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Competitively neutral universal service obligations

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Abstract

Universal service obligations impose specific costs on the universal service provider. The measure of these costs and their financing have been studied along two complementary lines of reasoning: is the universal service obligation sustainable? Who should bear its costs? Most often, a two-step procedure is put forward. In a first step the cost of USO must be assessed; in a second step the USP must be compensated for this cost. In this paper we argue that this procedure is most often problematic because the implementation of the compensation scheme directly affects the effective cost of USO. We therefore put forward an alternative approach to this problem which does not rely on this two-step procedure and fully acknowledges the distortions that result from the compensation mechanism.

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1 Introduction and summary

Universal service obligations (hereafter USO) have long been imposed in industries like telecommunication, energy or postal services. USO can be broadly divided into two categories: Obligations in terms of quality (minimum quality standards, ubiquity of the service) and in terms of prices (uniform price, affordable price). USO do not retain much attention when the industry is organized as a (possibly regulated) monopoly. As a matter of fact, when the universal service provider (hereafter USP) is a monopolist, the USO are self-financed by internal cross-subsidies: The profits realized on the profitable market segments finance the losses made on the loss-making segments that the USP must serve as part of the USO. However, the coexistence of competition, as resulting from the current trend in market liberalization, and USO might be problematic. Competition erodes the USP's profit and, eventually, threatens the financial viability of the USP who might not be able to sustain the same standard of services in a liberalized market as under monopoly.

In order to maintain universal services in a competitive environment, the design of an appropriate USO funding mechanism may be necessary. A standard approach to the financing issue is the following: First, using an appropriate methodology, the *net cost of the universal service* for its provider is evaluated. Second, based on this cost estimate, the need for a funding mechanism is assessed and, if necessary, an appropriate funding is chosen and implemented. Typically, this approach is followed by the European Commission for the postal sector.

> "Where a Member State determines that the universal service obligations entail a net cost, calculated taking into account Annex I, and represent an unfair financial burden on the universal service provider(s), it may introduce: (a) a mechanism to compensate the undertaking(s) concerned from public funds; or (b) a mechanism for the sharing of the net cost of the universal service obligations between providers of services and/or users." (Third postal directive (2008/6/EC), Article 7, §3)

In this paper, we shall argue that, whenever option (b) is retained, this two-step approach is misleading because it fails to recognize the distortions induced by any sharing mechanism of this kind. That is, compensating the USP on the basis of an estimated net cost of the USO is likely to be inappropriate whenever the tax modifies the behavior of the market participants.

An extreme example is provided by the Finnish postal market. The Finnish postal market has been fully liberalized since 1994. The regulator has imposed a licensing system and, accordingly, an alternative postal operator that would operate only in densely populated areas would have to pay a fee. This fee aims at ensuring that high quality services are provided also in sparsely populated areas. Actually, this fee is so high that it constitutes an entry barrier. As a result, the incumbent Finnish postal operator still enjoys a near monopoly position. Clearly enough, if this entry fee is based on an USO costing exercise, the estimated cost does not correspond to the actual cost because the costing exercise failed to take into account that the resulting tax is fixed at a deterrent level.

In this paper, we argue that, whenever a USO funding mechanism modifies market behavior, the induced change in the USP's profit must be included as part of the compensation for the universal service. If a universal service tax partially shelters the incumbent from competition, the additional profits made by the USP should be accounted for as part of the USO funding mechanism. Accordingly, the tax proceeds collected should be inferior to the estimated cost of the USO. Otherwise, the incumbent would be overcompensated. The funding should not be based on a ex-ante costing exercise. Instead, we put forward the competitive neutrality criterion where the profits of the USP, in a funded USO scenario, are equal to some benchmark level.

The paper is organized as follows. First we discuss the scope for evaluating the cost of USO ex-ante, i.e. independently of its possible financing. Several possible measures are discussed. Second we argue that, apart for the cases where non-distortionary taxation is sufficient to ensure compensation, the ex-ante cost of USO should not serve as a basis for determining the level of compensation. Relying on a competitive neutrality criterion allows to determine the tax level that will ensure adequate compensation. Third, we develop an example that fully illustrates our general argument.

2 Compensating for the cost of USO

2.1 Measuring the net cost of the USO

Consider a given set of universal service constraints (universal coverage, uniform price, ...) exogenously decided by a regulator. Assume further that a profit-maximizing firm would not have spontaneously offered the whole set of products or services prescribed by the USO. Then, complying with these obligations is costly for the USP. The (net) cost of the USO may thus be

broadly defined as the cost of conforming to these obligations. To measure this cost, several methodologies have been proposed. The net avoided cost (NAC), the entry pricing (Rodriguez and Storer, 2000) and the profitability cost (Panzar, 2000 and Cremer *et al.*, 2000) are the most popular.[1] And, obviously, the cost of the USO depends on the way it is measured.

- The *NAC* is an accounting exercise that consists in identifying the unprofitable submarkets for which the incremental cost exceeds the incremental revenue.[2] The NAC cost of the USO is then the additional profit that the USP would be able to achieve if it were relieved of the USO and allowed to withdraw from the unprofitable submarkets. The NAC has been criticized on the grounds that it is essentially a static approach that fails to take into account any change in the market structure i.e. the net avoided cost of the USO is based on a comparison between the incumbent's profit in a monopolized market with and without USO.

The other methods consider that issue explicitly as they are both based on the comparisons of two different market scenarios.

- The *entry pricing approach* compares the regulated monopoly situation that prevails before market liberalization (scenario 'm') and the liberalized market scenario with competition and USO (scenario 'cu'). The entry cost of the USO is equal to the lost revenue for the incumbent (referred to as firm I) on the set N of contested markets where entry occurs minus the impact of entry on the incumbent's total cost. Formally, the entry pricing cost of the USO is defined as

$$\Delta USO_{ep} = \sum_{j \in N} [R_{jI}^m - R_{jI}^{cu}] - [C_I(Q_I^m) - C_I(Q_I^{cu})] \qquad (1)$$

where R_{jI}^m and R_{jI}^{cu} are the incumbent's receipts in a contested submarket $j \in N$ before and after entry and $C_I(Q_I^m)$ and $C_I(Q_I^{cu})$ are the incumbent's total cost in the scenarios 'm' and 'cu' respectively.[3]

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[1]In all these approaches, it is assumed that the USP is an efficient operator i.e. costs are best practice costs. Thus, in principle, the net cost of the USO does not include any cost due to productive inefficiency.

[2]Distinguishing profitable and unprofitable products is far from obvious when there are common costs that must be allocated (see Pearsall, 2009 for a recent contribution).

[3]If the incumbent does not change its price after entry, then the entry pricing cost of the USO is equal to the difference between the incumbent's profit in the scenarios 'm' and 'cu': $\Delta USO_{ep} = \Pi_I^m - \Pi_I^{cu}$.

- The *profitability cost approach* is based on a comparison of the incumbent's profit in the scenario 'cu' and a counterfactual scenario (scenario 'c') with competition but without USO (the so-called *unsubsidized market scenario*, Panzar, 2000).[4] The resulting profit for the incumbent USP, Π_I^c, is then compared with its actual profit in a liberalized market with USO, Π_I^{cu}. The profitability cost of the USO (ΔUSO_π) is the difference between these two profit levels:

$$\Delta USO_\pi = \Pi_I^c - \Pi_I^{cu}. \tag{2}$$

  It estimates the loss in profits incurred by the USP specifically due to the USO, independently of the liberalization process since in both scenarios the USP faces competition.[5]

2.2 Funding USO

If providing the universal service proves to be costly, the regulator may compensate the USP. In this context, it seems logical to rely on some estimated cost of the USO (be it ΔUSO_{ep} or ΔUSO_π) as a basis for determining the compensation for fulfilling the USO. However, as developed hereafter, this intuition needs to be qualified.

In order to finance the USO, regulators face two basic options: public funds and cost-sharing mechanisms. In this paper, we focus only on the latter option. The principle is the following: the regulator creates a universal service fund; the fund is financed by taxes levied on market participants and receipts are used to compensate the USP. The choice of an appropriate tax base is a very complex question in practice.[6] In this paper, we consider two classes of taxes: a non-distortionary tax (a lump-sum entry fee) and a distortionary tax. The lump-sum tax is non-distortionary unless it deters entry (because of a deterring level as in the Finnish case). A distortionary tax modifies market prices, quantities exchanged and the set of contested markets where entrants have decided to compete in. At the very least, it may also affect the decision to compete which might be delayed or even

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[4]A similar approach is recommended by the European Commission in the third postal directive (2008/6/EC, Annex I).

[5]The profitability cost approach does not make any reference to the regulated monopoly situation (scenario 'm'). Cremer *et al.* (2000) decompose the transition from a monopolized market to a liberalized market into a profitability cost of liberalization measured as the difference between Π_I^m and Π_I^c and a profitability cost of the USO measured as the difference between Π_I^c and Π_I^{cu}.

[6]See the discussion and the examples in Oxera (2007), Borsenberger *et al.* (2009) and Gautier and Paolini (2010).

abandoned. Distortionary taxes include taxes on output, revenues, turnover that are all used in practice for financing universal service funds.

In order to assess the effects of a funded USO, we have to develop a fourth scenario 'cuf' with competition, USO and *a funding mechanism.* In this scenario, entrants will be asked to contribute to financing the USO by paying a tax.[7] We denote by T the entry fee, by τ the distortionary tax and by $T(\tau)$ the associated tax proceeds.

Suppose that there are only two firms competing on the market, the incumbent (firm I) and a potential entrant (firm E). The firms' gross profits (before tax) in the scenario 'cuf' are denoted by Π_k^{cuf}, $k = I, E$. When the tax is distortionary then $\Pi_k^{cuf}(\tau) \neq \Pi_k^{cu}$. The tax proceeds collected by the universal service fund will be paid back to the USP. Net payoffs are thus $\Pi_I^{cuf} + T(\tau)$ and $\Pi_E^{cuf} - T(\tau)$.

2.2.1 Entry fee

How should the regulator choose the tax level? In particular, should the tax proceeds be equal to the estimated cost of the USO? The answer to this latter question is 'yes' in the case of an entry fee because it is non-distortionary. The entry fee T equals to ΔUSO exactly compensates the USP for the USO, provided that firms effectively compete on the market. An entry fee can solve the USO financing problem and is compatible with market competition if

$$
\begin{align}
T &= \Delta USO \tag{3}\\
\Pi_E^{cu} &\geq T \tag{4}
\end{align}
$$

The only limit to the use of an entry fee is the feasibility constraint (4). If one adopts the profitability cost approach to estimate the net cost of the USO, a lump-sum tax is feasible if

$$
\Pi_I^{cu} + \Pi_E^{cu} \geq \Pi_I^c \tag{5}
$$

That is if aggregate profits in the scenario 'cu' with competition and USO are greater than the incumbent's profit when it faces competition but it is relieved from the USO. When this condition is not satisfied, the entry fee $T = \Delta USO$ that fully compensates the incumbent for the ex-ante cost of

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[7]The funding mechanism we consider is thus a Pay-or-Play. The incumbent will fulfill the USO (the 'play' option), the entrants will contribute to the financing (the 'pay' option).

USO deters entry. Thus the regulator must use a distortionary tax to finance the USO (or it accepts that no competition effectively takes place).[8]

2.2.2 Distortionary tax

Distortionary taxation reduces the competitive pressures exerted on the incumbent and this 'weaker competition effect' is part of the USO funding package. By protecting incumbent, the tax decreases the actual cost of the USO for the USP, so that the amount to be transferred through taxes in order to ensure a fair USO financing decreases. Therefore, **compensating the incumbent at a level ΔUSO with the help of a distortionary tax would actually lead to overcompensation**.

With a distortionary tax $\tau > 0$, the incumbent's profit in the scenario 'cuf' is not equal to its profit in the scenario 'cu'. The incumbent's net payoff when it receives a compensation equal to ΔUSO is equal to

$$\Pi_I^{cuf}(\tau) + \Delta USO \tag{6}$$

As compared to the entry fee, the USP is thus strictly better off with a distortionary tax τ such that $T(\tau) = \Delta USO$ if $\Pi_I^{cuf} > \Pi_I^{cu}$ i.e., if the distortionary tax increases the incumbent's profit. With a tax τ levied on the entrant, this condition is likely to be satisfied. Think for example of an output tax; its effect is akin to an increase in the entrant's marginal cost who then supplies a lower quantity at a higher price. Eventually, it also reduces the set of contested markets. This is clearly detrimental to firm E but not to firm I who faces a less aggressive competitor. With distortionary taxation, the regulator relies thus on two sources of income to finance the net cost of the USO: the tax proceeds $T(\tau)$ and the incumbent's additional profit created by the distortionary taxation $\Pi_I^{cuf} - \Pi_I^{cu}$. Taking this into account, the tax must be set at a level that guarantees that the global compensation is equal to the net cost of the USO. In addition, the tax must be compatible with competition on the market. That is, the tax τ must satisfy:

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[8]When the two types of taxes are possible, it is not necessarily obvious that the lump-sum tax is the preferred option. The universal service obligations may place the universal service provider at a competitive disadvantage, for example when some form of uniform pricing is required. A distortive universal service tax may then be used to countervail the impact of the universal service obligations (see for instance the examples in Armstrong, 2001 and Mirabel *et al.*, 2009). For that reason, even if a lump-sum tax is feasible, the regulator may eventually prefer a distortive tax to place all the competitors on a level playing field. The choice then depends on the distortive impact of both the set of universal service constraints and the associated financing.

$$\Pi_I^{cuf}(\tau) - \Pi_I^{cu} + T(\tau) \;=\; \Delta USO \qquad (7)$$

$$\Pi_E^{cuf}(\tau) \;\geq\; T(\tau) \qquad (8)$$

These two constraints into account imply that the compensation from the universal service fund cannot be equal to the estimated cost of the USO, whatever the definition we retain to measure that cost, when the taxes used to finance the fund are distortionary.[9] And, in particular, the tax proceeds should be inferior to the estimated net cost of the USO when imposing a tax increases the incumbent's profit.

For example, when $\Delta USO = \Delta USO_\pi$, a distortionary tax is feasible if

$$\Pi_I^{cuf} + \Pi_E^{cuf} \geq \Pi_I^c \qquad (9)$$

More generally, whenever financing USO with an entry fee is not feasible, it is possible to use a distortionary tax if this tax increases the industry profits i.e. if $\Pi_I^{cuf} + \Pi_E^{cuf} \geq \Pi_I^{cu} + \Pi_E^{cu}$.

2.3   Competitive neutrality

Finally, we would like to point the analogy between the above approach to USO financing and the concept of competitive neutrality. The criterion of *competitive neutrality* has often been put forward for qualifying the universal service and its supporting mechanism, especially in the telecommunications. In the US, the FCC requires that *the universal service support mechanisms and rule should be competitively neutral. In this context, competitive neutrality means that universal service support mechanisms and rules neither unfairly advantage nor disadvantage one provider over another.* Roughly speaking, the universal service and its financing are competitively neutral if they do not create a competitive advantage or disadvantage for the provider or the competitors. A possible way to interpret this requirement (adopted for instance by Choné *et al.*, 2002) is to impose that the profit of the designated provider is at least as big as the profit it would collect if it were relieved from the universal service obligations (in the scenario 'c').

Accordingly, the USO and the associated funding are competitively neutral if:

$$\Pi_I^{cuf} + T(\tau) \geq \Pi_I^c \qquad (10)$$

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[9]However, the definition retained for the cost of USO will obviously determine a particular compensation level and therefore the feasibility of a financing scheme.

Like the profitability cost approach, competitively neutrality relies on an unsubsidized market scenario 'c' to determine the incumbent's benchmark profit level. When $\Delta USO = \Delta USO_\pi$, the USO funding exercise we just described satisfies competitive neutrality: Conditions (4) and (8) are equivalent to (10) when $\Delta USO = \Delta USO_\pi$.

In the next section, we illustrate by mean of an example the extent to which the implementation of a distortionary tax might supplant the use of an entry fee in order to finance USO when this last instrument would deter entry. While doing this, we also show that when distortionary taxation is used, funding the USP at the level of the ex-ante cost of USO would induce overcompensation.

3 An example

We consider a continuum of independent local markets indexed by x in the $[0, 1]$ interval. On each market, active firms compete in quantities. Production costs are normalized to zero and the demand is given by $P = 1 - Q$ where Q is the aggregate supply. In order to serve a local market, firms must incur a fixed cost $F(x)$, with $F' > 0$. For illustrative purpose, we use a linear function $F(x) = f.x$ where f is a positive constant. There are at most two active firms in a local market, the incumbent (firm I) and the entrant (firm E). The gross profit realized by firm $k = I, E$ on market x is equal to Pq_k from which the fixed cost must be subtracted.

Universal service obligations are imposed on firm I but not on firm E. USO consist of a *universal coverage* constraint: firm I must serve all markets in $[0, 1]$. USO do not include any form of price regulation and absent a uniform price constraint, prices may differ across markets.[10] Firm E serves only those markets which are profitable to her, i.e. she targets those markets with the lowest fixed cost. We denote by n_E, the last market served by E, so that the industry can be decomposed into a subset $[0, n_E]$ of contested markets where firms I and E compete in quantities and a subset $[n_E, 1]$ where firm I remains as a monopolist.

• *Scenario 'm'* : Consider first the pre-liberalization stage where firm I monopolizes all the markets. On each market, I supplies the monopoly quantity $q^m = 1/2$, sold at price $P^m = 1/2$ and realizes a gross profit of $1/4$.

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[10]Notice that when USO entails restrictions in the price structure of the USP, the financing issue we discuss in this note is even more stringent since these restrictions will further decrease firm I's profits.

The total profit is equal to

$$\Pi_I^m = \int_0^1 (\frac{1}{4} - fx)dx = \frac{1}{4} - \frac{f}{2}. \tag{11}$$

USO are therefore sustainable in a monopoly whenever $\Pi_I^m \geq 0 \Rightarrow f \leq \frac{1}{2}$. Firm I realizes a positive net profit on all markets $x \in [0, \frac{1}{4f}]$, these profits subsidize the loss realized on the remaining $[\frac{1}{4f}, 1]$ markets. These losses resulting from USO amount to $\int_{\frac{1}{4f}}^1 (\frac{1}{4} - fx)dx = \frac{81(1-4f)^2}{2592f}$. All markets are profitable whenever $f \leq \frac{1}{4}$.

In the sequel, we assume that $f \in [\frac{1}{4}, \frac{1}{2}]$. In this case, USO imposed on a monopolist are always sustainable but never voluntary.

• *Scenario 'c'*: Consider next the liberalized market case in the absence of USO. In each contested market, firm k supplies a quantity $q_k = \frac{1}{3}$, the market clears at price $P = \frac{1}{3}$ and the gross profit is equal to $\frac{1}{9}$. Net profits are positive for the subset of markets $[0, \frac{1}{9f}]$. On markets in $[\frac{1}{9f}, \frac{1}{4f}]$, net profits are positive whenever only one firm operates and supplies q^m. We will assume that those markets will be served by firm I. Markets in $[\frac{1}{4f}, 1]$ will not be served in the absence of USO. Computations indicate that

$$\Pi_I^c = \int_0^{\frac{1}{9f}} (\frac{1}{9} - fx)dx + \int_{\frac{1}{9f}}^{\frac{1}{4f}} (\frac{1}{4} - fx)dx = \frac{41}{2592f}, \tag{12}$$

$$\Pi_E^c = \int_0^{\frac{1}{9f}} (\frac{1}{9} - fx)dx = \frac{16}{2592f}. \tag{13}$$

• *Scenario 'cu'*: Consider finally the case where firm I is subject to the ubiquity constraint and faces a competitor. Notice that the only difference between this scenario and the previous one is the obligation faced by firm I to serve those unprofitable markets located in $[\frac{1}{4f}, 1]$. The best she can do is to supply the monopoly quantity q^m in these markets. The resulting payoffs can be expressed as the monopoly profits under USO minus the profits lost on the contested markets $[0, \frac{1}{9f}]$. Computations yield:

$$\Pi_I^{cu} = \frac{1}{4} - \frac{f}{2} - \frac{40}{2592f}. \tag{14}$$

while the entrant's profit remains unchanged at the level Π_E^c. As noted above, whenever $f > \frac{1}{4}$, the profitability cost of the USO is positive.[11]

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[11]According to Cremer *et al.* (2000), market liberalization decreases the incumbent's profit by $\frac{40}{2592f}$ from which $\frac{40-81(1-4f)^2}{2592f}$ is accountable to competition and $\frac{81(1-4f)^2}{2592f}$ to the USO.

Computations indicate that

$$\Delta USO_\pi = \frac{81(1-4f)^2}{2592f}. \tag{15}$$

We now use our simple model to illustrate the choice of funding mechanism for the USO. We therefore consider a fourth scenario 'cuf' with competition, USO and a compensation mechanism, which relies on a funding mechanism $T(\tau)$. We consider two options. One is to use an output tax: $T(\tau) = \tau n_E q_E$, the other is a lump-sum entry fee $T(\tau) = T$.

The regulator aims at ensuring USO, while ensuring competitive neutrality. The funding mechanism must therefore be such that it satisfies the following constraints:

1. Sustainability: $\Pi_I^{cuf} + T(\tau) \geq 0$, $\Pi_E^{cuf} - T(\tau) \geq 0$.

2. Competitive neutrality: $\Pi_I^{cuf} + T(\tau) \geq \Pi_I^c$.

The first instrument to consider is a lump-sum fee. By definition, a lump sum fee does not modify the way firms compete on the markets i.e. profits in the scenario 'cu' are equal to those in 'cuf', unless it is set a level that actually prevents entry. A lump-sum fee is compatible with competition on the market if

$$T \leq \Pi_E^{cu}. \tag{16}$$

If the regulator adopts the competitive neutral criterion, the entry fee must be equal to:

$$T = \Delta USO_\pi. \tag{17}$$

Combining (16) and (17), we have:

Proposition 1 *When compensation is ensured through a lump-sum transfer, it is possible to ensure a competitively neutral and sustainable USO whenever $f \leq \frac{13}{36}$.*

The second instrument to consider is the output tax. In this case, scenarios 'cu' and 'cuf' are no longer equivalent. With a tax τ on each quantity supplied by the entrant, firms I and E are asymmetric. Optimal quantities in the Cournot game are: $q_E = \frac{1-2\tau}{3}$ and $q_I = \frac{1+\tau}{3}$. The contested markets clear at a price $P = \frac{1+\tau}{3}$. Notice that the market coverage by the

entrant now depends on the tax. More precisely, firm E covers all markets in $[0, \frac{(1-2\tau)^2}{9f}]$. The firms' operational profits and the tax proceeds are

$$\Pi_I^{cuf}(\tau) = \frac{(1-2\tau)^2}{9f}\frac{(1+\tau)^2}{9} + (1 - \frac{(1-2\tau)^2}{9f})\frac{1}{4} - \frac{f}{2} \qquad (18)$$

$$\Pi_E^{cuf}(\tau) = \frac{(1-2\tau)^4}{162f} + \tau\frac{(1-2\tau)^3}{27f} \qquad (19)$$

$$T(\tau) = \tau\frac{(1-2\tau)^3}{27f} \qquad (20)$$

Notice that the non-negativity constraint on q_E determines a feasibility condition $\tau \leq \frac{1}{2}$; higher tax rates completely deter entry.

It is a matter of computations to establish the condition for competitive neutrality. Solving $\Pi_I^{cuf}(\tau) + T(\tau) = \Pi_I^c$, we obtain a critical value for τ as a function of f:

$$\hat{\tau}(f) = \frac{1}{20}(10 - 5^{\frac{3}{4}}(-82 + 1296(1-2f)f)^{\frac{1}{4}})$$

If we evaluate that level of tax proceeds, as given by equation (20), for $\tau = \hat{\tau}$, we may observe that the corresponding amount is always strictly smaller than $\frac{81(1-4f)^2}{2592f}$, which is the ex-ante cost of USO. In other words, a distortionary tax that would compensate the USO provider with a tax proceeds equal to $\frac{81(1-4f)^2}{2592f}$ would amount to overcompensate firm I since the resulting profit would strictly exceed Π_I^c.

It then remains to identify the domain for which $\hat{\tau}(f)$ satisfies the feasibility constraint. Direct computations indicate that $\hat{\tau}(f) \leq \frac{1}{2}$ whenever $f \leq \frac{1}{36}(9 + 2\sqrt{10})$. Summing up we have therefore established the following proposition

Proposition 2 *When* $f \in [\frac{13}{36}, \frac{1}{36}(9 + 2\sqrt{10})]$, *there exists a sustainable output tax* $\hat{\tau}(f)$ *that ensures competitive neutrality.*

A direct implication of the above proposition is the following:

Proposition 3 *Whenever* $\frac{1}{36}(9 + 2\sqrt{10}) < f \leq \frac{1}{2}$, *competitive neutrality cannot be achieved, neither with a lump-sum, nor an output tax.*

Notice that the critical value $\frac{1}{36}(9 + 2\sqrt{10})$ is also a solution to the equation $\Pi_I^m = \Pi_I^c$: competitive neutrality cannot be implemented by an

output tax whenever the level of f is such that placing the USO constraint on a monopolist incumbent cannot be competitively neutral either.

Notice also that the amount to be financed to ensure competitive neutrality under an output tax is strictly decreasing in f. This immediately follows from the fact that a larger output tax better shields the incumbent from competition by the entrant, therefore, part of the virtual profitability cost of USO is actually indirect financed by a less tough competition that preserves the incumbent's margins. Should the regulator insist on covering ΔUSO_π while relying on an output tax, this would clearly lead to an over-compensation of the USP. Finally, one should note that the distortionary tax negatively impacts consumers welfare, though two channels: higher price and fewer contested markets. As a consequence, a regulator which is concerned by consumer welfare while sticking to competitive neutrality should prefer a lump-sum whenever it is possible to implement it.

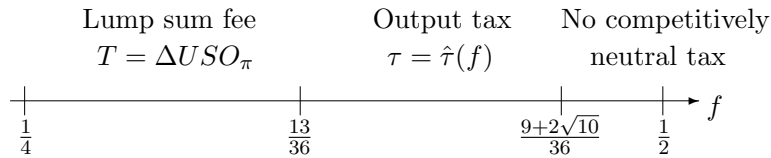The following figure summarizes our findings as a function of the parameter f.

Lump sum fee $\qquad$ Output tax $\qquad$ No competitively

$T = \Delta USO_\pi$ $\qquad\qquad$ $\tau = \hat{\tau}(f)$ $\qquad$ neutral tax

$\dfrac{1}{4}$ $\qquad\qquad\qquad$ $\dfrac{13}{36}$ $\qquad\qquad\qquad$ $\dfrac{9+2\sqrt{10}}{36}$ $\quad$ $\dfrac{1}{2}$ $\qquad$ f

Figure 1: Optimal tax for a competitively neutral USO financing

4 Concluding remarks

We have shown that an estimated cost of the USO should be used carefully in any USO policy. In particular, it cannot be used to determine the size of the universal service fund because, such a policy would ignore the impact of taxation on the firms' market behavior. In a funded USO scenario, the compensation for the USP comes from both the universal service fund and from lower competitive pressures. If regulators fail to take this into account, the USP is likely to be overcompensated. Thus, dissociating the USO costing exercise and the USO funding exercise is inappropriate because it leads either to an unnecessary compensation or to the absence of competition. If the compensation for the USO burden is based on an estimated cost of the USO, the compensation is likely to be inappropriate because the USO burden is endogenous to the funding mechanism (Boldron *et al.*, 2009). Instead of

relying on an estimated cost of the USO, we consider exclusively a funded USO scenario and compare it to an appropriate benchmark level. In the paper, we use the unsubsidized market scenario to determine the benchmark profit level because the competitively neutral criterion is closely linked to the profitability cost of the USO. In the literature and in practice, other criterions have also been used.

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