total welfare is made off consumer surplus, NPO's profit and VAT proceeds raised in the postal sector. We assume that the planner values the VAT proceeds using an exogenous cost of public funds, denoted by μ . With a VAT exempt NPO, the optimization problem is

$$\begin{aligned} \max_{q, p^I} W_N &= CS_x(q) + CS_N(p^I) + CS_R(p^I) + \Pi_N^I(q, p^I) + (1 + \mu)VAT_N(q, p^I) \\ \text{s.t. } \Pi_N^I(q, p^I) &\geq 0, [\text{Lagrange multiplier } \lambda] \end{aligned}$$

where $CS_x(q)$ measures the net consumer surplus of single-piece mail buyers and $CS_N()$ (resp., $CS_R()$) measures the net consumer surplus of the VAT exempt (resp., VAT rated) bulk mail buyers. The parameter λ is the Lagrange multiplier of the NPO budget constraint and measures the shadow cost of this constraint in terms of social welfare W_N .

When the NPO is VAT exempt, the amount of VAT proceeds in the postal sector is given by

$$VAT_N(q, p^I) = t\alpha_F F + t\alpha^I [(c_x + d^I)x(q) + (c_y^I + d^I)(y_N^I(p^I) + y_R^I(p^I))].$$

The FOC with respect to q is given by the Ramsey-like formula

$$\frac{q - [(1 + \frac{\lambda - \mu}{1 + \lambda}\alpha^I t)(c_x + d^I)]}{q} = \frac{\lambda}{1 + \lambda} \frac{1}{\varepsilon_x},$$

where ε_x denotes the demand price elasticity of single-piece mail. The reader will recognize the Ramsey rule, with the mark-up over marginal cost inversely proportional to the price elasticity of demand. The relevant marginal cost is a function of the parameters λ and μ . If $\mu = -1$, the planner does not take into account tax proceeds and the relevant marginal cost is the after-tax one for the firm. If $\mu = 0$ (zero cost of public funds), the tax part of the marginal cost is deflated by $\lambda/(1 + \lambda)$. If $\lambda = \mu$, the relevant marginal cost is the before-tax one, $c_x + d^I$, as the concerns

¹See Auerbach and Hines (2001) for a general presentation of the economic impact of value added taxation.

for the NPO breaking even and the cost of public funds neutralize each other. Other things equal, a larger value of μ decreases the relevant marginal cost and thus calls for a lower value of q , as intuitive (since a lower price boosts quantities and thus tax proceeds, at the expense of NPO's profit).

The FOC for the bulk mail price is obtained similarly, but is more complex because of the presence of two different kinds of customers.

When the NPO is VAT rated, the planner's objective is given by

$$\begin{aligned} \max_{q, p^I} W_R = & CS_x(q(1+t)) + CS_N(p^I(1+t)) + CS_R(p^I) \\ & + \Pi_R^I(q, p^I) + (1+\mu)VAT_R(q, p^I) \\ \text{s.t. } & \Pi_R^I(q, p^I) \geq 0, [\text{Lagrange multiplier } \lambda]. \end{aligned} \quad (1)$$

Now that the NPO is VAT rated, both single-piece mail customers and a fraction of bulk mail customers (those who are not rated) pay VAT. As for VAT rated buyers of bulk mail, they don't pay VAT themselves but rather charge VAT to their final customers. We make the simplifying assumption that the final amount of VAT paid by their final customers is not affected by the bulk mail price they pay.² We then have that

$$VAT_R(q, p^I) = t [qx(q(1+t)) + p^I y_N^I(p^I(1+t))].$$

The FOC with respect to q is then given by

$$\frac{q \left(1 + \frac{1+\mu t}{1+\lambda}\right) - (c_x + d^I)}{q} = \frac{\lambda + \mu t}{1 + \lambda} \frac{1}{\varepsilon_x},$$

which simplifies to the usual Ramsey formula when $t = 0$ and to the Ramsey formula in terms of after-tax price $q(1+t)$ if $\lambda = \mu$. Intuitively, both λ and μ tend to increase the optimal value of q , the former because of the strengthening of the NPO budget constraint it implies, the latter because of the larger weight put on VAT receipts.

In each case (NPO VAT rated or not), the Ramsey optimization program generates a pair of prices (q, p^I) that are consistent with the NPO breaking even and

²This is the case for instance if postal services represent a small fraction of the inputs of bulk mail buyers, so that their own output price is not affected significantly by variations in bulk mail price. The alternative to this simplifying assumption would require us to model the demand function for the final goods and services sold by VAT-rated buyers of bulk mail. This would complicate the model and introduce a further set of assumptions related to these demand functions.

which in general are different to one another according to the VAT regime. There of course exist other pairs of prices consistent with the NPO breaking-even. Among these pairs, a particularly interesting one corresponds to the minimum value of the single-piece mail price, since this price presents a particular interest for the planner (see Panzar (2004)). The problem the planner solves in that case is to find

$$\begin{aligned} \min q \text{ such that } \Pi_i^I(q, p^I) &\geq 0, \quad i = N, R \\ \text{and that } p^I &\leq q - k, \end{aligned} \quad (2)$$

where k is some preparation cost that bulk mail users have to incur. We assume that, if the price difference between bulk mail and single piece was not at least equal to this preparation cost, the demand for bulk mail would drop to zero.

2.2 Competition with access only

In the second part of the paper, we introduce an entrant (denoted by E) that competes with the NPO by offering a bulk mail product to both VAT rated and VAT exempt bulk customers. The bulk mail product offered by the entrant is an (imperfect) substitute to the good provided by the NPO. The entrant is VAT rated: it charges VAT to its customers and reclaims any VAT that it pays on its input. The quantity of bulk mail sold by the entrant is denoted by y^E . As we have seen with the NPO monopolist, the demand by VAT rated customers depends on before-tax prices. Denoting the entrant's before-tax price for bulk mail by p^E , we have that the demand by VAT rated customers for NPO (resp., entrant's) bulk mail is given by $y_R^I(p^I, p^E)$ (resp., $y_R^E(p^I, p^E)$). The demand by VAT exempt customers depends on after-tax prices. Assuming that the NPO is VAT exempt, we have demand functions $y_N^I(p^I, p^E(1+t))$ and $y_N^E(p^I, p^E(1+t))$. In the case where the NPO is also VAT rated, like the entrant, the demands are given by $y_N^I(p^I(1+t), p^E(1+t))$ and $y_N^E(p^I(1+t), p^E(1+t))$. Total demand for NPO (resp., entrant's) bulk mail is denoted by $y^I(p^I, p^E)$ (resp., by $y^E(p^I, p^E)$).

To summarize, we have that, if the NPO is VAT exempt,

$$\begin{aligned} y^I(p^I, p^E) &= y_R^I(p^I, p^E) + y_N^I(p^I, p^E(1+t)), \\ y^E(p^I, p^E) &= y_R^E(p^I, p^E) + y_N^E(p^I, p^E(1+t)). \end{aligned}$$

while, if the NPO is VAT rated, we have

$$\begin{aligned} y^I(p^I, p^E) &= y_R^I(p^I, p^E) + y_N^I(p^I(1+t), p^E(1+t)), \\ y^E(p^I, p^E) &= y_R^E(p^I, p^E) + y_N^E(p^I(1+t), p^E(1+t)). \end{aligned}$$

As for costs, we assume that the entrant has no fixed cost,³ a constant marginal upstream cost of c^E and is obliged to buy access to the NPO delivery network at a constant (net of tax) unit cost (access charge) of a . One unit of bulk mail necessitates one unit of access.

We assume that the entrant behaves like a competitive fringe. The before-tax price charged by the entrant is then

$$p^E = a + c^E.$$

Whether the NPO is VAT exempt has no direct impact on this price formula since the entrant behaves like a competitive fringe, and since the “true” marginal cost of a VAT rated entrant is not affected by whether the entrant has paid VAT on (part of) its inputs.

We first look at the case where the NPO is VAT exempt. Its total cost is given by

$$\begin{aligned} C_N^I(x, y^I, y^E) &= F(1 + \alpha_F t) + (1 + \alpha^I t) [(c_x + d^I)x \\ &\quad + (c_y^I + d^I)y^I + d^I y^E]. \end{aligned}$$

Its (net of tax) profit is then given by

$$\begin{aligned} \Pi_N^I(q, p^I, p^E) &= qx(q) + p^I y^I(p^I, p^E) + ay^E(p^I, p^E) \\ &\quad - C_N^I(x(q), y^I(p^I, p^E), y^E(p^I, p^E)), \end{aligned}$$

where $y^I(p^I, p^E) = y_N^I(p^I, p^E(1 + t)) + y_R^I(p^I, p^E)$ and $y^E(p^I, p^E) = y_R^E(p^I, p^E) + y_N^E(p^I, p^E(1 + t))$

The (second-best) optimization problem is given by

$$\begin{aligned} \max_{q, p^I, a} W_N &= CS_x(q) + CS_N(p^I, p^E(1 + t)) + CS_R(p^I, p^E) \\ &\quad + \Pi_N^I(q, p^I, p^E) + (1 + \mu)VAT_N(q, p^I, p^E) \\ \text{s.t. } \Pi_N^I(q, p^I, p^E) &\geq 0, [\text{Lagrange multiplier } \lambda] \end{aligned}$$

where $CS_N(p^I, p^E(1 + t))$ and $CS_R(p^I, p^E)$ are net consumer surpluses when the two types of bulk mail products are available at before-tax prices of p^I and p^E and where

³In the calibrations, we assume that the absence of fixed costs for the entrant translates into higher marginal (upstream and delivery) costs than for the NPO.

the amount of VAT proceeds paid by VAT exempt agents is denoted by

$$\begin{aligned} VAT_N(q, p^I, p^E) &= t\alpha_F F + t\alpha^I [(c_x + d^I)x(q) \\ &\quad + (c_y^I + d^I)(y_N^I(p^I, p^E(1+t)) + y_R^I(p^I, p^E)) \\ &\quad + d^I(y_R^E(p^I, p^E) + y_N^E(p^I, p^E(1+t)))] \\ &\quad + tp^E y_N^E(p^I, p^E(1+t)). \end{aligned}$$

We now turn to the case where the NPO is VAT rated. Its total cost is given by

$$C_R^I(x, y^I, y^E) = F + (c_x + d^I)x + c_y^I y^I + d^I(y^I + y^E),$$

and its (net of tax) profit is

$$\begin{aligned} \Pi_R^I(q, p^I, p^E) &= qx(q(1+t)) + p^I y^I(p^I, p^E) + ay^E(p^I, p^E) \\ &\quad - C_R^I(x(q(1+t)), y^I(p^I, p^E), y^E(p^I, p^E)), \end{aligned}$$

with $y^I(p^I, p^E) = y_N^I(p^I(1+t), p^E(1+t)) + y_R^I(p^I, p^E)$ and $y^E(p^I, p^E) = y_R^E(p^I, p^E) + y_N^E(p^I(1+t), p^E(1+t))$.

The Ramsey optimization problem of a VAT rated NPO is given by

$$\begin{aligned} \max_{q, p^I, a} W_R &= CS_x(q(1+t)) + CS_N(p^I(1+t), p^E(1+t)) \\ &\quad + CS_R(p^I, p^E) + \Pi_R^I(q, p^I, p^E) + (1+\mu)VAT_R(q, p^I, p^E) \\ \text{s.t. } \Pi_R^I(q, p^I, p^E) &\geq 0 \text{ [Lagrange multiplier } \lambda], \end{aligned}$$

with

$$VAT_R(q, p^I) = t [qx(q(1+t)) + p^I y_N^I(p^I(1+t), p^E(1+t)) + p^E y_N^E(p^I(1+t), p^E(1+t))].$$

We will also consider the objective of minimizing the single-piece price q while allowing the NPO to break-even, as defined in (2).

3 Calibration

Our calibration assumptions are the same as in De Donder et al. (2006), but without distinction between delivery zones. Note that, as in that paper, the assumptions used here do not represent the position in a particular NPO. Rather they are stylised and applied to illustrate the effects within the model given the complexity of analytical solutions to the formal model set out in section 2. We start from the hypothetical

situation where the VAT-exempt NPO does not face any entrants and posts a price of 0.50€ for the single-piece product and 0.40€ for its bulk mail product. Total quantities sold at those prices are, respectively, 2 billion and 8 billion items. We assume that VAT-rated and VAT-exempt consumers have the same demand function

$$y_R^I(p^I) = y_N^I(p^I),$$

so that they both demand 4 billion items for a 0.40€ bulk mail price. The direct price elasticities are -0.2 for single-piece mail and -0.4 for bulk mail at these prices. Finally, we calibrate linear demands based on these quantities, prices and elasticities.

We need further information to calibrate the demand functions for bulk mail products when the market is opened to competition. We use two types of information: the extent of entry for different price configurations and the substitutability between the two bulk mail products for consumers. We assume that entrants would capture 10% of the total market for bulk mail if both bulk mail products had the same price and 50% of the market if entrants were to offer a 20% price discount over the NPO. As for substitution between those products, we assume that the displacement ratio is set at 0.75 in both areas which means that three quarters of the quantities sold by entrants are displaced from the NPO, while one quarter represents additional volumes sold in the sector. We make the same assumptions for bulk mail demand emanating from VAT rated and VAT exempt customers.

The NPO constant marginal upstream cost (before tax) is $c_x = 0.173\text{€}$ for single-piece mail⁴ and $c_y^I = 0.115\text{€}$ for bulk mail. The NPO constant marginal delivery cost (for all kinds of mail), d^I is 0.116€. The share of fixed cost that is non-labor is $\alpha_F = 0.4$ while the corresponding fraction for variable costs is $\alpha^I = 0.2$. The VAT rate t is 20%. The (before tax) fixed cost F equals 1.556bn € so that the PO breaks even in the hypothetical monopoly situation (including a normal rate of profit, F equals 40% of revenue of 4.2bn €). An entrant does not face any fixed cost but we assume that this results in higher variable upstream and delivery costs than the NPO. Accordingly, an entrant's before tax upstream cost, c^E , is set at 0.144€, its delivery cost at 0.183€.

4 Results

We first look at the monopoly case before turning to the simulations with access-based competition for the bulk mail product.

⁴This value corresponds to an after-tax cost of 0.18€ (the value used in De Donder et al. (2006)) once a ($t=20\%$) VAT rate has been imposed on the ($\alpha^I=20\%$) fraction of the upstream cost that is non-labor.

4.1 Monopoly case

Table 1 shows the results of the monopolist NPO. The first three columns of figures relate to the VAT exempt monopolist. The first column shows the calibration used. With no VAT applied to the NPO the pre and post tax prices are the same, at 0.50 Euro for the single piece and 0.40 Euro for the bulk mail piece. The calibration assumptions correspond to the equi-proportional mark-up (EPMU) solution, with the same mark-up over marginal cost posted for both the single-piece mail and bulk mail. For these prices, 80% of volumes are bulk mail (40% from VAT exempt customers and 40% for VAT rated ones), and the remaining 20% is single-piece mail. Given the stylised assumptions used in the calibration set out in section 3, around 28% of the NPO's costs are subject to VAT (this is a weighted average of the percentage of non-labor fixed costs, 40%, and of non-labor variable costs, 20%). No VAT is paid by customers and the NPO pays VAT of 0.221m Euro through its input costs. Total consumer surplus is 6.500m Euro, while the NPO's profit equals zero by construction. The last row in the Table gives the value of the objective in (1), i.e. the sum of customer surplus and of $(1+\mu)$ times VAT proceeds, with $\mu = 0.3$ being the exogenous cost of public funds. This equals 6.788m Euro in the calibrated simulation.

[Insert Table 1 around here]

The second best welfare maximising results corresponding to program (1) are shown in the second column of figures. Demand elasticity is larger for bulk mail than for single-piece mail, so that Ramsey prices under program (1) are lower than EPMU for the first category of mail, and larger for the second. This remains true even when we add to the Ramsey's objective the weighted value of VAT proceeds. The single piece price increases to 0.615 Euro, and its demand reduces from 2.00bn items to 1.908bn. The bulk mail price reduces from 0.40 Euro to 0.371Euro, and its demand increases from 8.00bn to 8.25bn items. The NPO pays VAT of 0.222m Euro through its input costs. Single-piece customers' surplus decreases (compared to the calibration allocation), while bulk mail customers' surplus increases. As expected from the comparative nature of the two programs, the weighted sum of customers surpluses and VAT proceeds increases (since this is what is maximized in this simulation). Observe that total customer's surplus is also higher than in the calibration simulation.

The third column reports the solution of optimization problem (2). Observe that the constraint that $p^I \leq q - k$, with $k = 0.06$, is binding. The minimum single piece mail price decreases to 0.469 Euro, and its demand increases to 2.025bn.

Table 1: Results of the monopolist NPO cases

	VAT exempt NPO			VAT rated NPO		
	Calibration	Welfare maximising	Minimum q	Calibration – scaled down	Welfare maximising	Minimum q
Single piece						
Pre-VAT price	0.500	0.615	0.469	0.478	0.573	0.450
Post-VAT price	0.500	0.615	0.469	0.574	0.688	0.540
Volume	2.000	1.908	2.025	1.941	1.850	1.968
Bulk mail						
Pre-VAT price	0.400	0.371	0.409	0.382	0.359	0.390
Post-VAT price	0.400	0.371	0.409	0.459	0.430	0.468
Volume NR ¹	4.000	4.116	3.965	3.765	3.878	3.728
Volume VR ²	4.000	4.116	3.965	4.071	4.165	4.040
Net VAT receipts	0.221	0.221	0.222	0.566	0.569	0.564
Total consumer surplus and profit	6.500	6.510	6.493	6.198	6.187	6.197
Welfare	6.788	6.799	6.780	6.813	6.825	6.805

Table 2: Results of the NPO with Access Entry cases

	VAT exempt NPO		VAT rated NPO	
	Welfare maximising	Minimum q	Welfare maximising	Minimum q
Single piece				
Pre-VAT price	0.614	0.480	0.574	0.469
Post-VAT price	0.614	0.480	0.689	0.562
Volume	1.909	2.016	1.848	1.950
Bulk mail				
Pre-VAT price	0.371	0.420	0.359	0.409
Post-VAT price	0.371	0.420	0.431	0.490
Volume NR ³	4.117	3.793	3.528	2.460
Volume VR ⁴	3.643	2.548	3.529	2.639
Entry				
Pre-VAT price	0.369	0.354	0.351	0.349
Post-VAT price	0.442	0.425	0.421	0.418
Volume NR ⁵	0.000	0.172	0.463	1.571
Volume VR ⁶	0.633	1.832	0.845	1.768
Access price				
	0.224	0.210	0.207	0.204
Net VAT receipts	0.221	0.215	0.557	0.527
Total consumer surplus and profit	6.523	6.459	6.198	6.116
Welfare	6.810	6.755	6.846	6.758

¹ NR = non VAT rated or VAT exempt customers

² VR = VAT rated customers

³ NR = non VAT rated or VAT exempt customers

⁴ VR = VAT rated customers

⁵ NR = non VAT rated or VAT exempt customers

⁶ VR = VAT rated customers

The bulk mail price increases to 0.409 Euro - consistent with a minimum margin of 0.060 Euro between the bulk mail and single piece price – to recover the shortfall from the lower single piece price; the bulk mail demand reduces to 7.93bn items, split equally between VR and NR customers. The NPO pays VAT of 0.221m Euro through its input costs, total consumer surplus and profit reduces to 6.493m Euro and the total welfare reduces to 6.78m Euro. The welfare is marginally lower in this case as the single piece price is set to a minimum value and results in the bulk mail price increasing to reach breakeven.

The break even results involve a range of single piece prices between 0.469 Euro and 0.615 Euro. However, no VAT is charged on these prices, nor the bulk mail prices. VAT is only charged on the input to the NPO. As the combined volumes do not change substantially, the VAT and welfare are reasonably stable over the break even range of cases.

The final three columns of figures in Table 1 relate to the VAT-rated monopolist. Here the NPO charges VAT at an assumed rate of 20% on its services and reclaims the VAT it pays on its inputs. At the (pre-tax) calibration prices of 0.5 Euro for single piece and 0.4 Euro for bulk mail, the net impact for the NPO's profit of moving to a VAT-rated status (as discussed on page 5) is positive. In order to compare with the other columns of Table 1 (all of which having the NPO breaking even), we report in the first of the last three columns the results obtained when we scale down both pre-tax prices by the same percentage compared to the calibrated values reported in the first numerical column. In this case the post-VAT prices for the single-piece item is higher at 0.574 Euro and bulk mail at 0.459 Euro for NR customers, having applied VAT at a rate of 20%. However for VR customers the effective bulk mail price decreases to 0.382 Euro as those customers can reclaim the VAT applied to the price. Where the prices paid increase the demand reduces - to 1.94bn items for single piece and from 4.00bn to 3.76bn items for VAT exempt bulk mail customers. Volumes increase from 4.00bn to 4.07bn for VAT-rated customers of bulk mail. The reduction in total volume reduces the NPO's input VAT but this is more than offset by the VAT recovered through prices to yield net VAT receipts of 0.566bn Euro. Relative to the calibration in the first column of Table 1, total customer surplus is much lower. The increase in (weighted) VAT receipts more than compensates for the loss in total consumer surplus within the calibration.

The second best welfare maximising result for the VAT rated monopolist is shown in the fifth column of Table 1 and may be compared to the VAT exempt monopolist in the second column. The post VAT single piece price of the VAT rated NPO at 0.688 Euro is 12% more than the single piece price of the VAT exempt NPO of 0.615 Euro - the single piece price increases less than the VAT rate of 20%. In other words,

just over 60% of the tax is borne by consumers in the form of a higher after-tax price.

The combined effect of the tax on both types of bulk mail customers jointly is that less of the tax is shifted forward to bulk mail customers overall than in the case of single piece customers. This is in line with economic theory in that, in a perfectly competitive economy, the higher the elasticity of demand, the smaller the fraction of a tax on transactions that is borne by customers. However, the position is complicated by the different tax status of the two classes of bulk mail customers, those that are VAT rated and those that are not, which results from them facing , inclusive of the tax, significantly different effective prices for bulk mail. VAT rated customers, although charged the tax, actually face lower prices than without the tax (by 3% from 0.371 Euro to 0.359 Euro). This unusual situation arises inter alia because, first, the cost base of the NPO is lowered by its ability to reclaim input tax so helping to lower the pre-tax price and, secondly, that a VAT rated bulk mail customer itself can reclaim as input tax the VAT levied by the NPO. By contrast, for VAT exempt bulk mail customers the post VAT bulk mail price of the VAT rated NPO at 0.430 Euro is 16% more than the bulk mail price of the VAT exempt NPO of 0.371 Euro. A larger percentage of the tax (80%) is borne by NR consumers of bulk mail than by (NR) consumers of single piece mail. But the weighted average across both types of bulk mail customers is just over 30%, less than single piece customers.

Comparison of the second and fifth columns of Table 1 also shows that the total consumer surplus and profit of the VAT exempt NPO at 6.510m Euro is significantly higher than that for the VAT rated NPO of 6.187m Euro. At the calibration values set out in section 3, this means that VAT-rated bulk mail customers gain less than what VAT-exempt customers lose from the change of VAT status of the NPO (both single piece and bulk mail exempt customers lose). However, when VAT receipts are added to the total consumer surplus and profit and multiplied by 1.3 to reflect social welfare, the welfare of the VAT exempt NPO at 6.799m Euro is marginally less than that for the VAT rated NPO of 6.825m Euro. Under such assumptions, the movement from a VAT exempt to VAT rated NPO would reduce the economic welfare of postal consumers, but within the model framework this would be offset by the VAT receipts to the VAT authority such that the welfare would be very marginally more in the case of the VAT rated NPO for society as a whole at the cost of public funds assumed of 0.3. Finally, the Lagrange multiplier of the NPO's zero-profit constraint is larger than in Table 1, but remains smaller than the exogenous cost of public funds.

Moving to the minimum single-piece mail price consistent with the NPO breaking-even, and comparing the third and sixth columns of Table 1, we obtain a second tax incidence result, with roughly 75% of the 20% VAT rate borne directly by single-piece

mail consumers in the form of a higher after-tax price. Note that the NPO can break-even with smaller pre-tax prices when VAT rated because then it would be able, under the alternative tax regime, to recover input tax. As they care only about pre-tax prices, VAT-rated customers benefit from this move, while VAT-exempt customers suffer from higher after-tax prices. Total surplus is lower than in the third column of Table 1, but the sum of surplus and of weighted VAT proceeds is larger than in the third column of Table 1.

4.2 Competition with access only

[Insert Table 2 around here]

Some of the results of the NPO offering access entry are similar to those of the monopolist NPO. The first two columns of figures in Table 2 show the results of the NPO offering an access service to entrants for a VAT exempt NPO. The first column shows the welfare maximising results which for the single piece and bulk mail NR customers are almost identical to those in column 2 of Table 1. However, in this case the NPO's access service leads the entrant to undercut the NPO's bulk mail price for VR customers, as these customers are able to recover the VAT charged by the entrant. The VAT charged by the entrant cannot be recovered by the NR customers and in this case the entrant price exceeds the NPO's bulk mail price. Some of the VR customers' volumes transfer from the NPO to the entrant and the lower price offer results in some overall growth in demand. This results in a marginal improvement in total consumer and profit and total welfare for the welfare maximising access entry case in column 1 of Table 2 relative to that of the NPO monopolist in column 2 of Table 1.

The second column in Table 2 shows the minimum q with access entry and the VAT exempt NPO. When compared to the third column in Table 1, the results of minimum q in column 2 of Table 2 show higher single piece and bulk mail prices at 0.480 Euro and 0.420 Euro respectively. The price ranges within which break even occur are slightly narrower in the presence of access entry and the difference in total consumer and profit and total welfare measures between the minimum q and welfare maximising case increase with the access entry. The access price at 0.210 Euro in this case is marginally lower than that in the welfare maximising case of column 1 in Table 2.

The last two columns of figures in Table 2 show the results of the NPO with access entry for the VAT rated NPO. The first of these columns shows the welfare

maximising results which for the single piece customers are almost identical to those in column 5 of Table 1 for the calibration reported in Section 3. For bulk mail customers, the VR customers compare the pre-VAT prices of the NPO and entrant, and the NR customer compares the post-VAT prices. In both cases the entrant prices are less than the NPO's prices, and this leads to some of the NPO's volumes for both the VR and NR customers to switch to the entrants. In this case the volumes switching are similar for VR and NR customers, but more generally the volume switch is greater where the price difference between NPO and entrant is greater.

Finally, for both the welfare maximising and minimum q case the access prices are lower for the VAT rated NPO than the VAT exempt NPO. As with the NPO monopolist cases, the move from VAT exempt to VAT rated status reduces the total consumer surplus and profit, but increases the total welfare of the welfare maximising case. Under our calibration assumptions, the movement from a VAT exempt to VAT rated NPO would reduce the welfare of postal consumers, but this would be offset by the VAT receipts to the VAT authority such that the welfare is marginally more in the case of the VAT rated NPO for society as a whole.

5 Conclusion

In this paper we have looked at the effects of the VAT status of the NPO and customers on the incidence of tax and welfare. We have applied a model of two goods – single piece and bulk mail – for a monopolist NPO and an NPO that offers access to entrants competing with the NPO's bulk mail good.

In our model, the after tax price of the VAT rated NPO increases by less than the full amount of the VAT. Further we have shown that a move from a VAT exempt to a VAT rated NPO benefits the VAT rated bulk mail customers and the VAT authority. Additionally, a move from a VAT exempt to a VAT rated NPO dis-benefits the non VAT rated bulk mail customers, the single piece customers and significantly increases the single piece price. Overall the consumer surplus and profit in the postal sector is lower in the case of a VAT rated NPO, but this may be offset when the receipts to the VAT authority are included and scaled within the total welfare measure.

Our model does not take account of the potential for VAT rated bulk mail customers to create additional business and VAT receipts through reclaiming any VAT on postal services and conversely for VAT exempt customers. This could be included in the analysis as a further extension. Other areas of potential extension include consideration of a budget constraint for government whereby the sum of profit and VAT receipts is the same for both the VAT exempt and VAT rated NPO, different

VAT rates for the different taxed elements or goods and alternative forms of entry including full bypass of the NPO's network. Hence there is scope to develop the models presented in this paper to explore further the consequences of alternative VAT regimes within the postal sector.

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