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## FIBRE-OPTIC NETWORKS: ON INVESTMENT, REGULATION AND COMPETITION

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Investment in new technologies, such as fibre-optic networks is a necessary precondition for reaching the aims of the Lisbon agenda. In this paper, it will be argued that under market conditions investment projects that imply high levels of risk will only be undertaken if economic framework conditions are suitable to enhance innovation. At present, however, regulatory policies might tend to hamper investment incentives, thus delaying the leap into the digital age. In particular, access regulation of newly built networks seems to have a negative impact on the readiness to invest and innovate. There is clear evidence that the US telecommunications policy has recognized these regulatory shortcomings and implemented a much more liberal regime. As a result, huge investments have been stimulated by the deregulation of broadband access. This paper, thus, refers to the current investment plans of Europe's largest telecommunication company, Deutsche Telekom, and the debate that has arisen around the regulatory constraints to be imposed on the newly built infrastructures.

### Fibre-optic networks

Over the last decade, the development of the market for telecommunication services has shown an ever greater need for bandwidth in order to respond to the requirements set by innovative applications. Triple play, the integration of telephony, internet services and broadcasting in one service, is just one very simple possible service application. Probably

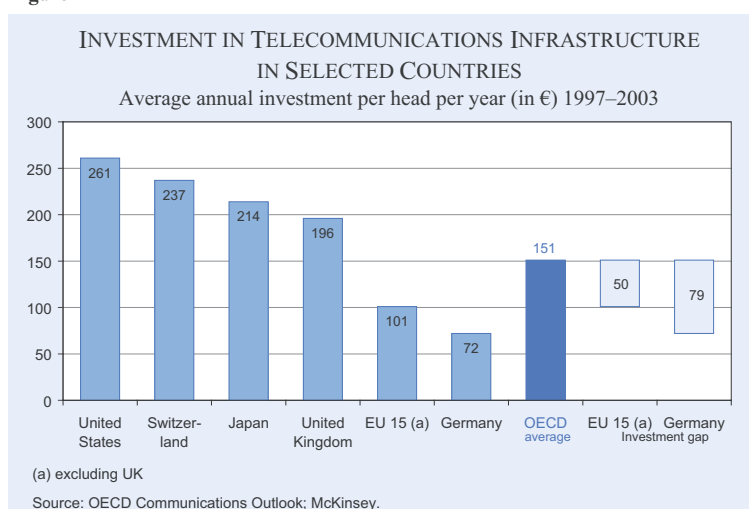
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more exciting ones will emerge from working with the network. History shows that the technology offers *options*, and it is for the users to decide which applications to generate. Indeed, Zysman and Weber (2000) identify as the central element of the "American network revolution" that it is user driven. Users develop innovations or ask for improvements and new services while they experiment with new technologies. Hence, the actual potential of advanced infrastructures will only reveal itself in the process of usage. Past experience suggests that there is a high probability that fibre optic networks will induce a whole series of product and service innovations (see also Caillaud and Jullien 2003).

Advanced infrastructures can generate surprising and revolutionary innovations. Jaron Lanier, a pioneer computer scientist, relates the development of large search engines, such as Google or Yahoo, to first experiments with a high speed pioneer internet version (Internet 2) that were not aimed at a particular application. Other prominent examples of unforeseen success stories that have relied on insightful infrastructure investment are e-mail and SMS (Süddeutsche Zeitung, 23 June 2006).

Röller and Waverman (2003) have shown that there is a strong correlation between investment in telecommunication infrastructures and economic growth. This direct link is also at the core of the Lisbon agenda and the i2010 initiative (Commission 2005). However, Europe, and in particular Germany, are falling behind, as shown in Figure 1. Therefore, it is essential for technology policy to support the construction of advanced networks and thus to promote growth and employment.

Figure 1



Infrastructure projects require the long-term investment of substantial amounts of capital. The risks involved in this will only be borne by the investing firm, if there is a prospect of competitive first-mover advantages and future gains to pay back the advanced capital and to earn necessary capital for replacement and expansion of the infrastructure. If the mechanism of rewarding extraordinary risk is no longer in place, potential investors will be reluctant to engage in infrastructure projects. If technological innovations are produced in short sequence, investors need to amortise their investment rapidly. Determining in advance the likely amortisation period for Deutsche Telekom's fibre optic network so that the regulator can impose the "right" price for access seems an insurmountable task.

The Commission argues that broadband penetration depends on the intensity of competition in a market and this, in turn depends on regulatory measures establishing competitive market regimes. Apart from the fact that the analyses cited by the Commission bear important flaws (see Indepen Report 2006),<sup>1</sup> relating broadband penetration exclusively to regulation seems too simplistic. The links constructed from regulation to competition to price and from there to broadband penetration are often weak, and many examples exist that contradict this pattern. For instance, Greece has a high level of competition, but low broadband penetration, and Denmark, on the other hand, combines high broadband prices with one of the highest penetration rates in Europe.

It would go beyond the scope of this paper to discuss all the facets of arguments put forward in the debate.<sup>2</sup> Therefore, the following chapters will focus on four main strands of arguments: the relation between investment and regulation, the ladder of investment hypothesis, the bottleneck argument, and the "new and emerging market" debate

This paper discusses general issues of the relation between investment and regulation, albeit from a German perspective. Regulatory measures proposed

by the German regulator and the European Commission are discussed in the light of innovation and competition theories, empirical evidence and experience from other countries.

### Investment and regulation

In the context of the Lisbon strategy, investment in high-speed networks is of eminent importance for Germany and Europe alike. However, telecommunication infrastructures are not being built in a liberalised market environment but are subject to intensive regulatory scrutiny. Indeed, the EU Commission insists that access to the VDSL<sup>3</sup> network that Deutsche Telekom plans to build in 50 German cities has to be put under ex-ante regulation. It is argued that the lack of infrastructure competition in the German market may lead to the emergence of a new monopoly. Ex-ante access regulation is presented as the only way to grant competitors access to an essential facility.

Regulated prices for unbundled local loops can, however, keep market incentives for infrastructure deployment artificially low (Bauer 2006). They are likely to send out the wrong signals, as it will probably always be much more efficient for competitors to use a dominant operator's network under regulated conditions than investing in their own facilities.

Vogelsang sees a high risk in non-regulation, as a decision in favour of exemption will cause objection and result in lengthy legal procedures (Vogelsang 2006). However, this argument holds for both options. Regulating the new network will slow down investment, because it will lead to long debates on the "right" access prices and leave all potential investors with a high level of uncertainty with respect to expected returns. According to Blum et al. (2005), the risk of regulatory intervention makes investment plans subject to considerable uncertainty, because price can no longer be used as a strategic variable to attract consumers or to occupy a competitive position. Moreover, ex-ante access regulation (at whatever price) diminishes first-mover advantages, which are highly important for innovation and competition in dynamic markets such as telecommunications.

As the Commission rightly states, it is extremely difficult for a regulator to correctly assess risks of an

<sup>1</sup> The correlation used in the report is based on a 'regulatory scorecard' provided by ECTA (ECTA 2006) that has been heavily criticised (Indepen Report 2006). As a consequence the Commission is now using an indicator provided by the OECD (Commission Staff Working Paper 2006). However, even this indicator seems hardly appropriate, since it was last updated in 2003, but the main progress in broadband deployment has been made in the last two years. In addition, it is doubtful, whether the variables used in the OECD indicator are suitable to capture those elements of regulation that influence broadband penetration.

<sup>2</sup> The hearing conducted by the *Bundesnetzagentur* on this issue has produced a series of contributions that document the state of the debate. See <http://bundesnetzagentur.de>.

<sup>3</sup> Very high speed Digital Subscriber Line.

**Box: The debate about the effects of unbundling on investment***Positive effects*

- **Willing et al. (2002)** confirm the “**competitive stimulus hypothesis**”: they have found that low unbundling rates induce competition and thus stimulate investment by incumbents: “a one percent decrease in the UNE-P<sup>a)</sup> rate generated between a 2.1 and 2.9 percent increase in ILEC<sup>b)</sup> investment”.
- **Phoenix Center Study (2003)**. According to this study the 1996 Telecommunications Act has created 92 000 jobs and has had a positive impact on CAPEX<sup>c)</sup> and productivity.

*Negative effects*

- **Hazlett and Bazelon (2005) and Hausman and Sidak (2004)** find that the stepping-stone and ladder-of-investment hypotheses are not supported by their theoretical analysis.
- **Haring and Rohlfs (2002), Pindyck (2004)** conclude on the basis of a real options approach that infrastructure investment has declined as a consequence of local loop unbundling.
- **Haring, Rettle et al. (2002), Crandall and Singer (2003), Ingraham and Sidak (2003), Eisenach, Lowengrub et al. (2003)** state that high prices for unbundling induce high investment in the network and raise the incumbent’s market capitalisation.
- **Crandall, Ingraham and Singer (2004)**: The lower prices for the unbundled local loop, the lower is the investment of competitors in network infrastructure. The step from operating on the basis of rented lines towards the building up of separate networks is not being done by market participants.
- **Wallsten (2005), Cambridge Strategic Management Group (2002)** can show that the higher the share of rented local loops is, the more slowly broadband access rates are rising. **Martin (2005)**: The access rules inhibit deployment of infrastructure.

*For Europe:*

- **Credit Suisse First Boston (2005)**: There is little incentive from a regulatory perspective for incumbents in Europe to pursue FFTP.<sup>d)</sup>

*Ambivalent results*

- **Chang/Koski/ Majumdar (2003)** have concluded that in the US lower interconnection prices have stimulated investment by the incumbents. However, they have found the contrary when studying European countries, albeit on the basis of not satisfactory data.
- **Garcia Murillo and Gabel (2003)**: There is no significant impact of unbundling on broadband diffusion, but measures to promote competition have a positive impact. However, regulatory measures should take country-specific factors, such as income levels into account.

<sup>a)</sup> Unbundled Network Elements Platform. – <sup>b)</sup> Incumbent Local Exchange Carrier. – <sup>c)</sup> Capital Expenditure. –

<sup>d)</sup> Fibre to the Premises.

Source: Based on Markova 2006.

investment and to include the “right” risk premium in the regulated price. However, the solutions proposed, namely cooperation between regulators and referring to the competences of the Commission (Commission 2006), are not convincing, because experience from one investment can hardly be transferred to investments that are conducted at a different time and in different markets; and “co-operation” and the centralisation of competences cannot effectively substitute for market mechanisms.

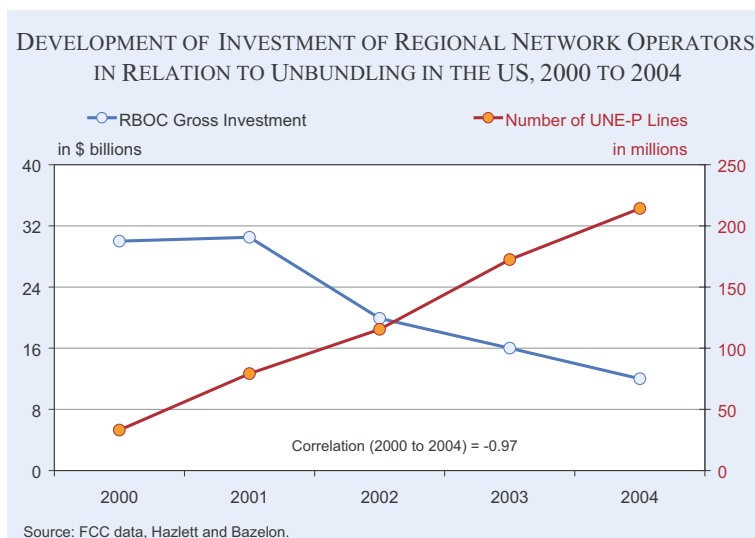
Mistakes that have been made in the past (e.g., by setting regulated prices for network access too low to stimulate investment in cable infrastructures) should not be used as a justification for a need for regulation today (Dahlke and Neumann 2006).

Instead of deploring a lack of competition at the infrastructure level, and preventing this competition to develop at the same time, the regulator should stimulate investment in alternative infrastructures and, thus, increase the intensity of inter-platform competition.

**The “ladder of investment” hypothesis**

The regulatory approach adopted by the Commission is based on the belief that creating favourable access conditions for market entrants at the service level will eventually motivate them to build up their own infrastructures – or to climb up an imagined “investment ladder”. The concept was originally based on an

Figure 2



The statistics on infrastructure investment by RBOCs (Regional Bell Operating Companies) in the US support the hypothesis of a trade-off between unbundling obligations and investment levels: the following graph shows a clear decline of infrastructure investment with the increase of unbundled local loops (see Figure 2).

Not surprisingly, therefore, Crandall, Ingraham and Singer (2004) conclude: “The best argument for maintaining the current unbundling regime – namely, that low UNE<sup>5</sup> rates encourage

CLECs<sup>6</sup> to rent at first, and then build facilities once they have some market experience – is not supported by the data.”

These insights seem to have little influence on the concepts used in Europe. The Commission denies the negative effects of strict unbundling obligations on infrastructure investment and claims the opposite, albeit with a weak statistical basis (Commission 2006 and Indepen Report 2006). Most surprisingly, a report by London Economics (2006) which the Commission advertises as evidence for its position does not support the claimed relationship (Press release JP/06/1123).

In Germany, the regulator takes the fact that investment by competitors has been higher than that of the incumbent in 2004 as an indicator for the effective transition from service-based to facilities-based competition (Bundesnetzagentur 2006). However, the figures provided do not differentiate between investment in fixed and in mobile networks. It can be assumed that the argument does not hold, when only investment in fixed networks is considered.

A prominent example of a successful market driven infrastructure project is the cable network in the US. An unregulated environment has led investors to build up cable infrastructures to compete with the DSL (digital subscriber line) network which was highly regulated at the time. As a consequence, cable plays a very important role in the supply of broadband access,

analysis of the Dutch case, and it was an ex-post explanation of the path of development of competition. As such, it was not meant to provide a manual for regulators or a bluebook for the micro-management of markets (see Cave and Vogelsang 2003).

However, up to now, there is little empirical evidence of the functioning of the ladder. On the contrary, some American authors have shown that in the US cheap and easy access to the existing network has worked as a disincentive rather than an incentive for infrastructure investment. Unbundling obligations imposed on the dominant network provider have resulted in a reduction of investment in the network by the network owners as well as to reluctance of competitors to engage in costly and risky infrastructure projects (e.g., Hazlett and Bazelon 2005).<sup>4</sup> This has given rise to a fundamental change in regulatory policy: unbundling obligations were abolished, and the market for broadband access was deregulated.

This new regulatory style went along with the substitution of a static concept of competition by a dynamic approach. In a static view, market configurations and market entrance are the central concern of the regulator. In a dynamic concept higher levels of concentration and the temporary dominance of individual players are tolerated for the sake of a dynamic development of technologies and innovation (see, for example, Bauer 2006). The overview shown in the Box summarises the debate.

<sup>4</sup> Crandall, Ingraham and Singer (2004); Pindyck (2004), Haring and Rohlfs (2002), Hazlett and Bazelon (2005), Hausman and Sidak (2004), Haring, Rettie et al. (2002), Crandall and Singer (2003), Ingraham and Sidak (2003), Eisenach, Lowengrub et al. (2003).

<sup>5</sup> Unbundled Network Elements.

<sup>6</sup> Competitive Local Exchange Carrier.



while investment in DSL remained behind expectations. The existence of an alternative infrastructure reduces the need for regulatory intervention, which is a benefit in itself, and it leaves the consumer with more options than without competing infrastructures.

### **The bottleneck argument**

Regulation of telecommunication networks is often justified with the existence of bottlenecks controlled by monopolistic operators. These bottlenecks do not allow competitors to offer services that rely on so-called essential facilities (e.g., Knieps and Blankart 2006; Vogelsang 2006; Neumann and Scherer 2006).

A distinction has to be made as to whether bottlenecks are the result of natural monopolies or whether they are a consequence of former state monopolies or licence policies or even static ex-ante regulation itself. In a natural monopoly regulation might be justified to counterbalance an automatic gravitation towards monopolies. However, even technical restrictions claimed to inevitably create a natural monopoly evaporate with technical progress. For example, access in the local loop: alternative technologies, such as WIMAX<sup>7</sup> or satellite transmission can substitute bottlenecks in wire-based networks. These technical options should be carefully explored before claiming the existence of “natural monopolies”. It is doubtful that a technical bottleneck actually exists in high speed broadband networks in Germany, in particular if an awakening cable infrastructure is taken into account.

If bottlenecks result from persistent market configurations, regulation has the purpose of creating incentives to eliminate these kinds of bottlenecks. Regulatory measures which perpetuate their existence are therefore jeopardising the long-term aims of the regulatory process and are to be rejected. If the provider of a newly built network is obliged to share this network under conditions imposed by the regulator, there is no incentive for competitors to bypass the bottleneck. This is the case of the VDSL network to be built-up by Deutsche Telekom. Regulating the new network would mean to support the emergence of a new bottleneck and to prevent the long term disappearance of bottlenecks (see also Bourreau and Doğan 2001). It therefore perpetuates the need for regulation.

Bottlenecks should not be confused with comparative advantages gained by innovators through investment in new technology. It is the very nature of innovations to create such “bottlenecks”, namely facilities that competitors cannot immediately replicate. The idea of competition would be completely thwarted, if new technical assets that an innovator creates would immediately be subject to regulated access by its competitors.

In the debate on the regulation of Deutsche Telekom’s fibre-optic network, it is argued that the newly built facilities must be subject to regulated access because the basic telecommunication network has been built with tax payers’ money. However the existing network is no longer the one “inherited” from monopoly times. The “old” network has been continuously updated and no longer contains many elements of the network that existed when the monopoly was abolished. It is doubtful, in any case, whether the incumbent’s network is still publicly financed, since with the privatisation of the incumbent telecom operators, all the assets of the former monopolist were bought and paid by shareholders and are, thus, privately owned. This argumentation has found clear support by a recent decision of the German Constitutional Court.

### **New and emerging markets**

The European Regulatory Framework exempts so-called “emerging markets” from regulation. The German government has implemented this rule by introducing Art. 9a in the Law on Telecommunications.

Therefore, if the investment in a high-speed fibre optic network creates a “new market”, regulation does not have to be discussed. The tricky question is now, how to identify a new market. For some authors, the existence of a “new” market requires an “innovation” (e.g. Vogelsang 2006). The notion of “innovation” itself is not undisputed, but some clarifications are made by the Oslo Manual<sup>8</sup>: “... the implementation of a new or significantly improved (good or service), or process, a new marketing method, or a new organisational method in business practices, workplace organisation or external relations” (OECD and Eurostat 2005, p.46).

<sup>7</sup> Or WIMAN: Broadband Wireless Metropolitan Access Network.

<sup>8</sup> Guidelines proposed by the OECD for collecting and interpreting technological innovation data.

This definition is widely accepted and extensively used in practice. It comprises incremental innovation (significant improvements), and, thus, technologies which build on previous technology but allow for the realisation of new adoptions – such as the planned fibre optic network. There is a consensus in innovation research that in Germany incremental innovations have always been more important than radical innovations and that German industry has been very successful with this model (see, for example, Soskice 1997, Abramson et al. 1997, Edquist 1997, BMBF 2006). Therefore, “incremental innovation” is a concept which is commonly used and has high explanatory power.<sup>9</sup>

As mentioned above, the innovative power of the technology lies in the applications. These innovations will emerge when the users of VDSL networks start to exploit the technical potential of VDSL. Therefore, the innovations to be generated cannot be described at the moment; it is for the market to decide what they will be. The emerging market clause responds to exactly this phenomenon: as markets are not there, but only ‘emerging’, it cannot be said what the market configuration and competitive situation will be.

## Conclusions

The crucial question is not whether there is a fundamental contradiction between investment and regulation, but whether in certain circumstances and under certain market constellations regulation has a negative impact on investment incentives and innovation. If regulation is supposed to establish competition, but obviously regulatory measures do not provide any incentive to overcome an existing monopolistic infrastructure shortage, for example by creating alternative infrastructures, extending these regulatory measures into the next infrastructure generation contradicts the core purpose of regulation.

The currently reigning regulatory regime seemingly promotes competition, starting from the correct assumption that competition is the main driver for investment and growth. However, in relying on a static concept of competition, this approach results in the destruction of competitiveness. Any competitive process needs winners; to forbid winners to win by

stigmatising any above-average profit paralyses the dynamics of growth in an economy. Europe can only reach its ambitious goals by stimulating innovativeness and efficiency. International competitiveness requires the highest level of technological expertise and the most advanced technological infrastructures. It also requires competition at all levels and not a static concept of market configuration and the fearful truncation of any non-regulated initiative.

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<sup>9</sup> The same misunderstanding seems to lie behind the questions asked by the regulator in its latest hearing (see <http://bundesnetzagentur.de>).

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