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Intellectual Property Rights and the Future of Universal Service Obligations in Communications

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Abstract

Network industries are traditionally strongly influenced by sector-specific regulation; especially universal service obligations (USO) play an important role. In these sectors, USO impact market forces by shaping competition asymmetrically. They also interfere with other regulations such as intellectual property laws which are of increasing importance in these industries. This interaction has recently become of interest in the postal sector due to its recent convergence with telecommunications and the emergence of innovative services at the interface of the two sectors.

In free markets, the design of intellectual property right trades off investment incentives against market distortions due to (temporary) exclusive rights. USO distort competition and thereby affect the optimal solution of this trade-off. The paper discusses various aspects of the influence of patents on universal service provision. It also illustrates these effects by means of a simple model of an innovation race under asymmetric regulation and with forced licensing to derive regulatory and policy implications to safeguard a cost-effective and consumer-oriented provision of universal services.

1. Introduction

Communication is a basic human need. Up until the end of the twentieth century, the two essential options for long-distance communication were the telephone for oral conversation and the letter for written correspondence. Because two or more persons take part in each communication, the corresponding channels are considered platforms on which economic network effects appear: the larger the number of persons who are participating in a platform, the more valuable this becomes for all users. As a consequence, the individual decision to join a platform impacts not just individual communication opportunities, but also affects those of all other existing and potential platform users. This so-called externality was one of the main reasons why such communication platforms were procured by the state: in many countries in the form of integrated postal and telecommunications operators. Corresponding universal service obligations (USO) were designed to ensure that all population groups received access to communication services at affordable prices and subject to uniform conditions.

At the end of the twentieth century, the increasing differences between the technological developments of letter mail and telephony led to the separation of the postal and telecommunications branches in the historic operators. In many countries, both companies still are universal service providers. The postal operator is typically required to collect and deliver letters throughout the country on a daily basis. Universal telecommunications services initially essentially entailed a telephone connection for all households. A new communication age was rung in at the start of the new millennium by the spread of internet use. This enabled a wide variety of written communications to be performed via the traditional telephone channel. It formed a new electronic communications platform. As a consequence, in some countries also data communication has recently become part of USO.

As a result, two platforms for written communication exist in the form of the postal network and the internet. They meet different needs but are increasingly converging: technical processes are being created which make e-mails more secure and confidential – just like a sealed letter or even registered mail. The digitalization trend of the past decades has therefore resulted in a number of new technologies allowing letters to be replaced and substituted. Written communication now takes place in digital media while letters have seen their peak in most industrialized countries.

The increasing intermodal competition between electronic and physical services within the communications market creates the need to establish a consistent general regulatory framework which, in addition to the provision of universal services, also encompasses further aspects, such as intellectual property rights in order to protect consumers from the abuse of market dominance and to safeguard incentives to innovate (see Maegli et al., 2010, and Dietl and Jaag, 2011). This paper discusses on aspect of such a regulatory framework, namely the optimum protection of intellectual property in sectors which are essentially governed by USO.

2. The interaction of patents and universal services

The economic rationale for patents

In his seminal article Arrow (1962) provided the foundation for the economics of innovation. He showed that inventors' incentives to innovate will suffer if they cannot appropriate the returns to their inventions, i.e. if others can freely copy them. He argued that knowledge created by innovators has the characteristics of a public good. This implies that once an idea has been released to the public, it may be used by everyone without the inventor having control over it. This constitutes the appropriability problem and it will lead to an underinvestment in innovation if left uncorrected.

Correction is provided by patents which are a form of intellectual property. They consists of a set of exclusive rights granted by a state to an inventor for a limited period of time in exchange for the public disclosure of an invention. Hence, ex ante a patent system also has important benefits for society by correcting market incentives to innovate.

In a context in which inventors have superior information about technology, which is due to their efforts to understand a technology, the patent system offers a reward for such efforts. This reward consists in the monopoly power conferred by the patent and its protection against copying. With a patent system, the patent holder will be able to monopolize a product market. Due to the patent owner being able to charge a monopoly price, ex post the existence of the patent is inefficient. The social optimum would be achieved if the innovation covered by the patent were freely available. There is an extensive literature on the trade-off between the deadweight loss due to patents (and the resulting market power) and the incentive effect necessary for innovation (see e.g. Denicolo, 1996).

In contrast to e.g. a system of prizes, a patent system allows society to incentivize innovators without the need to understand the value of their innovations and without the need to understand in which areas of technology innovations may be most promising. Accordingly, the patent system may be a good incentive system whenever society observes neither the cost nor the benefits of innovative activity (see Gallini and Scotchmer, 2002).

The precise value of the monopoly power conveyed by the patent depends on many factors. The most important are the duration of the patent and its breadth. The longer a patent right lasts, the greater is the expected value of that right. The same is true of greater patent breadth. Broader patents allow a firm to exclude a larger range of substitute technologies from use by competitors. The optimal solution to the trade-off of innovation incentives and competition will depend not only on length and breadth of patents but also on the cost of imitating patents and on firms' incentives and ability to license patents to rivals. In particular, if firms can license technologies to one another efficiently, then patents should be narrow and long lived because this is likely to al-

low several firms to enter a given market with rival technologies and because longer lived patents are more likely to give rise to licensing which leads to lower prices (see Halbheer et al., 2012, on licensing as a policy instrument to complement patents).

In recent years, patents are increasingly used as strategic instruments targeted at delaying or foreclosing specific competing products or services. Companies are using patents to create a currency from their various patent filings by ascertaining how much their own patents are worth compared with those of their competitors. As a consequence, firms will seek to patent as many substitute technologies as possible, even if only one is finally implemented. The aim of building such "patent fences" is to raise a rival's cost of imitating a technological improvement. Each of the patents in the fence reduces the threat of competition and raises the value of the patent which is actually used (see Reitzig, 2004). In addition, own patents provide firms with bargaining chips that can be used in cross-licensing negotiations with other firms (see Siebert and von Graevenitz, 2005). They also insulate the patent holder against opportunistic patent infringement suits brought by smaller rivals. This behavior is most prominent in the high-tech sector, where many new businesses emerge and where the need to register patents is most important.

In the postal sector, intellectual property rights have traditionally played only a minor role due to the comparably low intensity of product innovation in the sector (innovation in sorting and processing technology has mostly evolved outside of the sector and it has then been purchased by postal operators). Consequently, the Universal Postal Union (UPU) has focused its intellectual rights policy on avoiding conflicts between existing intellectual property rights and UPU standards (see UPU, 2008). It is only recently that patent disputes have found their way into the postal sector. A topical example is the legal dispute between the US-based RPost and various providers of physical and electronic postal services. At stake are the processes used to ensure the secure transmission of electronic messages. While a key RPost patent has been declared null and void by the United States Patent and Trademark Office in an initial court ruling, in future there is an increasing risk of the regulatory environment failing to keep pace with technical advances and market developments (see Post&Parcel, 2012).

Patents force competitors to abandon a specific technology or buy a license. Therefore, the patent system also determines the relative bargaining power of firms with complementary technologies and in cross-licensing agreements. As a consequence, theoretical considerations and empirical evidence suggest that patents have asymmetric impacts across countries and industry sectors (see e.g. Acemoglu and Akcigit, 2006, Acemoglu and Linn, 2004, and Scotchmer, 2006). Such evidence sustains that innovation policies be adjusted to the specific characteristics of their context. In post and telecommunications, the context is predominantly shaped by USO.

Universal service obligations in post and telecommunications

USO in the postal sector usually comprise provisions on the minimum number of days of delivery, on the accessibility to access points, on the tariffs' affordability, uniform prices for universal service, and certain free services for blind and partially-sighted persons. E.g. in the European Union, the USO ensures one delivery of postal items to the home or premises of every natural or legal person in the Member States on at least five days a week, as prescribed in Article 3 of the Postal Directive. The USO ensures that all (urban and rural) households and businesses have access to certain baseline services at the same conditions. Services within the USO must be provided countrywide on a permanent basis at a specified minimum quality and at affordable prices. There are several reasons why governments and regulators may want to introduce or maintain universal services (see Cremer et al., 1998, 2008 and Jaag and Trinkner, 2011): Equity, economic development and efficiency in the case of market failure, such as network externalities. The standard argument for uniform pricing is that it reduces the transaction costs for customers. This now applies mostly to small customers, where the transaction costs resulting from non-uniform letter pricing would be significant.

Similarly to the postal sector, the rationale of telecommunications USO is to act as a social safety net where market forces alone do not deliver affordable access to basic services for consumers. In order to achieve availability, affordability and accessibility, one or more designated operators may be obliged to deliver universal services. EU Member States must ensure that all end-users have access at a fixed location to voice and data communications, including 'functional internet access'. The USO is neutral as to the technology by which the services can be provided. While the USO in 2002 limited 'functional internet access' to narrowband data rates, the Telecom Package in 2009 allows Member States to define the data rates at national level, which may include broadband speeds. Currently, only, Finland, Spain and Malta have adopted legislation to include broadband in national USO.

With respect to coverage with broadband services, it is not quite clear what the policy objective is: Is it the availability of broadband to subscribers – the percentage of households, for example, that have access to broadband – or the actual use, or percentage of households that subscribe to the service? With voice telephone service, this distinction was mute because service was both universally available and universally purchased. With broadband, though, the distinction is relevant. Even though broadband connections are not generally part of the USO in the EU, 70% of households now have internet access and 61% have a wired or wireless broadband connection. Broadband usage rates vary considerably between Member States, however. Broadband take-up ranges from 23% of households in Romania and 26% in Bulgaria to 80% in the Netherlands and Denmark and 83% in Sweden (see European Commission, 2011).

On the basis of the widespread use of broadband telecommunication and to save on the cost of physical mail delivery, several postal operators have started to offer (re-

verse) hybrid mail services, e.g. Swiss Post's Swiss Post Box, Itella's NetPosti or e-boks in Denmark. With these services, customers have the choice of either letting the letter be opened and scanned by the postal operator, forward-ship it to another location, deliver it to his desk, deposit the check, recycle or shred the letter, securely archive the paper original or securely archive the scanned pdf (see Jaag et al., 2011). The increasing convergence of postal and telecommunications services thereby creates new interfaces and processes. From the postal point of view, this is currently where innovation mostly comes from. New technologies may then be related to the USO in three respects:

First, they may be necessary to fulfill (current or future) USO. As an example, the Swiss postal act allows the government to define further means (in addition to physical delivery) by which postal items have to be delivered within the scope of the USO, e.g. electronic delivery of letter mail items. Hence, if the government prescribes the use of a patented technology, the universal service provider (USP) has a very weak bargaining position if it has to license this technology from another firm. The USP's own incentives to develop technologies appropriate to meet the USO specification are also strengthened since own patents allow it to bypass the expensive licensing of another firm's patents.

Second, there may be economies of scope in the new services' provision together with USO services, e.g. if they share common processes in production or through cross-selling. In the example of reverse hybrid mail, economies of scale are present in the scanning and archiving of physical mail items during sorting in joint facilities.

Third, there may be complementarities in the consumption of new services and traditional USO services. Again in the example of reverse hybrid mail, it is convenient for recipients to be able to jointly manage their physical and electronic mailstream on one single platform.

As a result, the existence of a USO and its relation to new technologies introduces a fundamental asymmetry between the USP and its competitors in two main respects: First, without USO, the postal market could be considered to be contestable due to the lacking need of sunk investment (see Knieps, 2002). Irreversible investment in patentable innovation can then serve as an important commitment device in competition. However, the postal market's contestability is greatly reduced due to the commitment of a designated USP (see Jaag, 2011). Second, since the USP's range of products is defined within the scope of the USO, its bargaining power in cross-licensing agreements is strongly reduced.

For the design of an optimal patent system, this implies that it has not only to trade off the lack of innovation incentives against (temporary) market power. In addition, the market may fail due to the "wrong firm" winning the innovation race resulting in a patent. The close link between universal services and innovative services at the border between physical and electronic communication poses the question of the

extent to which related innovations should be protected by patents, and whether any possible patent protection actually hinders or blocks the provision of universal services.

The next section explores the optimal structuring of patent protection for technology in connection with current or future universal service obligations (USO) and related services.

3. A model of innovation with universal services

There are two kinds of firms $i \in \{I, E\}$. The incumbent I is also the USP. In addition, there is a number of potential entrants who are symmetric and may freely enter the market. There is an innovation race at the beginning of which each active firm chooses research and development investment effort. The innovation is assumed to be patentable. While the incumbent provides a certain range of traditional services, entrants are only active in the market if they win the innovation race.

The timeline of decisions is as follows:

1) Government chooses degree of protection of patents
2) USP decides on innovation effort
3) Entrants / competitors decide on innovation efforts

Due to the inherent asymmetry between the incumbent and the entrants, we also assume an asymmetric patent regime. If the incumbent wins the innovation race, it will be able to appropriate the entire value of it. The private present value of an innovation is v at time t. However, if an entrant wins the innovation race, it will be forced to license its patented innovation such that it only appropriates a fraction $\alpha \in [0,1]$ of it. This regulatory asymmetry is motivated by the assumption of strong complementarities in the consumption of the innovative and services and those under the USO such that some consumers prefer purchasing innovative services from the USP.

The success date of innovation is random. The expected time until a successful innovation is developed depends on the firms' investment effort x_i and is distributed according to a Poisson process with hazard rate $\varphi(x_i)$. Hence, firm i's expected success date is $\left(\varphi(x_i)\right)^{-1}$. It is assumed that $\varphi(x_i) = x_i$ such that returns to scale from research and development are constant. The total innovation effort is

$$X = \sum_{1=1}^{n} x_E + x_I = X_E + x_I.$$

The model is solved by backward induction.

Entrants' profit maximization

An entrant's profit function is given by

$$\pi_E = \int_0^\infty e^{-rt} e^{-Xt} x_E \alpha v dt - c_E x_E = \frac{x_E}{X + r} \alpha v - c_E x_E,$$

where $e^{-Xt}x_E$ is the probability density that entrant E is the firm to win the innovation race. The first-order condition governing an entrant's profit maximizing innovation effort is

$$\frac{d\pi_E}{dx_E} = \frac{(X - x_E + r)\alpha v}{(X + r)^2} - c_E = 0.$$

The marginal benefit of increasing the innovation effort consists of an increased probability to win the innovation race (which is diluted by an increase in the total innovation effort). c_E is the constant marginal cost of innovation.

The entrants' zero-profit condition implies that:

$$X = \frac{\alpha v}{c_E} - r.$$

Hence, entrants choose to enter the market and the patent race if

$$x_I \leq X = \frac{\alpha v}{c_E} - r,$$

i.e. if the incumbent has not already exhausted the commercially feasible innovation potential. This would be the case if it invested so much that an entrant's probability of successful innovation is low enough not to warrant any effort at all.

Observation 1: If there are entrants engaged in the patent race, the total innovation effort is governed by the entrants' incentives to invest in innovation.

Incumbent's profit maximization

The incumbent's incremental profit function from investing in innovation is similar to the entrants' with the exception that its cost is quadratic in effort:

$$\begin{aligned}\pi_I &= \int_0^\infty e^{-rt}e^{-Xt}x_I v dt + \int_0^\infty e^{-rt}e^{-Xt}X_E(1-\alpha)v dt - \frac{c_I}{2}{x_I}^2 \\ &= \frac{x_I}{X+r}v + \frac{X_E}{X+r}(1-\alpha)v - \frac{c_I}{2}{x_I}^2.\end{aligned}$$

The incumbents profits if it is the winner of the innovation race itself, but also due to forced licensing in case that an entrant innovates (by participating with a fraction $1-\alpha$ in the entrant's innovation. The first-order condition for the incumbent's profit-maximizing innovation effort is

$$\frac{d\pi_I}{dx_I} = \frac{v}{X+r} - \frac{(1-\alpha)v}{X+r} - c_I x_I = 0.$$

The marginal benefit of increasing the innovation effort is the increased probability to win the innovation race. The marginal cost consists of the foregone participation in an entrant's innovation and the incumbent's own marginal cost of innovation. Using the entrants' zero-profit condition, this implies that the optimum effort is given by

$$x_I^* = \frac{c_E}{\alpha c_I} - \frac{c_E(1-\alpha)}{\alpha c_I}.$$

Observation 2: If there are entrants engaged in the patent race, the incumbent's incentives to innovate do not affect overall innovation.

Social welfare maximization

Incremental welfare, based on existing activities, is composed to the incumbent's profit plus the consumer surpluses for the two cases the incumbent or an entrant wins the innovation race ($s_I(v)$ and $s_E(v)$, respectively). The entrants' profits are zero. It is assumed that $s_I < s_E$ since due to the licensing, innovative services are offered competitively if an entrant wins, while the incumbent will offer innovative services in monopoly if it wins itself. Consumer surpluses depend directly on v which basically distributes the total rent associated with an innovation between consumers and producers: $s_I'(v), s_E'(v) < 0$.

$$\begin{aligned} W &= \pi_I + \int_0^\infty e^{-rt}e^{-Xt}x_I s_I dt + \int_0^\infty e^{-rt}e^{-Xt}X_E s_E dt = \pi_I + \frac{x_I}{X+r}s_I + \frac{X_E}{X+r}s_E \\ &= \frac{x_I}{X+r}v + \frac{X_E}{X+r}(1-\alpha)v - \frac{c_I}{2}{x_I}^2 + \frac{x_I}{X+r}s_I + \frac{X_E}{X+r}s_E \\ &= \frac{x_I}{X+r}(v+s_I) + \frac{X_E}{X+r}\big((1-\alpha)v + s_E\big) - \frac{c_I}{2}{x_I}^2. \end{aligned}$$

There are two policy instruments with respect to patent protection:

The first instrument is v, the private value of a patent granted. This is affected by the duration of the patent and its breadth (with a maximum $\bar{v}$ which is equal the private value of infinite and full monopoly power in the use of the patent). Marginally increasing v increases the entrants' incentive to invest in innovation and their effort X_E. Thereby, this increases also total innovation effort X. Anticipating the entrants' effort, the incumbent's innovation effort is not affected by a change in v. Hence, the marginal social cost of increasing the private value of a patent consists of two parts: First, consumer surpluses s_I and s_E are reduced due to the tolerance of higher market power. Second, the incumbent's probability of winning the innovation race is reduced which results in a loss of the associated private benefit and consumer surplus. The marginal benefit of increasing the private value of a patent consists in the effects of a higher probability that an entrant wins the innovation race and a greater overall innovation effort.

The second instrument is α, the fraction of the private value of a patent belonging to an entrant firm in case it wins the patent race. In addition to the entrant's effort to innovate, also the incumbent's effort (with the associated cost) depends on the distribution of a patent's private value among the firms. Specifically, an increase in α, which decreases the incumbent's participation in an entrant's innovation, strengthens the incumbent's incentive to innovation itself and therefore decreases the probability that society benefits from a competitive provision of innovative services. It also de-

creases the incumbent's profit. However, it increases the overall innovation effort in the economy.

4. Conclusion

Intermodal competition between electronic and physical services within the communications market is increasing. From a policy perspective, the key challenge is to counterbalance the conflicting objectives of cost-effective universal service provision, effective competition and reasonable protection of intellectual property.

This paper has highlighted the significance of patents in USO environments and in their development. It has argued that the existence of USO affects the optimal trade-off of innovation incentives and competition in patent policy. Specifically, it has shown that the pre-existing asymmetry of operators in sectors with USO may call for asymmetric patent policies, too, with a focus on enabling a dynamic and cost-effective provision of universal services. Granting the USP access to a competitor's USO-related patents shifts innovation incentives between firms and may thereby be an effective policy instrument (in addition to the definition of a patent's duration and breadth) to strengthen competition while at the same time maintaining innovation incentives.

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