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Abstract

In some countries, like Sweden, regulatory reform of monopoly industries such as telecom and mail went ahead without much consideration to how competition would affect the universal provision of services. This paper reviews issues that ought to be considered in the process of shaping a universal-service policy that is conform to market competition.

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1. Introduction

The extensive and rapid network industry reforms in Sweden in the early 1990´s liberalized competition even in "core natural monopolies" such as rail and mail services, something not even Reagan and Thatcher had dared. A surprising feature of some of these reforms, in particular for telecom and mail, was the low emphasis given to universal service issues.[1] While most other Western goverments were hesitating similar reforms, weighing the risks of political backlashes of pro-competitive reforms that could erode the cross-subsidization sources for funding universal services, the Swedish government went ahead; apparantly hoping that it would find ways out if and when problems emerged.

Ten years later, for reasons that will be given below, it seems necessary to develop a less ad hoc approach to the provision of universal services in these industries. In this paper, I review some issues that ought to be considered in the process of shaping a universal service policy that is conform to market competition.

Universal services are defined in next section, which also comments on the political nature of universal services and how it is affected by liberalisation of competition. Section 3 then gives a short background on the recent history of universal service obligations in telecom and postal services in Sweden. Section 4 of this paper discusses the possibility for developing cost-benefit analysis to support decisions on regulations and procurement of universal services. Also, different options for funding these services are discussed. The subsequent section summarizes the literature on the relations between universal service and market structure and competition. Section 6 gives an overview of various measures for ensuring universal services, their merits and shortcomings. Section 7 gives more detail on the trade-offs between universal service policy and competition policy. Section 8 discusses different designs of universal service procurement and section 9 concludes.

2. The nature of universal services

Universal service is often a major concern in regulation of network industries. The services of such industries are often said to possess specific attributes of a social nature. A common argument for protecting incumbents in such industries against "destructive" competition is that monopoly allows production of services that are socially desirable but commercially unviable. Rules for securing a continued provision of such services, often called universal service, have been important ingredients of many regulatory reform packages.

The nature and content of these "social" aspects vary substantially between different countries and time periods. In this paper, I will focus on the literature on provision of *universal services*. I define this as ensuring services of some quality at a benchmark price level to all, or close to all, residents within a country or a region. This leaves open the definition of the benchmark price, quality of services offered, and the precise subset of the population covered. The universal service policy problem is the extension of access to services for consumers in regions with high costs, for example remote rural regions or disabled persons requiring additional equipment etc. to be able to use services, and for consumers with a low demand

[1] For rail, air transport, and taxi, public bodies even before the liberalization reforms procured universal services. In these cases, a major motive for allowing competition was to relieve the public bodies procuring transport services from being dependent on monopoly suppliers.

(low income, students, etc.). Policies targeting the latter category are however beyond the scope of this paper, as they are in the realm of social policy.[2]

Universal service obligations can be divided in two components (Choné et al 2000), ubiquity and non-discrimination. "Ubiquity" means that all consumers (or all consumers within a subset of consumers) should be connected to a network. "Non discrimination" implies that the same tariff should be proposed to all those consumers, whatever their location or connection cost.

Public services are services with specific content (for example, regional news services). Generally, that is not the same as universal service. However, *access* to public services (for instance access to public service TV channels in a CATV network) can be a universal service (i.e., "must carry" obligations).[3] Two other separate categories are *services purchased by public bodies* (such as broadband access to schools and libraries or services used for national security and defence) and *sectoral public goods*. The latter are services or facilities that are common resources to the whole industry, like infrastructure, essential facilities, or excess capacity that enhances the redundancy of the overall network.

Although the distinctions between these different "social" aspects may seem conceptually simple, in reality they are often mixed together. For instance, in the United States, telecom operators are obliged to provide discount for broadband access for schools, libraries and rural health care centres; services that in Europe are purchased by the local municipalities on regular commercial terms. For radio and TV, public and universal service policies are often closely linked. While sectoral public goods are input rather than output to the industry, to the individual firm they may represent just another obligation that drains profits.

However, universal service is a political concept, not a term created for analytical work. Confusion is in a sense part of its nature, since it has developed in the context of political bargaining between network industries and national or local authorities. Such bargaining has a long tradition (Newbery 1998). Industries that use a network for transmitting services strongly depend on such authorities for protection of property rights, rights-of-way, radio-spectrum rights, and so on, and realize that they will not always get that for free. Another reason for the industry to get into political bargaining is that in a new industry, due to the heavy sunk cost characteristics of network investments, the operator who builds the first network often can get a monopoly position. This gives rise to rent seeking by firms that spend money or commit future operations, etc. to get the rights or protection needed for establishing the first network.

The outcome of bargaining is some form of contract between firms and authorities. Often, the firm that gets the rights or protection it desires agrees formally or informally to contribute to the social good, for example by extending network coverage to rural areas, providing services for free to schools etc.[4] The amount and the precise labeling of such contributions (or obligations) are likely to vary depending on the different circumstances of the political bargaining process. Of course, in some instances, even bribery may occur, but that is besides

[2] Expenditure for subscription to a fixed-line telephone and TV are included in the social welfare aid to individuals provided by Swedish municipalities ("försörjningsstöd"). Sometimes the issue at hand is price discrimination; i.e., whether there are special price schemes for low demand customers.
[3] Must-carry policy in Britain is discussed by Simpson (2004). Ewertsson and Hultkrantz (2004, Ch. 10) and government report (SOU 2003:109) discuss on must-carry policy in Sweden.
[4] Newbery (1999) analyses various aspects of the interaction between network industries and public government.

the point here, which is that universal service obligations often have emerged from this kind of bargaining.

An important implication of this observation is that the conditions for universal service policy change when a network industry, formerly organized as a monopoly, is set under competition. First, as already noted, competition dries up the sources for cross-subsidization. Therefore, either universal service obligations have to be abolished, or new forms for funding has to be created. In fact, the possibility that the former outcome will result is often used as a main argument against liberalization ("cross-subsidies are the enemy of competition, *because* competition is the enemy of cross-subsidies"[5]).

Second, and less frequently observed, the motives for requiring provision of universal service change. Under a monopoly, *any* obligation imposed on a network operator to produce a socially valuable but non-commercially viable service can be justified by a public authority, at least as long as it disregards company profits in its objective function. However, when universal services are to be paid over the public budget, or from funds generated by consumption charges, it will be more difficult to ignore the cost of providing these services. Therefore, as cross-subsidies vanish, there is likely to arise a need development of political and administrative procedures deciding on whether, and to what extent, universal services should be provided, including cost-benefit assessments. This means that design of a universal service policy under conditions of competition is not just a matter of adapting the institutional framework to the change in market structure, by introducing level-playing-field (symmetric) obligations, funding etc. Competition also puts new issues on the agenda for public choice on competing demands for the use of public funds.

A universal service policy can be divided into three parts (Sorana 2000): the definition of the universal service obligation, specifying the price benchmark and the set of services and region covered by the policy; the design of the subsidy scheme used to support the provision of these services; and finally the design of the tax scheme used to finance these subsidies.

3. Liberalisation of telecom and mail in Sweden and universal service

Sweden was one of the first European countries to follow, and in some instances even surpass, the Anglo-Saxon network-industry deregulation movement in the 1980´s and early 1990`s. Among others, telecommunications and mail services were fully liberalized in 1993 (Hultkrantz 2002, Ewertsson and Hultkrantz 2004, Bergman 2002). The telecom liberalization predated similar reforms in most other countries in the European Union by 4.5 years. Also, Sweden was the first country in the world to allow free entry in deliveries of regular mail. In fact, it is still the only country in the European Union with completely liberalized mail services.[6]

One of the circumstances that made this possible was that the telecom and post incumbents both were in support of liberalization, unlike the case in many other countries. As these operators were in favour of the reforms, they could be expected to avoid provoking the general public by halting universal services, at least for some time. Also, both incumbents

[5] Larry White, quoted by Farrell (1996) and Laffont and Tirole (2000).
[6] In Finland, there are no formal barriers to entry.

stayed in full state ownership the first years after the reforms (Posten AB still is), which may have relieved government from some of the pressure to determine upfront rules for provision of universal service. For whatever of these reasons, government took a trial-and-error approach, opening the market to competition before considering whether economic or regulatory measures were needed to ensure continued universal service operations.

The incumbent operators, Telia and Posten AB, respectively, were indeed instructed to continue universal service operations, i.e. they were subjected to an asymmetric regulation limited to obligations on incumbents. These obligations included household and SME access to fixed-line low-speed telecommunications, i.e. for voice telephony, fax and low-speed Internet modems. For Swedish Post, nationwide service obligations included regular overnight mail distribution (to firms and households) and parcel post (households only). The incumbent was also required to continue the basic cashier services provided by the network of postal offices. But the terms for compliance to these obligations were not clarified. With a few exceptions, the operators were not given any economic compensation, although the change of market conditions could be expected to put an end to cross-subsidization. Also, both operators were changed from being parastatals ("affärsverk") in rather strict public control to share-hold corporations, with a more hands-off owner control subject to rules of the Companies Act. It was therefore not clear that the incumbents really would continue universal service operations as market competition became fierce.

However, the luck is for the brave. Universal service has rarely become a critical political problem in connection to "plain old" telecom and mail services. This may seem remarkable, especially in the case of mail services. In many countries, for instance in the U.S, the fear of a breakdown of universal service, in particular mail deliveries to rural regions, still prevent governments from allowing even a limited entry of new operators. However, no disaster happened in Sweden. In fact, it is difficult to find any detrimental effects at all. The number of Swedish households lacking daily mail services decreased från 1 594 in 1990 to 1 187 in 2002 (out of approximately 4.4 million).[7] The Posten AB performed in 2003 to deliver 95.7 percent of the overnight mail within the next day, and 99.8 percent within the next three days, which exceeds the legal service obligations (minimum 85 and 97 percent, respectively).

In retrospect, this outcome does not seem so strange. Universal national access for households to fixed-line telephony and basic mail services was accomplished a long time ago, at least before World War 2. Aggregate market demand has remained stable (in spite of the rapid growth of the use of mobiles, Internet, etc.). Estimates of the cost of universal access have indicated surprisingly low numbers. The annual costs of universal service of fixed-line telephony and regular mail services, respectively, have been estimated to maximum SEK 100 millions (approximately 1.2 Euro per capita).[8] This gives some support to the conjecture that complete national coverage in fact is commercially justified, taking into consideration company-level benefits that cannot be identified by the accounting data used in these estimations.

[7] Extended door-delivery services in rural areas (lantbrevbärning) for some 3.800 households with disabled persons are purchased by the postal regulator PTS at a cost of SEK 20 million (PTS 2003).

[8] These figures are very uncertain. Analysys (1996) has estimated the universal service cost of Telia. A guestimate of the universal service cost of mail services below SEK 100 million has been reported by the Ministry of Industry, but the national postal regulator´s view is that the real cost is considerably lower, see Andersson (2004).

But more drama has been seen in other scenes than these two; the development of basic cashier services has been markedly different. While fixed line telephony and to some degree mail so far have balanced losses and gains from the Internet revolution, cashier services have not. As the use of Internet banking, debit cards and ATM has evolved. The demand for basic counter services has declined. Since 1999 Posten AB has been receiving state aid for their cashier services. However, during the 1999 – 2004 period the number of transactions dropped by, on average, 16 percent per year (SOU 2004:52, p. 24). As a result, the average cost of remaining cashier services has skyrocketed. The state subsidy per transaction rose from SEK 9 in 1999 to SEK 20 in 2003. The accumulated state aid in the entire period between 1999 and 2003 amounted to SEK 4.2 billion (approx. Euro 0.5 billion).

Huge investments have been made in networks for new technologies, such as high-speed Internet connection, GSM and 3G mobile communications, digital TV and digital radio, etc. Following this, sometimes even before the first investments, lobbying for political measures to enhance coverage and access started. Also, as public institutions for schools, health and numerous other services become dependent on web access and various information and communication technologies like telemedicine, services to disabled[9], electronic surveillance of elderly, etc., political pressure is pumped up further. However, the costs of extending coverage to all parts of the country are often overwhelming, in particular in a country like Sweden with large sparsely populated rural areas.

- For these networks, a range of different universal access policies developed. The roll out of the terresterial digital TV and digital audio broadcasting networks has been assigned a state-owned operator. The cost of complete national coverage (for DTV up to 99.8 of the population) is ultimately to be covered by charges on operators.

- A nationwide optofibre network connecting all municipalities in the country has recently been completed (supplementing several other backbones owned by private and public companies). The cost at SEK 2.5 billion was funded over the public budget.

- Companies owned by municipalities have built a vast number of urban and rural optofibre networks. Some of these have ample room for cross-subsiding investments in peripheral areas from local monopoly rents in district heating, garbage collection, water and sewage, etc.

- A universal-service subsidy is given for broadband access to households and small firms in rural areas. The total grant for this support is SEK 5.8 billion (prop. 1999/2000:86).

- The first three GSM mobile communications operators were granted licenses in the early 1990´s conditioned on certain coverage requirements. These may have seemed very demanding at the time, but in retrospect, when the rapid market uptake of the GSM technology is known, this was not the case. These three operators have all rolled out networks with a wider coverage.

- For the third generation UMTS licenses no such conditions were stipulated. However, the licences were allocated in a beauty contest designed as a universal-service competition. Each of the four winners promised to cover 99.98 percent of the

[9] See PTS (2003) for some examples.

population within three years; which was a target and a speed that was unheard of in other EU countries (Hultkrantz and Nilsson 2002). However, as network sharing was allowed to some extent, the final outcome was that two rural networks would be constructed, both expected to give rise to heavy economic deficits.[10]

Apart from network coverage, other universal service issues have emerged as well. One, raised by the digital convergence, concerns the access to public service in different networks for electronic communication such as CATV, broadband, and mobile networks. In this cases, coverage is not the problem, but whether, and on what terms, operators of all kind of networks can be obliged to reserve a substantial share of the capacity for public service channels. (Ewertsson and Hultkrantz 2004, Simpson 2004).

4. Cost-effectiviness analysis of universal service

Universal service objectives can be set under two different circumstances. In the first, policy is following market development. In the second, policy is trying to lead the market.

In the first case, there has already been a market test of the services. The value of the services has been demonstrated through the market, and the service has been taken up on commercial terms by a substantial part of the population, to which it is availabe. The political assessment of a universal service policy can then be confined to considering whether households deprived ot the service will suffer seriously, and whether the cost of extending the market is acceptable. This is the approach recommended by the World Bank (Wellenius 2000).

In the second case, the universal service policy is active rather than reactive. The aim of the policy is then to offensively promote market penetration of a new technology, so as to attain a critical mass of users, needed to attain goals connected to industry productivity and competitiveness, more efficient use of public resources (eg., by the use of telemedicine, electronic surveillance, etc), enhancing citizen participation and democracy ("e-democracy"), etc. The Information Society program of the European Union can to some extent be classified in this category. Also, considering the political bargaining framework in which universal service obligations often emerge, a "lead" rather than "follow" strategy may be politically more effective, as the bargaining strength of the political side, relative to the industry, may be stronger in the early stages of development of a new network industry.

It may seem that economists have little guidance to give political decision-makers in developing the objectives of universal service policy. Both reactive and active policies are derived from "soft" objectives such as social inclusion, regional distribution, national competitiveness, etc. Such values may be difficult to estimate in monetary terms. However, often cost-effectiveness, rather than cost-benefit, analysis can be used. In cost-effectiveness analysis, the costs of different alternatives for reaching a specific target are compared, and the benefits need not be assessed.

Such an approach is made possible in situations where there are several partly overlapping networks. In a case like the first construction of an intercontinental railway Canada, the

[10] Björkdahl and Bohlin (2003) estimate the investment costs in commercially unviable areas to be SEK 5 billion for each of the two networks. Although all operators committed the full 99.98 coverage at the end of 2003, the network roll out is still not completed, probably because the operators expect substantial losses from the rural networks.

benefits to the whole nation of connecting the eastern and western parts may have been difficult to assess in economic terms. However, today the value of train services on remote tracks can usually be estimated from the opportunity cost of bus services, as there is a road network. In a similar fashion, the benefit of cashier service in rural districts can be assessed as the cost of allowing the consumers such services for instance by a free taxi service to the nearest town. The benefit of fixed-line broadband access can be evaluated by the cost of radio conveyance, etc. Such opportunity costs thus cap the benefits that can be attributed to universal-service measures. Although these caps exceed the benefits, they can be very useful in sorting out obligations that are overly expensive from a social point of view, and thus narrow the field in which political discretion is needed.

To the extent that the aim of a universal service policy is income redistribution, a cost-effectiveness assessment can use alternative means for redistribution as reference. An important benchmark for such an analysis is a result in the theory of optimal taxation derived by Atkinson and Stiglitz (1976). They analyze different means for redistribution in an asymmetric information context, where the abilities of tax payers to earn money are unobserved by tax authorities, while their incomes are perfectly verifiable. Atkinson and Stiglitz show that the income tax is all that is needed for redistribution. Therefore, the consumption of goods and services should be taxed at a uniform rate. Consumption decisions should not be distorted, i.e. relative prices should only reflect marginal costs. In other words, income should not be regionally redistributed by forcing rural communities to consume, for example, optofibre access. Instead, redistribution should be done with the tax system and income transfers.

The scope of this argument, however, is limited by the assumptions of the analysis (see Laffont and Tirole 2000, Ch. 6.2 for a more extensive discussion). One such assumption is that the income distribution is known. In reality this is often unobservable to some extent, for instance because the real prices of goods and services include an unobservable transport cost component borne by consumers (such as the cost of travelling to a place with cashier-services). Then redistribution by the income tax may not be possible, and a universal service obligation may be the only feasible means for getting a more equal distribution in the regional dimension. Another condition that Atkinson and Stiglitz' result is based on is that there are no consumption externalities. For instance, surveillance systems requiring high-speed connection can be a potential source of productivity improvements in the provision of elder care in rural communities. If the elder care is payed by the municipality, then it may be willing to support a broadband network.

Another cost-effictiveness aspect of universal service obligations concerns the design of a funding mechanism. One of the choices to be made, when cross subsidization within an incumbent company cannot be relied on anymore, is whether a support scheme should be funded by industry charges (to be paid by operators or, directly, by users) or out of the (tax-funded) public budget.

Industry charges are used for funding universal services in many cases. In Sweden, there are such charges in among others electricity, airline, seafreight, and rail. For instance, part of the cost of the Öresund bridge between Sweden and Denmark is funded by charges imposed on all train operators in Sweden, even on train operations in the northern part of the country. In a similar manner, levies on sea and air transport cover the costs of the national infrastructures of these modes. For telecommunications, France is so far the only country within EU with industry charges for universal services. For mail services, Finland formally allows

competition, but operators that enter metropolitan areas have to pay contributions to a universal-service fund. In fact, as of yet no such entry has occurred.

For the choice between industry charges and funding over the public budgets, some guidance is given by another fundamental result in tax theory, derived by Diamond and Mirrless (1971), recently reviewed by Ahlberg (2004). They showed, in a vein similar to Atkinson and Stiglitz, that to promote overall productive efficiency, firms´ choices of technology should not be distorted by the tax system. More specific, charges should not be levied on intermediate goods, as that may bias the allocation of inputs in production. For instance, a user fee on transmissions over the internet would distort decisions on whether to use e-mail or regular mail from the underlying relation of marginal costs. Once again, the upshot is to use the general tax system instead, with its much broader tax base.

However, the Diamond and Mirrless result is not based on considerations of principal-agent relationships or politico-economic equilibria. Average-cost or "club-model" user charges seem to have become more popular in the European Union. A recent example is the proposal for the so-called new Eurovignette directive for km-taxes of heavy haulage (EC 2003), which dismisses the marginal-cost focus of the European transport policy, allowing a mark-up for covering fixed costs of infrastructure, i.e. on an intermediate input to many industries. Other examples are bridge and road tolls with the main purpose of funding infrastructure, for instance the Öresund bridge toll, which exceeds the level that would be chosen within a marginal-cost based framework. Possibly, to some extent such solutions can be defended by improvements in cost control, management of operations and maintenance, etc. in a self-funded, compared to a tax-funded, infrastructure administration.

It should be observed, however, that tax funding is also associated with a real social cost, the so called deadweight loss. In the cost-benefit appraisal system used for evaluating road and rail infrastructual programs, a mark-up at 30 percent is made on all expenditure covered by tax revenue. In addition, the economic assessments are made in consumer prices, which makes it necessary to include another mark-up representing indirect taxes. The total mark-up on tax-funded expenditure is therefore 52 percent. The implication of the Diamond and Mirrless result is that funding by an industry-wide charge is socially even more costly than that.

5. Universal service policy strategies

Since long, monopoly operators in network industries have implemented broad subsidy programs to remote rural areas, to household markets or to specific services such as call boxes. As noticed above, these operators may sometimes have exaggerated the extent of such cross-subsidization, but nonetheless it is clear that the emergence of competition in these industries considerably has changed the conditions for universal service operations. As a rule, entrants to a market first targets the most profitable market segments, while avoiding segments that incur losses. In a markets with heterogenous consumers with respect to the costs of serving different consumers, "cream skinning" is likely to occur. Hence, incumbents have strong incentives to "rebalance" tariffs by lowering prices on low-cost segments and raising prices in areas and on items with high costs.

Regulators who want to ensure continued operation of universal services on a liberalized market can consider five main alternatives:

1. Imposing universal service obligations on the incumbent (*asymmetric regulation with or without compensation*).
2. Imposing obligations on all firms (*symmetric regulation with or without compensation*).
3. Procuring universal service from one firm (*single firm ex-ante subsidy*).
4. Procuring universal service from several firms (*multiple firm ex-ante subsidy*).
5. Offering universal service subsidies (*multiple firm ex-post subsidy*, or *voucher*).

These options differ in multiple respect. Various considerations may affect the choice between these alternatives.

Monopoly provision (option 1 vs. 2; option 3 vs. 4): In the first and third option, one firm only will provide universal service. This is an advantage when there are substantial economies of scale in the operation of universal service as wasteful duplication of fixed costs is avoided. In the regulation option 1 one firm, often the incumbent, is selected upfront to be the provider. In the procurement option 3, the selection is made in a tender for the universal service franchise. However, both these options may distort competition by giving one firm a unique market position. This will be analyzed below and in more depth in section 6. On the other hand, imposing symmetric instead of asymmetric obligations (option 2 vs. option 1) may give rise to excessive costs for universal provision. For instance, when GSM licenses were granted in Sweden, the first three operators were imposed the same coverage requirements (around 60 percent of the population), apparantly absent any cost estimates. A similiar symmetric obligation for 3G (where operators, in their competiton for licenses, committed to 99.98 percent coverage) would have required the construction of four rural networks at a total cost of at least SEK 20 billion (Euro 0.22 billion).[11] A monopoly rural network allowing other operators national roaming would then have saved SEK 15 billion.[12]

Control of output or costs (option 1 or 2 vs. option 5): Options 1 through 4 ensure that universal service operations will be performed, while the fifth, voucher, alternative leaves the ultimate decision to operators. The usual "p-q" trade-off in choice of regulatory instruments therefore applies (Weitzman 1974): If the regulator is uncertain about the marginal cost or benefit of the universal service the effectiveness of "q" instruments (options 1-4) versus "p" instruments will depend on the slopes of the cost and benefit curves and how far expectations deviate from reality. The regulator will probably prefer the regulation options 1 or 2 when precise control of the amount of universal service is required, with no consideration of costs, and the voucher option 5 if she is willing to allow the amount of universal services to depend on the real cost of providing them.

Box 1: The p/q-problem

Figures 1a and 1b show two policy cases. Figure 1a represents for instance the case of Digital TV coverage. Here, there is a very strong political desire for network access to almost all households (as that makes it possible to close down the analog network). This is illustrated by a steep marginal willingness-to-pay curve by a regulator for additional household coverage at the targeted coverage rate. Figure 1b represent a polar case, which represent a politically "non-essential" technology (3G or broadband?). There is a willingness to pay for a larger network coverage than will

[11] Based on cost estimates by Björkdahl and Bohlin (2003), see the previous note.
[12] The licence allocation procedure resulted in a compromise with two rural networks, both jointly owned by two operators. However, whether both networks will actually be completed remains yet to be seen.

be rolled out on commercial grounds, but there is no specific threshold level that has to be achieved. Therefore the marginal-willingness-to-pay curve is more flat.

In the figures, the voucher option 5 (universal service subsidy or “price”) is compared to the regulation option 1 (administrative rule or “command”) policy. Both cases show the outcome when the regulator underestimates the cost of extension of a network to more household, beyond the coverage brought about by the market without regulation. The marginal cost of additional coverage expected by the regulator is shown by the dotted cost curves, while the real, higher, marginal costs are denoted by the full lines.The outcome when the price policy is chosen will depend on the actual cost, while the outcome of the command policy will not. As the marginal cost was underestimated, the price policy will give a lower coverage than was expected, as shown in the figures.

In the first case, the command policy will perform better than the price policy, while it is the other way around in the second case. This can be seen from the shaded areas in the two figures. These areas show the net cost of choosing the wrong instrument given the misperception of cost.

Figure 1a: Digital TV. Steep marginal willingness-to-pay.

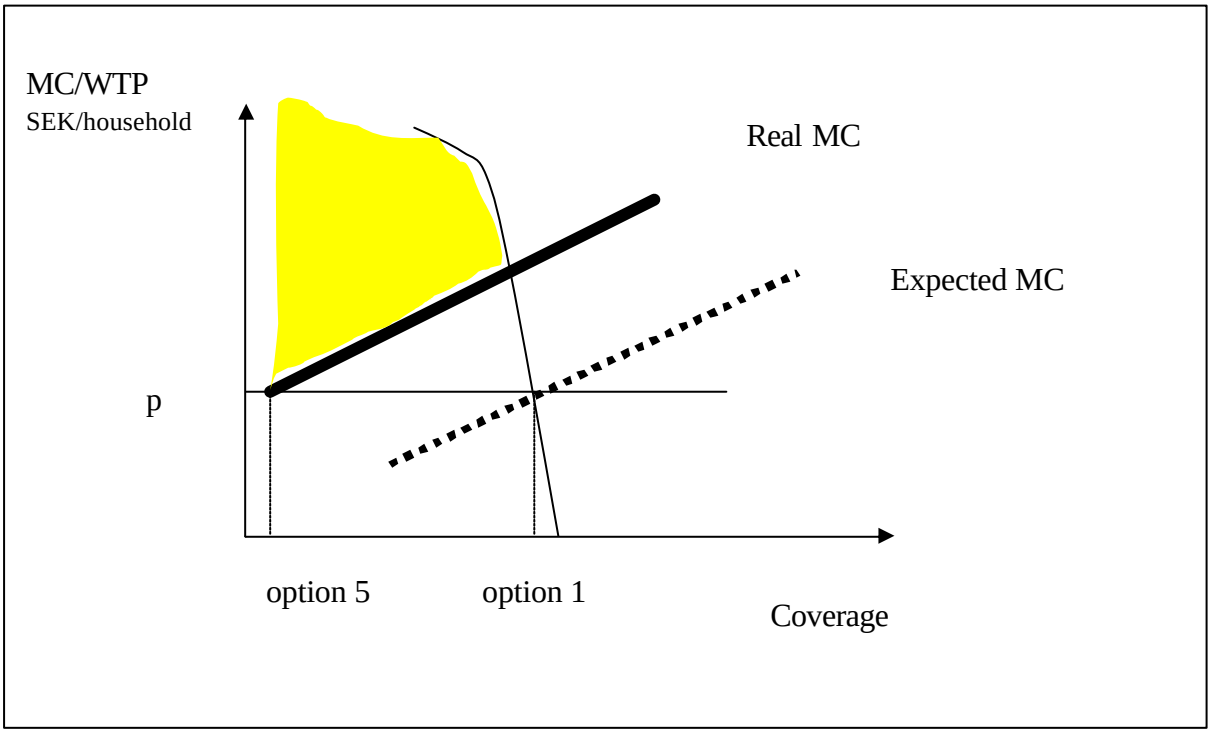
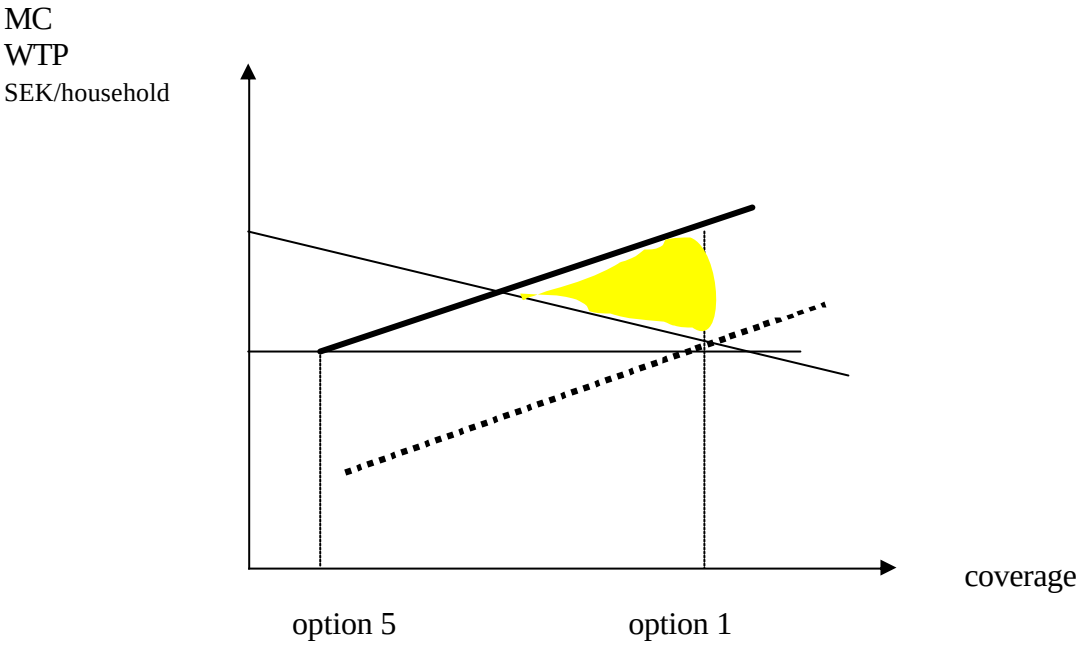


Figure 1b. A "non-essential" network



Reducing cost uncertainty (options 1, 2 (and 5) versus options 3 and 4): However if there is a considerable uncertainty about costs, this constitutes a strong argument for the choice of procuring universal services in an open tender, i.e. options 3 or 4.

Box 2. **Vickrey-Clarke-Grooves mechanisms**
The choice between, say, options 1 and 3, is called a choice of mechanism design. The theory of mechanism design builds on seminal contributions by Vickrey (1961) and Clarke (1971) and Grooves (1973). Vickrey analysed competition among bidders in an auction. Clarke and Grooves studied the public choice problem when members of a group (tax payers, say) decide on a public project that is to be paid by contributions from the members themselves. A so-called Vickrey-Clarke-Grooves (VCG) mechanism is an incentive compatible mechanism, which means that it results in truthfully reporting (for example, bidders in a procurement auction will reveal their real costs; tax payers will state their real preferences/willingness to pay for public goods, etc.).

Vickrey, and Clarke & Grooves, showed that under some circumstances such mechanisms exist. A common feature of the mechanisms they studied is that the participants are pivotal, i.e. consideration of each participant's report changes the decision. In particular, auctions (i.e. procurements) can be designed as VCG mechanisms. For instance, in an ordinary ascending auction with open bids ("*bondauktion*") it is in the interest of all bidders except the winning bidder, to bid up to their own reservation prices (i.e. to truthfully report their reservation prices); and then the winning bidder truthfully reports having the highest reservation price. For more on this, see Milgrom (2004).

Overcompensation to one firm (option 1 vs. 3): If the universal services obligations are imposed on the incumbent without procurement, the regulator will be at an informational disadvantage and there will normally not be any means to get precise and reliable cost assessments. As a result, it will only by chance be possible to give an economic compensation to the incumbent or to the the universal service provider with an amount that is equal to cost. To ensure the operation of universal services, the regulator may be inclined to add a safety margin to his cost estimate, hence to overcompensate. In the regulation literature this phenomenon has for long been analyzed as the Averch-Johnson effect of rate-of-return regulation (Kahn 1970).

Another reason for overcompensation is economies of scope. Economies of scope are prevalent in the provision of universal services. This means that the cost of providing universal services jointly with other (commercial) services is often (much) lower than the stand alone cost. The source of economies of scope is joint costs. Allocation of joint costs is often difficult and ambigouos. Joint costs include not just investments in physical capital, but management time, build-up of brand name, advertising, costs of complementary services, and so on. For physical networks, there are often significant economies of scope for serving adjacent areas.

When there are strong economies of scope, an incumbent universal-service provider who feels that the compensation it gets is too low can organize the universal-service operations in a separate division with its own accounting. In that way, it can produce evidence on the stand-alone cost. Such a case occurred in Sweden in 2001 when the postal and cashier services of Posten AB were split in different companies. Since 2002 cashier services have been operated by Svensk Kassaservice AB (Swedish Cashier Service), a whole-owned subsidiary to Posten AB. This company set up a new network of local offices, only performing cashier services, generating a huge deficit that had to be compensated by state aid. The possibility to make such a horisontal split may represent a credible threat in negotiations with the regulator/treasury on compensation levels and could therefore further a tendency for overcompensation.

A third reason for overcompensation may be the difficulty of estimating the benefits of universal services to the universal service operator. While the costs of these sevice may possibly be assessable from accounting information, the effects on customer´s demand and loyalty of being an operator with a nationwide network cannot be apprehended in that way.

Overcompensation is, from a social point of view, the source of two types of ineffiencies. The first source comes from cost ineffiency, i.e. to the extent that the incumbent firm does not choose the technology or organization for the production that minimizes costs. The second source comes from the rents gained by the incumbent, i.e., the difference between cost and compensation. Such rents are socially costly, for instance if compensation is paid from tax revenues, which give rise to deadweight losses.

In addition to these effects, which also apply to overcompensation in option 2 policies, overcompensation to the incumbent is a form of state aid that distorts competition. For cashier services, a Swedish government report (SOU 2004:52) has recently come to the conclusion that the present solution of a state-owned company as the provider of basic counter services is not compatible with the state aid rules of the EC Treaty. The government investigator, therefore, proposed that the National Post and Telecom Agency shall be commissioned to

procure these basic payment services, i.e., a switch from option 1 to option 3 in the terminology used here.

A range of experiences from Swedish liberalization reforms in the 1990´s suggests that overcompensation is a likely outcome of option 1 practices when compensation is paid. One example is the re-organization by the Swedish national road administration (Vägverket, VV) of basic road operations (such as snow clearance) from in-house provision to competitive tendering. The reform was performed over several years and started with the creation of a state-owned production company (Vägverket Produktion AB, VP) that took over all operations, thus taking the role of an incumbent subject to an "option 1" policy. During the period 1992 – 2000, contracts for 98 separate road districts were competitively tendered, while 53 contracts were sole-sourced directly by VP. A study by Arnek (2002) shows that the cost of tendered contracts were, on average, 22 - 27 percent lower than those who were not. Thus it seems that VP was given a considerable overcompensation in the cases where it did not have to compete.

Undercompensation (options 1, 2 vs. 3, 4 and 5): As previously described, the universal service obligations imposed on the telecom and post incumbents in Sweden were in most cases not compensated at all. A net deficit on universal service operations has to be financed by cross-subsidies, so uncompensated obligations are in the short run likely to make an incumbent more reluctant to re-balance tariffs. On the positive side, this can stimulate market entry, but it may also adversively lead to excessive entry (or by-pass) by firms with higher marginal costs than the incumbent. In the long run, a possible result is that the incumbent either will underinvest, reduce service quality etc. to reduce the cost of universal service; or threaten to do that so as to get full compensation.

Another case is undercompensation in option 2, i.e., when several or all firms of the industry are required to provide universal service for less than full remuneration. An example from Swedish practicies is GSM license conditions of the first three GSM providers in Sweden, which required these firms to roll out networks covering around 60 percent of the population. Such a requirement raises the cost of entry and may thus reduce market competitition, in addition to the effects already mentioned (although it turned out not to be the case in this example because of the rapid market development). Also, it may distort competition if the obligations are limited to a subset of the industry. Once again, GSM provides an example. A fourth licence was later given to an operator that planned to build a network in the three largest cities only.

By way of summary, there are several conflicting priorities in the design of a universal service policy. Because of economies of scale and scope in operation of networks that require huge sunk-cost investments, it is desirable to minimize the number of operators providing universal service. On the other hand, this may harm competition by putting some firm or firms at an advantage or disadvantage, depending on the size of the economic compensation. Because of information asymmetry, procurement may be desirable. On the other hand, procurement is costly in itself and, for this reason, obligations imposed by regulation (options 1 and 2) or incentives by price (universal service subsidy, option 5) may be preferred. In the next sections, we will scrutinize these conflicting priorities more closely. We begin with the trade-off between duplication of fixed costs and market competition.

6. Single or multiple universal service providers

In industries that are characterized by large sunk costs there is often an efficiency tradeoff in the number of firms between, on the one hand, the wish to economize on fixed cost, and on the other hand the benefits from market competition. For industries with so called exogenous sunk costs ("set-up costs", see Sutton 1992), market concentration in markets that can be described by Cournot competition can be expected to increase with the proportion of set-up costs to market demand.[13] Hence it follows that network industries, which generally require large sunk cost investments in a physical infrastructure, can be expected to have a more concentrated market structure in rural areas and other regional sub-markets with low demand, than in for example metropolitan areas.

However a counteracting factor is economies of scope in both supply and demand that may smoothen regional differences in market structure. For instance, metropolitan mobile customers may prefer to subscribe to an operator that has a network that can serve them also when on temporary visits to rural regions. Brand names may be built in a national (or European) context, making it desirable for an operator to serve customers everywhere. But, of course, there would be a cost limit to such considerations.

There are thus some ambiguities here that present a dilemma to a regulator or policy maker designing a universal service policy. Should this policy assign one operator, either by procurement or by asymmetric regulation, as the universal service provider, or should there be a level playing field giving several operators equal terms for the market competition?

Market competition can be brought about in two ways, either by competition in the market, between firms that each receives a market share, and for the market, by competitive tenders for a franchise. These alternatives can also be combined by multiple-units auctions for several overlapping universal service franchises.

6.1 Market competition: Universal service vouchers

In a situation where market competition already has developed, a seemingly simple way to get a level playing-field is to give a universal service subsidy (option 5). The regulator then defines a level of subsidy for a specific region, to which any operator offering a specific universal service bundle would be entitled. Such a subsidy is equal to a universal service voucher that the consumer can allocate to the operator of her choice. It is also called an ex-post open subsidy (Sorana 2001), to indicate that it is open to any operator that wants to enter the market after the subsidy level has been determined by the regulation. The opposite case is an ex-ante open subsidy, determined in a procurement auction (see next section).

The subsidy level can, for instance, be computed as the forward-looking cost less the national benchmark price of the bundle (Laffont & Tirole 2000, Ch. 6). In that way, by not basing the compensation on historical costs, it would give the individual firms incentives to reduce their costs.

[13] Under Bertrand competition, only one firm enters and sets a monopoly price. With horizontal product differentiation the relation between sunk costs and market structure depends on several circumstances, see Sutton (1992, Ch. 2).

Such a system is in principle competitively neutral. It does not, however, compensate for conditions that vary initially between different operators. For instance, if there are economies of scope between adjacent areas served, the cost of serving a specific area may differ among operators. Also, operators may have different abilities for offering complementary and more advances services that bring additional revenue.

A closer look at the voucher method reveals further problems. As consumer heterogeneity often is gradual, costs of serving customers are likely to differ not just between regions with and without subsidies but also within a region (or market segment) in which a voucher system is valid. Thus, firms that provide universal service within such a region (segment) will get subsidies for both high-cost and low-cost customers in the area. As more than one firm offers universal service, the competition for low cost consumers in the region can be expected to get more fierce, in particular if price discrimination is possible, since the subsidy lowers the net marginal cost of serving these consumers. If they are offered lower prices than the high-cost consumers, the low-cost "tax base" is eroded and hence there is a need for an even larger subsidy than previously to compensate the losses on the high-cost consumers in the region, i.e., a vicious circle can develop much like adverse selection problems in insurance (see Laffont and Tirole 2000, pp. 239-243).

One may therefore want to consider various forms of restrictions to a subsidy system to avoid cream skinning within a voucher region or segment. One is to restrict entry to the subsidized universal service segment. Another is to enforce non-discrimination within the subsidized segment. Of course that may be difficult as there are numerous ways to differentiate prices and service quality between customers. A third possibility is so called "pay-or-play" regulation. In "pay-or-play", the incumbent is imposed an universal service obligation, but in addition a tax is levied on firms that do not offer such service. Firms that do offer such service are exempted from the tax. "Pay-or-play" is used in telecommunications policy in Australia and Argentina and has been considered for the United Kingdom.

Choné et al. (2000) have studied the welfare effects of supplementary constraints to voucher systems. They find that in the absence of non-discrimination regulation, welfare is higher under "pay-or-play" regulation than under restricted entry. The basic reason is that it enhances productive efficiency in cases where entrants are more efficient that the incumbent. However, if compliance to non-discrimination can be enforced, then there are cases (i.e., when the tax rate is high) when restricted entry is better.

The "pay-or-play" option is however not compatible to the EU directive on universal service for extensions of universal service to new advanced services. Any such increase can probably not be funded by a direct levy on the industry and must therefore be paid for out of the public budget (Simpson 2004).

6.2 Competition for and on the market: Procuring universal service from several operators in the same area

A disadvantage of both universal service regulation (options 1 and 2 in Ch. 5) and a voucher system (option 5) is that the subsidy level has to be determined by the regulator. Therefore when the cost of universal service is uncertain, it may be better to procure the universal service. Then the subsidy to each operator will be determined endogenously, in a competitive tender.

Moreover, aside the informational limitations, it can be shown that in a wide set of cicumstances the total subsidy will be larger with an ex-post open voucher subsidy than with an ex-ante subsidy to a single firm allocated through a universal-service auction (Sorana 2000, 2001). The reason is that the latter case leads to subsidies equal to an average of the net cost of serving consumers in the area. In contrast, a voucher scheme must pay a subsidy that is high enough to make even the costliest consumers attractive to some firms, and pay that for every consumer.

However, if the regulator choses procurement strand, another decision to be made is whether to auction a single or multiple universal service franchises. There are three aspects to consider; whether the additional competition *in* the market gives desirable effects for (i) the *supported services* that are subsidized, (ii) for other, supplementary but not supported, services provided in the same area, and (iii) for services in other (commercially viable) areas provided on regular market terms without any subsidy.

From the outset, it may seem that if competition is desirable, then more competition is better, and hence it would be nice to have both competition for a market, through procurement, and in the market, by having multiple providers. However, for the supported services this may not be so clear after all. In such a market, there would be both a ceiling on prices (non discrimination) and a minimum quality level constraint. Therefore, the benefits of competition on the market must be attributable to cost reductions above those expected by the bidders in the procurement auction, or to quality improvements above those that can be defined and monitored by the regulator. And given that such possibilities exist, the bidding firms can expect in-market competition to reduce the upside of the ex-ante profit distribution, and will thus require a larger subsidy than if the winner of the universal-service procurement auction was granted a monopoly (Laffont and Tirole 2000, p. 251).

However, the problem of ensuring sufficient service quality may be quite difficult in a single-firm franchise. The main reason is that the operator loses money whenever she has to serve another high-cost consumer. By switching from a lump-sum to a per-subscriber subsidy this problem may be mitigate, but only under some specific circumstances. The winner of the tender faces no competition for the consumers and will provide a high quality only if their demand is sufficiently elastic, i.e., if they would drop out if not given this quality level (Sorana 2000, 2001).

The second aspect is the effects of in-market competition on *non-supported services*. In some cases, different network operators supply different sets of services. For instance, different networks for TV distributions offer various bundles of TV and movie channels. 3G mobile communication networks deliver different service packages to their customers. In such cases, the variety of services provided on the universal service segment of the market will clearly depend on the number of operators serving that segment. To be noticed, however, is that this effect is related to the absence of an effective access regulation. If, for instance, a 3G operator is granted a universal service franchize for a network in a rural area, an obligation to allow subscribers to other networks (national) roaming would do the trick, and save on the cost of rolling out several rural networks that operate considerably below their full capacity.

The third aspect is the effects from allowing several providers of unversal service on the whole market. As noted previously, a subsidy to users within a certain segment of the market may enhance competition for low-cost consumers within that segment (and increase the

subsidy demanded by the bidders in the procurement auction). In addititon it may increase competition on the segments of the market that are not subsidized, if there are complementarities in either the supply or demand. Supply complementarities are present if there are economies of scope, for instance in providing services in adjacent areas. Complementarities in demand can emerge from the geographical mobility of customers (after all, mobile communications have been developed for mobile users), (for instance, because subscribers in a metropolitan area want to use their handsets also while they temporarily visit the countryside), or from the needs of users to be able to reach other users nationwide (for instance a company with subsidiaries in rural areas). If such complementarities are strong, then a monopoly in the universal service segment of the market may harm competition in the whole market, as the holder of this monopoly can gain a large market share of the rest of the market as well.

There are thus some advantages of enabling in-market competition for universal services. On the other hand, the cost of a second or a third network in rural areas may be tremenedous, as witnessed by the 3G networks in Sweden. In this case, the outcome of the 3G licence procedure was that two "network clubs" were formed. Each "club" consists of two operators jointly owning a rural network. This solution was regarded with suspicion by the national competition authority, but was finally accepted.

This development thus raises the question whether network operators competing in the commercially viable segments of the market should be allowed to share networks in areas with a low population density. The economic literature on "infrastructure clubs" normally assumes that all firms in an industry jointly own a common infrastructure. The upshot of such analysis is that if the infrastructure service is an essential input to all firms, then the club will work as a device for organizing a cartel (Tirole 1988, Ch. x). It seems that a "rural network club" owned by all operators would give a similar result, at least if no operator can avoid serving rural customers. The price of the intermediate infrastructure services would hence be set above marginal cost, raising the retail prices.

A situation with competing clubs, like the case of 3G in Sweden, has recently been examined by Nordberg (2003). He finds that the effects on market competition of the network cooperation will be less severe in such a case, as a mark-up on infrastructure services by one network will impinge on the owners' competitiveness on the product market. However, an extension of this analysis to a case fully corresponding to a universal service setting, considering for example the possibilities that operators may have to affect their market shares in different regions (by marketing etc.), remains to be done.

7. The design of multi-unit universal service auctions

Multi-unit universal service auction seem to be the solution to a number of problems: to the uncertainty about costs and the uncertainty about complementarities in both supply and demand.

A problem, however, is that the type of auction most commonly used for multi-unit auctions hitherto, the "FCC auction" or multi-unit ascending auction, is an open auction. It therefore invites collusion among bidders; a problem that was prevalent in the 3G auctions (Klemperer 2002).

Furthermore, as shown by Sorana (2000, 20011), auction designs aimed at stimulating competition among several subsidized carriers may be particularly vulnerable to collusion. The reason is that the competition *in* the market makes it possible for firms that want to organize a bidder´s ring in the competition *for* the market to punish defectors immediately, instead of waiting until next time the contract is tendered. In a perverse way, the appointment of several universal- service providers per area makes things worse by reducing the cost of carrying out such punishments.

To solve this problem, a procedure for universal service auctions based on closed bids has been suggested by Paul Milgrom and others (Milgrom 1996). The idea is to allow an endogeneous market structure, determined by relative size of bids for compensations for universal service in an area. The closer together bids are, the greater the number of bids that will be accepted. In this way, it is possible to trade-off the value of added competition in the market firms against the cost of accepting the second-best (or worse) bid.

Sorana (2000, 2001) finds that this type of auction indeed can do even better than that, as it makes collusion more difficult. Therefore it may be a way of deriving the full benefits of the competition for the market.

Laffont and Tirole (2000) comment, however, that the analysis of universal service auctions with endogenous market structure is still in its infancy.[14] They notice that the Milgrom proposal, has some obvious drawbacks. As we have noted, the compensation needed for universal service will depend on the final market structure, so the endogeneity of the market structure adds uncertainty to the firms' decisions while bidding. Hence they will require an additional risk premium, and in the end the cost of the universal service will increase. Second, bidders will not be able to take into account complementarities between adjacent areas, which also is likely to raise bids.

Moreover, Lunander and Nilsson (2003) observe that small firms may have an opposite problem in a closed-bid auction for multiple units, as they may have rising costs to scale (scope). For such firms, the possibility of winning to many units presents another source of risk that raises bids. Paradoxically then, closed-bid auctions for multiple units that do not allow bids for packages (see below) will put both large firms (with economies of scope) and small firms (with diseconomies of scope) at disadvantage, and ultimately raise the cost to the regulator procuring these services.

However, these issues can be settled by a procurement auction that allows combinatorial bids, i.e. bids not just for single units but with discounts or premiums for different combinations (packages) of units. In a field experiement, using thge Swedish national road administration´s procurement of contracts for painting roads, Lunander and Nilsson (2003) show that combinatorial bidding, allowing for different bids depending on if a firm wins one, two or three contracts, outperforms the standard procurement format. In this case, the bidders' cost functions are non-linear, with synergies for the large bidders in winning contracts in adjacent regions, and dis-economies for the small bidders in winning more than one bid.

Moreover, in another experimental study, Lunander and Nilsson (2004) find that combinatorial auctions is also a remedy to collusion, by simply making it substantially more difficult to organize a bidders´ring than in an acution where package bids are not allowed.

[14] Some work has been done recently though, for instance in connection to the German 3G auction which allowed an endogenous market structure.

This solution to universal service auctions was, it seems, first proposed by Kelly and Steinberg (1997). However, the consensus in the economic literature seems to be that combinatorial auctions have several desirable properties but are too difficult to be used. Laffont and Tirole (2000) state that "such auctions quickly become extremely comples to organize. There is actually in the current state of our knowledge a discrepancy between the comceptual simplicity of combinatorial auctions and the complexity of their implementation." (pp. 261-2). Likewise, Milgrom (2004, p. 298) states that "With many bids for overlapping packages, just determining the identity of the winning bidder - the winner determination problem - is a hard computational problem that has become a hot topic in computer science."[15]

However, it seems that this is the issue on whether the bumble bee can fly or not. Combinatorial auctions have been successfylly used in recent years, not the least in Sweden, in large numbers and in complex procurement settings, with numerous bidders and units (Karlsson and Lunander 2003, Lunander and Nilsson 2003, 2004, Andersson et al. 2004). The algorithm used in Swedish applications and elsewhere has without any problem so far been able to select winners in a large number of real procurements performed by public agencies and private firms.

As already observed, a package auction is able to take into account complementarity and substitution effects between different units (areas to be served). In a universal service auction, however, the objects procured would normally just be non-commercially viable areas; i.e., the areas for which is a subsidy is needed. As noted above, consumer heterogenity is likely to be present not just between different geographical areas, however defined, but also within these areas. Therefore, the ultimate outcome will depend on how the universal service areas are defined (Laffont and Tirole 2000, pp. 238-243). Moreover, in a context where not all firms on the market serve all commerically viable areas, the outcome is likely to depend on which areas that are included in the auction, and which are not.

A case where such problems are prevalent is procurement of public transport by bus or train. The Swedish experiences from procurement of non-commerical passenger train-services illustrates The Swedish passenger train market was until recently delineated in two segments, commercial and non-commercial lines. The commercial lines were granted as a free monopoly franchises to the incumbent state owned train operator, SJ. Lines that were expected to be operated at a deficit, were let oput for competitive tenders. It turned out, however, that some of the non-commercial lines could be operated with a surplus by the contenders to SJ. In at least one case the contract was won by a zero bid. Similar problems are likely to occur in procurement of for instance city bus-traffic, where costs and revenues may vary significantly between lines and departures.

In such cases, it may be very difficult to a regulator to determine in advance, before an auction, which areas are to be subsidized, and the extent of services to be procured in each

[15] These views have recently been echoed by two consultance firms in a report to Post- och telestyrelsen (2004): "Although combinatorial acutions should produce the most efficient outcome, an SMRA [*i.e., a FFC-type auction, my comment*] may still be preferred on grounds of cost and reduced complexity. In situations where there are multiple regional licenses and potentially many bidders, who may be seeking different combinations of licenses auction design is much easier if the levels and patterns of demand are well understood. Demand evaluation is a fundamental part of the auction design process." (p. 75)

unit. In such cases, it may be desirable to use a repeated auctioning process that allows the regulator to interact with the bidding firms.

Such an auction was suggested by Hultkrantz and Nilsson (1999). The auction would allow for positive and negative bids for licences to operate in all areas, i.e., not just in pre-defined areas that will be subsidized. A first round of bids would be submitted to participants in the experiment for (say, four) licenses. A bid would, however, have to be accompanied with a specification of geographical coverage, i.e. in which parts of the country the network would be built. After this round, some parts of the country could be left without any bids at all. The second and the following rounds would therefore invite offers also for these non-commercial contracts, awarding one frequency license to the bidder asking for the smallest subsidy in order to supply the services specified in the auction.

Such an auction would combine an "ordinary" auction for commercially desired licenses with a second stage universal service procurement auction. Another possibility, however, would be to merge both steps in a one-shot combinatorial auction allowing positive and negative bids.

In a first laboraty experimental testing of these ideas, Hultkrantz and Nilsson (in revision) allowed participants in economic experiments the possibility to submit both positive and negative bids in closed one-shot and open ascending auctions with and without combinatorial bidding, respectively. The participants bidded for licences to three separate areas with positive and negative payoffs and with synergies (i.e., depending on which and how many areas were contracted). The results show that the mix of positive and negative bids presents no major difficulties to the bidders. It was easy to come close to a fully efficient allocation, whatever format that was used.

8. Conclusions

Universal service remains an important regulatory issue in many network industries. While the cost of universal telephone and mail services have been exaggerated, the costs of universal services in for instance rail and air transport remain high, and even more so for extension of new networks for electronic communications to high-cost areas. In competitive environments the cost of universal services will have to be compensated. Whether such compensation should be funded by industry (or user) charges or by taxes needs further analysis. On the one hand, broad tax-bases are better than narrow tax-bases, on the other, cost control may be better in self-funded than tax-funded units.

An important side-effect of subsidy schemes is that the value of universal-service obligations will be openly scrutinized. It seems that it often is possible to estimate useful caps to these values (or reservation prices) from the opportunity cost of using alternative networks.

Ex-ante open subsidy schemes are based on cost information revealed by operators in a competitive procurement auction, unlike ex-post open voucher subsidies. Moreover, even with full information, the total subsidy in an ex-post open scheme is likely to be larger than in a single-firm universal-service auction.

However, single-firm provision of universal services has several disadvantages. One is the low incentives for provision of service quality to high-cost consumers. Others are caused by various kinds of complementarities in both demand and supply.

A serious problem with universal-service auctions, however, can be collusion. Collusion is more easy in open ascending auctions and when there is in-market competition. Possible remedies are combinatorial bidding and/or endogenous market-structure auctions.

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