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Flacher, David and Jennequin, Hugues and Lorenzi,
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Innovation, Investment and Regulation: What are the Options for Regulation in the Near Future? (*)

David FLACHER

Paris XIII University

Hugues JENNEQUIN

Orléans University and Paris XIII University

Jean-Hervé LORENZI

Paris IX-Dauphine University

Abstract: This paper addresses the question of what options are available to regulate the sector in the near future. In order to answer this question, the paper focuses on the problem of investment and innovation in an *ex ante* regulated sector. Relying on existing literature, we argue that *ex ante* regulation could represent a danger for the long-term development of the sector by delaying or cancelling investment projects, especially (but not only) concerning the construction of new infrastructures. We also argue that *ex ante* regulation is distorting investment itself: incremental investment is privileged as opposed to radical investment. In this context, we identify three possible options for regulation in the near future: 1) continuing *ex ante* regulation, 2) substituting *ex post* regulation for *ex ante* regulation and 3) implementing an industrial policy for macro-strategic reasons. After describing a few major mutations in the sector that must be taken into account by regulators and presenting the major dilemmas that the latter are facing, we propose two possible solutions inspired by foreign policy. The first solution consists of offering investors regulation holidays, with regular reviews to deem whether these holidays should be prolonged or not. The second solution consists of implementing an industrial policy that could take the form of a contract negotiated between the regulator and operators. This would guarantee the absence of *ex ante* regulation if the conditions of the contract (in terms of regional planning, price, quality of service, types of investment...) are met.

Key words: regulation, innovation, investment and industrial policy.

More than other industries, the telecommunications sector plays an important role in the economy and society as a whole: it is a source of economic development, regional planning and, in some

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respects, of social activity and cohesion (See for instance RÖLLER & WAVERMAN, 1996, 2001; MEZOUAGHI, 2005). This importance of the telecommunications sector is both due to network externalities and to the high rate of innovation characterizing the sector.

These characteristics justify the State's special interest in the sector and its regulation. This regulation usually consists of imposing specific obligations on operators (in terms of price, interconnection, access etc.), but can also consist of the absence of any intervention if this solution is considered more efficient. Asymmetrical *ex ante* intervention has been the main rule in many countries for the past decade or so in order to promote competition and guarantee universal service. The question this paper seeks to address is whether regulation policy needs to be changed to foster the long-term growth of innovation and investment, thus creating a dynamic perspective for the future.

In the first section, this paper briefly addresses the question of the origins and limits of telecommunications regulation. Beginning with a short summary of asymmetrical *ex ante* regulation tools and aims, we challenge the idea that using these tools in order to introduce effective competition can have negative effects on the future of the telecommunications sector. In the second section, we address the question of how regulation policy should look in the near future. To answer this question, we identify the three options open to regulators, highlighting the characteristics and tendencies that the latter must take into account. Finally, on the basis of these regulatory options and the changes characterizing the sector, we suggest two possible ways of regulating the sector in the near future.

■ Telecommunications regulation: origins and performances

Efficiency and regulation

Regulation tools aim to develop and/or stabilize an economic or social system. In other words, they aim to improve its efficiency in its various dimensions.

At the mesoeconomic or macroeconomic level, the first and most famous dimension of efficiency is Pareto-efficiency (or allocative efficiency). This indicates whether scarce resources are well allocated (can the situation of an agent be improved without negatively impacting that of another agent?). This concept has two major advantages: it is independent from the definition of any welfare function (and thus from subjective and political decision) and it is theoretically linked to perfect competition. Indeed, perfect competition is a sufficient condition for achieving allocative efficiency. Thus, developing the conditions of perfect competition could be a way of reaching allocative efficiency. Even if this reasoning can be criticized, as we will see later in the article, it is the main explanation for past and current policies in the telecommunications sector.

However, improving allocative efficiency is not the only goal that the regulator wants to achieve by developing effective competition. Indeed, even if market failures still characterize the sector, the choice of introducing competition is often considered as the appropriate tool for two reasons: firstly, monopoly is often not considered as very efficient due to the weak incentives it gives operators to reduce their costs. This so called Leibenstein (1966) "X-inefficiency theory" explains that competition is a way to reach productive (i.e. cost minimizing) efficiency. Secondly, competition is supposed (although this is not proven) to "produce" new types of markets and firms, which are more efficient than the existing ones. Competition should thus lead not only to static efficiency, but also to dynamic efficiency.

Finally, we must note that allocative and productive efficiencies (in their static or dynamic dimensions) are not the only aims of the regulator. Indeed, allocative efficiency has little to say about economic and social topics such as social cohesion, redistribution, regional planning etc. These aspects mainly concern distributive efficiency, which refers to the economy's ability to achieve a distribution of the scarce resources that maximize a given (and subjective) social welfare function. Nevertheless, distributive efficiency is compatible with allocative efficiency and with perfect competition since any chosen Pareto-equilibrium (corresponding to the chosen redistribution) can theoretically be achieved by competition. This idea is the foundation of the concept of universal service, implemented by *ex ante* regulation, but defined by policy makers. This article does not deal very much with this aspect and concentrates on the development of effective competition in order to achieve allocative and productive efficiencies.

In order to develop competition, two types of regulation are considered here: *ex ante* and *ex post* regulation. "*Ex post* regulation" is the application

of common competition law. It aims at preventing (*ex ante*) and prosecuting (*ex post*) operator abuses of a dominant position. By limiting the market power of firms, it is supposed to contribute to allocative efficiency gains, but does not necessarily contribute to the development of effective competition. Moreover, when a sector such as telecommunications is liberalized, economies of scale and scope, but also network externalities, naturally limit the development of competition. This explains why "*ex ante* regulation" (i.e. sectoral regulation) has been used to introduce effective competition in the services market and, where possible, in the infrastructure market ¹.

Indeed, the nature of the problem is different for the regulator depending on the layer of the sector under consideration. Let us describe the two main layers in a simplified way:

- The lowest layer is that of infrastructures (considered in the broadest sense). It is characterized by strong economies of scale (especially for the local loop), preventing easy, facility-based competition, which would ensure the absence of barriers in the services market. In this layer, infrastructures are mainly owned by the incumbent and a few operators. In Noam's typology, countries are characterized by "2.5 platforms" (two powerful wires - telecom and cable - plus a few smaller infrastructures) as in the USA, or by "1.5 platforms" (one powerful wire - telecom - plus the smaller options) as in many European countries.

- The highest layer is that of services offered to consumers. It is much less characterized by economies of scale, but still by economies of scope and network externalities. Effective competition is much easier and natural to develop if access to the incumbent's infrastructure is provided to competitors at a reasonable (generally cost-oriented) and "non-discriminatory" rate.

Given the structure of the sector, there are two types of tool available to achieve effective competition: market structure regulation with licensing, and price regulation of wholesale and retail markets.

In order to develop competition, licensing can prevent the dominant firm from accessing new emerging markets (for at least a period of time). However, price regulation is probably the most important way to force competition. Indeed, through asymmetrical obligations imposed on the incumbent (or on the operator with significant market power), the first step in

¹ Note that *ex ante* regulation also intervenes *ex post*, in particular when the ARN receives a complaint.

ex ante regulation is to provide cost-based and non discriminatory access to infrastructure in order to allow the incumbent's competitors to enter the services market. This step generally relies on the regulation of both wholesale and retail prices (in order to control possible anti-competitive practices). This asymmetrical intervention is supposed to be stronger for 1.5 platform countries than for their 2.5 counterparts. The second step is to favour progressively facility-based competition, in line with Cave's ladder of investment theory, for example ². In a final step, the *ex ante* regulator should disappear (except for managing and controlling the universal service) and should be replaced by the *ex post* regulator. *Ex ante* regulation is conceived as a transitory form of regulation before full and free competition takes hold.

Achieving all of these three stages remains quite difficult, particularly due to both information asymmetry (between the regulator and operators) and the method used to establish wholesale or retail rates. Depending on the regulator's choices, the market can be exposed to efficient or inefficient entry, and operators can be encouraged or discouraged to innovate and to invest. This can result in an increase or decrease in global welfare. As shown in the next section, these aspects raise the important problem of dynamic efficiency.

■ Paradoxical, but transitory intervention?

The research, innovation and investment problem

As we just pointed out, *ex ante* regulation consists of a paradoxical intervention in order to introduce competition into the market. While the paradox of intervening to reach a free competitive market is understandable, this principle can also be criticized for at least two reasons. Firstly, neoclassical theory has shown that fostering competition, market by market, can be counter-productive when looking at the general equilibrium resulting

² In this theory, the regulator first sets low access prices to the infrastructures, so that competitors enter the services market, develop their market shares and benefit from network externalities. When competitors have sufficiently developed their business, the access price can increase in order to incite competitors to build their own infrastructure (instead of renting that of the incumbent). Since the telecommunications sector is composed of many layers, the idea is to regulate each layer's access price in order to favour a progressive climbing of the ladder: Competitors invest sequentially in services and national points of access, then in regional points of access, then in local ones etc. However, as we will see, applying this theory could also discourage incumbents (and possibly other operators) from investing and innovating. The final results of such a policy are thus uncertain.

from this policy (LIPSEY & LANCASTER, 1956). Secondly, if the persistence of market failures justifies the persistence of regulation, new problems emerge when the transitory regulation becomes durable. These problems concern the compatibility between the regulation process and the development of research, innovation and investment.

Indeed, if competition introduced by *ex ante* regulation can be considered as responsible for the emergence of many new services (especially in the internet and mobile telephony fields) and for the decrease in prices, sectoral growth can also be attributed to the major changes that took place before liberalization, especially in Europe. These changes include the fact that the techniques and standards for mobile telephony were mainly developed before 1998, while the internet and its main associated tools were invented by the U.S. army and developed by the public sector. The internet was also opened up to commercial purposes by the Clinton administration before 1998. Following on from this latter assumption, competition only accelerated the adoption of innovation and price decreases in the short term. These two points of view regarding the role of competition in ICT growth cannot be considered as purely abstract since the regulatory choices have been heavily discussed in the United States, especially the trade-off between competition on the one hand and investment and innovation on the other hand (JORDE, SIDAK & TEECE, 2000; CRANDALL, 2005). Is the theory able to clarify the effects of competition and of regulation?

In order to answer this question, we propose to distinguish between two types of innovation: incremental and radical. Incremental innovation can be defined as innovation aiming at horizontal differentiation. It allows firms to provide similar products in terms of quality and functionality, which, however, appear different to the various types of consumers. This difference is not due to qualitative rupture, but to commercial and development investments. The incremental innovation can usually be considered as short-term oriented and mainly benefits the firm that introduced it. Conversely, radical innovation corresponds to a qualitative rupture. It induces vertical differentiation. In the telecommunications sector, radical innovation is often associated with investment in new infrastructures, but also concerns the development of radically new services. Radical innovation can mainly be considered as long-term oriented and usually benefits the whole sector in the end. These two types of innovations appear to be complementary. In this article, investment leading to incremental (/radical) innovation will be called incremental (/radical) investment. We assume that this distinction also stands for upstream R&D investment: the more fundamental the research is, the more

it can be considered as radical investment. What does the theory say about regulation and investment?

The main body of research into regulation and investment concerns investment in infrastructures. As JORDE, SIDAK & TEECE (2000) point out, *ex ante* regulation of network elements (through mandatory unbundling on a cost-oriented and non discriminatory basis) reduces investment by incumbents both in maintaining and improving networks, but also in adopting new techniques because regulation reduces the option value of investing. At the same time, regulation delays investment by competitors since they are able to take advantage of incumbents' investment without taking risks. This idea has been deepened with the theory of real options. PYNDICK (2003), for instance, points out the uncertainty and irreversibility of the heavy investments in the telecommunications sector. Mandatory unbundling can thus be considered as a transfer of benefits from the investor to its competitors without the corresponding transfer of risks (see also BAAKE *et al.*, 2005; ALLEMAN & RAPOPPORT, 2006).

However, in the theoretical debate concerning regulation, innovation and investment, no consensus can be established in the very limited literature. For instance, concerning the tools that are used, AVERCH & JOHNSON (1962) have shown that the rate of return regulation can lead to over-investment, while the work of GILBERT & NEWBERRY (1988) leads to the opposite conclusion. The debate also exists concerning price regulation, but seems to be dominated by the risk idea of under-investment in both incremental and radical innovation.

FOROS (2004) and KOTAKORPI (2006) have provided two game theory models in which they distinguish one integrated firm (active in both infrastructures and services layers) and a competitor (only active in the services layer). In their model, investment in the infrastructure (maintenance and improvements) can be considered as incremental. The models show that when the access rate is regulated, the integrated operator under-invests since regulation is equivalent to sharing benefits with competitors. This situation is thus socially suboptimal.

Concerning radical investment, the model by BOURREAU & DOGAN (2005) has shown that low unbundling rates can lead to under-investment in new infrastructures since competitors prefer to rent an infrastructure, rather than build a new and innovating one. In our model (FLACHER & JENNEQUIN, 2006a) we have also pointed out that taking into account the short and long-term effects of a radical investment on consumer welfare also

leads to under-investment if the regulator is not able to forecast and integrate these long-term effects in its decisions, which is reasonably the case. Other models, such as that of GRIMM & ZOETTL (2006) reach similar conclusions concerning the risk generated by price regulation for investment and thus innovation.

It is worth underlining at this point that these theoretical warnings concerning the efficiency of *ex ante* regulation, even if not shared by all models, are largely corroborated by the few existing empirical analyses (FLACHER & JENNEQUIN, 2006b) and raw data. After almost a decade (and sometimes more) of telecommunications liberalization, the results of regulation appear to be ambiguous: The increased competition does not guarantee an improvement in productivity (BOYLAUD & NICOLETTI, 2000; LI & XU, 2002), nor an increase in the quality of services (URI, 2003); and while prices are decreasing³, profitability also drops (BORTOLOTTI *et al.*, 2002), reducing operators' revenues and subsequently the possibility of investment. Between 2001 and 2004, for instance, investment by French operators dropped by over 48% according to ARCEP data, which cannot merely be explained by the bursting of the speculative bubble, cyclical investments or by technical advances. The share of invested revenues also fell dramatically: from 21.2% in 1995 to 11.3% in France according to ITU's data. This situation is similar in all countries (13.5% in 1995 and 6% in 2003 in the USA, 26% in 1995 and 13% in the United Kingdom⁴).

If incentives to innovate and to invest in the infrastructure are reduced instead of stimulated by liberalization and the *ex ante* regulation process, the problem also seems to be very important in the R&D field. According to IDATE data, the percentage of the revenues dedicated to R&D by the incumbents has fallen (from 3.7% in 1995 to 1.3% in 2004 for France Télécom, from 2.4% to 1.4% for British Telecom etc.) and has not necessarily been compensated for by R&D growth in the equipment industry. Moreover, according to POUILLOT & PUISSOCHET (2002) or to CALDERINI & GARRONE (2001, 2002), competition and regulation could have structurally modified R&D activities, favouring short-term and very application-oriented projects, rather than facing long-term and fundamental

³ Price globally decreases, but with a large degree of heterogeneity: local rates did not change much, while long distance rates fell dramatically. At the same time, rental rates have increased in many cases. For Europe, see, for instance, the 8th to 11th European reports on electronic communications, regulation and markets.

⁴ Only Korea remains at a quite high level of investment when compared to revenues generated: 41.1% in 1995 and 32.5% in 2003

research. This substitution between incremental and radical investments in R&D can have immediate positive effects, offering a large range of products and lower prices, but it could also have negative effects on the dynamics of telecommunications development.

■ How should the telecommunications sector be regulated in the future?

Three possible scenarios for the regulation of the sector

The first option for regulation in the near future consists of retaining the same regulation policy, but adapting it to the past and current changes that have occurred in the sector. The justification of this option is the persistence of market failures. They concern both wholesale markets (still characterized by economies of scale) and retail markets (still dominated by network externalities). In this context, *ex ante* regulation in favour of effective competition would stimulate technical progress and thus lower fixed costs and allow competition to develop. Obligations concerning interconnection and the provision of non discriminatory and cost-based wholesale rates (together with the monitoring of retail prices) would also contribute to the development of a large range of products and to price decreases that are advantageous for consumers. Although in the short term it seems possible to claim that, by promoting competition, *ex ante* regulation contributed to these positive effects, we have shown that the positive effects in the long-term are not guaranteed. Regulation also limits incentives for more fundamental research, for radical innovation and investment, however necessary to the development of the sector.

The second option is thus to replace *ex ante* with *ex post* regulation, relying only on competition law. Indeed, maintaining *ex ante* regulation (which was supposed to be a transitory model of regulation) would partly mean a regulation failure. For the moment, this option is not really on the agenda, even although a few countries, like France, are announcing that they will reduce their intervention in retail markets and although the debate over the mandatory unbundling of FTTH local loops is (or has been) very active, as in the United States. However, as we will see later, an intermediate option between *ex ante* and *ex post* regulation is now being seriously studied by a few regulators.

The third option consists of taking into account the macro-strategic dimensions of developing the telecommunications sector at a national and international level on the one hand and, the importance of institutions in the country's technological path on the other. Choosing this option means following a vertical industrial policy that is a "sectoral policy aimed at promoting sectors of key importance to the nation due to the independence question, technological autonomy, regional or political equilibrium". (COHEN & LORENZI, 2000, p. 14). This policy can draw on direct assistance from the State. It may also rely on social, cultural and technological policies. In some cases the policy can also consist of planning important projects. For many economists, the problem of such policies is that they are generally not compatible with competition policies.

As CORIAT (2000) points out, we must distinguish, particularly in European policies, between two types of restrictions on industrial policies, due to the pre-eminence given to competition policies. One is understandable: since national and independent policies inside Europe could go against the common interest, limiting unilateral decisions is acceptable. However, limiting concerted industrial policies at the European level is more debatable. Indeed, this limitation can be explained by the idea, broadly accepted in the European Commission, that promoting competition is the best way to fight market failures and to best allocate resources. However, various authors, like Dixit, Stiglitz and Krugman, have shown that imperfect competition can justify an industrial policy for at least two reasons (See, for instance, KRUGMAN & HELPMAN, 1985):

- Economies of scale can justify State help for a given sector since this could help to develop competition at an international level and subsequently reduce the revenues of monopolies or oligopolies. Thus, an industrial policy can reduce market failures and improve global welfare.

- Comparative advantages are not only due to differences in technical or factor allocations. They largely result from a country's history, as well as its strategic and technical choices. The State should thus play an active role in order to define its priorities for long-term development in partnership with economic and social agents. Many countries have expressed the wish to develop ICTs: this is the case in the "Lisbon agenda" for European nations, in North America, in many Asian countries (like Korea, Japan, etc.). But all of these countries do not apply the same policy: the Korean government, for instance, intervenes much more than European countries to promote investment.

These ideas are also developed by the "new geographical economics" (KRUGMAN, 1991; FUJITA *et al.*, 1999) considering that industrial policies can be justified in order to benefit from proximities and agglomeration effects ("cluster theory") at a national or regional level. Beyond these macro-strategic justifications to industrial policies, social and institutional dimensions can appear is important because of their role in defining the national system of innovation and in orienting a country's technological path. Industrial policies can be considered as necessary to enable a country to seize opportunities (DAVID, 1975; DOSI, 1988; FREEMAN, 1995; LORENZI & BOURLÈS, 1995). Finally, industrial policies can be a means of fighting possible destructive or ruinous competition. For the OECD (1993), destructive competition refers to: "situations when competition results in prices that do not chronically or for extended periods of time cover costs of production, particularly fixed costs".

Among the three identified regulatory options, countries' choices depend on the sector, its history and institutions; these choices heavily influence a nation's competitive position in the ICT sector. That is why Europe should consider the other possible policies in order both to catch the new opportunities offered by the sector and to take into account the growing risks.

Regulation and mutations in the telecommunications sector

Continuing current policy without taking into account the major changes that have occurred in the sector over the past decade would pose a major threat to its long-term development. Three aspects can be underlined concerning those changes.

Firstly, the rate of technical progress and innovation has accelerated substantially. The most emblematic example of this acceleration is the increase in the transfer rate in the telecommunications network: this rate increased almost fifty-fold in only ten years on the copper local loop (64 kbps in 1997 on the PSTN network and 20 Mbps today on ADSL networks). The transfer rate has also increased dramatically on wireless networks (9.6 kbps in 1996 on GSM and over 10 Mbps is planned for UMTS).

Secondly, the sector is characterized by a complex phenomenon of convergence: A convergence of techniques allows the usage of the same protocol (IP) for almost all applications and networks; and thus the creation of new services and the convergence of a large range of activities. The

telecommunications, hardware, software and information sectors have become closer to each other and favour the convergence of usages: consumers always benefit more from offers integrating the various services (fixed and mobile telephony, internet, music, television, etc.). This convergence also favours the emergence of new types of players, like the virtual operator Skype.

Thirdly, it seems reasonable to forecast that needs for broadband will continue to grow in the years to come and that the development of very high-speed broadband networks should contribute to sector growth, and improvements to consumer welfare and the economy as a whole. However, building this new network represents an important risk both for investors and for regulators, who generally fear the possible re-monopolization of the telecommunications sector.

Beyond this risk of re-monopolization, the major changes previously described in a regulated framework are affecting investment behaviour, as well as distorting the incentives of the various types of operator and the various markets.

In fact, these major changes can create the risk of investing in the wrong technology at the very least. Indeed the acceleration in the innovation rate makes the choice of a technique particularly difficult: is the costly fiber local loop a good option when far less costly wireless solutions are (such as WiMax) are developing fast? Is paying very high prices for UMTS licenses a good idea when future demand is uncertain? The instability of demand certainly poses a major risk. Lastly, part of the risk is related to the convergence phenomenon since new players in the telecommunications market sometimes create value by destroying previous existing businesses and the related ability of incumbents to invest and take risk.

This Schumpeterian creative destruction could be more destructive than creative if the value creation resulting from free rider behaviour by firms such as Skype or Google, for instance, does not pay for the use of the network, but contributes to the overall value of network usage. However, while Skype is a substitute for existing traditional services, Google looks like a complement. How should existing and emerging markets consequently be regulated in the near future?

Regulation of existing and emerging markets: typology and proposal

If we consider the relation between regulation and the telecommunications sector dynamics, it appears that we must distinguish between the case of services and infrastructures. Let us follow de STREEL (2004)'s typology in order to develop our reasoning (table 1).

Table 1 - Typology of telecommunications markets

	Existing service	New service / market
Existing infrastructure	A	B
New infrastructure	C	D

Source: de STREEL, 2004

In case A, *ex post* regulation should apply, except if entry barriers are too high. In this case, *ex ante* regulation may apply but it must take into account the previously mentioned mutations in the sector. The redefinitions of the boundaries of relevant markets must consider the risks taken by investors in a context of rapid technical change, the social need for new radical investments (such as FTTH) and the convergence phenomenon. These aspects must lie at the heart of a new regulation policy in order to integrate the incentives to innovate and invest in a dynamic perspective. This question is particularly fundamental since it conditions whether the traditional telecommunications operators will be able to maintain, develop and innovate on the network layer, essential for the ICT sectors and for the whole economy. How can these aspects be taken into account in the regulation policy? The definition of markets needs to evolve more quickly in order to integrate evolutions in the sector. Among the 18 markets defined by the European Commission, three markets concern broadband and nine concern fixed telephony. The definition and analysis of relevant markets must take into account the convergence phenomenon: fixed telephony markets, for instance, must integrate Voice on IP through ISP and through virtual operators like Skype. The other techniques of access, such as cable, must also be integrated. Finally, the markets should not be too numerous in order to limit intervention by the regulator

In the cases of emerging services (B and D), it can be useful to distinguish if they are complements or substitutes to existing services. In the case of complements, the externalities creating wealth and the entry barriers for those services must be completely removed. Regulation should encourage their development whatever the innovator is (the incumbent or competitors). The first mover advantage must be retained otherwise it

reduces the incentives to innovate. In the case of substitutes (and even if the service is not an emerging one), the problem of financing the infrastructures appears to be a real problem, especially in a dynamic perspective of maintaining, improving and replacing the network with new innovative techniques (which will be a necessary condition for the development of many new services). In this case, must we allow operators and service providers to use price or quality discrimination, offering better conditions for their own services? Must we allow them to charge Google or Skype fees? This is the question of Net neutrality. Must we add regulatory constraints while operators already face these incentive problems? Conversely, should the State help operators by inciting them to invest, as in Korea? For the moment, European regulation, far from implementing an industrial policy, fosters competition on the retail markets thanks to asymmetrical regulation on the wholesale markets (mainly on the markets concerning infrastructure accesses). However, this question could be crucial for the emergence of services that need new infrastructures (case D). The regulator thus faces the dilemma between short and long term aims: Asking for cost-oriented and non-discriminatory prices stimulates the quick development of services once infrastructures built but discourages the operators to invest into new infrastructures (which are however necessary for the long term development of the sector).

In the case of the deployment of new infrastructures (cases C and D), we have shown that incentives to invest are reduced and the risk of under-investment is important when regulation obliges dominant operators to provide cost-oriented and non-discriminatory access rates. But the absence of regulation induces the risk (more important in 1.5 platform countries) of re-monopolization of strategic activities. Moreover, a conflict exists (case C) between the principle of technological neutrality, which imposes the same regulation of the same service (independent of the infrastructure) and the principle of not regulating emerging markets.

In order to avoid such dilemmas, it appears that other types of regulation policies could be implemented. Two solutions, partly compatible, seem worth exploring. One is inspired from intellectual property theory, and the other is the third option previously mentioned (i.e. implementing an industrial policy).

The first solution has been proposed by BAAKE *et al* (2005). It consists of the temporary absence of regulation ("regulation holidays") in order to give operators enough time to get returns on their investment. The probability of reaching dynamic efficiency could result from the combination between of such regulation holidays and possible *ex ante* regulation after the

holiday period, if specific conditions regarding effective competition are not fulfilled. According to GANS & KING (2004), such a period should depend, case by case, on the nature of the investment and the associated risk. According to BAAKE *et al.* (2005), steps should be defined: every two or four years, the competition conditions could be analyzed and the necessity of regulating the infrastructure or prolonging the holiday period could be envisaged. Such regulation would thus both incite investors to provide their network to competitors on a commercial basis and increase their incentives to invest by taking into account the risk and the irreversibility of investments.

The other solution, which may be compatible with the solution explored above, is to implement an industrial policy. This solution would consist of actively favouring the development of new infrastructures and services. The policy would be investment-oriented (eventually with State's help), rather than competition-oriented in order to achieve the development of the sector in the long-term perspective. This policy could be understood as a contract between the regulator and the dominant operator: asymmetrical *ex ante* regulation would be suspended provided that negotiated goals (in terms of regional planning, price, quality of services, type of investments etc.) were met.

These goals would take into account the various dimensions of efficiency and the various constraints previously identified for the development of emerging markets and the necessary development of both incremental and radical investment in the research, service and infrastructure fields. Such a solution could thus benefit from the competition between the operators of the oligopoly (which did not exist before liberalization) and from providing the necessary conditions for planning long term investments (this planning resulting from the discussion between the regulator and the operators). Moreover, it would not exclude more intensive competition in the market where this appears natural.

These two solutions provide interesting perspective for theoretical research and empirical studies since they have been partly chosen in a few countries: For instance, the United States decided not to unbundle the FTTH local loop in 2003, as did Canada and Korea, following the principles of the first solution. These decisions involved important investments in building new networks. Korea is also a very interesting example because it applies an industrial policy with undeniable success: Thanks to the State's direct and indirect support of infrastructure deployment, but also of the development of new services and applications (KII project, IT 839 Strategy, etc.), and thanks to the development of institutions dedicated to technological surveys (KISD)

and to R&D (ETRI), Korea has become a leading country in the ICT field. While the European framework for telecommunications is being reviewed, such solutions should seriously be studied by the European Commission if Europe is to remain a competitive player in this strategic sector.

■ Conclusion

Should telecommunications regulation change in the future? This paper argues that the asymmetrical *ex ante* regulation model used in Europe should be replaced. It should be replaced not only since it is theoretically a transitory model, but mainly because continuing with the same regulation could represent a threat to the long-term development of the sector. Indeed, *ex ante* may delay or cancel investment projects, especially (but not only) in the construction of new infrastructures. In fact, *ex ante* regulation is decreasing the option value of investing: it decreases the expected benefits from investment and increases the option value of waiting for competitors. Moreover, the *ex ante* regulation of infrastructures is not only driving the sector towards under-investment, but is also distorting investment itself. Radical investment in R&D and in infrastructure seems to be more sensitive to this type of regulation than incremental investment.

In this context, we identify three possible options for regulation: 1) continuing *ex ante* regulation as in the past in Europe, 2) substituting *ex post* regulation for *ex ante* regulation, and 3) implementing an industrial policy for macro-strategic and institutional reasons. This paper also highlights the necessity of taking into account several major mutations in the sector including the accelerated rate of technological progress and innovation, the phenomenon of convergence, the necessary development of new infrastructures and the associated risks for investors. Considering these elements and the dilemmas the regulator is facing between regulating (and thus fostering competition, but reducing the incentives to invest, especially in infrastructure) and not regulating (and thus increasing the incentives to invest in infrastructure with the risk of allowing new dominant positions), we propose two possible solutions inspired by foreign policies. The first solution consists of offering regulation holidays to investors, with regular reviews in order to decide whether to prolong holidays or not. The second consists of negotiating a contract between the regulator and operators guaranteeing the absence of *ex ante* regulation if the conditions of the contract (in terms of regional planning, price, quality of service, type of investments etc.) are met.

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