

Innovation, investment and regulation: What are the options for the regulation in the coming period?

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Summary

We address the question of the available options for regulating the sector in the coming period. In order to answer this question, we focus 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 canceling projects of investment, especially (but not only) concerning the construction of new infrastructures. We also argue that *ex ante* regulation is also distorting the investment itself: Incremental investment is privileged compared to radical investment. In this context, we identify three possible options for regulation in the coming period: Continuing *ex ante* regulation; substituting *ex post* regulation to *ex ante* regulation; and finally implementing an industrial policy for macro-strategic reasons. After having described a few major mutations of the sector that must be taken into account by the regulator and after having presented the major dilemmas the regulator is facing, we propose two possible solutions inspired from foreign policies. The First one consists in offering regulation holidays to investors, with regular reviews in order to prolong or not those holidays. The second one consists in implementing an industrial policy which could take the form of a contract negotiated between the regulator and the operators. It 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.

Introduction

More than other sectors, the telecommunications one plays an important role in the whole economy and society: it is a source of economic development, of regional planning and, in a certain way, of social activity and cohesion⁴. This importance of telecommunications sector is both due to the network externalities and to the high rate of innovation characterizing the sector.

These aspects legitimate a specific attention from the State for the sector and its regulation. This regulation usually consists in imposing specific obligations to the operators (in terms of price, interconnection, access...) but it can also consist in the absence of any intervention if this solution is

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⁴ See for instance Röller & Waverman (1996, 2001) and Mezouaghi (2005).

considered as more efficient. In many countries since about ten years or more, asymmetrical *ex ante* intervention has been the main rule in order to develop competition and to guarantee the universal service. The question we want to address in this article is whether we have to change regulation policy if we want innovation and investment to keep developing in a long term (and thus dynamic) perspective.

In the first section, we briefly address the question of the origins and limits of telecommunications regulation. Starting from 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 for the future of the telecommunications sector. In the second section, we address the question of what should be the regulation policy in the coming period. In order to answer this question, we identify the three available options for regulation. We point out the characteristics and tendencies that the regulator must take into account. Finally, relying on this regulation options and on the changes characterizing the sector, we suggest two possible ways to regulate the sector in the coming period.

Telecommunications regulation: Origins and performances

Efficiency and regulation

Regulation tools aim at developing and/or stabilizing an economic or social system. In other words, they aim at improving the efficiency in its various dimensions.

At the mesoeconomic or macroeconomic level, the first and the most famous dimension of efficiency is Pareto-efficiency (or allocative efficiency): it indicates if scarce resources are well allocated (can the situation of an agent be improved without deteriorating the one 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 in order to reach allocative efficiency. Thus, developing the conditions of perfect competition could be a way to reach allocative efficiency. Even if this reasoning can be criticized, as we will see further in the article, it is the main explanation of past and current policies in the telecommunications sector.

However, improving allocative efficiency is not the only goal that the regulator wants to reach by developing an 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: first, monopoly is often not considered as very efficient due to the weak incentives it would have 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. Second, competition is supposed (although this is not proven) to “produce”

new types of markets and firms, which are more efficient than the current ones. Competition would 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... These aspects mainly concern distributive efficiency, which means the ability for the economy to reach a distribution of the scarce resources that maximizes 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 reached 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 reach allocative and productive efficiencies.

In order to develop competition, two types of regulation have been considered: *ex ante* and *ex post* ones. “*Ex post* regulation” is the application of the common competition law. It aims at preventing (*ex ante*) and prosecuting (*ex post*) abuses of dominant position. By limiting the market power of firms, it is supposed to contribute to allocative efficiency gains but does not necessarily contribute to develop effective competition. Moreover, when a sector such as telecommunications is liberalized, economies of scale and scope, but also network externalities, are naturally limiting the development of competition. This explains why an “*ex ante* regulation” (i.e. sectoral regulation) has been used to introduce effective competition on the market of services and, when it was possible, on the market of infrastructures⁵.

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

- The lowest layer is the one of infrastructures (considered in a broad sense). It is characterized by strong economies of scale (especially for the local loop), preventing an easy facility-based competition which would ensure the absence of barriers on the market of services. In this layer, infrastructures are mainly owned by the incumbent and by very few operators. In Noam’s typology, countries are characterized by “2.5 platforms” (two powerful wires - telecom and cable - plus a few smaller infrastructures) like in the USA or by “1.5 platforms” (one powerful wire - telecom - plus the smaller options) like in many European countries.
- The highest layer is the one of services offered to consumers. It is much less characterized by economies of scale but still by economies of scope and by network externalities. Effective competition is much easier and natural to develop if an access to the incumbent’s infrastructure is provided to competitors at a reasonable (generally cost-oriented) and “non-discriminatory” rate.

Given this structure of the sector, the available tools in order to reach effective competition are of two types: the market structure regulation, with licensing, and the 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). But price regulation is probably the most important way to force competition. Indeed, through asymmetrical obligations imposed to the incumbent (or to the operator with a significant market power), the first step of *ex ante* regulation is to provide a cost based and non discriminatory access to the infrastructure in order to allow incumbent's competitors to enter the market of services. 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 rather than for 2.5 ones. The second step is to favor progressively facility-based competition, following for instance Cave's ladder of investment theory⁶. In a final step, the *ex ante* regulator should disappear (except for managing and controlling the universal service) and should be replaced by the only *ex post* regulator: *Ex ante* regulation is planned to be a transitory regulation before full and free competition.

Reaching all those three stages remains quite difficult, in particular because of both the information asymmetry (between the regulator and the 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 the operators can be encouraged or discouraged to innovate and to invest. This can result in an increasing or decreasing of global welfare. As shown in the next section, these aspects raise an important problem of dynamic efficiency.

A paradoxical but transitory intervention? The research, innovation and investment problem

As we just pointed out, *ex ante* regulation consists in a paradoxical intervention in order to introduce competition on 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. First, the neoclassical theory has shown that fostering competition, market by market, could be counter-productive when looking at the general equilibrium resulting from this policy (Lipsey & Lancaster, 1956). Second, if the persistence of

⁵ Note that *ex ante* regulation also intervenes *ex post*, in particular when the ARN receives a complaint.

⁶ In this theory, the regulator first sets low access prices to the infrastructures so that competitors enter the market of services, develop their market shares and benefit from network externalities. When the competitors have enough developed their business, the access price can increase in order to incite the competitors to build their own infrastructure (instead of renting the incumbent's one). Since the telecommunications sector is composed of many layers, the idea is to regulate each layer's access price in order to favor a progressive climb of the ladder: the competitors invest sequentially in the services and in national points of access, then in regional points of access, then in local ones... However, as we will see, applying this theory could also

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, another assumption could attribute the sectoral growth to the main changes that happened before liberalization, especially in Europe: the techniques and standards for mobile telephony have mainly been developed before 1998; the Internet and the main associated tools have been invented by the American army and developed by the public sector. Internet has been opened to commercial purposes by the Clinton administration also before 1998. Following this assumption, competition would only have accelerated the adoption of innovation and the price decrease in the short term. These two points of view about the role of competition in ICT growth cannot be considered as purely abstract since in the United States the regulatory choices have been heavily discussed, especially arguing the trade-off between competition on the one hand and investment and innovation on the other hand⁷. Is the theory able to clarify the effects of competition and of regulation?

In order to answer this question, we propose to distinguish two types of innovation: incremental and radical ones. The 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 as different ones for 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 to the firm which introduced it. Conversely, the radical innovation corresponds to a qualitative rupture. It induces vertical differentiation. In the telecommunications sector, it is often associated to the investment in new infrastructures but it also concerns the development of radically new services. The radical innovation can be mainly considered as long term oriented one and usually benefit, at the end, to the whole sector. These two types of innovations appear to be complementary ones. In this article, investment leading to incremental (/radical) innovation will be called incremental (/radical) investment. We assume that this distinction also stands for the 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 research on regulation and investment concerns the investments into 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 incumbents' investment both in maintaining and improving the networks but also in adopting new techniques because regulation reduces the option value

discourage the incumbents (and possibly the other operators) to invest and innovate. The final results of such a policy are thus uncertain.

⁷ See Jorde, Sidak & Teece (2000) or Crandall (2005).

of investing. At the same time, regulation delays competitor's investment 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 risks⁸.

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 overinvestment while the work of Gilbert & Newberry (1988) lead 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 on both infrastructures and services layers) and a competitor (only active on the services layer). In their model, the investment into the infrastructure (maintenance and improvements) can be considered as an incremental one. The models show that when the access rate is regulated, the integrated operator under-invest since regulation is equivalent to share the 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 the infrastructure rather than building 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 consumers' 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 the one by Grimm & Zoetl (2006) have similar conclusions concerning the risk generated by price regulation on investment and thus innovation.

It is worth underlining at this point that these theoretical warnings concerning the efficiency of *ex ante* regulation, even if they are not shared by all the models, are largely corroborated by the few empirical analyses⁹ and raw data. After almost ten years (and sometimes more) of liberalization of the telecommunications sector, the results of regulation appear to be ambiguous: The increase of competition does not guarantee an improvement of the productivity (Boylaud & Nicoletti, 2000; Li & Xu, 2002) nor an increase in the quality of services (Uri, 2003) and while the prices are decreasing¹⁰, the profitability is also going down (Bortolotti et al., 2002), reducing the operators revenue and then the possibility of investment.

⁸ See also Baake et al. (2005) and Alleman & Rapoport (2006).

⁹ See Flacher & Jennequin (2006b).

¹⁰ Price globally decrease but with important heterogeneity : local rates did not change a lot while lon distance decreased a lot. In the same time, we have to not that rental rates have often increased. For Europe, see for instance the 8th to 11th European reports on electronic communications, regulation and markets.

For instance, between 2001 and 2004, the investment of French operators fell of more than 48% according to ARCEP data, which cannot be explained by the only burst of the speculative bubble, by cyclical investments or by technical progress. 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 the countries (13.5% in 1995 and 6% in 2003 in the USA, 26% in 1995 and 13% in the United Kingdom¹¹).

If incentives to innovate and to invest in the infrastructure are reduced instead of stimulated by the liberalization and the *ex ante* regulation process, the problem seems to be also very important in the R&D field. According to IDATE's data, the incumbents' share of R&D in the revenue has fallen (from 3.7% in 1995 to 1.3% in 2004 for France Télécom, from 2.4% to 1.4% for British Telecom...) and is not necessarily compensated by the growth of R&D in the industry of equipments. Moreover, according to Pouillot & Puyssochet (2002) or to Calderini & Garrone (2001, 2002), competition and regulation could have structurally modified the R&D activity, favoring short term and very application oriented projects rather than facing long term and fundamental 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 we regulate the telecommunications sector in the coming period?

The three possible options for regulation

The first option for regulation in the coming period consists in keeping the same regulation policy, adapting it to the past and current changes occurred in the sector. The justification of this option is the persistence of market failures. They concern both the wholesale markets (still characterized by economies of scale) and the retail markets (still dominated by network externalities). In this context, *ex ante* regulation in favor of an effective competition would stimulate technical progress and thus lower fixed costs and allow competition to develop. Obligations concerning interconnection and concerning 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 the decrease in price which are favorable to consumers.

Although in the short term, it seems possible to claim that, by favoring competition, *ex ante* regulation contributed to these positive effects, we have shown that the positive effects on 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.

¹¹ Only Korea remains at a quite high level of investment when compared to the revenue : 41.1% in 1995 and 32.5% in 2003.

The second option is thus to replace *ex ante* by *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 if a few countries, like France, are announcing that they will reduce their intervention on retail markets and even if the debate about mandatory unbundling of FTTH local loops is (or has been) very active, like in the United States. However, as we will see later in the article, an intermediate option between *ex ante* and *ex post* regulation is now seriously studied by a few regulators.

The third option finally consists in taking into account on the one hand the macro-strategic dimensions of developing the telecommunications sector at the national and international level and, on the other hand, the importance of institutions in the country's technological path. Choosing this option means following a vertical industrial policy which is a "sectoral policy aiming at promoting particularly important sectors for the nation because of independence question, technological autonomy, regional or political equilibrium"¹². This policy can use direct assistance from the State. It can also rely on social, cultural and technological policies. Sometimes, it can also consist in planning important projects. For many economists, the problem of such policies is that they do not suit always very well competition policies.

As Coriat (2000) points out, we must distinguish, particularly in European policies, two types of restrictions to industrial policies, due to the preeminence given to competition policies. One is understandable: since national and independent policies inside Europe could be 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, largely shared in the European Commission, that promoting competition is the best way to fight against market failures and to best allocate resources. However, various authors, like Dixit, Stiglitz or Krugman, have shown that imperfect competition can justify an industrial policy for at least two reasons¹³:

- Economies of scale can justify State's help for a given sector since this could contribute to develop competition at the international level and then 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 factors allocations. It largely results from the country's history and from 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 the economical and social agents. Many countries issued the wish to develop ICT: it is the case in the "Lisbon agenda" for European's nations, in North America, in many Asian countries (like Korea, Japan...). But all those countries do not apply the same policy, Korea's state, for instance, intervening much more than European countries to promote investment.

¹² Cohen & Lorenzi (2000), p.14.

These ideas are also developed by the *new geographical economics*¹⁴ 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, the social and institutional dimensions can appear is important because of its role in defining the national system of innovation, in orienting the country's technological path. Industrial policies can be considered as necessary ones in order that the country be able to catch opportunities¹⁵. Finally, industrial policies can be a mean to fight against possible *destructive or ruinous competition*: for 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 options of regulation, the countries' choices depend on the sector, on the history and on the institutions and largely influence countries competitive position in the ICT sector. It is why Europe should consider the other possible policies rather, at least because telecommunications sector is changing, offering new opportunities but also facing new or growing risks.

Regulation and the mutations of telecommunications sector

Continuing the current policy without taking into account the major changes occurred in the sector in the past ten years would represent an important risk for its long term development. Three aspects can be underlined concerning those changes.

First, the technical progress and the innovation rate have substantially accelerated. The most emblematic example of this acceleration is the increase of the transfer rate on telecommunications network: this rate was multiplied by almost 50 in only ten years on the copper local loop (64 kbps in 1997 on the PSTN network and 20 Mbps today on ADSL network). They also increased a lot on wireless networks (9.6 kbps in 1996 on GSM and more than 10 Mbps is planned for UMTS).

Second, 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 the applications and networks and thus the creation of new services and the convergence of a large range of activities. The sectors of telecommunications, hardware, software and information sector become closer to each other and favor the convergence of usages: the consumers benefit always more from offers integrating the various services (fixed and mobile telephony, Internet, music, television...). This convergence also favors the emergence of new types of actors, like the virtual operator Skype.

¹³ See, for instance, Krugman & Helpman (1985).

¹⁴ See Krugman (1991) or Fujita et al. (1999).

¹⁵ See David (1975), Dosi (1988), Freeman (1995), Lorenzi & Bourlès (1995).

Third, it seems reasonable to forecast that needs for broadband will continue to grow in the next years and that the development of very high broadband networks would contribute to the development of the sector, of consumers' welfare and of the whole economy. However, building this new network represents an important risk both for the investors and for the regulator which is generally afraid by the possible re-monopolization of the telecommunications sector.

Beyond the risk of re-monopolization of telecommunications sector, the major changes previously described in a regulated framework are affecting the investment behavior, distorting the incentives of the various types of operators and the various markets.

In fact, these major changes generate at least the risk of investing in the wrong technology. Indeed, the acceleration of innovation rate makes the choice of a technique particularly difficult: Is the costly fiber local loop a good option when much less costly wireless solutions are quickly developing (such as WiMax)? Is paying very high prices for UMTS licenses a good idea when the prospective about demand is uncertain? The risk concerning demand instability is an important one, indeed. Last but not least, a part of the risks are linked to the convergence phenomenon since the new actors on the telecommunications market create value sometimes destroying previous existing businesses and associated ability of the incumbents to invest and take risk.

This Schumpeterian creative destruction could be more destructive than creative if value creation result from free rider behavior: Skype or Google, for instance, do not pay for the use of the network but contribute to the overall value of network usage. But while Skype is a substitute of existing traditional services, Google look likes a complement. What should thus be the regulation of existing and emerging markets in the coming period?

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 the case of services and infrastructures. Let us follow de Streel (2004)'s typology in order to develop our reasoning (Table 1).

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

Table 1 – Typology of telecommunications markets (source: De Streel, 2004).

In the case A, *ex post* regulation should apply, except if entry barriers are too high. In this case, *ex ante* regulation can apply but it must take into account the previously mentioned mutations of the sector. The redefinitions of the boundaries of relevant markets must consider the risk taken by the investor in a context of rapid technical change, the social need for new radical investments (such as FTTH) and the

convergence phenomenon. These aspects must be at the heart of a new regulation policy in order to integrate the incentives to innovate and to 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 the markets should evolve more quickly in order to integrate the evolutions of the sector: among the 18 markets defined by the European Commission, three markets concern broadband and nine for 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 be integrated as well. Finally, the markets should not be too numerous in order to limit the intervention of 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 are creating wealth and the entry barriers for those services must be completely removed. The regulation should encourage their development whatever the innovator is (the incumbent or the competitors). First mover advantage must be kept otherwise it would reduce 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 by new innovative techniques (which will be necessary condition for the development of many new services). In this case, must we allow operators and service providers to discriminate the users, offering a higher quality for their own services? Must we allow them to ask fees to Google or Skype? This is the question of *Net neutrality*. Must we add regulation constraints while operators are already facing those incentive problems? Conversely, should the State help the operators inciting them to invest as in Korea? For the moment, the European regulation, fostering competition in the upper layers with the asymmetrical regulation applied to the lower layer appears very far from industrial policies. However, this question could be crucial for the emergence of the services that need new infrastructures (case D). The regulator is thus facing the dilemma between offering the best conditions for the development of services in the short term (which means asking for cost oriented and non discriminatory prices) and for the development of infrastructures, necessary to the many new services development in a long term perspective.

In the case of new infrastructures deployment (cases C and D), we have shown that incentives to invest are reduced and the risk of under-investment is important when regulation oblige 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 to regulate in the same way the same service (independently from the infrastructure) and the principle of not regulating emerging markets.

In order to avoid these dilemmas, it appears that other types of regulation policies could be implemented. Two solutions, partly compatible, seem interesting to explore. One is inspired from the intellectual property theory, and the other one 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 in the temporary absence of regulation (*regulation holidays*) in order to give enough time to the operator to get a return on investment: The probability to reach dynamic efficiency could result from the combination between this regulation holidays and a possible *ex ante* regulation after this holidays period if given conditions concerning the effective competition are not reached. According to Gans & King (2004), such a period should depend, case by case, on the nature of investment and on 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 the one of prolong the holidays period would be envisaged. This regulation would thus both incite the investor to provide its network to competitors on a commercial basis and increase its incentives to invest by taking into account the risk and the irreversibility of investments.

The other solution, which can be compatible with the previous one, is to implement an industrial policy. This solution would consist in favoring actively 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 reach 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: the asymmetrical *ex ante* regulation would be suspended provided that negotiated goals (in terms of regional planning, price, quality of services, type of investments...) are 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, the service and the infrastructure fields. Such a solution could thus benefit from the advantages of a relative competition between the firms composing the oligopoly (which did not exist before liberalization) and the advantages of planning together with the actors the conditions of the development of radical investments. Moreover, it would not exclude the more intensive competition on the market where it appears natural.

Those two solutions are interesting perspective for theoretical research and empirical studies since they have been partly chosen in a few countries: For instance, the United States decided in 2003 they would not unbundle the FTTH local loop, as well as Canada and Korea, following the First solution principle. These decisions involved important investments in building new networks. Korea is also a very interesting example because it applies an industrial policy with an undeniable success: Thanks to State's direct and indirect help for infrastructure deployment but also for developing new services and applications (KII project, IT 839 Strategy...), thanks to the development of institutions dedicated to technological survey (KISD) and to R&D (ETRI), Korea has become a leading country in ICT fields. While the European

framework for telecommunications is being reviewed, such solutions should seriously be studied by the European Commission if we want Europe to remain a competitive actor in this strategic sector.

Conclusion

Should telecommunications regulation change in the coming period? This paper is arguing 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 the same regulation could represent a danger for 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 the investment and increases the option value to wait for competitors. Moreover, the *ex ante* regulation of infrastructures is not only driving the sector to underinvestment but is also distorting the investment itself: Radical investment in R&D and in infrastructure seems to be more sensitive to this type of regulation rather than incremental investment.

In this context, we identified three possible options for regulation: Continuing *ex ante* regulation as in the previous period in Europe; substituting *ex post* regulation to *ex ante* regulation; and finally implementing an industrial policy for macro-strategic and institutional reasons. We also pointed out the necessity to take into account the major mutations of the sector: The acceleration of technological progress and innovation rate, 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 the infrastructure) and not regulating (and thus increasing the incentives to invest in the infrastructure with the risk of allowing new dominant positions), we propose two possible solutions inspired from foreign policies. The first one consists in offering regulation holidays to investors, with regular reviews in order to decide whether to prolong holidays or not. The second one consist in negotiating a contract between the regulator and the 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...) are met.

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