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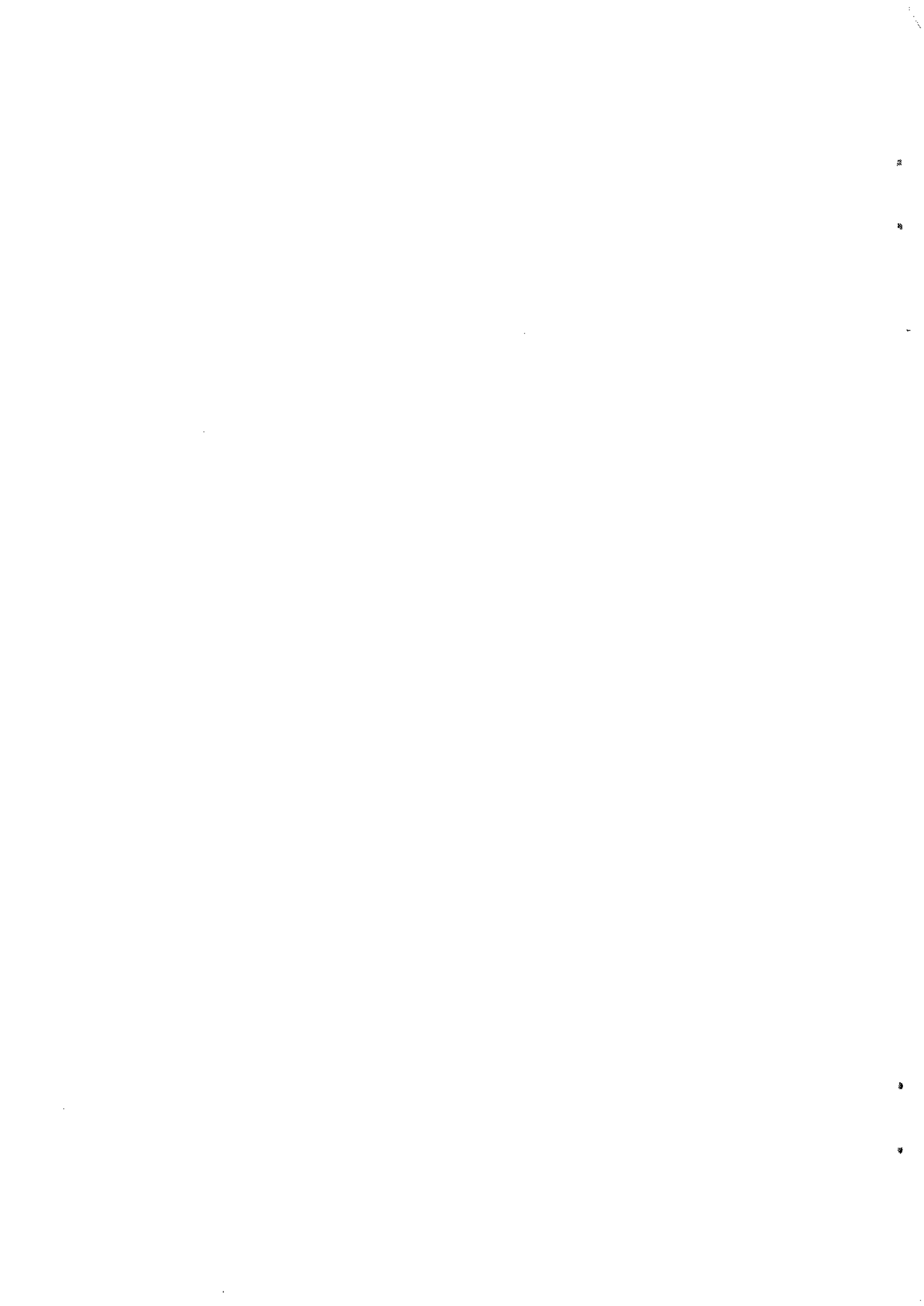
## Serie Research Memoranda

### Borders and Barriers: Telecommunication Systems

R. Capello  
P. Nijkamp

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**BORDERS AND BARRIERS: TELECOMMUNICATION SYSTEMS**

**Roberta Capello (\*) and Peter Nijkamp (+)**

**(\*) Istituto di Economia Politica  
Università Bocconi  
Via Sarfatti 25  
20136 Milano**

**(+) Department of Economics  
Free University  
De Boelelaan 1105  
1081 HV Amsterdam**

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## BORDERS AND BARRIERS: TELECOMMUNICATION SYSTEMS

Roberta Capello and Peter Nijkamp

### 1. A Sector in Transition: High Potentialities with Low Adoption Rates

Our society is gradually but undoubtedly exhibiting the signs of a transition towards a network economy. The rapid rise of the service sector - not only for domestic but also for international activities - mirrors the fact that the western world is increasingly marked by a wide variety of communication and interaction patterns ranging from a local towards a global scale. This tendency is even reinforced by the emergence of the information sector, also denoted as the new information technology (NIT) sector or the information and communication technology (ICT) sector (Freeman et al., 1982; Giaoutzi and Nijkamp, 1988). The NIT (or ICT) sector has shaped the conditions for the current knowledge-based economies.

The pioneering study of Machlup (1962), followed by Porat (1977), began to stress already the significance of a "knowledge based" economy in those years when Bell (1973) was signalling the emergence of a service-dominated economies in our post-industrial society. From these early works, a series of theoretical and empirical analyses have emerged, strengthening the idea of a new development trajectory of an economy governed by different rules and actors and dependent upon different (information-oriented) strategic resources. Jonscher (1983), for example, sought to explain the emergence of the "Information Economy" through categorising economic activities into two classes, viz. "production tasks" (tasks associated with the manufacture and delivery of products and services), and "information tasks" (tasks associated with the coordination and manipulation of production tasks). The major source of added-value appears to shift clearly from the production task to the information task.

All these studies witness the emergence of an information economy, characterised by a growth and intensification of those activity indicators (such as investment and employment) associated with the collection, manipulation, storage and communication of information. Knowledge-based and information-based activities are becoming important strategic resources upon which the competitiveness of firms and comparative advantages for regions increasingly depend (Gillespie et al., 1987). Thus, the economy is going through a period of transformation, signalled by the move from "capital-intensive" production systems to "information-intensive" production systems (Willinger and Zuscovitch, 1988), where information and knowledge are inextricably linked strategic resources for economic development.

The emergence of the Information Economy is highly dependent upon the widespread diffusion and adoption of new Information and Communications Technologies (ICTs), born from the interaction of computing and telecommunications, which give rise to new potentialities in the way of storing, manipulating, organising, visualising and transmitting information. Given this perspective, the telecommunications sector and its future development become critical for the understanding of future economic positions of countries and regions, and thereby of the competitiveness of national, regional and urban territorial and industrial systems in the 1990s. Thus, at first glance the ICT sector seems to be a promising sector with a high growth potential.

Paradoxically, empirical analyses on the adoption process of these technologies in the economy demonstrate a relatively low penetration rate. While there has been significant growth in the level of expenditure on ICTs, there remain open questions on the extent to which these technologies are being used and exploited. In other words, there remain uncertainties on the extent to which the new techno-economic paradigm can be said to have been secured.

The relatively limited diffusion of computer networks is demonstrated by both official statistical data and primary data. In the U.K., for example, OFTEL (Office of Telecommunications) publications indicate a rather limited use of private circuits, central to computer networks, achieving only 10% of British Telecom revenues in 1988. Furthermore, 90% of private circuits are analogue and these circuits represent 75% of private circuits revenues, 25% is derived from digital circuits. Moreover, 75% of all private circuits are within the same exchange area while the City of London is the main geographic market.

The relatively limited diffusion of computer networks is also demonstrated by a recent survey of organisations (1). Whilst 40% of respondents used a computer network, and over 65% of these organisations had installed their computer networks since 1985, the broad diffusion of computer networks into the functional structure of organisations has remained relatively undeveloped (Table 1) (Capello and Williams, 1991). In effect computer networking has predominantly remained within the account function and the dominant network application has been the maintenance and analysis of the basic accounts ledgers. This evidence is in line with official statistical data which shows that in 1984 65% of large administrative offices (establishments) supported a computer network (Ducatel, 1989). However, the 1989 survey of organisations has provided evidence of a growing technical infrastructure and increasing number of users. Thus, in 1982 69.4% of organisations had less than 10 users, whereas by 1989 only 23.6% of respondents had 10 users or less. This growth is also reflected in the number of users only 5.9% of organisations in the survey had more than 100 users in 1982, whereas by 1989 28.1% of organisations had more than 100 users. A similar observation can be made regarding technical infrastructures: while only 13.1% of the organisations had 100% on line transactions in 1982, 28.3% had this possibility by 1989.

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Table 1

Use of Computer Networked Appliances in Selected Functions

Selected Applications	Finance	Marketing	Production	Purchasing	Distrib.
Data Processing	85%	47%	53%	54%	40%
Relational Data Base	30%	25%	21%	14%	12%
Electronic Mail	22%	16%	16%	9%	9%
Diarying	10%	9%	9%	5%	3%

Source: Taylor J. and Williams H., Pict Survey, 1989



This situation which shows a rather limited use of advanced telecommunication networks and services is not only typical of the United Kingdom. In Europe, in general, the level of digital lines installed, representing the main physical infrastructure for the development of advanced services, is still very low (Table 2), although the situation varies considerably from country to country. Italy and Spain show very low levels of digital lines, and face a strong barrier effect on the development of advanced services.

The empirical material provides prima facie evidence of the growing diffusion of ICTs but suggests also a complexity in the adoption of computer networks, both as public utilities and as intrafirm infrastructure. In this second case, difficulties are concerned by the integration into the activities and processes of organisations.

Thus there appears to be a paradox with, on the one hand, a growing awareness and focus upon the implications of a new techno-economic paradigm upon the behaviour and structure of organisations, and on the other hand, a pattern of adoption of new ICTs which suggests there are uncertainties and difficulties in translating these concepts into reality (Capello and Williams, 1991).

The aim of the present paper is to explain this paradox through the analysis of major elements that in diffusion processes of these technologies can turn into barriers to the widespread adoption of the new technologies. Moreover, some policy recommendations will be drawn, which may be useful in overcoming such adoption constraints in order to move realistically towards an "Information Economy".

Table 2 - Number of digital lines installed by geographical areas  
1988

	A1	A2	A3	A4
USA	127.2	45.0	32.2	28.07%
Giappone	51.7	9.0	42.7	14.58%
Francia	25.8	15.6	10.2	3.48%
UK	23.4	5.5	17.9	6.11%
Germania Ovest	27.0	1.4	25.6	8.74%
Italia	29.0	2.2	17.8	6.08%
Spagna	10.5	0.7	9.8	3.35%
Svezia	6.1	1.8	4.3	1.47%
Australia	7.1	1.3	5.8	1.98%
Argentina	3.2	0.2	3.0	1.02%
Brasile	3.8	0.7	3.1	2.77%
Cecoslovacchia	2.1	0.1	2.0	0.68%
Cina	3	0.7	7.3	2.49%
Sudcorea	9.6	1.7	7.9	2.70%
India	3.5	0.3	3.2	1.09%
Indonesia	0.8	0.2	0.6	0.20%
Iugoslavia	3.1	0.2	2.9	0.99%
Malaysia	1.3	0.9	0.4	0.14%
Messico	4.3	0.7	3.6	1.23%
Rdt	1.8	0.2	1.6	0.55%
Taiwan	5.7	0.6	5.1	1.74%
Ungheria	0.8	0.1	0.7	0.24%
Ussr	30.3	0.2	30.1	10.28%
TOTALE	382.1	89.3	292.8	100.0%
Aree Geografiche				
Europa Occident.	142.9	32.3	110.6	31.94%
Nord America	140.6	50.3	90.3	26.08%
America Latina	19.8	2.5	17.3	5.00%
Africa/Medio Or.	9.5	2.7	6.8	1.96%
Asia/Pacifico	93.7	12.6	81.1	23.42%
Europa Orientale	40.9	0.7	40.2	11.61%
Totale	447.4	101.1	346.3	100.0%

Source: Zanfei, 1990

A1: Total lines installed  
A2: Total digital lines installed  
A3 and A4 : Potential of substitution

## 2. The Nature of Existing Barriers to the Development

Until recently, the telecommunications industry was rather restrictively defined as the area of production and distribution of voice and text communications, through the telephone and telex services (Pasini, 1959). Nowadays, this definition is far too limited and insufficient to explain the characteristics of this rapidly changing industry. The radical technological innovations of the seventies and eighties have broadened the range of communications services and instruments, their technological transmission capacity and, moreover, have changed the role telecommunications services and infrastructures were playing in the economic system. The pervasive nature of the ICT sector has however also faced many barriers (OECD, 1988a and 1988b).

The nature of such barriers and bottlenecks are strictly linked to the profound changes taking place in the telecommunication sector. The drastic transition processes force actors - regardless whether they are users or suppliers - to adjust their behaviour to the new market rules, a development which has created problems at both the supply and the demand side.

Although technological forces are generally pinpointed as the major causes for modifications in the telecommunications sector, an approach to this transformation process focusing only on indigenous technological aspects would fail to conceptualise and describe properly the new characteristics of the telecommunications sector. At least four factors can be regarded as prominent causes for the transformation of the sector (Capello, 1991a):

- technological dynamics. Although it is not the unique reason for change, the technological revolution is certainly playing an important role in the development trajectories of the new sector. A host of product innovations takes place, from digitalisation of switching and transmission equipments to a broad range of new services which offer high transportation possibilities of data, voice, text and images;
- institutional dynamics, changing the market structure from a monopoly structure to a competitive market, imposing new "game rules", after decades of traditional static oligopoly (in manufacturing firms market) and monopoly régimes (in the service market);
- market dynamics, stemming from an increased awareness of users about the strategic importance of these infrastructures, and stimulated through customers' attempt to influence suppliers towards customised products and innovation, thus acting as "technological gatekeepers";
- new economic relationships characterising the telecommunications "filieres", representing the matrix of economic relationships among manufacturing firms, and between suppliers, the operator and customers. The traditional oligopolistic rules which have historically governed manufacturing firms and their linkages with public operators

have been substituted in the last decades by more competitive rules, by low national protective barriers and by greater competitive threats from firms belonging to previously separated sectors.

These profound changes provoke, paradoxically, on the one hand high technological potentialities but, on the other hand, bottlenecks and barriers to the development of high adoption rates. Barriers and bottlenecks arise at both the supply and the demand side.

Barriers in the telecommunications refer to all phenomena (economic, organisational, technological, cultural, political, etc..) that impede a smooth penetration, adoption and development of this ICT sector. This means that barriers can be interpreted as losses in (marginal) benefits accruing from the use or supply of telecommunication. To some extent barriers act as "negative production factors" decreasing the maximum possible productivity of conventional production factors (see Nijkamp and al., 1990). Barriers can be external to a certain information system (e.g., language barriers, physical bottlenecks) or internal (e.g., as a result of user externalities such as congestion). A good example of barriers in a telecommunication network can be found in a study by Klaassen, Wagenaar and van der Weg (1972), who studied the implications of language barriers between the Flemish and the Walloons in Belgium by means of a spatial interaction model for telephone calls. More recent applications of the identification of barriers in international telecommunication networks can be found in Fischer et al. (1990), Giaoutzi and Strategea (1990), Rietvelt and Janssen (1990) and Rossera (1990).

From a supply side perspective, the profound changes mentioned above threaten the capacity of suppliers - both manufacturers and public operators - to deal with the rapid and increasing competition which quickly grows in front of the complex technological, institutional and market dynamics the sector is facing (Section 3).

From a demand side perspective, bottlenecks concern inter alia the complex nature of new technologies which require a high degree of interrelation with the organisational structure of firms to be secured. Moreover, the importance these technologies represent for achieving a competitive advantage for users, can turn into a threat imposed to users to adopt these technologies in a shorter time span and for new purposes (Section 4);

An accurate analysis of the bottlenecks to the development of this strategic sector is crucial for suggesting some policy recommendations in order to overcome the barriers to a quick and widespread development of telecommunication technological potentialities (Section 5).

### 3. Barriers at the Supply Side

At the supply side, the major structural changes affecting the telecommunication market destroy the traditional economic rules governing the relationships among suppliers, public operators and the market. Increasing competition requires the development of different corporate strategies and different market approaches, that in some cases result to be a barrier for the development of market shares for traditional telecommunication suppliers. Thus manufacturing firms have to deal with two types of strategic issues:

- a) an increasing competition, which may be difficult to face for technologically backward countries and regions;
- b) a different nature of the market, which raises problems regarding appropriate policies to approach markets.

Both elements will be discussed in subsections 3.1 and 3.2, respectively.

#### 3.1. Barriers in the development of market shares

It is undoubtedly true that the level of competition has raised considerably in the telecommunications sector in the past decade and this change has had some deep supply implications. The reasons for this phenomenon stem from both technological and institutional changes, through which barriers to the development of national markets come about.

As far as the institutional side is concerned, major changes have been imposed by the EC through the publication of the Green Paper (1987) and of its further revisions, leading the system towards more liberalised market structures. The characteristics of these institutional changes reflect rather narrow national trajectories of the liberalisation process, despite the EC efforts to ensure a uniform process (Table 3). This non-uniformity in institutional behaviour at the European level has some drastic consequences for the national competitiveness of firms and thus for the national supply development. In fact, the existing differences in the national trajectories will become crucial - once liberalisation will be imposed in all countries -, when the specific innovative capacity of each single country is tested. Inevitably firms which have faced competition for a longer period will have more advantages in terms of marketing policies than those used to operate in an oligopolistic market.

Barriers in the development of market shares for firms with less liberalisation experience stems from:

- less consolidated market policies and consumer orientation, stemming from their shorter experience on the market and their weaker direct contacts with customers;
- lack of strategic efficiency-oriented mechanisms for a better harmonisation of telecommunication systems in an international economics;
- less consolidated product innovation policies, stemming from lower technological, scientific and organisational know-how.

The risk for firms still governed by monopoly rules is the

Table 3 - Institutional situation in most developed countries - 30/4/91

Countries	Italy	U.K.	France	Germany	USA	Japan
Relation between post and telecom services	Separated/ PTT	Separated	Separated	Separated	Separated	Separated
Basic-service network						
a) local	Monopoly	Duopoly BT/Mercury	Monopoly	Monopoly	Limited competition among private companies	Limited competition between private company and public op.
b) interurban	Monopoly	Duopoly BT/Mercury	Monopoly	Monopoly	Limited competition among private companies	Limited competition between private company and public op.
c) international and intercontinental	Monopoly	Duopoly BT/Mercury	Monopoly	Monopoly	Limited competition among private companies	Limited competition between private company and public op.
Customer premises equipments						
1*Telephone	Monopoly	PO and Priv. Comp.	PO and Priv. Comp.	Monopoly	PO and Priv. Comp.	PO and Priv. Comp.
Pabx	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.
Cellular radio	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.
Modem	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.
Telex machine	Monopolio	PO and Priv. Comp.	PO and Priv. Comp.	Private Companies	PO and Priv. Comp.	PO and Priv. Comp.
Teletex machine	PO and Priv. Comp.	Private Companies	PO and Priv. Comp.	Private Companies	PO and Priv. Comp.	PO and Priv. Comp.
videotex machine	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.
Fax machine	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.	PO and Priv. Comp.

PO = Public Operator

Priv. Comp. = Private Company

Source: Capello, 1991b

loss of market shares, probably leaving the development of the sector in the hands of foreign firms.

The main changes in the manufacturing sector have taken place in the customer premises equipment sub-sector. The main problems in the protection of national markets can be summarised as:

- firstly, a major threat for many European firms is not caused by European competition itself, but by American and Japanese firms legally entering the European market. These firms represent a highly potential threat in terms of more advanced technical products and more ad-hoc marketing policies developed through years of experience in competitive markets (especially for the American case);
- secondly, even at a European level, competition favours countries with a stronger supply structure, created through years of extremely favourable telecommunications public policy. This is, for instance, the case with France, with a historically strong supporting public policy devoted to the creation of "national champions". The other extreme case is represented by Italy, which has always been reluctant to spend resources for developing strong national telecommunications supply, and has favoured other sectors in public policy. A concrete case of possible market losses by technologically backward firms is the British case. In fact, in front of Mercury competition, British Telecom changed its purchasing policies favouring Japanese and American technologically more advanced customer premises equipments, rather than national firms products, thus destroying British manufacturing firms (Charles et al., 1989; Williams and Gillespie, 1988).

Thus, the effects of internationalisation of customer premises equipments are profound, once radical technological differences among products exist. It is clear that barriers to the development of market shares for national firms stem from:

- the backward technological know-how;
- the backward policies to approach the market.

Even in the liberalised provision of advanced services, competition increases between firms belonging to previously separated sectors. While informatics firms are legitimated to offer their technical know-how in the provision of value added services, with a high software component, traditional manufacturing firms face a problem in developing their market shares in these sub-areas because of the lack of technological know-how required ("infant industries").

Liberalisation in the domain of public purchases destroys the historical division of labour characterising the relationship between telecommunications manufacturing firms and public operators in most European Countries.

Thus, the extremely high R&D expenditures and investments required especially in the switching equipments market will act as entry barriers in this market, and liberalisation of public purchases pushes firms towards product specialisation in order to keep market shares under control and to achieve a "natural" division of labour in the market.

Minor negative effects on market shares provoked by foreigner competition will, on the contrary, affect the development of market shares for the public operators. The EC, in fact, clearly protects monopoly in the most profitable market area for public operators, namely the provision of network-based services.

Moreover, liberalisation of customer premises equipments may turn out to have positive effects on public operators business. By stimulating the use of services through low-pricing terminal equipments, traffic on public networks is consequently positively affected. This has been the case for the Italian videotex service, increasing considerably the number of subscribers after the abolishment of a monopoly on the too expensive terminal equipment.

Liberalisation of advanced services, which should help the development of these services on a broader base, meets obstacles because of the threat of the capacity resale phenomenon by the public operator, at least in the European monopolistic markets. The implementation of private networks through leased circuits can in fact lead to the illegal provision of network-based services on these networks, thus decreasing traffic on public infrastructures and generating economic losses to the legally protected network-based services market of public operators.

The concern about this phenomenon is related to both its highly geographical and quantitative diffusion and to the non-existence of control mechanisms for avoiding it. Although all European countries have witnessed the growing phenomenon of capacity resale on private networks, none of them has provided a legal efficient mechanism to keep the phenomenon under control. The most effective proposal to avoid this problem is concerned with the change of the present tariff structure of private leased circuits, based on leasing contracts. This tariff structure should turn out to be based on the volume of information transported, thus destroying economic advantages on which capacity resale rests. Objections to these changes are presented by business users, arguing that this solution would completely inhibit the use of private circuits, upon which the development of a networked economy is predicated.

### 3.2. Barriers to approach the market

There exists another source of barriers limiting the development of new telecommunication technologies from the supply side, viz. one related to the changing nature of ICTs markets.

Computer networks are far from being standard technologies and their exploitation for purposes of achieving higher economic performance is highly dependent on their integration into the organisational structure of each adopter (see Section 4). For this reason, these technologies have to be tailored to each adopter's need.

The markets for traditional telecommunication services (such as telephone and telex) are relatively homogeneous, and are



characterised by standardised and mass produced outputs and the achievement of economies of scale playing an important role in defining competitiveness of individual firms. Technological knowledge required to produce such output is linked to the traditional background of telecommunications producers and suppliers. Thus competition may be based predominantly on price and quality factors, supported by traditional mass advertising and marketing policies designed to separate an individual producers' output from its competitors.

With respect to computer networks and their application the characteristics of the market are different to those of product markets, thus obliging suppliers to put in place different competitive strategies. Because the adoption of computer networks is dependent upon an interaction between the technology and the organisational structure, the marketing strategies need to be tailored to individual users.

In the light of the above observations, it is clear that barriers for the traditional manufacturing firms to develop appropriate policies stems from:

- first, their lack of experience in terms of marketing strategies based on customised policies for each adopters' characteristic, rather than mass advertising policies;
- secondly, and even more drastically, their lack of knowledge in the organisational sphere, which turns out to be of crucial importance to putting in place new ad hoc technologies.

Their weakness represents a possible chance given to the so called "value-added resellers" to enter the market. The potentially strong positions in the market of these new entrants stems from their capacity to capture information from both the supply (for example, in terms of technological developments, and the demand side, for example in terms of the interaction between the technology and the organisational structure of individual customers). This market positioning allows intermediaries to integrate technological possibilities with the needs of users, generating from one side larger markets for computer networks and their applications, but from the other side market losses for traditional telecommunication firms.

#### 4. Barriers at the Demand Side

It is undoubtedly true that some barriers to the development of these technologies exist also at the demand side; these are concerned with the complex nature of these new technologies, requiring ad-hoc learning processes to be used and exploited by both industrial and territorial systems. The adoption and widespread use of ICTs may require - and may in fact be dependent upon - organisational changes, and the relationship between technology and organisation undoubtedly represents a barrier to the diffusion of these technologies.

From a users' perspective, in fact, the rapid increase in communications potentials embodied in the new communications technologies opens the way to the exploitation of competitive advantages on the basis of the achievement of more information and knowledge. Competitive advantages are now based on the capacities of new technologies to transmit, process, store and elaborate a greater volume of information (Gillespie and Hepworth, 1986). Thus, the higher technological potentialities present major opportunities for firms to achieve competitive advantages.

However, despite general beliefs, these opportunities are not provided by the simple adoption of these technologies, but by their innovative use. By innovative use we refer to the application of these technologies to produce new products, new processes, new transactional structures. The development of on-line services in the banking sector, (e.g., points of sales, cash dispensers, home-banking, provided by the development of inter-banking computer networks systems) are a clear example of innovative use of these infrastructures. By the same token, process innovation can be generated through the use of these new infrastructures by enabling "islands of automation" (such as flexible manufacturing systems) to intercommunicate, either within a single site (Local Area Networks) or among a multitude of sites (Wide Area Networks). As a managerial innovation, computer networks operating over space through telecommunication channels have obviously greatly increased the ability of multi-site organisations to control and integrate their activities over space (Antonelli, 1988; Camagni and Rabellotti, 1988; Fornengo, 1988; Rullani and Zanfei, 1988).

The impact of ICTs upon business performance can be analysed in terms of increased efficiency, greater effectiveness and enhanced competitive advantage. Increased efficiency is achieved, for example, by reducing costs and maintaining existing output levels through the use of technology as a substitute for other inputs (e.g. clerical staff). Effectiveness is concerned with the capacity to deliver more and improved products within the existing resource base. Competitive advantage is obtained through the exploitation of ICTs to achieve more strategic information and to generate product, process and managerial innovations (Capello et al., 1990; Williams, 1987).

The innovative and strategic use of ICTs, generating

positive effects on business performance, is strongly associated for its development to deep organisational changes. In fact, innovative use of these technologies implies the interrelation of technology and organisation as two unseparable variables (Mansell, 1990; Zeleny, 1985). Technologies in themselves appear as neutral devices, as a pool of opportunities available at a given cost and can be interpreted as some quasi-public goods. But what really matters - and what is not at all a public good - is the cultural and organisational capability of exploiting their potentialities, through a creative blend of technologies devices, organisational styles and business ideas.

Thus, the simple adoption of these technologies does not provide an immediate positive effect on corporate performances (Tolmie, 1987). The rather complex and relatively new technological possibilities embodied in computer networks have drastic implications for potential users, imposing profound changes in the organisational structure of a firm. Because of their capacity to support the transactional structure of a firm, these networks are inevitably able to reshape inter- and intra-corporate information flows with profound effects on the organisation (Bar et al., 1989; Ciborra, 1989; Williams, 1987).

To achieve higher economic performances through the use of computer networks, corporate users have to adjust their organisational structure to these new "routines" and organisational rules (Nelson and Winter, 1982). The development of modern networks is thus related to the capacity of firms to change their organisational routines, and to link the technological trajectories with organisational changes. It is thus very much the case that a high rigidity of attitudes and behaviour exists, which hampers an adjustment to new conditions and the exploitation of technologies to achieve higher economic performances.

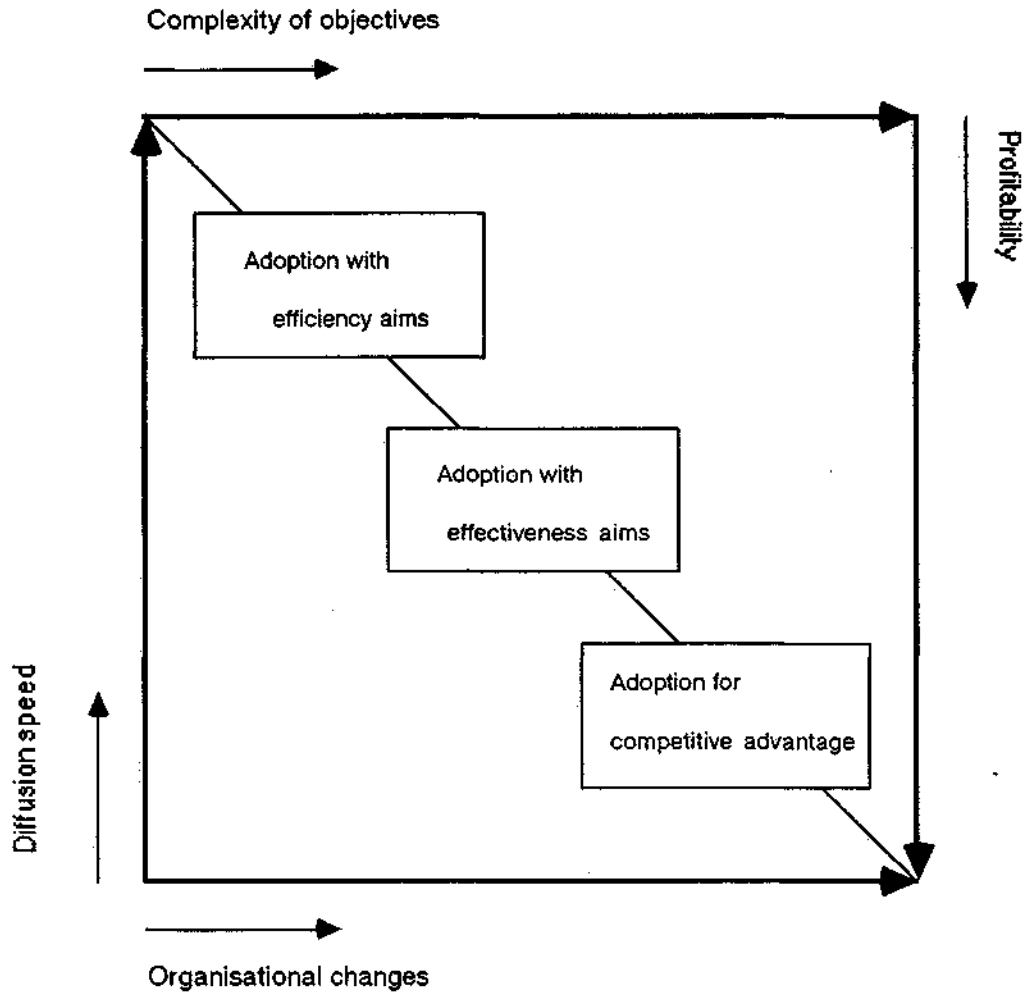
A trade-off exists between the speed of technological development, the profitability obtained by the exploitation of new and advanced technologies, the organisational costs required to use them and the complexity of economic objectives achieved through the adoption of computer networks (Table 4).

The complexity of technological systems reflects ambitious economic objectives and requires profound organisational adjustments to new technologies and a long penetration speed of it. Consequently, we can expect a lower speed of diffusion for technologies implied to achieve more complex objectives, such as higher efficiency and effectiveness and, moreover, competitive advantages. These last objectives imply, in fact, a relevant capacity to use these systems to achieve innovative products and to adapt the organisation to new technology.

## 5. Policy Recommendations

The interpretation of barriers limiting the telecommunications sector development raises some crucial

**Table 4 . Trade-off between objectives, organisational costs, adoption speed and profitability of new technologies**



Source: Camagni and Capello, 1991a

concerns about the most "appropriate policies" to be put in place. The notion of "appropriate policy" is concerned with the idea that telecommunications, and more in general ICTs, is increasingly regarded as an effective way to increase competitiveness of firms and competitive advantages for regions. Thus, appropriate policies are oriented towards overcoming barriers in order to avoid:

- a slow diffusion of modern infrastructures and advanced services over time and space;
- an increase of territorial (regional, national, international) asymmetries in the infrastructure endowment;
- an increase of discontinuities, in terms of "missing networks";
- an inability to exploit new infrastructures and applications for innovative uses, thus trying to achieve product and process innovations, and enhanced competitive advantages for firms, cities and regions;
- an increasing loss of competitive capacities of national suppliers.

The previous arguments suggest that "appropriate policies" regard different areas of application. The first and more general area is concerned with public policy, the second regards demand policy and, finally, the third is related to appropriate corporate strategies of telecommunications suppliers.

### 5.1. Public policies

The technological complexity and difficulty in the use of modern technologies suggest that the development of new communications technologies is a difficult process, while a smooth diffusion over time and space will require "public policy" stimuli.

The pattern of use of these computer networks suggests that the development trajectory of new technology is still in its infancy. Thus, inevitably, public policy support should create a pressure on those mechanisms that in diffusion processes generate accumulation rates through spin-off effects. Public policy should thus encourage computer networks development in areas with high potential demand density, e.g. central regions, where mechanisms such as network externalities could generate positive cumulative effects and, thus, where critical mass could be achieved in shorter time.

Positive network externalities, in fact, arise because the total number of subscribers has an important effect on the user-value of each additional subscriber, and each additional connection has important effects on the user-value of the network of existing subscribers (Allen, 1989; Antonelli, 1989; Hayashi, 1991). This mechanism is more efficient when applied in central areas, where the user-value of the network of subscribers is higher.

Related to this idea is the assumption that most economically developed areas are legitimated to be "networked"

first, in order to develop a cumulative process. A top-down public policy is thus suitable, implementing "information highways" between metropolitan areas. A bottom-up development policy, focusing on network development in local areas, risks to generate a development model with few possible inter-linkages among "islands of networks" and thus presenting a high risk of failure because of its local characteristic.

For instance, Italy witnesses the inadequacy of "bottom-up" policies in telecommunications sector, with respect to many local projects stimulating geographically restricted advanced telecommunications networks. It is the case of the Sprint project in Prato (Tuscany) (Zanfei, 1986), or "Lombardia Cablata" in Lombardy, just to quote two of them, where local advanced networks were implemented and modern services offered, with the result of a complete failure in their use (Camagni and Capello, 1990; Capello, 1988 and 1989). Their failure is in part contingent upon the local development of these networks, which can rather be interpreted as "white elephants" instead of efficient projects generating real interest from the demand side.

A top-down approach is in this respect a more appropriate public policy to generate cumulative adoption processes. Nevertheless, to be efficient, these policies have to consider the geographical asymmetry in networks, which are created by following a top-down approach, only as a timing difference in investments among regions. These asymmetries must not turn into discontinuity, reflecting different investment intentions. In this case, in fact, discontinuity would become a structural difference between central and peripheral regions, these last being penalised by the lack of modern infrastructures, losing the possibility of achieving advantages typical of central locations, i.e. agglomeration economies, and thus the possibility of overcoming limits of a peripheral area.

By the same token, public policy should be concerned with the existence of "missing networks" at an international level. This concern should go far beyond the simple physical infrastructure, and should take into consideration a series of concerns in the form of critical success factors, as a recent study for the Round Table of Industrialists has pointed out (Maggi et al., 1991):

- hard ware (physical infrastructure)
- soft ware (logistic and informatics)
- org ware (institutional and organisational setting)
- fin ware (financial arrangements/funding)
- eco ware (environmental and safety effects)

In this study it was concluded that the telecommunications sector could perform much better. To improve the current situation in European telecommunications the following suggestions were made:

- the introduction of a base European telecom network including standard facilities, uniform rules and tariffs, and services;
- a separation of responsibility between regulators (government, policy) and operators (implementation (org ware) is needed;
- avoidable barriers to entry should be minimised (org ware); the

- existence of monopoly should be avoided;
- since deliverable technologies are changing too fast, a sustainable basis for regulation is missing. Improving competition should then be the keyword (org ware);
  - telecommunications prices should be cost-related (org ware);
  - use the outcome of current ENS-applications (e.g. the European Nervous-system) in transportation, banking, environmental protection, health care, education (org ware, hard ware, soft ware, eco ware and fin ware) to develop European-wide applications.

These suggestions reflect a demand-side oriented policy, neglecting monopoly as a useful market structure in highly technologically dynamic sectors, and interpreting competition as a key force for rapid diffusion processes in an era of a networked economy.

## 5.2. Supply policies

Also at the supply level some policy considerations can be offered, regarding two aspects:

- policies related to corporate strategies to enter the market, in essence marketing policies;
- policies related to best corporate strategies to face increasing competition from other manufacturing telecommunications firms, in essence strategic market policies.

The need for a strong interaction between technology and organisation brings into focus the changing nature of computer networks markets. The distinction between products and systems markets is important to overcome the limits of adoption due to the changing nature of ICTs markets.

With respect to computer networks and their applications the characteristics of their market are different to those of traditional telecommunications product markets, thus obliging suppliers to put in place different competitive strategies. Because the adoption of computer networks is dependent upon an interaction of organisation and technology, the marketing strategies need to be tailored to individual users, so that these technologies are essentially customised products.

The adoption process becomes a "bricolage" process, where new technological opportunities have to be linked to an efficient organisational structure in order to achieve a new "business idea" (Camagni and Capello, 1991; Capello and Williams, 1991).

This "bricolage" process allows intermediaries to integrate technological possibilities with the needs of users, generating larger markets for computer networks and their applications. This "bricolage" process can also be developed by manufacturing telecommunications suppliers through strategies of cooperation agreements with:

- some large organisational experts,
- some large firms users, strong in their learning processes;
- some experts in the field of software and integrated systems;

- some value added resellers, or experts in telematics applications.

In this way, complementary technological, organisational and strategic know-how can be exploited and most appropriate marketing policies developed.

Moreover, the development of new technologies is strictly linked to the structure of power in which these technologies are implemented. Because of their direct impact on transactional structure and, thus, on power relationships, computer networks are easier to be installed in hierarchical structures where the "division of power" is not disrupted. On the contrary, their development is particularly difficult when a transaction of bargaining relationships is involved. The case of the Sprint project in Prato is significant in this respect: here an attempt was made to substitute the traditional informal network of interpersonal relationships within the "local district" with a new telematics network, but different strategic intentions have not coalesced into a common purpose and unsolved power relationships among participants generated the failure of the project (Camagni, 1987; Camagni and Capello 1989; Capello and Williams, 1991).

Another perspective is related to the supply policies, namely the strategic policies suppliers have to follow to face increasing competition in the market. Here it seems plausible that cooperation agreements, such as joint ventures and all kinds of equity agreements, should be developed between:

- telecommunications manufacturing suppliers. Firms supplying technologically backward products should develop agreements with advanced firms, in order to achieve two different purposes
  - to achieve better technical know-how in more restricted time
  - to share the market with a previously selected partner.
- telecommunications manufacturing firms and informatics firms, in the area of value added services, for the exploitation of complementary know-how;
- telecommunications manufacturing firms and experts in organisations, in the area of computer networks, for the exploitation of complementary know-how, necessary for supplying customised products.

### 5.3. Demand policies

As said already, the innovative use of advanced technologies provides major opportunities for users to achieve the highest economic benefits and advantages from these new technologies. However, the simple adoption of these technologies does not provide an immediate positive effect on corporate performances (Tolmie, 1987) and does not help in overcoming the barriers represented by the need to merge the technology with the organisational structure. In fact, because of their capacity to support the transactional structure of a firm, these networks are inevitably able to reshape inter- and intra-corporate information



flows with profound effects on the organisation (Bar et al., 1989; Ciborra, 1989; Williams, 1987).

The best way for users to handle the complex interrelation between technology and organisation is the development of learning processes regarding (Camagni and Capello, 1991):

- technological potentialities of the new technologies;
- possible applications of these new technologies to solve corporate problems;
- possible integration of these technologies in the organisational structure.

These learning processes are the mechanisms to develop among users adoption processes of these new technologies, overcoming the rigidity of attitudes and behaviour associated with a transition phase, which hampers an adjustment to new conditions.

## 6. Conclusions

Major structural changes have affected the telecommunication sector in the last decades, which have profoundly modified the nature of the sector and its development trajectories.

In particular, in the last decade the academic debate has focused the attention on the emergence of an Information Economy, and has agreed on the development of the economy towards the fifth Kondratief cycle. However, empirical evidence suggests that the diffusion of these new communication technologies is fraught with difficulties and that still some efforts should be devoted to the understanding of the reasons and causes that hamper the "Information Economy" to become reality.

The paper has highlighted the reasons for this paradox and especially has underlined strategic policies from both the supply and the demand side, which should be able to overcome the still existing bottlenecks in the exploitation of the technological potentialities.

The problem of bottlenecks and barriers to the development of the ICT sector is a subject whose importance should be stressed more. The competitiveness of industrial and territorial systems in the next years is highly dependent on the exploitation of these technologies. Firms, regions and countries that will be able to understand this and thus to overcome bottlenecks and barriers in the development of the ICTs sector will also be the ones which will have the greatest probability to achieve a privileged position in the international economic competition of the 1990s.

## Note

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