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## INNOVATION AND REGULATION IN THE TELECOMMUNICATIONS SECTOR

*Since the mid 1980s, steps have been taken at the international level to liberalize market entry in the telecommunications sector. Technological change and the opening to competition of previously monopolistic markets create new challenges to be met by the regulatory framework. Intervention by the regulator is required not only to ensure fair competition for newcomers to the market and to achieve a socially balanced distribution of the costs of adjustment to structural change; regulation may also have a significant effect in terms of technology policy.*

Norbert Knoll is economist at the Austrian Institute of Economic Research. The paper summarizes the results of the "tip" Workshop on "Regulation and Innovative Activities: Part II – Telecommunication" held on 23 May 1997, at the Austrian Institute of Economic Research (proceedings in preparation). The "tip – Technology: Information, Policy Counseling" program, based on an initiative taken by the Federal Ministry of Economic Affairs and the Federal Ministry of Science and Transport, is being implemented by the Austrian Institute of Economic Research in cooperation with the Seibersdorf Research Institute. The author wishes to thank Hannes Leo for valuable suggestions and information.

A glance at a number of current trends confirms the highly dynamic nature of the telecommunications sector. In technological terms, the progress achieved since the beginning of the 1980s has resulted in an extraordinary increase in the performance of telecommunication networks (*Horrocks – Scarr, 1993*) and, at the same time, brought costs down. The conditions which used to determine the costs of the telecommunication infrastructure for many years are being put into question through the presence of modern transmission and switching systems, e.g., ATM (asynchronous transfer mode), the use of fiber as a transmission medium, and the availability of compression procedures for the transmission of information. Advanced uses of the electro-magnetic radio spectrum permit the provision of an extended range of services for mobile communication under commercial conditions, with the differences between fixed and mobile infrastructures in terms of variety of applications about to disappear; moreover, through the architectural separation between basic switching and data storage and processing, the new intelligent network architectures permit an extension of the range of commercial telecommunication services and applications.

### INTERNATIONAL DEVELOPMENTS AND TECHNOLOGICAL CHANGE

The economic significance of these technological changes is due to their profound impact on the conditions under which services are offered in the market (*OECD,*

1997). On the one hand, decentralized alternatives to what used to be a largely monopolistic offer of telecommunication networks and services are becoming available and are implemented on an international scale through adjustments of the regulatory framework. In that case, the offer of telecommunication services largely follows the model of an international competitive market, the imperfections of which are to be compensated through regulation. On the other hand, the regulatory conditions themselves provide incentives for the development and diffusion of new technologies, thus promoting the emergence of new markets; hence, regulation also has a significant impact in terms of innovation policy (OECD, 1996).

Any modern infrastructure policy for the telecommunications sector must account for technological and economic changes. Hüber (1998) therefore contrasts the traditional telecommunication infrastructure with the notion of “infrastructure”, which is defined as the “infrastructure supporting symmetric or asymmetric services and applications, ranging from very low band-width to high band-width. This definition reflects the new technical and economic realities” (Hüber, 1998). On a longer-term basis, the development anticipated by Hüber (1998) means that the costs of transporting information on the emerging telecommunication infrastructures will be negligible, compared with the added value created through future services (e.g., multi-media). As regards the technological development, a change of paradigm from the dominance of a few solutions – or even a single one – to a pluralism of technological solutions is to be expected. At the same time, the commercial success of the service providers in the individual market segments will depend on their ability to cope with internationalization and to position their offers as favorably as possible along an extended value chain.

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Through their combined appearance, technological change and the internationalization of supply confront the regulatory authorities with new challenges. On the one hand, regulation is becoming more and more dependent on an international harmonization of regulatory strategies. On the other hand, the question arises as to the scope of active regulation and the nature of the goals to be

achieved. Hüber (1998) tends to take a reductionist approach based on the polarization of two extremes – i.e., “protective regulation” versus “enabling regulation”:

“The thinking on the purpose of regulation varies considerably. For some it is a guarantee that a privatized and liberalized sector does not escape political control and its socio-economic obligation as a key infrastructure. For others regulation is a launch pad for making communications drive economic progress and international competitiveness. . . . The impact of regulation will very much depend on which objective prevails – the protective or the enabling” (Hüber, 1998).

However, developments in the telecommunication markets, in particular, point to regulatory requirements of a new quality.

## REGULATORY REQUIREMENTS AND REGULATORY REFORM

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Traditionally, regulation of the telecommunications sector has always been necessary for technological and economic reasons. In general, regulation comprises a variety of institutionalized forms of state intervention with economic activities, which manifest themselves in the definition and change of “rules of the game” to be observed, the monitoring of compliance, and the provision of sanctions in the event of non-compliance with the rules of the game. The existence of competitive forces or their partial elimination in a market is to be regarded as a rule of the game requiring a corresponding regulatory regime. Furthermore, according to Chang (1997), regulation is target-oriented and refers to a specific public interest to be secured through regulation:

“The conventional definition of regulation is government activity that is intended to affect directly the behaviors of private sector agents in order to align them with the ‘public interest’. This excludes the provision of public goods through budget disbursement or the operation of public enterprise, as well as tax/subsidy measures, from the realm of regulation” (Chang, 1997, p. 704).

With regard to the telecommunications sector and certain forms of market failure, economic theory provides us with a number of arguments in support of regulatory intervention, one line of reasoning being that communication services are associated with network externalities: as the

number of subscribers to a service rises, consumer benefit increases accordingly. Discriminating practices by individual players must therefore be combated through regulations creating fair and transparent conditions of interconnection (in terms of cost, quality and availability). Along similar lines, regulatory intervention may be motivated by considerations of distribution policy and based on a concern to secure a socially and regionally balanced basic supply of communication services (universal service). Typical forms of market failure would be monopolistic market structures or cost conditions as imposed by a natural monopoly, the latter meaning that – owing to economies of scale and economies of scope – a service can only be offered at the lowest possible cost, if the entire market volume is accounted for by a single supplier.

In the past, the regulatory requirements in the field of telecommunication were frequently met by a regime of direct intervention through public ownership in sector-dominating enterprises. However, the existence of natural monopolies has been put into question by recent technological developments, and political constellations have emerged which attribute a higher priority to a functioning market mechanism (see *Chang, 1997*); as a result, a process of regulatory reform has been under way also in the telecommunications sector since the beginning of the 1980s (*OECD, 1997*).

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*Skouby* (1998) refers to the example of Denmark to illustrate the process of structural reform since 1986. Between 1987 and 1995, the regional, publicly owned telecommunication providers were integrated, privatization was initiated and, at the same time, segments of the telecommunication market were gradually opened up. In the course of the process, it turned out that new instruments and institutional arrangements were needed to meet some of the regulatory requirements. Regulation proved to be necessary not only to permit competition in the various markets, but also to protect the consumer from undesirable side effects of emerging competition. The establishment of an independent regulator (directly accountable to Parliament instead of a ministry in certain respects), the specification of universal service obligations, and the defi-

inition of conditions for interconnection as well as the allocation and utilization of scarce resources, such as frequencies and numbers, were essential components of the Danish reform. Having perceived the need for reform at a very early point in time, Denmark was able to create the prerequisites for the complete opening of the telecommunication markets to competition well before the deadline agreed upon within the European Union: not 18 months – as originally planned – but still an impressive 6 months ahead of schedule. *Skouby* (1998) notes that the reforms have created the prerequisites for competition both in formal terms and from the viewpoint of new entrants, although a valid assessment cannot yet be made in the absence of practical experience.

The changing requirements to be met by the arsenal of regulatory instruments are illustrated most convincingly in connection with the allocation of rights to the use of scarce resources, such as frequencies. Under a monopolistic regime, the allocation and management of frequencies, e.g., for the establishment of cellular services, was equivalent to a formal act by the public authorities. Since the beginning of the 1990s, competing providers of mobile services have appeared on the market and new frequency uses have been made possible through technological progress<sup>1</sup> – with new forms of regulatory requirements emerging as a result. When it comes to frequency management, there is also a technology-policy component to regulation, the point at issue being not primarily the efficient utilization of the electro-magnetic spectrum – which in turn provides incentives for innovation – but rather the diffusion of new services based on the utilization of frequencies.

The development of uniform technical standards, such as GSM, is one of the essential prerequisites for the creation of markets<sup>2</sup>, the availability of a frequency spectrum being another prerequisite for the actual introduction of new technologies. Hence, regulatory reforms often also comprise the introduction of innovative practices for the allocation of rights to use the frequency spectrum. *McMillan* (1994) refers to the first international experiences indicating that allocation based on the principle of auctioning is a meaningful alternative to administrative procedures. However, the theoretical basis of the design of auctions does not suffice to optimize the allocation mechanism. Frequently, the necessary parameters can be estimated in qualitative terms only; considerable transactions costs might arise; to implement a theoretically based auction

<sup>1</sup> For a survey of the economic prerequisites for frequency allocation, see *Kruse* (1997) and *Leo* (1998); technological trends are discussed, i.a., by *Horrocks – Scarr* (1993).

<sup>2</sup> For the development of GSM into a global standard, see, e.g., *Azoulay* (1996).

design, serious information deficits first need to be overcome; and unambiguous theoretical recommendations for auction design are not yet available. Moreover, the highly specific conditions created by past regulatory decisions may add to the complexity of the theoretical framework<sup>3</sup>.

Using the granting of licenses for paging services according toERMES standards in September 1996 as an example, Hofmann (1998) shows that auctioning improved both the transparency of allocation practices and the establishment of market access in conformity with the principles of competition. Nevertheless, the actual performance of auctions presupposes a large measure of theoretical reflection and the consideration of practical experience. In the context of regulatory reform this implies that innovative instruments, such as auctions<sup>4</sup>, may be expected to play a considerable role in the future, although a phase of institutional learning – in addition to the application of theoretical and practical knowledge – will be necessary for the regulators.

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From the economic point of view, the changing relationship between innovation and regulation affects not only the allocation and management of frequencies, but also the arrangements governing the interconnection of the networks (services) of competing operators. The conditions of interconnection have an immediate impact on market entry and thus exert an indirect influence on the diffusion of new communication technologies and services. According to Sadowski (1998), the regulation of interconnection influences the competitive conditions of the commercial offer of traditional and innovative services as well as the corresponding incentives to innovate for incumbents and new entrants. An empirical analysis of the introduction of digital switching technology in the OECD region between 1985 and 1994 leads to the conclusion that networks were modernized more quickly in the majority of countries

<sup>3</sup> A detailed discussion of GSM auctioning conditions in Austria are to be found in Leo (1998).

<sup>4</sup> Besides auctions, lotteries are another novel instrument of regulation: the allocation of resources by lottery is of interest, if demand for resources is subject to explicit preferences and the allocation method is to be both neutral in terms of competition and transparent. In particular, lotteries may gain in importance for the allocation of numbers.

with “more liberal” conditions of interconnection. Using Germany as an example, Sadowski (1998) shows that – under a regulatory regime supporting the dominating position of the traditional operator (Deutsche Telekom) – the conditions of interconnection delayed the modernization of the telecommunications network. The regime was to the disadvantage not only of business customers (e.g., users of corporate networks), but also of new service providers, such as Mannesmann Mobilfunk. In addition, it hindered the establishment of the telecommunications infrastructure in Eastern Germany<sup>5</sup>.

## REGULATION, INNOVATION AND THE “OPEN NETWORK” PARADIGM

A change of paradigm from “closed” to “open” systems also appears to create a need for reform and a re-definition of the relationship between economic regulation, standardization and innovation. Using electronic commerce (EC) as an example, Hawkins (1998) shows that the importance of regulation and standardization change, if open network environments establish themselves as the prevailing paradigm for the provision of electronic communication services<sup>6</sup>.

Historically speaking, “closed networks” constituted the dominating paradigm for electronic communication networks: dedicated infrastructures were established for specific services, e.g., telegraphy, telephony or television. Since the 1960s, the advent of new technologies has made the convergence of services and infrastructures possible; however, different regimes continued to exist with regard to standardization and economic regulation. New data communication services have gained in importance since the 1970s, but their introduction continued to follow the paradigm of the “closed” telephony network.

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As the content of information and its transmission are being digitized to a growing extent, the interconnection between systems and the integration of services are becoming a realistic possibility. However, major adjustments in

<sup>5</sup> For a detailed analysis, see Sadowski (1996).

<sup>6</sup> Hawkins – Mansell – Skea (1995) review the issue of standardization and innovation. Katz – Shapiro (1994) discuss the relationship between network externalities and compatibility and offer some general conclusions for public policy.

terms of regulation and standardization are required to that end. To date, user-independent technological progress and an innovation process dominated by the supply side have been characteristic of the coexistence of closed systems in the field of telecommunication. Consequently, users have traditionally played a minor role in the standardization of new communication services. The situation is different in an open network environment, where standards support different and highly specialized applications and allow networking between services and users; hence, users are often actively involved in the development of standards.

In general, the change of paradigm from closed to open systems is accompanied by a re-definition of the relationship between traditional, public standardization bodies and private standardization consortia. Standardization bodies consider it their task, above all, to develop standards which are intended to reduce the variety of products offered – as a way of cutting costs – or to harmonize systems and components to permit the utilization of external effects. Private consortia approach standardization projects from a different, largely strategic aspect (understanding the collective status quo of technological progress, harmonization of product development and market development, etc.). Besides such strategic considerations, a certain measure of discontent within the business community with the progress made and the results achieved by established standardization bodies has led to a fast increase in the number of industrial standardization consortia since 1990.

*Hawkins* (1998) uses the example of electronic commerce (EC)<sup>7</sup> to illustrate some of the implications of the change of paradigm in the regulation of communication services. The growing interest in EC is attributable, above all, to the following factors:

- falling telecommunication prices and a growing offer of services by public networks;
- wide availability of information and communication technologies for private and business users (e.g., steep increase of PC density and use of Internet);
- technological progress, which leads to the convergence of previously separated electronic media and, at the same time, permits the interactive use of virtually all electronic media;

<sup>7</sup> Applications of electronic commerce use information and communication technologies for the initiation, conduct and support of commercial transactions. In other words, electronic commerce transfers market functions to an electronic environment (electronic market-place). One of the elements of EC is the electronic exchange of structured business data (Electronic Data Interchange – EDI), which can be used for ordering, order confirmation, transmission of price and product data, invoicing, payment receipts, etc.

- strong incentives to promote EC applications in some sectors of the economy (cost advantages, information gain, differentiation from competitors, etc.).

For the time being, transactions between enterprises along the value chain account for the largest commercial volume and the highest growth rates in EC. Transactions between enterprises and private users, made possible through “open” access via the Internet, also represent a highly dynamic sector. This is where the strongest growth is to be expected in the near future. The establishment of a “backbone facility” appears to be an essential prerequisite – more important even than the availability of user-friendly interfaces and a sufficient network band-width. The representation and implementation of commercial transactions in an electronic environment needs to be socially accepted; users must be able to rely on the confidentiality of the messages communicated, the integrity of information and the authenticity of the partners involved in the transaction. Current international debates about the use of cryptographic methods and the creation of institutional prerequisites for the establishment of the corresponding certification services are but one example of the points at issue.

Innovations such as electronic commerce, which are primarily user-driven, not only require a technological basis modeled according to the new paradigm of open systems, but also point to the need for a reform of economic regulation; questions concerning the development, the applicability and the extent of regulatory intervention are yet to be answered. The emergence of a regulatory approach suited to the innovative applications of electronic commerce may be impaired, if the technical and legal arrangements based on a tradition of regulation of “closed (telephone) networks” are maintained without due consideration of changing needs. As a matter of fact, regulation ought to guarantee fulfillment of the basic requirements and functions of public networks, so as to enable the development and diffusion of innovative applications. Thus, a regulatory regime that gives due consideration to innovative activities ought to go beyond the traditional tasks of ensuring that market structures are in conformity with the principles of competition or, generally speaking, compensating for market failures. Users of communication services would have to be allowed a central role in the definition of their network environment. After all, progress in information and communication technology has derived much of its momentum from the user side.

Given the regulatory requirements in the field of electronic commerce, the change of paradigm can be summarized as follows: “for network ‘backbones’ to emerge that will support user-led networking initiatives and encourage di-

verification in the sources of innovation, attention must shift from regulation of the network infrastructure to regulation of an activity in an electronic environment. The kind of regulation needed to develop a broad base of trust and confidence in electronic commerce is 'commercial' regu-

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lation. Telecommunication regulation will play a role, but it must be coordinated with a much wider range of technical and non-technical regulatory areas than apply currently to telecommunication regulation. 'Backbone' development in open networks is more than a telecommunication issue and it cannot be left up to telecommunication regulators alone" (Hawkins, 1998).

## REGULATION AND CONVERGENCE OF ELECTRONIC COMMUNICATION

The convergence of electronic communication demands a comprehensive reform of the regulatory framework (see Garnham, 1996). Latzer (1997) also holds that the international trend towards the liberalization of market access in telecommunication as well as the audio-visual media must be seen from the viewpoint of regulatory reform rather than the abandonment of any regulatory structure. The power of well-established existing suppliers, the risk of future restrictions of an effective market mechanism, strategic behavior, and the trends towards vertical and horizontal integration certainly call for some measure of regulatory intervention. As a matter of principle, the trend towards convergence may also necessitate a redesign of the institutional basis of regulation, with market participants from formerly separate sectors, such as audio-visual media, print media and telecommunication, interacting to an increasing extent through cross-ownership or operating in a common market as suppliers of multi-media products and services.

In the past, different regulatory regimes were established in different sectors to maintain a variety of public interests (freedom of opinion, basic supply of simple communication services, etc.).

"In particular, telecommunications regulation has been based on the presumption of natural monopoly in the provision of fixed networks, the separation of carriage and

content, and the regulation of access but not content. In broadcasting, regulation was based on spectrum scarcity and the strict regulation of content. Print remained largely unregulated and governed by the philosophy of a 'free press'" (Garnham, 1996, p. 113).

Instruments were developed to meet specific regulatory goals of the individual sectors, with some of these goals only making sense within the specific context of the sector concerned; ensuring non-discriminatory access to the network, for instance, was of little importance for print media, whereas for operators of telecommunication networks the regulation of content had hardly any significance. Thus, there was no need in the past for formal organizational measures providing for coordination between the individual regulators. A greater need for coordination has only emerged during the past decade, with applications of mass communication and individual communication now competing for scarce frequencies and the validity of traditional forms of regulation being put into question through the existence of the Internet.

According to Latzer (1997), the gradual blurring of the dividing line between two previously separated sectors and the resulting emergence of a broader-based sector of electronic communications is taking place in two phases of convergence. The first phase of convergence has been noticeable since the early 1970s and concerns the merger between telecommunications and the computer industry (telematics: telecommunications + informatics). A second phase of convergence began in the early 1980s and concerns the electronic mass media and the field of telematics (mediamatics: electronic media + telematics). Borderlines are disappearing everywhere – with respect to the technological basis of supply (digitalization), the separation of target groups for the offer of services (business and private users), and the sector affiliation of suppliers. In all, the process of convergence leads to a restructuring of the markets which – not least as a result of specific institutional prerequisites – may take on a variety of forms.

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In view of the tendency of markets to converge, Latzer (1997) concludes that the institutional set-up and the use of regulatory instruments have to be adapted accordingly.

New services (e.g., multi-media) no longer fit into traditional categories, the classification of new services tends to be rather arbitrary, as is the case in Germany, and existing regulations concerning market entry, the dissemination of information content or the protection of privacy appear to be inadequate in the face of rapid technological change. Hence, an integrated policy approach (mediamatics policy) would have to be developed on the basis of a common regulatory framework for the entire field of electronic communication. Basically, such an approach would be highly desirable, particularly with a view to the stimulation of new markets in the multi-media sector (see also *Knoll – Peneder – Warta*, 1998). *Latzer's* (1997) arguments in favor of an integrated regulator for electronic communications as a whole, however, need to be seen in a more critical light. After all, an effective division of labor between content and carrier regulation ought to be possible also between independent regulators. At any rate, a reorganization of the institutions in charge of the regulation of telecommunication, audio-visual media and print media would have to be preceded by a comprehensive debate – in socio-political terms – of the goals of regulation and the strategies to be employed in their implementation; in the absence of such a debate, a pro-active strategy aimed at institutionalizing the regulation of the mediamatics sector might – at best – turn out to be premature.

## CONCLUSIONS

Any reform of the regulatory framework for the telecommunications sector must be seen against the background of rapid technological change. The main focus of reform is on the transformation of formerly monopolistic structures for the provision of the telecommunications infrastructure into a competition-driven market structure. Very often, this involves a profound change of the regulatory regime – if, for instance, the sector is initially dominated by a state-owned enterprise, and regulation is primarily effected through direct intervention by the owner. The new regime demands the development of strategies and instruments which allow the public interest to be maintained and, at the same time, permit fair competition between old and new providers. Time is an essential factor for a successful transition from a monopoly to a competitive market. Hence, the reforms should be preceded by an adequate planning phase, as shown by the Danish example (*Skouby*, 1998); consideration should also be given to the international experience of countries with a successful history of liberalization. Moreover, it is to be expected that a certain learning phase will be necessary before the new institutional arrangements become fully effective. For the new regulatory instruments, such as auctions, to be used meaningfully, they must be based on both theoretical con-

siderations and practical experience (*Hofmann*, 1998, *Leo*, 1998).

In the case of regulatory reform in the field of telecommunications, as in other network-based infrastructures<sup>8</sup>, the issue of technological change needs to be considered. On the one hand, technological change is regarded as a trigger of reform. On the other hand, regulation may either further the achievement of results desirable in terms of technology policy, e.g., a greater diffusion of innovative services, or – unintentionally – produce the opposite effect; the conditions for interconnection prevailing in Germany at the beginning of the 1990s (*Sadowsky*, 1998) being a good illustration of this point.

The relationship between reform requirements and technological change became extremely complex by the beginning of the 1990s, if not earlier. The change of paradigm from “closed” to “open” systems has resulted in the emergence of a new framework not only for the technical regulation of telecommunications (standardization), with the position of market participants shifting in the process of standardization and more and more innovative stimuli coming also from the user. As a matter of fact, new applications, such as electronic commerce, are themselves providing the basis for a change of paradigm, which in turn calls for a wider perspective going beyond the historically developed regulatory structure of telephony (*Hawkins*, 1998). As the borderlines between the technological basis (digitalization), the separation into target groups of the services offered (business and private users), and the sectoral classification of providers are disappearing through the convergence of telecommunications, information technology and the media (*Latzer*, 1997), adoption of a broader perspective is becoming necessary.

Against this background, the attempts at reform undertaken in Austria can be seen as a first, important step in the elaboration of a “strategy of delayed implementation” of telecommunications reform (*Leo et al.*, 1994). For a preliminary assessment, the objectives and strategic considerations of a more comprehensive “communications policy”, as outlined in an expert report on the information society, may be used (*Office of the Federal Chancellor*, 1997). Although the expert report of the Federal Government focuses, primarily, on telecommunications issues in the narrower sense of the term, it also considers new regulatory requirements (electronic commerce, institutional encryption requirements, interfaces between telecommunications and the new electronic media, etc.). The extent to which this theoretical approach to the information society

<sup>8</sup> *Knoll* (1997) elaborates on the relationship between innovation and regulation in the electricity sector.

can be successfully translated into practice remains to be seen. Previous experience in the field of telecommunications policy – e.g., in connection with the award of licenses for mobile communication services – certainly indicates that a phase of institutional learning will be essential to overcome the paradigms still prevailing in the present situation.

## REFERENCES

- Azoulay, P., "The GSM Standard: An Impetus for the Globalization of Mobile Communications?", *Communications & Strategies*, 1996, (21), pp. 95-134.
- Chang, H., "The Economics and Politics of Regulation", *Cambridge Journal of Economics*, 1997, 21, pp. 703-728.
- Dodgson, M., Rothwell, R. (Eds.), *The Handbook of Industrial Innovation*, Edward Elgar, Aldershot, 1994.
- Dutton, W. (Ed.), *Information and Communication Technologies: Visions and Realities*, Oxford University Press, Oxford, 1996.
- Elixmann, D., Kürble, P. (Eds.), "Multimedia – Potentials and Challenges from an Economic Perspective", *Wissenschaftliches Institut für Kommunikationsdienste*, Proceedings, 1997, (5).
- Freeman, C., Soete, L., *The Economics of Industrial Innovation*, M.I.T. Press, Cambridge, MA, 1997.
- Garnham, N., "Constraints on Multimedia Convergence", in *Dutton* (1996), pp. 103-119.
- Hawkins, R., "Building a Network 'Backbone' for Electronic Commerce: Innovation, Standardisation and the Role of the Regulator", in *Knoll* (1998).
- Hawkins, R., Mansell, R., Skea, J. (Eds.), *Standards, Innovation and Competitiveness: The Politics and Economics of Standards in Natural and Technical Environments*, Edward Elgar, Aldershot, 1995.
- Hofmann, H., "Innovative Trends in Regulating Entry into Telecommunications Markets: Auctioning Licenses and Frequencies in Germany", in *Knoll* (1998).
- Horrocks, R., Scarr, R., *Future Trends in Telecommunications*, John Wiley & Sons, Chichester, 1993.
- Hüber, R., "Innovation, Regulation and Employment in the international Context", in *Knoll* (1998).
- Katz, M., Shapiro, C., "Systems Competition and Network Effects", *Journal of Economic Perspectives*, 1994, (8), pp. 93-115.
- Knoll, N. (Ed.), *Regulation and Innovative Activities: Electricity Supply Industry*, Proceedings of the First tip Workshop on Regulation and Innovative Activities, WIFO, Vienna, 1997.
- Knoll, N. (Ed.), *Regulation and Innovative Activities in Telecommunications*, Proceedings of the Second tip Workshop on Regulation and Innovative Activities, WIFO, Vienna, 1998 (in preparation).
- Knoll, N., Peneder, M., Warta, K., "Multimedia-Produktion in Österreich: Ergebnisse einer Unternehmensbefragung", *WIFO-Monatsberichte*, 1998, 71(1), pp. 55-63.
- Kruse, J., "Frequenzvergabe im digitalen Mobilfunk in der Bundesrepublik Deutschland", *Wissenschaftliches Institut für Kommunikationsdienste*, Diskussionsbeitrag, 1997, (174).

### *Innovation and Regulation in the Telecommunications Sector – Summary*

Regulation is one of the key factors shaping both supply of and demand for new technologies and services. Consequently, the regulatory framework for utilities – although primarily focused on the introduction of competition – can play an important role for technology and innovation policy. Especially, the diffusion of information and communication technologies (ICT) and new services and applications, such as electronic commerce, hinges upon the creation of an appropriate regulatory framework, which, i.a., supports technology policy objectives and strategies.

The liberalization of telecommunications markets has a number of implications for public policy. The process of regulatory reform is rather complex and requires institutional adjustments as well as the utilization of new regulatory instruments. These are the main lessons we can learn from countries in which the transformation from monopoly to competition started in the mid 1980s. Regulators have to get used to new instruments – such as auctions for frequency allocation – which have implications for the creation of new markets. Institutional learning beyond a theoretical approach will be required. Furthermore, regulators have to take into account the international dimension in terms of markets and suppliers.

Technological change in information and communication technologies produces another set of questions for public policy. The shift in the basic paradigm for "electrical" communication networks from closed systems towards open systems as well as the convergence between telecommunications, broadcasting and print will probably have the most striking effects on the future of these industries. In an open system standards create access environments that are not necessarily oriented towards any specific service environment. An open network paradigm includes the user, and significant innovation is not necessarily generated within the supply sector alone.

An appropriate policy towards innovation and diffusion of new services has to account for the role of industry consortiums in the standardization process, for users as an important source of innovation and for regulatory activities beyond regulation of the network infrastructure. Recent Austrian initiatives towards the information society suggest that there is some leeway for a broader and more integrated communication policy. However, it is far from clear whether regulatory reform can overcome old paradigms.



- Latzer, M., "Institutionalization of Mediamatics Regulation for Converging Markets", in *Elixmann – Kürble* (1997), pp. 89-106 (will be published in *Knoll*, 1998).
- Leo, H., "Ökonomische Aspekte des Frequenzmanagements am Beispiel der Mobilkommunikation", *WIFO-Monatsberichte*, 1998, 71(3), pp. 197-207.
- Leo, H., Peneder, M., Knoll, N., Ohler, F., Latzer, M., *Telekommunikation im Umbruch. Innovation – Regulierung – Wettbewerb*, WIFO, Forschungszentrum Seibersdorf, im Rahmen von tip, Vienna, 1994.
- Lundvall, B. (Ed.), *National Systems of Innovation: Towards a Theory of Innovation and Interactive Learning*, Pinter Publishers, London, 1992.
- McMillan, J., "Selling Spectrum Rights", *Journal of Economic Perspectives*, 1994, (8), pp. 145-162.
- OECD, *Regulatory Reform and Innovation*, Paris, 1996.
- OECD, *Communications Outlook*, Paris, 1997.
- Office of the Federal Chancellor, Information Society: Report of the Austrian Federal Government Working Group, Vienna, 1997, (<http://www.austria.gv.at/infoges/english/index.html>).
- Sadowski, B., *Back to Monopoly: Opportunities and Constraints for Public and Corporate Networks in Post-Unification Germany*, Avebury, Aldershot, 1996.
- Sadowski, B., "Does Interconnection Foster Innovation? – An Empirical Analysis", in *Knoll* (1998).
- Skouby, K., "The Danish Regulatory Reform of Telecommunications", in *Knoll* (1998).
- Tewes, D., Stoetzer, M., "Der Wettbewerb auf dem Markt für zellularen Mobilfunk in der BRD", *Wissenschaftliches Institut für Kommunikationsdienste, Diskussionsbeitrag*, 1997, (171).
- Winston, C., "Economic Deregulation: Days of Reckoning for Microeconomists", *Journal of Economic Literature*, 1993, (31), pp. 1263-1289.