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Efficiency of uniform pricing in universal service obligations

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ABSTRACT

We provide an efficiency justification for the imposition of the uniform pricing constraint in universal service obligations (USO), where USO are defined as a set of constraints imposed on firms belonging to a network industry. In addition to the uniform pricing (UP) constraint, which is an obligation to serve all consumers at an identical price, constraints considered are the coverage constraint (CC), which is an obligation imposed on one of the firms to serve a given segment of the market, and the license constraint (LC), which is a minimum or a maximum coverage restriction that is imposed on entrants. We show that adding the UP constraint to both a CC and a LC leads to an increase in welfare. Our contribution comes from the full recognition of the role of a LC in well-designed USO and we illustrate this role with the particular case of linear demand.

1. Introduction

Universal service obligations (USO) are meant to ensure the largest access to a service that is deemed essential. They are common in network industries. Cremer et al. (2008), Cremer et al., (1998), Jaag and Trinkner (2011), and Madden (2010) mention as possible normative justifications for their wide use that they are a remedy for a network externality (e.g. in telecommunications), a redistribution policy instrument, a means to supply a public good, or an instrument that is used to conduct a regional policy. Madden (2010) stresses that, from an "economic perspective", remedying network externalities constitutes the primary justification for USO, while Cremer et al. (2008) see their role as an instrument of the redistributive policy to be the most "compelling theoretical justification".[2] Following such points of view, efficiency properties of USO in the absence of network externalities have not been the object of extensive analysis and, consequently, are poorly known.[3] This is surprising because USO have historically replaced Rate of Return (RoR) regulation, which was precisely criticized on efficiency grounds, as the main instrument to regulate network industries.

Our goal is thus to focus on the efficiency performance of USO in network industries. The economic literature has already stressed some issues concerning USO: how they are allocated and funded, and how they can be competitively neutral. However, the question regarding the justification of their underlying principles has not been addressed by economists. Why should USO constraints such as ubiquity, uniform pricing, and reserved areas, be imposed? In this analysis, we try to provide some efficiency justifications for these traditional tools and rules. We use a model where identical consumers are distributed on a continuum of markets that differ by their fixed connection costs to the network.[4] Two firms can potentially enter each market. Following Cremer et al. (1998) and Valletti et al. (2002), we consider USO as constraints imposed on firms' activities. Three such constraints are analyzed: a *coverage constraint* (CC), which obliges one of the firms to serve a given segment of the markets, a *license constraint* (LC), which controls

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[2] Two types of redistributions are highlighted: from low-cost to high-cost consumers and from high-income to low-income consumers.

[3] However, in the context of the postal sector, Cremer et al. (2008) studied alternative economic justifications of USO and namely, certain redistributive pricing arguments.

[4] As mentioned in Choné et al. (2000), this is meant to represent the "geographical component" of USO, i.e. the component that addresses the redistribution from low-cost to high-cost consumers, as opposed to the "social component", which addresses the redistribution from high-income to low-income consumers. This geographical component is prevalent in network industries.

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competition by determining whether there are one or two firms in each market, and a *uniform pricing* (UP) constraint, which forces firms to offer the good at the same price in all markets they serve. The CC can be considered to be the basic component of a USO, because it corresponds to the idea of making the service available to the largest group of consumers possible. The UP constraint is often considered complementary because, as argued by Cremer et al. (1998), it is meaningless for high-cost consumers to formally have access to a service if the firms are able to price them out of the market. However, this is a rule rather than an optimally set instrument, so its contribution to welfare is uncertain. The LC is also complementary to CC in that it protects the firm that is subject to the latter (the USO provider) from unfair competition: it can either force entry in high-cost markets in order to avoid cream-skimming, or restrict entry to ensure profitability of the USO provider.[5]

We first study these constraints separately in order to isolate their properties. We show that, for *given coverages*, UP improves allocative efficiency by (*i*) equalizing marginal willingness to pay among the consumers and (*ii*) making the price paid on average closer to marginal cost. However, the imposition of UP creates strategic links among markets that provide incentives to firms to modify their coverages; therefore, the *given coverages* assumption does not hold at equilibrium. This is why the CC and the LC are needed to counter adverse effects of these links on welfare. As a result, UP does increase welfare as long as it is combined with both the CC and the LC. We use the particular case of linear demand in order to illustrate this result.

The main contribution of this paper is to highlight the potential efficiency properties of UP in well-designed USO. Most models on coverage and funding of USO generally assume that their imposition is exogenous, but they do not provide a justification for them. Typically, either (*i*) one does not know whether USO are warranted or not in terms of welfare, because the assumption that a market is not profitable for a monopolist does not indicate whether consumer surplus is higher or lower than cost,[6] or (*ii*) there are transfers among consumers, so that there are winners and losers and the overall welfare change is not identified.[7] Although our model clearly follows the lines of Valletti et al. (2002), who "pointed out how different groups would fare under various policies, but leave the question of optimal policies for further research",[8] we sharpen their results by making the conditions under which uniform pricing increases welfare clear. This result is obtained through the consideration of the LC, along with the CC and UP. Although the LC (or more precisely, the reserved area) was recognized by Crew and Kleindorfer (1998) as being an important efficiency instrument within well-designed USO, it was not included in the analysis of Valletti et al. (2002). Note also that we use an extension of the homogeneous good framework of Anton et al. (2002) to continuous markets rather than the heterogeneous good framework that Valletti et al. (2002) propose. Besides the fact that a number of network industries submitted to USO are best thought as suppliers of homogenous goods,[9] this avoids the complexities related to the possibility of multiple equilibria with mixed strategies that Valletti et al. (2002) sketched in their paper and that were fully analyzed by Gautier and Wauthy (2010). More fundamentally, as noted by Anton et al. (2002), this makes the cross-market UP constraint unambiguous as consumers then purchase the same good at the same price. However, the case of homogeneous goods does not alter the basic strategic links among markets that UP brings up: in fact, all results obtained by Valletti et al. (2002) for differentiated products are reproduced in our model. Note that our model does not consider the possibility of network sharing and, thus, eschews the question of access pricing. We rather focus on the case of competing networks. One can have in mind the present discussions of extending USO to broadband, where a defined homogeneous service (e.g. connection speed) can be supplied by firms with independent networks, which can incidentally use different technologies (e.g. fiber, cable, satellite).[10]

Our work can be related to the literature on the impacts of third-degree price discrimination on welfare as we compare welfare under uniform pricing (i.e. with no discrimination) and price discrimination. Analysis of third-degree price discrimination dates back to Pigou (1920) and Robinson (1933) and has been done for monopolistic and oligopolistic markets, as well as for the case we consider here, where a multimarket firm faces competition in one of its two markets.[11] One important result of this literature, which is robust in the face of the different assumptions on market structure and which is especially relevant to our work, is that imposition of uniform pricing can cause firms to withdraw from some markets.[12] This problem is partially dealt with in USO since an essential feature of USO is to force at least one firm to serve otherwise unserved markets. However, this proves insufficient because uniform pricing can also modify the number of served markets with more than one firm. A contribution of this paper is to show that an instrument that allows the regulator to control the competitive structure, namely the LC constraint, is needed to ensure that uniform pricing improves welfare.

The following section presents our model of the network industry, the USO constraints analyzed, and the benchmark scenarios used to evaluate the performance of USO. Section 3 analyzes the properties of each USO constraint separately, while Section 4 shows that UP increases welfare when combined with both the CC and the LC. In Section 5, we discuss the robustness of our main results in the face of heterogeneous demands across locations. The conclusion discusses the possibility of using our framework to study the equity properties of USO. Proofs of lemmas and propositions are found in the Appendix.

2. Model

Two firms can potentially supply a homogeneous good at a continuum of locations $\theta \in [0,1]$ that are distributed across the territory according to the density function $f(\theta) = F'(\theta)$, where $F(\theta)$ is logconcave. At each location, there is a mass 1 of identical consumers so that $F(0) = 0$ and $F(1) = 1$. Consumers are represented by a twice differentiable demand function $D(p)$, where p is the price of the good. Consumers' surplus is then given by $v(p) = \int_p D(x)dx$. For each firm, there is a fixed cost $C(\theta) = k\theta$ of entering location θ, where $k > 0$. Locations are thus ranked in increasing order of cost. Accordingly, parameter k is the highest fixed entry cost; as a result, supplying all markets is only efficient when k is assumed to be lower than the total (gross) surplus. Firms also have the same marginal cost of production, which is assumed constant and normalized to zero. The operating profit that is obtained

[5] In the latter case, the LC is referred to as the "Reserved Area". The reserved area is pervasive in the postal sector and was first analyzed by Crew and Kleindorfer (1998).

[6] See, for instance, Anton et al. (2002), Gautier and Minuzo (2011), Gautier and Paolini (2011), Gautier and Wauthy (2010), Gautier and Wauthy (2012), and Jaag (2011), where welfare is sometimes compared between different implementations of universal service, but the imposition of USO is taken to be exogenous. In other cases, as in Choné et al. (2000), Choné et al. (2002), Bourguignon and Ferrando (2007), a perfectly discriminating monopolist does not wish to serve the high-cost market; therefore, it is implicitly assumed that USO are not justified in terms of welfare. It is then clear that the rationale behind the imposition of USO must be found outside the model.

[7] See Calzada (2009), Fabra et al. (2004) and Foros and Kind (2003).

[8] Valletti et al. (2002), p. 185.

[9] This is particularly the case of energy markets, such as electricity or natural gas.

[10] This is not to deny that, in practice, interconnections (and thus, access charges) can exist among networks, but we consider cases where these are not prevalent when compared to own-network activities.

[11] See Armstrong and Vickers (1993), Cheung and Wang (1999), Aguirre (2011) and Jorge and Pires (2013).

[12] See Battalio and Ekelund (1972), Varian (1985), Hausman and Mackie-Mason (1988) and Layson (1994). The conditions under which withdrawal occurs with uniform pricing when a multimarket firm faces competition in one of its two markets are analyzed by Aguirre (2011) and Jorge and Pires (2013).