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Abstract

Regulators have long been aware of the social aspects of communication. In the past, regulated monopolists have provided Universal Service Obligations, typically funded via a system of cross-subsidies. In this paper, we first review the rationale for imposing Universal Service Obligations, based both on theoretical arguments and empirical results. We then address some of the new questions raised by the ongoing liberalisation process. Regulators now face the challenging problem of organising the provision and financing of universal service in a competitive environment.

JEL Classification: L43, L51, IL2.

Keywords: universal service obligations, regulation, competition.

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1. Introduction

Regulators have long been aware of the social aspects of communication, and have been intimately involved with the various services - telecommunications, post, broadcasting etc. - since their beginnings. Due to the widespread use of these services, there are many social dimensions for regulators to cover. Initial 'public interest' arguments meant that virtually all aspects could be regulated. For example, the 1927 Radio Act in the U.S. gave federal regulators the power to issue a licence to a broadcaster if they found that it was in the "public interest, convenience or necessity". The absence of any clear definition of 'public interest' means that the FCC - the U.S. regulator - could determine the number and identity of broadcasters, the terms and conditions of their operation, and even their broadcast content.

In this paper we address some broader social aspects of communication regulation, as well as the competition issues that are raised by the adoption of particular policies. To give an example, the interplay between regulation and competition can be seen in the current 'broadband debate'. Higher bandwidth services, such as high-speed Internet service, video on demand and interactive electronic commerce, have been deemed by many governments to be of fundamental importance to the development of their economy; see e.g. Oftel (1999). A particular concern is the provision of these services to residential customers, and also small businesses. This has highlighted the lack of competition in local telecommunications markets. In the U.K., broadband services are likely, in the medium-term, to be provided using enhancements (Digital Subscriber Line, DSL) to the fixed copper loop telephone network; this sector is dominated by the incumbent British Telecom, which supplies over 85% of access lines. In the U.S., local access is provided both by cable and local telephone companies; the issue there is what carriage requirements to impose on entrants to the local access market. Finally, the content that can be delivered over high bandwidth access lines has lead to regulatory initiatives such as the European Union's Action Plan on Promoting Safer Use of the Internet, adopted on January 25th, 1999.

We will not attempt to cover all aspects of regulation in this paper. Instead, we will focus on the interaction between the two objectives stated by most telecoms regulators. For instance, the U.S. Telecommunications Act of 1996 directs the FCC to "promote competition and preserve and advance universal service".

2. Definition and evidence

There are several reasons given for imposing universal service obligations (USOs). First, it is often thought that utilities such as electricity, water and telecommunications services are necessities that should be readily available to all, simply on the grounds of equity. This argument can be supplemented with the idea that complete access to essential services stimulates economic development and growth. Thirdly, there may be significant positive externalities associated with a service (such as a communication network) that the market, left unregulated, would fail to incorporate, leading to insufficient coverage of the network. A USO may be required to correct for this market failure. For these and other arguments, see Cremer et al. (1998).[1]

Even if the general principles behind USOs are agreed upon, there still is the problem of putting them into practice. There are three aspects to this. First, what exactly should be provided and to whom? Secondly, who should be required to fulfil a USO? Thirdly, who should pay for the costs of a USO?

The exact definition of universal service is not clear. The most commonly used notion refers to achieving a "minimum quality level" of a "basic package" of services to all consumers and at "affordable prices". In the case of telecommunications, this sort of statement can be found in Federal Communications Commission (FCC) and European Commission (EC) communications; see the FCC's CC Docket 96-45 and the EC communication COM(96) 73. Each part of this statement is open to interpretation - what is a minimum quality level, what constitutes a basic package, what prices are affordable? Hence the FCC has listed a set of services and quality levels that are included in universal service (e.g., voice-grade access to the public switched network, touch-tone, etc.), and detailed maximum prices that can be charged for specific services, and on average across all services. This exercise is, of course, problematic. Technological progress means that the set of basic services is constantly expanding, and minimum quality levels are ambiguous (for example, wireless services allow greater mobility, but typically have lower sound quality and completion rates).

[1] See also Laffont and Tirole (2000, chapter 6), Mason and Valletti (2001), and Riordan (2001) for further discussions of universal service in telecommunications.

In the past, incumbent telecom operators were responsible for USOs; indeed, in the U.K., this is still the case.[2] In the U.S., USOs are not restricted to incumbents, and universal service subsidies are paid to any company that accepts a commitment to service all consumers in its area. The subsidies are paid for typically by cross-subsidization: the income from more profitable markets (such as long-distance or business customers) is used to cover losses incurred by charging low prices to low-income or high-cost consumers. The alternative of financing universal service subsidies through general taxation is not generally used in telecommunications, although it is used in other markets; for example, in the U.K., subsidies to winners of railroad franchises are covered from general taxes. This is despite the fact that financing from general taxation could be a cheaper (i.e., less distortionary) way to raise the required revenue.

USOs are under increasing pressure. The first source of pressure appears to be political, but actually has solid economics to back it up. A major problem with USOs is that they are blunt. A USO to cover high-cost rural areas at the same price as low-cost urban areas benefits high-income rural consumers at the expense of low-income urban consumers. More precisely, it may be inefficient to further a particular objective - higher welfare for rural residents - through distorting the prices of particular services. This point has been made formally by Atkinson and Stiglitz (1976), who show that, under certain circumstances, the best way to redistribute income is through the taxation of income, not consumption. In their model, consumers differ in their income levels (actually, in their ability levels, which affect income). Hence their result speaks most directly to the issue of subsidies to low-income consumers. It is straightforward, however, to re-interpret their model in terms of low- and high-cost consumers. One of the key conditions required for this result is that low- and high-income consumers have the same relative preferences for consumption goods (i.e., the marginal rate of substitution between consumption goods is independent of income). In this case, taxing consumption - effectively what occurs when the prices of telecommunications services are altered - in order to fund universal service is unnecessarily inefficient. A better way to redistribute income (which, after all, is what a

[2] In the U.K., British Telecom is restricted to charging geographically uniform prices to ensure that high-cost (e.g., rural) areas are serviced. The regulator - Oftel - first decided that USO costs be funded by all operators, on the basis of indicators like revenue shares. However, the limited size of the burden subsequently convinced the regulator in 1997 that there was no need to establish a fund because USOs gave BT some benefits that outweighed the direct costs (benefits included rather cloudy concepts such as brand enhancement, ubiquity and "life-cycle" effects, where an uneconomic customer can become a more

universal service subsidy does) is to tax income. To encourage people to live in high-cost rural areas, the theorem suggests that a location-specific income tax break is better than offering a telecommunications subsidy.

Changes in the assumptions underlying the Atkinson-Stiglitz theorem will, evidently, change the result. For example, it may be that the marginal rate of substitution between consumption goods is not independent of income. Then it may be worth taxing those goods that the rich have a relative preference for and subsidizing the goods preferred (relatively) by the poor. Nevertheless, the result is important for emphasizing that USOs must be assessed carefully for their validity and not simply accepted.[3]

Abstracting now from theoretical motivations that may justify the imposition of USOs, how have they fared *in practice*? To answer this question, one needs to understand first why telephone penetration may be different in different areas. After surveying the existing empirical literature on the topic, Riordan (2001) summarises that the major predictor of residential telephone penetration is poverty. In particular, an income redistribution that would lower the poverty rate of an area by 10%, while holding the median income constant, would add 2.5% percentage points to telephone penetration in the U.S.. Published research generally finds that the price elasticity of residential demand is very low - of the order of -0.02. This is a bit worrying since the lack of responsiveness of demand could undermine both targeted and untargeted public programs that subsidise penetration. However, the price elasticity for low income people is significantly higher, giving some support for universal service policies that target low income households. There is also some (weaker) evidence that network externalities matter, justifying policies that may expand the reach of service beyond the level that would be chosen individually by people and to overcome a co-ordination problem when too few people connect if it is expected that too few people connect. Also, race seems an important predictor in the U.S.. Asian populations are more likely, and black and Hispanic populations less likely than white households to have telephones.[4]

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profitable BT customer in the future). In any case, the idea of a fund has not been dismissed and may become relevant in the future.

[3] The idea that it is more efficient to finance USOs from general taxation has to be assessed against the efficiency of the taxation system of the country under consideration. This may make the "old" system of financing that relies on cross subsidies still an attractive solution in developing countries, if the social cost of public funds is high or if there is some leakage of tax revenues due, for instance, to corruption. See Gasmi *et al*. (2000).

[4] See also Taylor (1994).

It may be argued that network externalities should not be central anymore to the debate on universal service for many "mature" services in developed countries, given that the level of penetration reached is already high. In addition, operators themselves may use pricing strategies to co-ordinate consumers, thus internalising the network externality. These views are not immune to criticism. For instance, even if the marginal consumer confers a small externality, this has to be multiplied by a large number. For example, suppose that each individual gains a benefit of 1 from being able to communicate with any other individual; and suppose that there are N individuals on the network. Then the total value of the network is the number of pairings $N(N - 1)$, which is close to N^2 when N is large. This square relationship between the number of members of a network and the value of the network is known as Metcalfe's law, and it still does provide a theoretical argument for universal service programs. However, it is clear that there are also limits to this kind of justification for subsidies. In particular, subsidies should be at the margin and it is not necessary to subsidise the majority of infra-marginal customers that would be on the network without any inducement. It is perhaps fair to say that there is now a consensus that targeted programs fare better than uniform subsidies and that the latter are unlikely to improve average consumer welfare. There also seems to be room for the introduction of more optional tariffs for local services. A "menu" of contracts, designed having in mind the needs of the poor and of the low-volume users, could be designed at a low cost in order to induce more people to subscribe without having to subsidise the large majority of the population.

The FCC has recently established a programme of subsidies for the highest cost wirecenters in the highest cost states in the U.S.. The estimates obtained by the FCC for the average cost of local telephone services are used to calculate a "benchmark" that determines the eligibility of operators to receive universal service funds (subsidies are "portable", i.e. they are paid to whichever firm provides the service). The intention of the recent legislation is to move from implicit to explicit subsidies, while promoting the affordability of telephone service and access to the network. These are laudable goals but one should check the data to see whether the intentions are implemented in practice by federal and state programs. Rosston and Wimmer (2000) assess the costs and benefits of universal service programs at the state level, assuming that states provide subsidies to those areas with costs higher than the benchmark (net of federal subsidies). In order to evaluate the impact of different policies, it is important to have information about

customers' responses to price changes, something that is completely ignored by regulations purely based on costs.

Since – as we wrote before – demand for access is typically inelastic (some people may actually be driven off the network by usage-related charges rather than access charges), they find that the current system in the U.S. has the unfortunate effect of requiring huge amounts of money while producing small effects on subscription rates. There are important differences among states, but the results of Rosston and Wimmer challenge the myth of affordability in a developed country by showing that the elimination of subsidies would only have a mild impact on the size of the network. If the current programs fail with respect to subscribership, their magnitude could still be justified by horizontal equity considerations. Rosston and Wimmer show how they fail in this respect too: winners may be rich households living in rural areas while losers in urban areas include a disproportionate percentage of poor, black and Hispanic households. Also in this case, targeted programs are cheaper and perform better than cost-based rules that pay a subsidy to all consumers in an area, whether they need the subsidy or not. However, targeted programs themselves may still be wasteful. Some authors believe there is no need to continue either type of subsidy, since the impact on telephone penetration is negligible.[5] The main reason for keeping such programs in place – they would argue – is then to redistribute income and/or to use them for political reasons given the rents at stake.

3. Universal Service in the European Union

The current EU regulatory framework requires national regulatory authorities (NRAs) to impose obligations to ensure that a defined minimum set of services of specified quality are available to all, regardless of their geographical location, and at an affordable price, where affordability must be seen in the context of the national situation. There are also obligations to provide payphones to cover reasonable needs, and directory services. In addition, there are provisions for specific measures for disabled users and users with special needs. A Member State may impose these obligations on one or more operators.

[5] There are some studies on the impact that some specific programs (Lifeline and LinkUp) have had in the U.S. in recent years. Such programs reduce the monthly cost of the telephone service of low-income households and subsidise the installation of a new subscription for eligible households. The evidence is mildly in favour of them as an effective way of promoting universal service. See Garbacz and Thompson (2001) and Riordan (2001) for a discussion.

Despite the natural rhetoric in claiming that the objective is to give EU citizens a world-class communications infrastructure, delivering the best deal in terms of prices, quality, etc., the EU has left the actual implementation of its recommendations to Member States. Originally, the Commission tried a more proactive role, suggesting the creation of some specific funds, one per Member State, that would control the use of EU structural funds for regional development projects. These projects could be targeted at those countries that were greatly in need of basic infrastructure. While these plans are indeed still a possibility, they have not been adopted for Universal Service provision, highlighting the lack of authority on the EU telecommunications industry. Hence the details of USOs are entirely left to NRAs. On the other hand, the EU does regulate how a Member State may design a US fund. Only simple public switched telephony services, which include voice, fax, and data transmission, may be funded. Providers of Internet services, value-added services and private networks are exempted from contributing to USOs. Finally, there are two funding options. The first is to levy supplementary charges on top of regular interconnection charges, and the second is to create a US fund. The Commission has clearly stated that it prefers the latter option, whereby the US cost is paid either out of the State budget, by eligible market participants, or by end users though a tax.

We cannot review here all the single national experiences. However, it is important to stress three points: a) historically, USOs have been intertwined with the liberalisation process occurring within a given country, b) the stance that a given country decided to take with respect to USOs reflected the general national philosophy towards the importance of competition in the telecommunications industry, c) where USO costs have been calculated (but not necessarily funded), the best practice consisted in the calculation of net avoidable costs based on LRIC, which is good accounting practice but does not necessarily reflect economic principles. In practice, this has led most countries not to implement any funding because the US costs were deemed to be too small. As we argue below, different reasons were behind this outcome.

To give a few examples, quite a lot of confusion arose in the early days on the linkages between access deficit contributions (ADCs) and USOs. This was due to different stages in the price rebalancing process accompanying liberalisation. For instance, we have already mentioned that the UK decided that the costs incurred by BT for USOs did not justify any payment. That was due to the small figures involved (gross costs of around £ 50-70m in 1999, less than 0.3% of telecommunications turnover). Price rebalancing in the

UK started back in 1984 with the privatisation of BT, hence when the discussion on USOs became central in the late 90's, line rental rates had already been increased close to their relative costs. Since BT also received direct revenues from US, on top of some indirect benefits, the regulator decided that USOs did not represent an unjust burden and did not require any funding (the NRA will review this decision in 2003). Finland, which has a very well developed telecommunications infrastructure, does not even have an explicit definition of USO in its legislation.

On the other hand, in France the regulator calculated figures much higher than in the UK (FF 5,000-6,000m in 1997 and 1998 – around 4% of telecommunications turnover) that did include the lack of rebalancing (hence the loss made on access by France Telecom), requiring other operators to pay a surcharge in their interconnection charge. Only in 2000 France introduced a new mechanism entirely based on a US fund, where all the operators must contribute according to their volumes of traffic. The French case reflects a preference for a sort of protection of the incumbent operator that, according to their view, would ensure that the country would receive essential services. On the other hand, entrants have to bear some of the costs, making USOs a potential barrier to entry.

Italy started with a tariff structure much closer to France than to the UK. Telecom Italia calculated big access deficits (decreasing from lira 5,500 billion in 1997, to 4,100 in 1998, 3,300 in 1999) on top of USOs (lira 650 billion in 1999, 390 in 2000). However, the NRA systematically challenged the figures put forth by the incumbent, cutting them down to considerably lower levels (USOs: lira 120 billion in 1999, 114 in 2000), which then had to be funded by fixed and mobile operators, proportionally to their revenues. The Italian regulator is now considering the introduction of "pay-or-play" mechanisms where USOs may be fulfilled by various operators.

In Germany no operator a priori has US obligations, but they can be imposed in specific markets if it is acknowledged that they are underprovided, or if the incumbent operator DT decides to change its terms or range of providing universal service. In this case, DT is obliged to give one year's advance notice, so that the regulator has enough time to intervene.

3.1 Accession countries

A particular area of concern is universal service in telecommunications for the 13 countries that are in the process of negotiating accession to the EU. Most accession

countries have implemented US policies because of their commitment to transpose the acquis communautaire. This may be worrying because it is not clear if universal service policies that are valid in EU (rich) countries with fully developed networks should be replicated on a similar scale in (middle and lower-middle income) accession countries. According to a recent study commissioned by the EC (WIK, 2001), these policies would be too costly given the other pressing needs for tax revenues such as for healthcare, education or pensions.

The WIK study recommends to focus instead on addressing USO problems with market based solutions, with modest schemes being added incrementally onto market outcomes. For instance, they recommend targeted schemes, tariff rebalancing and de-averaging of tariffs. The latter, in particular, can help overcome the reluctance of operators to build networks and add subscribers in high cost rural areas. Another problem of accession countries is that they may even not have the appropriate institutional endowment to handle the level of detail and intervention that is required to administer USO programmes. EU law should then not require these countries to adopt measures that are beyond their present economic means.

4. USOs and competition

A major challenge facing USOs comes from the introduction of competition. Telecommunications markets in many countries have been opened up to competition. In the U.S., the break-up of AT&T in 1984 allowed competition in previously monopolized markets. In the U.K., the first competitor to the previously-nationalized BT was licensed in 1982; in 1991, the market was opened further and several new operators were licensed. In both cases, the idea was to use competitive forces to assist in the regulation of dominant operators. But this has consequences for the financing of USOs. USOs are supported by cross-subsidization. This cross-subsidization is sustainable while a single firm operates across the various markets, as was the case in the U.S. and the U.K. until the early 1980s. But when a second firm is able to operate, it will choose to enter the more profitable markets (precisely the ones that generate the cross-subsidy) - a process known as cream skimming. This has three implications that we address in turn. First, the distortions in prices that the USO requires can lead to inefficient entry. Secondly, the subsidy required to support the USO is higher than what it would be if entry could not occur. Since financing the USO is distortionary, this means that the social cost of the USO is higher.

Finally, USOs that come in the form of a uniform pricing requirement have strategic effects that need to be recognised by regulators. Notable examples of such strategic effects are coverage decisions and auctions for minimum subsidies required to supply a high-cost region.

4.1 Entry

The point on the possibility of inefficient entry is most clearly seen in a single market case. (The following example is taken from Armstrong 2001.) Suppose that there is a single group of consumers with inelastic unit demand for telecommunications service. The incumbent can provide this service at cost C per consumer, giving each consumer gross utility U. The price that the incumbent charges is mandated to be P per consumer; if the consumers belong to a high-cost market, then typically $P < C$. An entrant can provide the same service at cost c, giving gross utility of u; it charges a price p, where p is not restricted (since the USO is imposed only on the incumbent).

Social welfare is the sum of consumer surplus and firms' profits; so welfare when the incumbent serves the market is $(U – P) + (P – C) = U – C$, and when the entrant serves the market, it is $u – c$. Hence entry is socially desirable if and only if $u – c \geq U – C$ i.e., $C \geq c + U – u$. Given the incumbent's price, the entrant can attract consumers if its price satisfies $u – p \geq U – P$; that is, if $P – U + u \geq p$. Entry will occur whenever the maximum price that the entrant can charge covers its cost, that is when $P – U + u \geq c$, or $P \geq c + U – u$. Comparing this with the socially optimal condition for entry, we see that whenever P does not equal C (which is typically the case when USOs are involved), entry occurs inefficiently. When $P > c + U – u > C$, entry occurs when it is socially undesirable. When $P < c + U – u < C$, entry does not occur, even though it is socially desirable.

A well-designed universal service fund could be instrumental in order to align the private with the social incentives. To see this, imagine an output tax $t = P – C$ has to be paid into an industry fund when supplying the areas in question. Then the entrant would indeed enter only when it is socially efficient. Notice that the tax corresponds to the opportunity cost of the incumbent when it loses a customer after entry has occurred. In practice, operators should pay into the fund when they enter a profitable market ($P > C$) and receive a subsidy from the fund when they serve otherwise loss-making areas. This argument can be extended to incorporate access pricing. Armstrong (2001) shows that a variant of the Efficient Component Pricing Rule would be efficient, charging access at

cost so long as an output tax calculated along the lines shown above is also in place. The general moral that emerges is that when there are retail distortions due to a USO, a retail instrument should be used in combination with an appropriate access charge. Use of the access charge alone both to provide the right entry incentives and to correct the retail distortion is inferior.

4.2 Subsidies

We now turn to the second type of interaction that USOs and competition might produce. When consumers are heterogeneous, with some being high-cost and others low-cost, a USO subsidy set without regard to competition will be "too" low. Imagine, for the sake of the argument, that there are x customers in an urban area, with unit cost equal to 1, and $(1 - x)$ customers in a rural area where it costs 2 to supply each one of them. Also imagine that at first there is only one regulated monopoly firm and that the regulator chooses a "bracketed" uniform price $1 < p < 2$ for all the customers, due to the typical requirement of average geographic price uniformity. In order not to make losses, the monopolist supplier will have to be paid a subsidy per customer equal to the difference between the average cost and the uniform price, i.e. $s = (2 - x) - p$.

Consider now what happens if there is potential entry. The previous situation would not be sustainable due to cream skimming. If the potential entrant is an operator not subject to universal service requirements (and not eligible to any subsidy), it could target the customers in the urban area only. Also imagine now the incumbent is not subject anymore to a geographic averaging requirement (more on this below), however it still has to charge at most the previous price p to all customers. Potential competition then brings the price in the urban area down to its cost, i.e. 1. In equilibrium, urban customers would still be supplied by the incumbent since it would still get a subsidy s' per customer while the entrant is not eligible. It is then immediate to calculate the subsidy that is now needed for the incumbent to break even: $s' = (2 - p)(1 - x)$. The result is that the new subsidy per customer has to be higher than before: $s' - s = x(p - 1) > 0$. The reason is simple. The "old" subsidy assumes that the operator can earn excess profits from low-cost consumers that can be used to finance service to high-cost consumers. Competition eliminates these profits, and so increases the required subsidy (see Laffont and Tirole, 2000, for further elaboration on this).

4.3.1 Multimarket oligopolies and coverage

The third interesting implication arises precisely from the geographic averaging requirement that the regulator often still imposes even in a competitive environment and that we neglected above. The effects from these obligations have been studies by Anton *et al*. (2001), Choné *et al*. (2000) and Valletti *et al*. (2002). These authors show that a USO affects the way in which operators compete. In particular, a uniform pricing restriction creates linkages between markets, along the lines identified in Bulow *et al*. (1985). This makes operators less aggressive in those markets, leading to higher equilibrium prices and deadweight loss.

Following Valletti *et al*. (2002), we assume that there is a continuous set $[0, x^{max}]$ of *a priori* independent markets, ordered by the fixed cost of serving them – from the cheapest to the most expensive – but identical in terms of the population served. In a first step we assume that an incumbent firm and an entrant have decided to cover the areas $[0, x_1]$ and $[0, x_2]$, respectively, with $x_2 < x_1$. For simplicity we assume zero marginal cost and that firms compete in quantity competition with linear demand functions $P = 1 - Q$, similar to Anton *et al*. (2001), while Choné *et al.* (2000) and Valletti *et al.* (2002) treat the arguably more realistic case of price competition. Under positive marginal cost, or price competition with sufficiently differentiated goods, the results are qualitatively the same. If no uniform pricing constraint is imposed, and in the absence of other price regulation,[6] it is clear that the equilibrium in each market is determined independently, with $P^C = 1/3$, the Cournot equilibrium price, in the duopoly area $[0, x_2]$, and $P^M = 1/2$, the monopoly price, in the monopoly region $[x_2, x_1]$.

A uniform pricing constraint imposed on the incumbent makes this kind of discriminatory pricing impossible, but more importantly creates two opposing incentives in all markets which link them strategically: The incumbent would wish to set a high price to cash in on his captive consumers, while competing effectively in the duopoly area. This leaves the incumbent at a strategic disadvantage in the duopoly markets, benefiting the entrant.

With quantity competition, a uniform pricing constraint can be interpreted as the constraint to not charge a higher price in the monopoly markets than in the duopoly

markets, which is equivalent to requiring that in these markets the incumbent sells a quantity equal to the sum of quantities in the duopoly markets. Incumbent and entrant solve:

$$\textit{Incumbent}: \max_{q1} q_1(1-q_1-q_2)x_2 + (q_1+q_2)(1-q_1-q_2)(x_1-x_2)$$
$$\textit{Entrant}: \quad \max_{q2} q_2(1-q_1-q_2)x_2$$

While the entrant's best response $q_2 = 1/2 - q_1/2$ is the usual Cournot best response, the incumbent's best response is $q_1 = 1/2 - (1 - x_2/2x_1)q_2$. It depends on *relative coverage* $k = x_2/x_1$, and therefore also the ensuing equilibrium will do so. The result is *price bracketing*, with the equilibrium price $P^{UP} = 1/(2 + k)$ between the Cournot and monopoly prices, $P^C < P^{UP} < P^M$. For $k = 0$ we obtain $P^{UP} = P^M$, and for $k = 1$, $P^{UP} = P^C$. A lower relative coverage k turns the incumbent's reaction function downwards, and leads to lower equilibrium total quantity $Q = (1 + k)/(2 + k)$ and a higher equilibrium price P^{UP}. This means that the lower prices created by competition that were supposed to be distributed everywhere through the uniform pricing constraint may hardly materialise if the relative coverage of the entrant remains small.

This effect is compounded if the incumbent is required to cover the whole country [0, x^{max}], and the entrant can freely choose its coverage. Valletti *et al.* (2002) show that the larger the mandated coverage of the incumbent, the larger the equilibrium coverage of the entrant will be, but this increase in coverage is less than proportional: *relative* coverage decreases. This means that through the strategic effect prices will rise as mandated coverage is increased even though the competitive position of the entrant is effectively strengthened. As a result, the entrant and newly served customers are the ones who gain from a higher mandated coverage, while previous customers may lose out. The welfare of the latter decreases because they face higher prices, unless strong network effects compensate for the price increase.

If firms compete in prices instead of quantities some additional effects may arise if the services offered are close substitutes: Valletti *et al.* (2002) have shown that in this case the incumbent has a strong incentive to lower the intensity of competition with the entrant. One instrument to achieve this is (strategic) quality degradation, where the incumbent

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[6] Qualitatively similar results are obtained in the presence of a price cap.

deliberately offers lower quality to some customers. If these consumers are then more likely to buy from the entrant, in this way competition is effectively restricted to a smaller set of customers, while the incumbent on the surface still offers his services to all of them. For close substitutes the resulting rise in the equilibrium uniform price more than compensates for the loss in customers, and leads to higher profits for both firms, while consumer welfare decreases.

4.3.2 Multimarket oligopolies and auctions for subsidies

The tension between universal service and competition represents a considerable challenge for regulators. A promising line of research to resolve this tension is the use of universal service auctions, in which operators bid for a level of subsidy (competition for the market), with the market structure after the auction determined by the bids in the auction (competition in the market).

Anton *et al.* (2001) have analysed this question in a framework of two markets. Let us call $[0, x_2]$ the (profitable) urban market, and $(x_2, x^{max}]$ the (loss-making) rural market (now $k = x_2/x^{max}$). They ask the question: Starting from two firms serving only the urban market, how high will the subsidy be that is necessary to auction off the obligation to serve the rural market, in the presence of a uniform pricing constraint? In this initial situation, firms play the Cournot equilibrium, with equilibrium price $P^C = 1/3$ and profits $\pi_c = x_2/9$ (gross of fixed cost). From a non-strategic point of view, the subsidy should be equal to the losses generated by serving the rural market, subject to the restrictions imposed on pricing in this market, i.e. $s = F - \pi_r > 0$, where π_r are rural profits, and F is the fixed cost of serving the rural market, assumed to be larger than even the monopoly profits.

The strategic effect discussed above weakens the competitive position in the *urban* market of the firm serving both markets, resulting in lower urban profits for this firm, and higher profits for the other firm. Therefore the firm that takes on the universal service obligation must not only be reimbursed for the costs of serving the rural market, but also for the lower profits it will make in the urban market. Furthermore, the auction must solve the "free rider" problem caused by the increase in profits of the firm that continues to serve only the urban market: Each firm would like the other one to win the auction unless the subsidy is high enough. If the *ex post* urban profits under uniform pricing are $\pi_u = x_2/(2 + k)^2 > \pi_c$, and the profits of the firm serving both markets are $\pi_{ur} = x_1/(2 + k)^2 - F <$

π_c, the subsidy must be such that both firms are indifferent between winning the auction or not, $s' = \pi_u - \pi_{ur}$, which leaves them with profits $\pi_u > \pi_c$. The need to take into account the strategic effect of serving both markets under a uniform pricing constraint may thus raise the subsidy substantially, and even leaves both firms with higher profits than if they were just serving the urban market.

The mere *process* of the determination of the value of subsidies can have important strategic implications if a uniform pricing constraint is imposed. Returning to the model from above, assume that the incumbent firm has mandated coverage $[0, x^{max}]$ and makes losses in the markets with the highest fixed cost. If the subsidy required to cover these losses is calculated with respect to the price level and coverage without subsidy, and paid as a lump-sum, there are no strategic effects. If on the other hand the regulator or government incur a *commitment* to cover any losses that are made in the high-cost markets, without fixing the amount *ex ante*, the result is that the incumbent will be a more aggressive competitor. In the extreme case where the subsidy completely covers all losses in the high-cost markets, these markets disappear from the incumbent's objective function, and in terms of payoffs he is in the same situation as if he could freely choose his coverage. Valletti *et al.* (2002) have shown that when both entrant and incumbent can choose coverage, the entrant's equilibrium coverage and prices are lower. This means that the incumbent makes losses in many more markets than previously, and therefore the benefit of lower prices is contrasted with a possibly substantially higher subsidy and a smaller coverage by the entrant. The difference of this result from Anton *et al.*'s is that here the subsidy itself has strategic effects because it effectively liberates the incumbent from the mandated coverage constraint and its strategic implications.

5. Conclusions

We conclude by summarizing the most important problems related to Universal Service Obligations:

- Universal Service Obligations are justified on efficiency grounds while it is debatable if they are also called for on equity grounds, since there may be better tools to achieve redistribution.
- On the efficiency side, there is a sound theoretical argument for universal service programs. They can reduce the risk that customers may not subscribe to a network

since they do not take into account the benefit they confer on existing users. Even if the marginal consumer confers a small externality, this has to be multiplied by large numbers.

- However, it has to be clear that there are also limits to this kind of justification for subsidies. In particular, subsidies should be *at the margin* and it is not necessary to subsidize the majority of infra-marginal customers that would be on the network without any inducement. In this respect, targeted programs fare much better than uniform subsidies. There also seems to be room for the introduction of more optional tariffs for local services. A "menu" of contracts, designed having in mind the need of the poor and the low users, could be designed at a low cost in order to induce more people to subscribe without having to subsidize the large majority of the population.
- There is no reason to subsidize or maintain artificially distorted tariff structures in the belief that this is the only way to increase the subscriber base. As said above, affordability should be interpreted as affordability among an incremental group of users who are considering taking up or dropping the service.
- Regulators should play carefully with USOs since they tend to be used by market players to extract too many concessions.
- Recent research has also shown that USOs have important strategic implications and affect the way firms compete against each other.
- Countries should distinguish clearly between universal availability and universal service guarantees. The former is promoted by encouraging investments and removing entry barriers. Only the latter should be explicitly linked to possible costing and financing requirements.
- The approach should be technologically neutral, enabling wireline and wireless technologies to be used to provide services. It is important to maintain incentives for competing networks and/or technologies to provide (part of) the universal service provisions.
- There are benefits from using auctions to assign USOs since the regulator does not need to calculate net costing. There are also problems. It may be difficult to have sufficient participants bidding against the incumbent (in many cases entrants would need to use alternative infrastructure or acquire the use of the incumbent's assets). Another reason is the asymmetry of information between the incumbents and new

entrants, for example concerning the costs and benefits of serving groups of customers.

- If an auction is not feasible due to the reasons described above, then the regulator must calculate the net cost and then proceed to financing requirements.
- Financing these costs imposes distortions and regulators should try to minimize losses of allocative efficiency. The least distortionary way to finance net costs is probably from the government central budgets. Alternatively, funding should be recovered within the sector, raising a tax from the broadest possible base, in order to minimize the impact of the financial burden falling on end-users. The answer to this depends to a great extent on the efficiency of the tax system.

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